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PROGRAMA DE MAESTRÍA Y DOCTORADO EN INGENIERÍA
INGENIERÍA CIVIL – HIDRÁULICA

ALGUNOS ASPECTOS SOBRE LA IMPORTANCIA DE CONSIDERAR LAS PÉRDIDAS LOCALES EN EL CÁLCULO DE REDES DE AGUA POTABLE

TESIS
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FIRMA

AGRADECIMIENTOS

A mis padres

A mis hermanos y familiares

A mi novio y amigos

A la Universidad Nacional Autónoma de México

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Al Dr. Oscar A. Fuentes Mariles

A todos aquellos que me apoyaron para llegar hasta donde me encuentro

¡Gracias Totales!

Resumen

Se modela una red de abastecimiento de agua potable, con la finalidad de señalar bajo que características es importante considerar las pérdidas locales en los cálculos; se empleó el método iterativo del Instituto de Ingeniería-UNAM (Método Sánchez-Fuentes). Para obtener la información necesaria, se propuso una manera de calcular el coeficiente de pérdida local para "tes", en función de los gastos de entrada y salida de la pieza; para determinar los coeficientes de codos y cruces se emplearon los propuestos por el Dr. G. Sotelo (1999) y el M.I. J. Patiño (2011) respectivamente. Se establecieron diversos casos considerando la variación de las magnitudes de longitud, diámetro y gasto de demanda horaria; observando que también era relevante la variación en la carga del tanque de abastecimiento, a fin de operar bajo condiciones mínimas de energía (situación que incrementa la diferencia entre considerar o no las pérdidas menores). El estudio se complementa con una comparación entre la situación crítica obtenida con el Método y los resultados modelados con EPANET bajo las mismas características.

Palabras clave: pérdidas locales, pérdidas de energía, red agua potable

Abstract

A clean water supply network is modeled with the objective to point out under what features are important to consider the local losses in calculations, using an iterative method developed at the *Instituto de Ingeniería* of *Universidad Nacional Autónoma de México* (Sánchez-Fuentes Method). To obtain the necessary information, a procedure to calculate the local losses coefficient to "tee" connectors is proposed, depending on the entrance and exit flow of the piece, using the elbow and crosses coefficients proposed by Sotelo, G. (1999) and Patiño, J. (2011). A different cases considering the variation of length, diameter and hourly demand flow magnitudes, were analyzed and it was observed that also is relevant to consider the energy variations on water supply tank, in order to operate under minimum conditions of energy (a situation which increases the difference between considering or not local losses). The study is complement by a comparison results among the critical case retrieved by the method above mentioned and EPANET under the same conditions.

Keywords: Local losses, energy losses, drinking water supply network

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Símbolo	Definición
A	Área transversal [m^2]
a	Aceleración [m/s^2]
C	Constante , “Conservación de la masa en tubería- ecuación de continuidad”
C	Coeficiente en función de f, L, d “Cálculo de redes de tuberías a presión” [m^{-4}]
C	Coeficiente rugosidad “Formula Hazen-Williams” [adim]
CVD	Coeficiente de variación diaria [adim]
CVH	Coeficiente de variación horaria [adim]
d	Diámetro de la tubería [m]
dA	Diferencial del área [m^2]
D_d	Demanda diaria [l/s]
D_t	Dotación total [l/hab/día]
E_T	Energía hidráulica total disponible [m]
f	Coeficiente de fricción
F	Fuerza [N]
F_I	Fuerza de inercia[N]
F_v	Fuerza de viscosidad [N]
g	Aceleración de la gravedad [m/s2]
H	Duración de periodo de máxima demanda , entre 1 y 4 horas
h	Pérdida de energía de la sección, por fricción o piezas especiales[m]
h_f	Pérdida de carga por fricción[m]
h_L	Pérdida de energía o carga local [m]
h_n	Carga en nodo c/r al tubo n [m]
h_{in}	Carga en nodo final c/r al tubo n [m]
h_{sn}	Carga en nodo inicial c/r al tubo n [m]
K	Coeficiente de pérdida local “Cálculo de pérdidas locales o menores”
K_r	Coeficiente de pérdidas en superficie rugosa “piezas especiales – Sotelo”
K_s	Coeficiente de pérdida en superficie lisa “piezas especiales-Sotelo”
K_n	Coeficiente en función de L, d, f del tubo n, “Cálculo de redes de tuberías a presión”
L	Longitud de la tubería [m]
L_{eq}	Longitud equivalente [m]
m	Masa [Kg]
N	Parámetro a analizar
n	Coeficiente de rugosidad de Manning [adim]
P	Número de habitantes o población de diseño [hab] “Estimación gasto de diseño”
P	Presión[Pa]
q	Gasto de demanda [l/s]
q_m	Gasto promedio diario [l/s]
q_{med}	Gasto de demanda media [l/s]
Q	Gasto que fluye por la conducción [l/s]
Q_E	Gasto específico [l/s]

Símbolo	Definición
Q_{max}	Gasto máximo instantáneo [l/s]
Q_{md}	Gasto máximo diario [l/s]
Q_{mh}	Gasto máximo horario [l/s]
Q_l	Gasto que entra o sale en tubería secundaria “Cálculo de pérdidas locales en tes” [l/s]
Q_r	Gasto que entra o sale en tubería principal “Cálculo de pérdidas locales en tes” [l/s]
Re	Numero de Reynolds [adim]
s	desplazamiento
T	Temperatura [°C]
t	Tiempo [s]
V, v	Velocidad media en la sección transversal [m/s]
V_h	Componente vertical de la velocidad a una profundidad h [m/s]
V_{ma}	Volumen de consumo medio anual [m^3]
y	Tirante[m]
z	Cota geométrica c/r al nivel de referencia, Energía cinética [m]
α	Coeficiente de Coriolis, “Conservación de la energía” [adim]
α	Coeficiente en función de C, Q “Método Sánchez-Fuentes” [m s]
ε	Rugosidad absoluta [mm]
ε_ρ	Rugosidad relativa
γ	Peso específico del fluido [N/m^3]
μ	Viscosidad dinámica [kg/(m s)]
ν	Viscosidad cinemática del fluido [m^2/s]
ρ	Densidad [kg/m^3]
τ	Tensión tangencial [Pa]

Introducción

El agua es una sustancia sorprendente, esencial para la mayoría de las formas de vida. Entre los diversos usos de aprovechamiento del agua están la generación de energía eléctrica, el riego de campos agrícolas y el consumo de los habitantes. De manera absurda, se considera que el recurso es ilimitado y que es natural tener acceso al agua en cualquier instante; desafortunadamente esto no es cierto, y el incremento en su uso manifiesta una inminente problemática debido a su insuficiencia o escasez del agua en algunas regiones.

Actualmente, el consumo doméstico de agua que representa el 8% del uso total del agua en el mundo, se relaciona directamente con la cantidad de agua a que tiene acceso la población que habita en ciudades medianas y grandes. A pesar de los esfuerzos, el 19% de la población mundial carece de acceso directo al servicio de agua potable.

Los requisitos humanos básicos del agua para beber, el saneamiento, el baño y la preparación de alimentos es de 50 litros por persona por día (18.25 m^3/año); sin embargo, una persona que vive en una ciudad de un país desarrollado puede llegar a utilizar 633 litros por día. En México se estima que el consumo promedio sea entre 220 y 300 litros por persona por día.

El sistema hidráulico de México vive una etapa crucial, debido entre otros factores, al deterioro que tiene el patrimonio natural, por lo que se está considerado ya al recurso agua como asunto de seguridad nacional.

Para disponer del agua potable en las viviendas de los habitantes es necesario un conjunto de obras de ingeniería denominado: sistema de abastecimiento de agua potable, entre sus componentes destaca la red de tuberías de distribución.

Cuando se específica que la red de distribución es a presión, entonces estará constituido por un conjunto de conductos cerrados que se conectan entre sí para el transporte del líquido, el cual llena en su totalidad el espacio volumétrico de la tubería y se desplaza por la diferencia presiones entre sus extremos.

Una red cerrada de tuberías es aquella en la cual los conductos o tuberías que la componen se ramifican sucesivamente, conformando al menos un circuito o anillo cerrado. Un circuito es cualquier trayectoria que puede recorrer una partícula fluida, partiendo desde un punto o nudo de la red, fluyendo por distintos tramos, hasta llegar al punto de partida.

Las redes urbanas de distribución de agua forman ramificaciones sucesivas de tuberías, siguiendo el trazado de las calles y vías de acceso, buscando formar circuitos cerrados, para que el agua, en un nudo de la red, pueda venir por dos o más direcciones distintas, para no interrumpir el suministro de agua durante las reparaciones o labores de mantenimiento.

La topografía y accesibilidad a las poblaciones no siempre facilita la colocación de la red; así mismo, las ciudades presentan desniveles naturales que afectan la presión hidrostática del interior de las tuberías.

En el análisis de una red cerrada de tuberías se plantea de un sistema de ecuaciones no lineales, que es posible resolver por métodos de aproximaciones sucesivas, uno de los cuales es el Método de Hardy Cross.

En esta tesis se estudia la importancia de la pérdida de presión que se presenta por las piezas especiales que componen el sistema de abastecimiento, ya que al diseñar la red por lo general se desprecian estas disminuciones y solamente se consideran las ocasionadas por la fricción del fluido en movimiento con las paredes de los conductos cerrados.

Cuando se tiene una limitada cantidad de recurso, que apenas pueda satisfacer la demanda doméstica, las pérdidas generadas por la fricción del material de la tubería, los codos, tes y cruces aumentan su relevancia en el diseño y presentan un alto porcentaje de afectación al considerarlos o no en el cálculo del diseño de la red de abastecimiento.

Objetivo

El presente documento tiene por objetivo mostrar la importancia de considerar las pérdidas locales en la revisión, diseño y operación de redes de agua potable. Además se señala bajo que características es crucial el cálculo de la pérdida de energía provocada por las piezas especiales.

Se empleó un método de cálculo de redes donde fuera sencillo proponer y determinar el funcionamiento de la red bajo diferentes circunstancias (Método del Instituto de Ingeniería UNAM) y se incluyeron tablas y figuras para determinar el valor de varios coeficientes que no es fácil encontrar en los manuales.

En el Capítulo 1 "Redes de distribución de agua potable", se presentan los principales componentes y características que presentan los sistemas de abastecimiento; el análisis que actualmente se plantea para su análisis, denominado "Distritos Hidrométricos"; los gastos de demanda que se tienen que busca satisfacer el sistema de distribución, y la manera en la que estos gastos se cuantifican en la vivienda a partir de la llamada micro-medición.

En el Capítulo 2 "Fundamentos de cálculo de redes de tuberías funcionando a presión" se presentan las ecuaciones que describen el funcionamiento de la red de abastecimiento de agua potable, a partir de la suposición de tener un flujo permanente; para tener datos básicos del comportamiento del agua en las tuberías de distribución. Así mismo, se explica el método propuesto para la resolución del cálculo de redes de tuberías a presión en flujo permanente.

En el Capítulo 3 "Pérdidas de energía" se explican las pérdidas de energía provocadas por la fricción que se ejerce entre el agua y el material del que está hecha la tubería, y las pérdidas de energía provocadas por el paso del agua en las piezas especiales que conforman la red de distribución (codos, tes, cruces, etc.); de igual manera se explica brevemente el proceso de convertir las pérdidas locales (por piezas especiales) a pérdidas por fricción mediante la "longitud equivalente".

En el Capítulo 4 "Análisis de resultados" se presenta la información obtenida a partir del planteamiento de una red de distribución con diversas características y bajo distintas circunstancias, aplicando el Método Sánchez-Fuentes propuesto en el presente documento; con la finalidad de observar la importancia de considerar las pérdidas locales en el diseño y análisis de la red de distribución.

En el Capítulo 5 “Análisis con EPANET” se presenta la comparación de los resultados obtenidos a partir de emplear el Método Sánchez-Fuentes y los conseguidos con el programa EPANET, a fin de comparar la información que cada uno aporta.

Capítulo 1. Redes de distribución de agua potable

Las redes de distribución de agua se conforman con un conjunto de conductos o tuberías que se ramifican mediante diversos tipos de uniones o conexiones (codos, tes, cruces, etc.), conformando circuitos cerrados.

Las redes urbanas generalmente se ramifican siguiendo el trazado de calles y vías de acceso, para satisfacer el suministro por direcciones distintas. En el presente capítulo se presentan las principales características de las redes de distribución.

1.1 Sistemas de abastecimiento

Un sistema de abastecimiento de agua es el conjunto de infraestructura, equipos y servicios destinados al suministro de agua para su consumo, ya sea doméstico (urbano o rural), comercial, industrial, agrícola, pecuario, generación de energía eléctrica, etc.; en cualquier caso debe ser suministrada en cantidad suficiente, calidad especifica y presión adecuada.

Cuando se específica que la red de abastecimiento de agua potable es a presión, indica que el sistema será constituido por un conjunto de conductos cerrados que se conectan entre sí para el transporte y distribución del líquido.

En cualquier caso debe cumplir con los valores establecidos en la normatividad local.

En la siguiente imagen (Fig.1) se puede apreciar de manera esquemática el sistema de abastecimiento básico de agua potable para una población.

- La captación consiste en extraer el agua necesaria para abastecer a la población, a partir de fuentes superficiales (ríos, lagos, vaso de almacenamiento de presas, etc.) o subterráneas (acuíferos).
- En la planta de tratamiento se modifican las características del agua extraída con la finalidad de cumplir con la calidad requerida para su uso y distribución.
- La línea de conducción incluye obras como canales, acueductos e instalaciones que permitan llevar el agua desde la fuente hasta el centro de distribución.

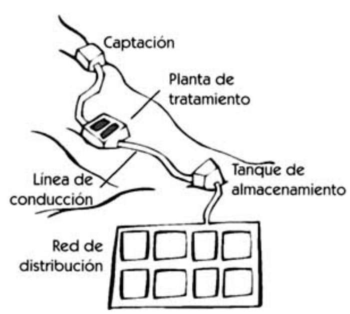


Fig.01 Sistema de abastecimiento de agua de una ciudad

Fuente: Tecnologías Apropiadas en Agua Potable y Saneamiento Básico [helid.digicollection.org]

Los diferentes accesorios como válvulas, bombas, codos, cruces, tes, etc., caracterizan el funcionamiento del conjunto, así como la longitud, diámetro y coeficiente de rugosidad de la tubería. Las conexiones entre los tubos se denominan nodos o nudos de unión, en ocasiones a sitio donde inicia la tubería ligada a la fuente de abastecimiento también se le denomina nodo fuente.

La pérdida de presión es la principal consideración en el diseño de las tuberías; las fuentes de pérdidas de presión se pueden dividir en pérdidas mayores o de fricción, y en pérdidas menores o localizadas. Las pérdidas de carga se obtienen aplicando las ecuaciones de Darcy-Weisbach, Manning o Hazen Williams.

En la figura 2 se representa la pérdida de energía que existe en el sistema de abastecimiento de agua potable desde su captación hasta su distribución en la red.

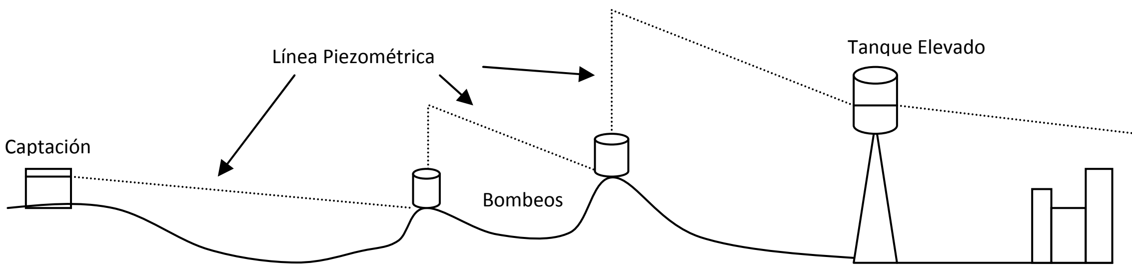


Fig.02 Línea piezométrica en la línea de conducción entre la captación y tanque de almacenamiento

En la figura 3 se representa la pérdida de carga en relación con la demanda.

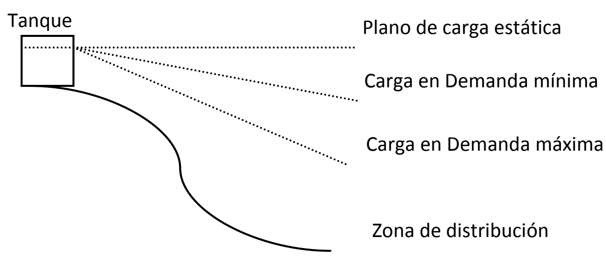
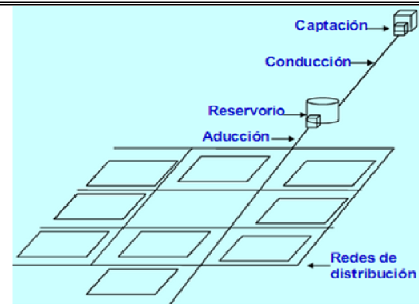


Fig.03 Líneas piezométricas variable en relación con la demanda

1.1.1 Clasificación de los sistemas de abastecimiento

- Sistemas convencionales: brindan el servicio de agua potable al usuario a través de redes o conexiones domiciliarias. A continuación se muestra su configuración

Tabla 01. Clasificación de sistemas de abastecimiento

<table>
<tr><td rowspan="2">○ Sistemas por gravedad</td><td>▪ Sin tratamiento</td><td>
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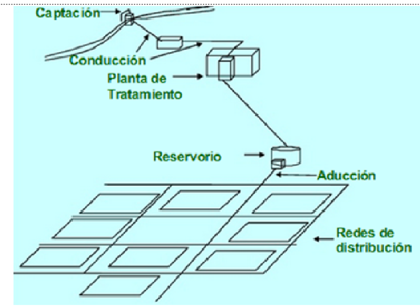
<tr><td>▪ Con tratamiento</td><td>
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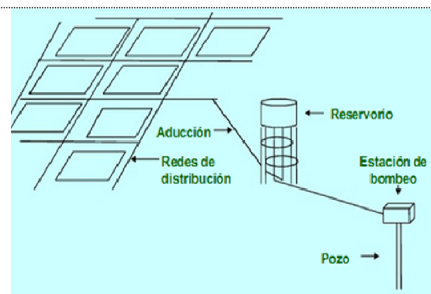
<tr><td rowspan="2">○ Sistemas por bombeo</td><td>▪ Sin tratamiento</td><td>
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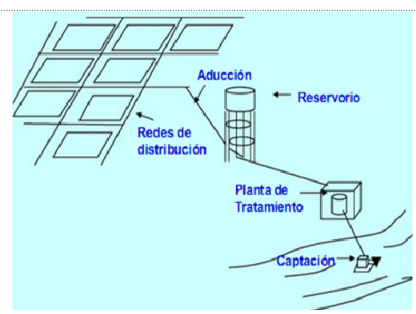
<tr><td>▪ Con tratamiento</td><td>
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</table>

Imágenes fuente: [http://es.scribd.com/doc/53617183/Abastecimiento-de-Agua-Potable]

- <u>Sistemas no convencionales</u>: no existen redes de distribución, están compuestos por soluciones individuales, por lo general requiere transporte, almacenamiento y desinfección del agua en el domicilio.

1.1.2 Clasificación de los sistemas de abastecimiento en tomas domiciliarias

- Sistema de abastecimiento directo.
  En este sistema no es necesario contar con cisterna ni con tinaco, ya que la presión en la red municipal que abastece dicha vivienda es suficiente para hacer uso de las instalaciones domiciliarias, así mismo, el caudal se mantiene constante; es decir, existe abastecimiento continuo 24 horas al día los 365 días del año (la presión mínima será de 0.2 kg/cm^2 en el punto más alto de la instalación).

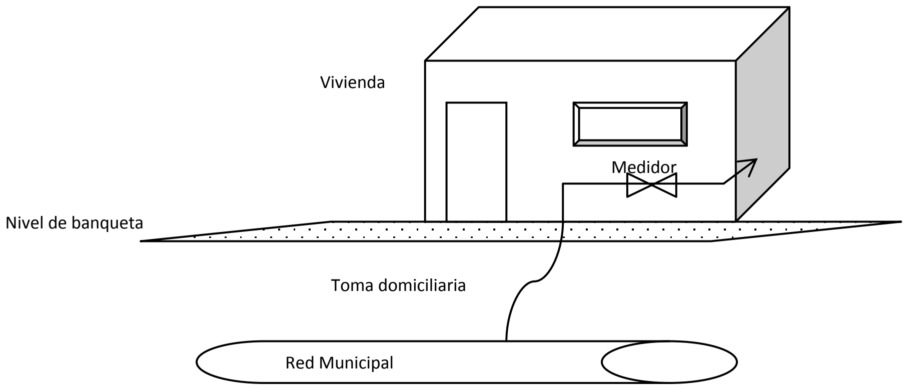


Fig.04 Sistema de Abastecimiento Directo de Agua Potable

- Sistema de abastecimiento a presión inducido por gravedad.
  Así se conoce al sistema en el cual es necesario contar con un tinaco en la parte más alta de la vivienda a partir del cual se realiza la distribución del agua a toda la instalación hidráulica de la vivienda; será abastecido directamente a partir de la red municipal; la distribución municipal no se da de manera continua, pero con lapsos sin abastecimiento lo suficientemente cortos para que no sea necesario el uso de una cisterna.

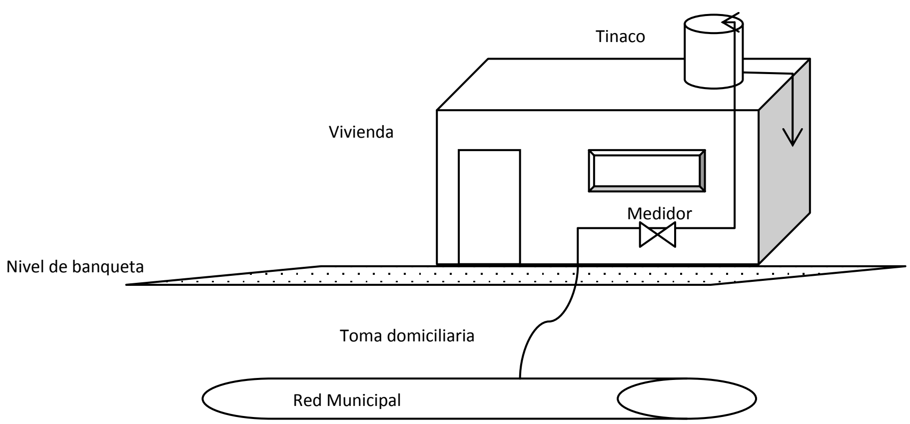


Fig.05 Sistema de Abastecimiento a presión inducido por Gravedad

- Sistema de abastecimiento combinado.
  Es necesario en este sistema contar con cisterna y tinaco, además de la bomba que consiga llevar el agua desde la cisterna hasta el tinaco, y de esta manera distribuir el recurso por gravedad dentro de la vivienda. Este sistema es necesario cuando el abastecimiento en la red municipal se da por intervalos muy separados de tiempo.

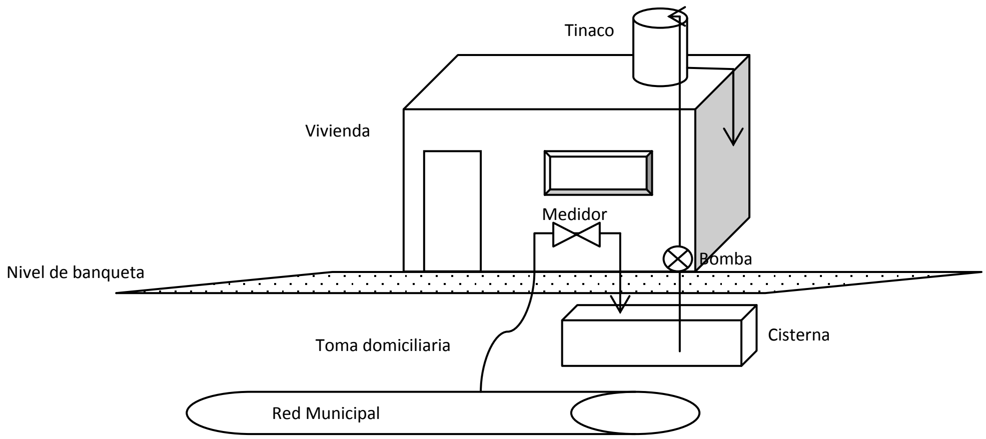


Fig.06 Sistema de Abastecimiento Combinado

1.1.3 Distritos hidrométricos

La Comisión Nacional del Agua (CONAGUA) ha establecido para el control de las redes de abastecimiento de agua potable a la población, se consideren a los sistemas conocidos Distritos Hidrométricos (DHs). Ellos consisten básicamente en una subdivisión (sector) de la red de distribución en varias más pequeñas (generalmente mediante la manipulación de válvulas de control), con la finalidad de tener el registro preciso del volumen de entrada uno o pocos sitios (y de salida en caso de ser necesario), el consumo de la población (o volumen de demanda) y el volumen que se pierde en las fugas; mediante una supervisión constante se tiene la localización y control del sistema.

Con el manejo de los DHs, se han logrado mejores funcionamientos hidráulicos en las principales ciudades de México y se ha optado por el diseño y construcción con base en estos; pero no se trata simplemente de tener sistemas supervisados, también se debe optar por conocer el comportamiento real que se tenga en cada uno, para garantizar la calidad y cantidad óptima en el agua y la presión de abastecimiento.

Por lo anterior se han empleado modelos de simulación matemática, estimando los diferentes estados que se generan en la red de distribución de agua potable, ahorrando tiempo y dinero en la puesta en marcha de la red.

1.2 Gastos hacia o provenientes del exterior de la red de tuberías

La demanda de agua en un sistema de abastecimiento de agua potable se obtiene a partir de la suma del consumo total de los usuarios más las pérdidas físicas del recurso (fugas) en su trayecto por la red.

El consumo de los usuarios varía por diversos factores como: nivel socioeconómico, condiciones climatológicas e hidrológicas, costumbres locales, accesibilidad al agua disponible, tipo de abastecimiento, presión en la red, control de consumo, etc.

1.2.1 Gasto de demanda

Dotación o gasto de demanda, es aquella cantidad de agua estimada para satisfacer las necesidades del usuario a abastecer; en diversas ocasiones estos valores se basan en los registros que tengan los Organismos Operadores (OO) de Agua Potable, a partir de la cual se determina la dotación diaria por habitante.

Cuando no se cuentan con dichos valores se pueden estimar a partir de otros registros que cumplan con condiciones similares en la zona poblacional. Por este motivo, se presenta a continuación una tabla donde se ubican los valores generales aplicables a las poblaciones del país, en litros/habitante/día.

Tabla 02. Valores de gasto de demanda en poblaciones del país

Número de habitantes	Clima		
	Cálido	Templado	Frío
2500 a 15000	150	125	100
15000 a 30000	200	150	125
30000 a 70000	250	200	175
70000 a 150000	300	250	200
Mayor de 150000	350	300	250

A continuación se presentan las curvas-demanda del agua potable durante el día en la Ciudad de México, otras ciudades grandes y poblaciones pequeñas; de acuerdo a la información proporcionada por la Comisión Nacional del Agua (CONAGUA). [Fuente: CONAGUA]

Tabla 03. Factores de variación de las curvas-demanda del agua potable horaria

Tiempo	q/q_{med}		
[h]	[DF]	[ciudades]	[pob.peq]
0	0.570	0.606	0.450
1	0.560	0.616	0.450
2	0.550	0.633	0.450
3	0.560	0.637	0.450
4	0.580	0.651	0.450
5	0.650	0.828	0.600
6	0.800	0.938	0.900
7	1.000	1.199	1.350
8	1.300	1.307	1.500
9	1.425	1.372	1.500
10	1.475	1.343	1.500
11	1.500	1.329	1.400

Tiempo	q/q_{med}		
[h]	[DF]	[ciudades]	[pob.peq]
12	1.495	1.288	1.200
13	1.430	1.266	1.400
14	1.350	1.216	1.400
15	1.250	1.201	1.300
16	1.175	1.196	1.300
17	1.125	1.151	1.200
18	1.100	1.121	1.000
19	1.075	1.056	1.000
20	1.000	0.901	0.900
21	0.780	0.784	0.900
22	0.650	0.710	0.800
23	0.600	0.651	0.600

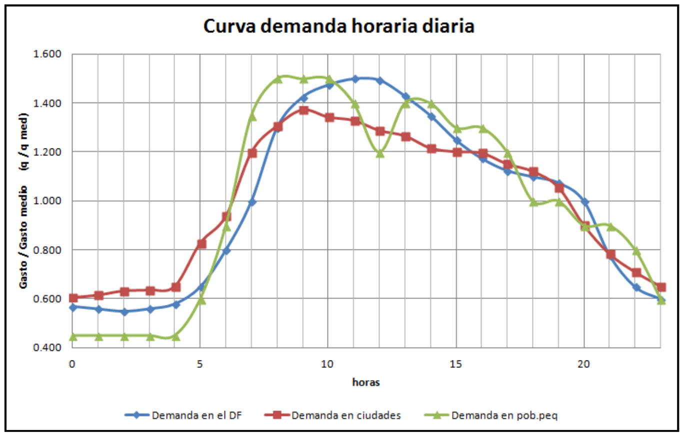


Fig.07 Curva demanda horaria diaria

Otros valores de demanda importantes para el diseño de redes de distribución son las que a continuación se mencionan.

- Consumo medio anual: volumen de agua que se estima se necesitará en un año de servicio; determinando con este valor si la fuente de abastecimiento puede satisfacer la demanda anual.

$$V_{ma} = \frac{D_t \; P \; 365}{1000}$$

V_{ma} : consumo medio anual [m^3]
D_t: dotación [lt/hab/día]
P: número de habitantes

- Gasto medio diario: es la cantidad de agua requerida para satisfacer las necesidades de la población en un día de consumo promedio

$$q_m = \frac{D_t \; P}{86400}$$

q_m : gasto promedio diario [lt/s]
D_t: dotación [lt/hab/día]
P: número de habitantes o población de diseño
86400: segundos que tiene un día

- Gasto máximo diario: se utiliza para calcular el volumen de extracción diaria de la fuente de abastecimiento, el equipo de bombeo, la conducción y el tanque de regularización y almacenamiento.

$$Q_{md} = q_m \; CVD$$

Q_{md} : gasto máximo diario [lt/s]
q_m: gasto medio diario anual [lt/s]
CVD: coeficiente de variación diaria

- Gasto máximo horario: es el requerido para satisfacer las necesidades de la población en el día de máximo consumo y a la hora de máximo consumo; es el gasto que se emplea para el diseño de la red de distribución y en algunos casos también para líneas de conducción

$$Q_{mh} = q_m \; CVD \;\; CVH$$

Q_{mh} : gasto máximo horario [lt/s]
q_m: gasto medio diario anual [lt/s]
CVD: coeficiente de variación diaria
CVH: coeficiente de variación horaria

De acuerdo a los Lineamientos técnicos de la CONAGUA, se tienen los siguientes valores técnicos de los coeficientes de variación (observando la Tabla 3, el valor empleado para el DF es CVH=1.5)

CVD = 1.2 a 1.5 CVH = 1.5 a 2.0

Los valores comúnmente usados para proyectos en la República Mexicana, de acuerdo a la información proporcionada por la Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA), son:

CVD = 1.2 CVH = 1.5

El Instituto Mexicano de Tecnología del Agua (IMTA) realizó un estudio para determinar el coeficiente de variación diaria y horaria (CVD y CVH), concluyendo que se pueden utilizar valores promedio de:

CVD = 1.4 CVH = 1.55

- Consumo diario: es el gasto que se estima será demandado por los usuarios diariamente

$$D_d = 0.36\, Q_{max}\, H$$

D_d : demanda diaria [lt/s]
Q_{max}: gasto máximo instantáneo [lt/s]
H: duración del período de máxima demanda (entre 1 y 4 horas)

- Gasto específico: es el gasto que se asigna de manera preliminar a la tubería

$$Q_E = \frac{Q_{mh}}{longitud\ total\ de\ la\ red}$$

Q_E : gasto específico [lt/s]
Q_{md}: gasto máximo horario [lt/s]

Cuando se tiene que diseñar el sistema de abastecimiento, se requiere utilizar los gastos y consumos anteriormente señalados para diversas etapas del proceso, a continuación se presenta dicha relación:

Tabla 04. Relación componente- gasto de diseño

Componente	Gasto de diseño
1. Fuente y obra de captación	Q_{md}
2. Línea de conducción	Q_{md}
3. Línea de alimentación	Q_{mh}
4. Planta potabilizadora	Q_{md}
5. Tanque de regulación	Q_{md}
6. Red de distribución	Q_{mh}

1.2.2 Servicio intermitente

Como ya se menciono, en ocasiones no se puede otorgar un servicio de abastecimiento de agua continuo las 24 horas del día – ya sea por la disminución en el volumen disponible de agua en las fuetes de abastecimiento, el incremento en la demanda de la población, la falta de infraestructura para dotar a la población del servicio las 24 horas del día, la falta de planeación en la red de abastecimiento hasta control en el consumo de los usuarios-, se tiene que realizar de forma intermitente o rotativa; es decir, se tiene que abastecer durante algunas horas del día un determinado sector, suspender el servicio y suministrar de la misma manera a otro, se realiza de manera cíclica, variando en función del tiempo y del sector o zona a abastecer.

Este tipo de abastecimiento provoca una variación en el comportamiento del sistema, cuando se reinicia el abastecimiento, la descarga es libre a depósitos sometidos a presión atmosférica, ya que el sistema no trabaja presurizado, con consumo generalizado; comportándose entonces como un sistema con orificios. Por lo tanto, la demanda a satisfacer depende de la presión existente en el sistema y no de la necesidad del usuario

En el momento en el que comienza a abastecerse la red en una zona específica, las presiones bajan y las demandas se incrementan, después de un determinado tiempo se comienza a estabilizar el sistema, se llenan las tuberías (saturación) y se elevan las presiones; se pueden observar dos comportamientos, es decir: la demanda es inversamente proporcional a la presión, y el caudal es directamente proporcional a la presión.

Obviamente existen otras consecuencias cuando se emplea este tipo de sistema:

- Utilizar de manera permanente cisterna y tinaco para almacenar el agua en los lapsos que no sea suministrada la zona
- Debilitamiento de las tuberías por la variación que existe en la presión dentro de las mismas, generando grietas y orificios, que provocaran fugas.
- Pérdida de agua por fugas durante el periodo de servicio, e infiltración de contaminantes a la red cuando se cancela el suministro.
- En los puntos más alejados y elevados se tendrán niveles de presión y gastos bajos

Desafortunadamente esto será cada vez más frecuente, debido a la escasez del recurso, por eso se debe tener en consideración al momento de diseñar la red, a fin de disminuir los problemas que es generan.

1.3 Medición de caudales

Existen diversos tipos de medición, la principal clasificación es la micro y macro medición; simplemente se define a partir del volumen de agua que circula a través de la red a medir. En el sistema de abastecimiento doméstico del recurso se presenta la micro-medición, a partir de la cual los Sistemas Operadores de Agua Potable de la región pueden percatarse del consumo o demanda que presenta esa vivienda.

Para realizar la macro y micro medición se emplean frecuentemente medidores de volumen o caudalímetros; los cuales , como su nombre lo indica, miden el caudal o gasto volumétrico del fluido que circula a través de ellos con la finalidad de obtener el valor de gasto másico.

Estos aparatos suelen colocarse en línea con la tubería que transporta el fluido, en el inicio de la toma domiciliaria, antes de entrar a la vivienda, con la finalidad de que todo el consumo que se realice dentro de la misma quede registrado en el medidor.

En México, el porcentaje de usuarios domésticos con micro-medición es del 69% del total de usuarios, esta deficiencia se ve reflejada en un cobro erróneo o nulo del servicio de abastecimiento.

Capítulo 2. Fundamentos del cálculo de redes de tuberías funcionando a presión.

En el presente capítulo se presentaran las ecuaciones fundamentales que describen el funcionamiento de la red de abastecimiento de agua potable, a partir de la suposición de que el flujo es permanente; este hecho no es cierto; sin embargo, permite tener una aproximación adecuada del comportamiento del agua en las tuberías de distribución.

2.1 Flujo permanente

El flujo permanente, o flujo estacionario, se caracteriza porque las condiciones de velocidad de escurrimiento en cualquier punto no cambian con el tiempo, o son extraordinariamente pequeñas con respecto a los valores medios; tampoco existen cambios en la densidad, presión o temperatura con el tiempo.

$$\frac{\partial \rho}{\partial t} = 0 \qquad \frac{\partial T}{\partial t} = 0 \qquad \frac{\partial p}{\partial t} = 0$$

Donde:

ρ densidad

T temperatura

t tiempo

P presión

El flujo permanente se puede dar si los parámetros tirante, velocidad, área, etc., no cambian con respecto al tiempo

$$\frac{\partial y}{\partial t} = 0 \qquad \frac{\partial v}{\partial t} = 0 \qquad \frac{\partial A}{\partial t} = 0$$

Donde:

y tirante

v velocidad

t tiempo

A área

Recordando:

Clasificación de flujo

El movimiento de los fluidos puede clasificarse según sus características, este puede ser:

- Flujo turbulento:
  En este tipo de flujo las partículas del fluido se mueven en trayectorias erráticas, es decir, en trayectorias muy irregulares sin seguir un orden establecido, ocasionando la transferencia de cantidad de movimiento de una porción de fluido a otra, de modo similar a la transferencia de cantidad de movimiento molecular pero a una escala mayor. Se pueden tener partículas de tamaños variados.
  Cuando se compara un flujo turbulento con uno que no lo es, se puede encontrar que en la turbulencia se desarrollan mayores esfuerzos cortantes en los fluidos, al igual que las pérdidas de energía mecánica, que a su vez varían con la primera potencia de la velocidad.

$$\tau = (\mu + \eta)\frac{\partial u}{\partial y}$$

- Flujo laminar:
  Se caracteriza porque el movimiento de las partículas del fluido se produce siguiendo trayectorias bastantes regulares, separadas y perfectamente definidas dando la impresión de que se tratara de laminas paralelas entre sí, las cuales se deslizan unas sobre otras, sin que exista mezcla macroscópica o intercambio transversal entre ellas

$$\tau = \mu \frac{\partial u}{\partial y}$$

- Flujo incompresible:
  Es aquel en los cuales los cambios de densidad de un punto a otro son despreciables, mientras se examinan puntos dentro del campo de flujo; esto no exige que la densidad sea constante en todos los puntos
  [ρ: densidad, t: tiempo]

$$\frac{\partial \rho}{\partial t} = 0$$

- Flujo compresible:
  es aquel en los cuales los cambios de densidad de un punto a otro no son despreciables.
  [ρ: densidad, t: tiempo]

$$\frac{\partial \rho}{\partial t} \neq 0$$

- Flujo permanente: o flujo estacionario.
  Se caracteriza porque las condiciones de velocidad de escurrimiento en cualquier punto no cambia con el tiempo, o bien, si las variaciones son tan pequeñas con respecto a los valores medios. No existen cambios de densidad, presión o temperatura en el tiempo.
  [ρ: densidad, T: temperatura, p:presión, t: tiempo]

$$\frac{\partial \rho}{\partial t} = 0 \qquad \frac{\partial T}{\partial t} = 0 \qquad \frac{\partial p}{\partial t} = 0$$

- Flujo no permanente: o flujo no estacionario.
  En este flujo, las propiedades y características serán diferentes de un punto a otro, y de un instante a otro.
  [N: parámetro a analizar, t: tiempo]

$$\frac{\partial N}{\partial t} \neq 0$$

- Flujo uniforme
  Este flujo ocurre cuando el vector velocidad en todos los puntos del escurrimiento es idéntico en magnitud y dirección para un instante dado, es decir, es idéntico con respecto al espacio.
  [s: desplazamiento, v: velocidad]

$$\frac{\partial v}{\partial s} = 0$$

- Flujo no uniforme
  Este tipo de flujo se encuentra cerca de fronteras sólidas por efecto de la viscosidad
  [s: desplazamiento, v: velocidad]

$$\frac{\partial v}{\partial s} \neq 0$$

2.2 Ecuaciones fundamentales

Para describir de manera teórica el funcionamiento de la red a presión, se adopta una serie de hipótesis, a continuación se enuncian las tres más importantes:

1) Flujo unidimensional en el sentido del eje de cada conducción de la red
2) Distribución uniforme de velocidades y presiones en cualquier sección transversal de las tuberías
3) Fluido incompresible, newtoniano y de características homogéneas

Al realizar el análisis hidráulico de la red de distribución se emplean métodos basados en las leyes de conservación de la masa (Ley de continuidad), cantidad de movimiento y energía.

2.2.1 Conservación de la Masa – Ecuación de Continuidad –

2.2.1.1 Conservación de la masa en una tubería

La conservación de la masa postula que la masa no se crea ni se destruye. Este concepto origina la "ecuación de continuidad", que establece que dentro de cualquier sistema hidráulico se debe balancear la descarga que entra, el volumen que se almacena y la descarga que sale.

La ecuación de conservación de masa en una sola dimensión espacial y flujo incompresible no permanente, se puede expresar de la siguiente manera:

Donde:
Q gasto que fluye por la conducción
V_a y V_b velocidades medias en las secciones externas a y b del volumen de control
C constante
A_a y A_b áreas transversales respectivas

$$\frac{\partial A}{\partial t} + \frac{\partial Q}{\partial x} = 0$$

Cuando el flujo no cambia con el tiempo, es permanente y por tanto

$$\frac{\partial Q}{\partial x} = 0$$

$$Q_a = Q_b = C$$

como $Q = VA$, de la ecuación anterior resulta que

$$V_a A_a = V_b A_b = C$$

Con lo anterior se establece que en cada una de las conducciones de la red de distribución hidráulica, la masa que entra en un volumen de control (o nodo) debe ser igual a la que sale, como se muestra en la figura 7.

$$Q_{entra} - Q_{sale} = 0$$

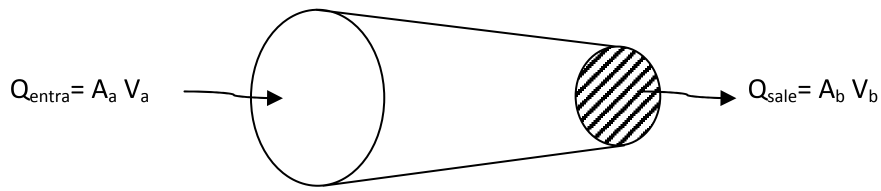
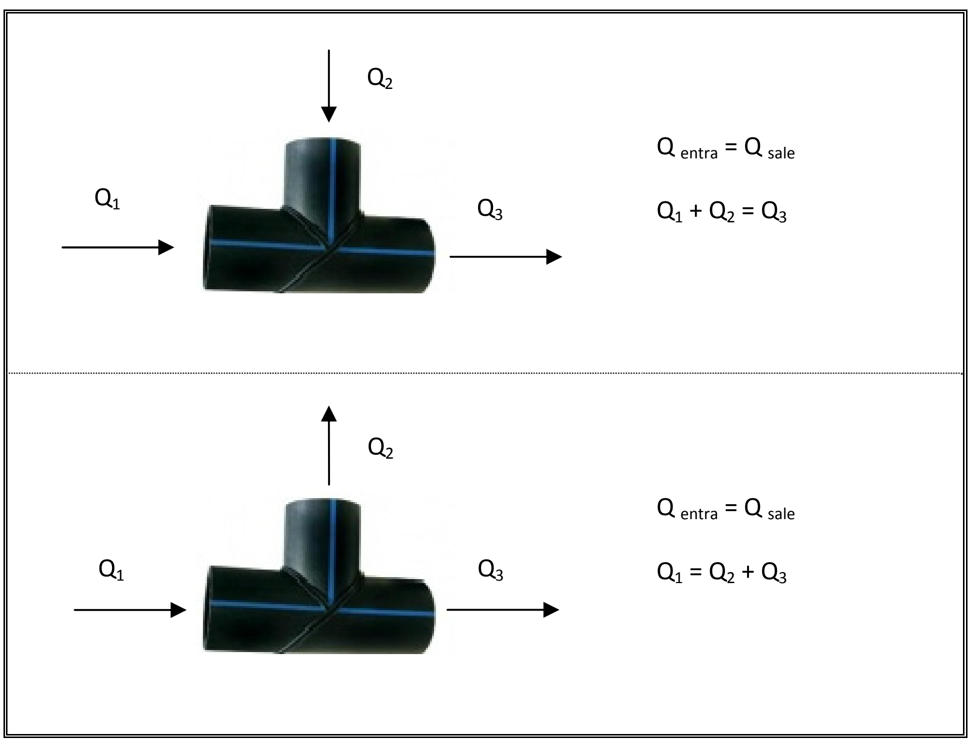


Fig.08 Esquema de entrada y salida del volumen de control

2.2.1.2Conservación de la masa en las uniones de tuberías

El postulado anterior se aplica para cualquier combinación de situaciones que se tengan en las conexiones de tuberías en la red de distribución de agua potable.

A continuación se muestran algunas de estas



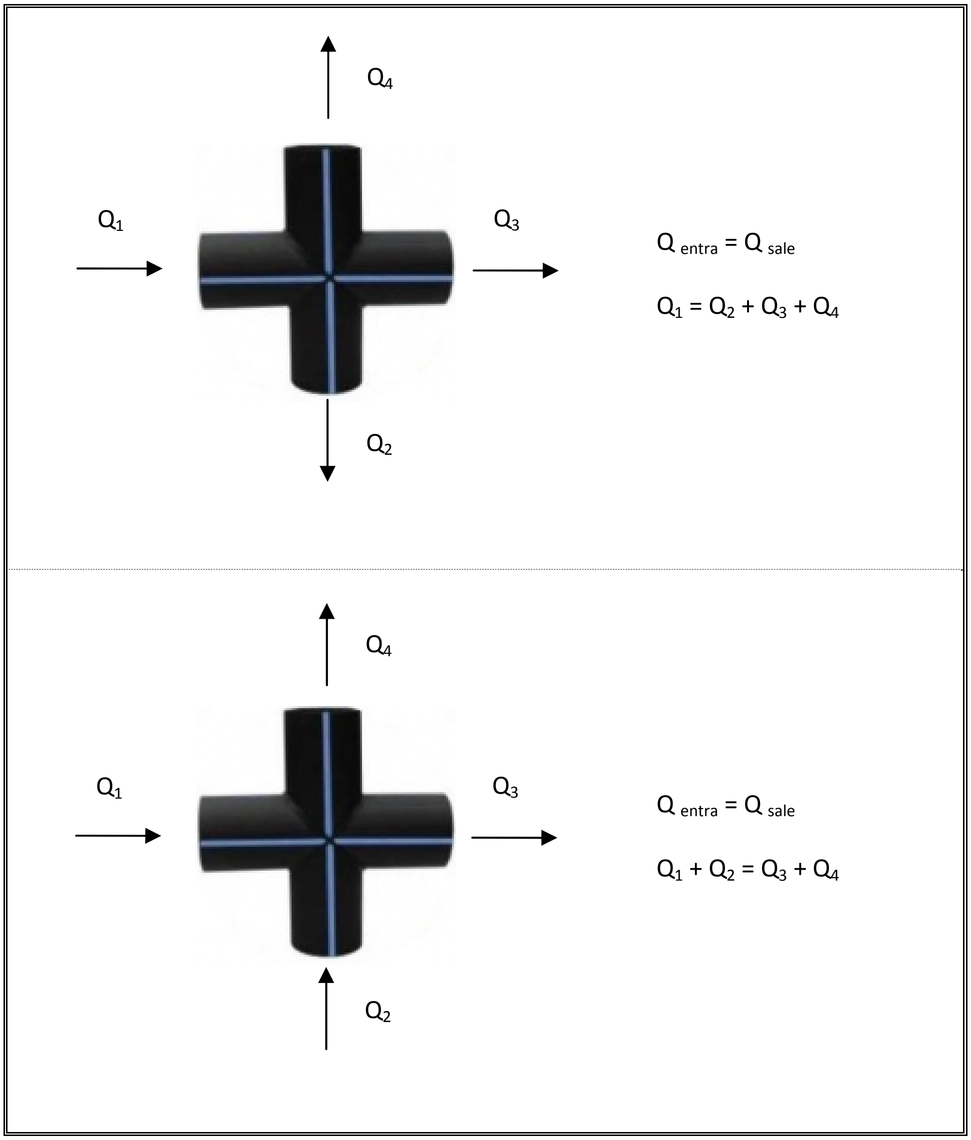


Fig.09 Combinación de conexiones de tuberías en la red

2.2.2 Conservación de la energía

La ley de la conservación de la energía establece que la energía no se puede perder, convierte en otras formas; es decir, la suma de todas las energías es una constante.

El principio de conservación de la energía es uno de los principios fundamentales de todas las disciplinas científicas; existen ecuaciones primarias que se pueden ver exactamente como una apropiada reformulación del principio de conservación de energía, por ejemplo:

- Fluidos: Ecuación de Bernoulli
- Circuitos eléctricos: Ley de Voltaje
- Calor y Termodinámica: Primer ley de la termodinámica

El principio de Bernoulli describe el comportamiento de un flujo laminar moviéndose a lo largo de una corriente de agua; expresando que: un fluido ideal –sin viscosidad ni rozamiento- en régimen de circulación por un conducto cerrado, la energía que posee el fluido permanece constante a lo largo de su recorrido.

La energía de un fluido en cualquier momento consta de tres componentes:

1. Energía cinética: es la energía debida a la velocidad que posea el fluido
2. Energía potencial gravitacional: es la energía debido a la altitud que un fluido posea
3. Energía de flujo: es la energía que un fluido contiene debido a la presión que posee.

Energía hidráulica total disponible	=	Energía cinética	+	Energía potencial (gravitacional)	+	Energía del flujo (presión)

$$E_T = z + \frac{P}{\gamma} + \frac{\alpha V^2}{2g}$$

Donde:

Z cota geométrica con respecto al nivel de referencia

$\frac{P}{\gamma}$ carga de presión del fluido (presión relativa o manométrica)

γ peso específico del fluido

$\frac{\alpha V^2}{2g}$ carga de velocidad del fluido

V velocidad media de la sección transversal

g aceleración de la gravedad de la Tierra

α coeficiente de Coriolis, para corregir el efecto de considerar la velocidad media

Recordando:

"Coeficiente de Coriolis"

Como resultado de la distribución no uniforme de velocidades en una sección de canal, la altura de velocidades en un flujo en canales abiertos es mayor que el valor calculado de acuerdo con la expresión ($V^2/2g$) donde V es la velocidad media. Cuando se utiliza el principio de energía en cálculos, la altura de la velocidad real puede expresarse como $\alpha(V^2/2g)$.

El coeficiente de Coriolis α que aparece en la expresión de la energía cinética, representa la relación que existe, para una sección dada, entre la energía real y la que se obtendría considerando una distribución uniforme de velocidades. Su valor se calcula con la siguiente ecuación:

$$\alpha = \frac{\int V_h^3 \, dA}{V^3 \, A}$$

Donde:

V_h Componente vertical de la velocidad a una profundidad h

dA Diferencial de área correspondiente a la velocidad V_h

V Velocidad media

A Área total

Los ensayos experimentales muestran que α varía entre 1.03 y 1.36 para los canales prismáticos (canales con sección transversal y pendiente del fondo constante).

El uso del coeficiente de Coriolis, depende de la exactitud con que se estén haciendo los cálculos, en muchos casos se justifica considerar: α = 1,siendo un valor límite utilizado generalmente en secciones transversales de alineación casi recta y tamaño regular; en este caso la distribución de la velocidad será estrictamente uniforme.

[Fuente: ingenierocivilinfo]

En una situación ideal, sin pérdidas, la energía total de un fluido debería permanecer constante a lo largo de su recorrido, sin embargo, debido a factores como el rozamiento del fluido con las paredes del interior de la tubería, o la presencia de accesorios o piezas especiales, una parte de la energía se transforma en calor, por lo cual se tiene que incluir en la ecuación, como se muestra a continuación:

$$E_{entra} = E_{sale} + \Delta E$$

$$Z_a + \frac{P_a}{\gamma} + \frac{\alpha V_a^2}{2g} = Z_b + \frac{P_b}{\gamma} + \frac{\alpha V_b^2}{2g} + h_{ab}$$

h_{ab} son las **pérdidas de energía** entre las secciones, sea por fricción o piezas especiales; se hablara detalladamente de estas en el **capítulo 3** del presente documento.

Se puede representar este comportamiento en la siguiente figura:

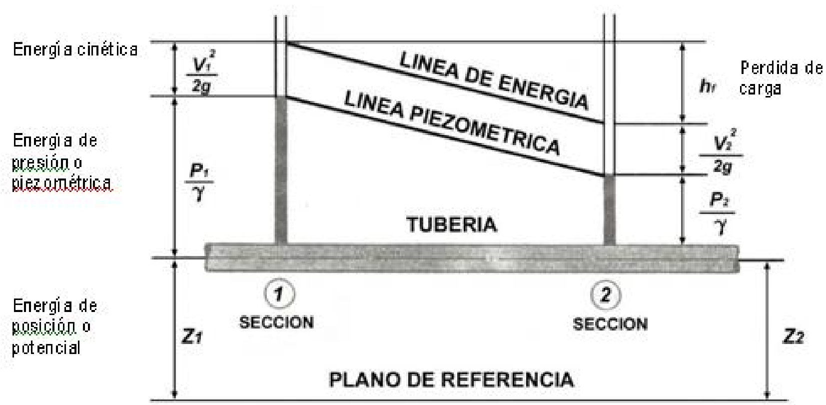


Fig.10 Esquema del comportamiento de la energía en la tubería

[Fuente: apuntesingenierocivil]

2.2.3. Conservación de la cantidad de movimiento

La segunda ley del movimiento de Newton se puede ordenar en variables de la mecánica de fluidos como:

$$F = m\,a = (\rho Q \Delta t)\left(\frac{\Delta V}{\Delta t}\right) = \Delta(\rho Q V) = \Delta(\rho A V^2)/2$$

Tomando en cuenta la ecuación anterior, se puede escribir el cambio de la cantidad de movimiento de un volumen dado de un fluido como:

$$M_{salida} = F + M_{entrada}$$

$$\rho Q V_b = F + \rho Q V_a$$

Esta ecuación expresa la Ley de conservación de la cantidad de movimiento, que establece que la cantidad de movimiento no se puede perder en un sistema hidráulico, aunque parte de la misma se pueda convertir en fuerzas de impulso; por lo tanto, si se conoce la razón de flujo de masa y la configuración física del canal de flujo que es causa de un cambio en la dirección del flujo, se puede calcular las fuerzas resultantes de impulso que actúan sobre el componente o estructuras hidráulicos.

A partir del principio de conservación de la cantidad de movimiento se puede llegar a la ecuación de conservación de la energía para un fluido, como a continuación se muestra:

Considerando la ecuación de la segunda ley de Newton, aplicada en una sección con entrada y salida tenemos (considerando constante la masa):

$$\sum F_x = mv_2 - mv_1 = m(v_2 - v_1)$$

La diferencia de velocidades se puede escribir así para un elemento diferencial:

$$\sum F_x = m\, dv$$

Si sabemos que

$$m = \rho\, A\, v$$

Sustituyendo tenemos

$$\sum F_x = (\rho\, A\, v)\, dv$$

Por otra parte, si el eje x coincide con la dirección del flujo, el término de "fuerzas externas"

$$\sum F_x = -dW\ sen\theta - (dA + A)\, p_1 + A\, p_2$$

Como el peso se puede expresar en términos del volumen por el peso específico

$$-dW\ sen\theta = -\gamma\, A\, dx\, sen\theta = -\gamma\, A\, dz$$

Ya que

$$-(dA + A)\, p_1 + A\, p_2 \approx -A\, p_1 + A\, p_2 = -A\,(p_1 - p_2) = -A\, dp$$

Sustituyendo las ecuaciones anteriores se tiene que

$$\sum F_x = -\gamma\, A\, dz - A\, dp$$

$$m\, dv = -\gamma\, A\, dz - A\, dp$$

$$(\rho\, A\, v)\, dv = -\gamma\, A\, dz - A\, dp$$

Al dividir entre γA y ordenar

$$dz + \frac{dp}{\gamma} + \frac{\rho v\, dv}{\gamma} = 0$$

Recordando la relación que existe entre el peso específico, la densidad y la aceleración de la gravedad

$$\gamma = \rho\, g \qquad\qquad g = \frac{\gamma}{\rho}$$

Se puede simplificar la ecuación a:

$$dz + \frac{dp}{\gamma} + \frac{v\,dv}{g} = 0$$

Integrando entre dos secciones transversales 1 y 2:

$$\int_1^2 dz + \frac{1}{\gamma}\int_1^2 dp + \frac{1}{g}\int_1^2 v\,dv = 0$$

$$(z_2 - z_1) + \frac{1}{\gamma}(p_2 - p_1) + \frac{1}{g}\left(\frac{v_2^2}{2} - \frac{v_1^2}{2}\right) = 0$$

$$z_2 + \frac{p_2}{\gamma} + \frac{v_2^2}{2g} = z_1 + \frac{p_1}{\gamma} + \frac{v_1^2}{2g}$$

2.3 Cálculo de redes de tuberías funcionando a presión con flujo permanente.

Si suponemos una red como a continuación se muestra, con longitudes (L_1, L_2, L_3, L_4 y $_{L5}$), diámetros (d_1, d_2, d_3, d_4 y d_5) y coeficientes de fricción (f_1, f_2, f_3, f_4 y f_5) de tuberías conocidas, así como gastos de demanda definidos (q_2, q_3 y q_4).

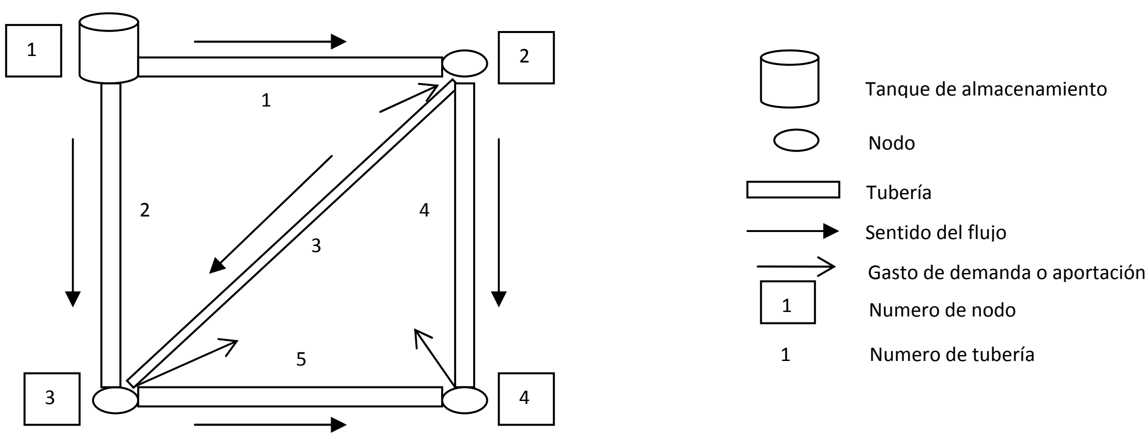


Fig.11 Esquema de Red, 4 nodos

Considerando las ecuaciones de continuidad en los nudos, se define lo siguiente:

Nodo1: $-Q_1 - Q_2 = q_1$

Nodo2: $Q_1 - Q_3 - Q_4 = -q_2$

Nodo3: $Q_2 + Q_3 - Q_5 = q_3$

Nodo4: $Q_5 + Q_4 = q_4$

Donde
Q : gasto que circula en el tubo
q: gasto de entrada o salida en el nodo

Recordando:

A partir de la ecuación de pérdida de carga por fricción de Darcy-Wiebach

$$h_f = f\frac{L}{d}\frac{V^2}{2g} = f\frac{L}{d}\frac{Q^2}{2gA^2}$$

En el Sistema Internacional de unidades

$$h_f = 0.0826\frac{fL}{d^5}Q^2$$

$$C = 0.0826\frac{fL}{d^5}$$

$$h_f = CQ^2$$

Y considerando

$$h_f = h_s - h_i$$

$$h_s - h_i = CQ^2$$

Despejando el gasto “Q”

$$K = \sqrt{\frac{1}{C}}$$

$$Q = K\,(h_s - h_i)^{1/2}$$

Sustituyendo las ecuaciones a fin de dejarla en función de las cargas de energía

Nodo1: $$-K_1\left(h_{s_1} - h_{i_1}\right)^{0.5} - K_2\left(h_{s_2} - h_{i_2}\right)^{0.5} = q_1$$

Nodo2: $$K_1\left(h_{s_1} - h_{i_1}\right)^{0.5} - K_3\left(h_{s_3} - h_{i_3}\right)^{0.5} - K_4\left(h_{s_4} - h_{i_4}\right)^{0.5} = -q_2$$

Nodo3: $$K_2\left(h_{s_2} - h_{i_2}\right)^{0.5} + K_3\left(h_{s_3} - h_{i_3}\right)^{0.5} - K_5\left(h_{s_5} - h_{i_5}\right)^{0.5} = q_3$$

Nodo4: $$K_5\left(h_{s_5} - h_{i_5}\right)^{0.5} + K_4\left(h_{s_4} - h_{i_4}\right)^{0.5} = q_4$$

Donde
h_{sn} : carga en nodo inicial, c/r tubo n
h_{in}: carga en nodo final, c/r tubo n
q_n: gasto entrada o salida en nodo n
K_n: coeficiente en función de
L_n longitud del tubo n
d_n: diámetro del tubo n
f_n: factor de fricción del tubo n

De esta manera se obtienen las siguientes expresiones:

Nodo1: $$-K_1(h_1 - h_2)^{0.5} - K_2(h_1 - h_3)^{0.5} = q_1$$

Nodo2: $$K_1(h_1 - h_2)^{0.5} - K_3(h_2 - h_3)^{0.5} - K_4(h_2 - h_4)^{0.5} = -q_2$$

Nodo3: $$K_2(h_1 - h_3)^{0.5} + K_3(h_2 - h_3)^{0.5} - K_5(h_3 - h_4)^{0.5} = q_3$$

Nodo4: $$K_5(h_3 - h_4)^{0.5} + K_4(h_2 - h_4)^{0.5} = q_4$$

Donde
h_n : carga en nodo, c/r tubo n
q_n: gasto entrada o salida en nodo n
K_n: coeficiente en función de
L_n longitud del tubo n
d_n: diámetro del tubo n
f_n: factor de fricción del tubo n

Por lo que se puede observar, tenemos un sistema de ecuaciones complejo, por este motivo se tienen que buscar maneras sencillas de solucionar este sistema.

Para resolver sistemas de ecuaciones no lineales puede utilizarse el método de Newton-Raphson, o bien un procedimiento que simplifique el problema matemático a resolver. Por ejemplo, el método de Hardy-Cross, que al considerar circuitos dentro de la red disminuye el número de ecuaciones no lineales por solucionar.

Nota:

Método de Cross

El Método de Aproximaciones Sucesivas, de Hardy Cross, está basado en el cumplimiento de dos principios o leyes: Ley de continuidad de masa en los nudos y Ley de conservación de la energía en los circuitos.

El planteamiento de esta última ley implica el uso de una ecuación de pérdida de carga o de "pérdida" de energía, bien sea la ecuación de Hazen & Williams o, bien, la ecuación de Darcy & Weisbach.

Como quiera que el Método de Hardy Cross es un método iterativo que parte de la suposición de los caudales iniciales en los tramos, satisfaciendo la Ley de Continuidad de Masa en los nudos, los cuales corrige sucesivamente con un valor particular, en cada iteración se deben calcular los caudales actuales o corregidos en los tramos de la red. Ello implica el cálculo de los valores de R y f de todos y cada uno de los tramos de tuberías de la red, el cálculo del coeficiente de fricción, f, es también iterativo, por aproximaciones sucesiva.

2.3.1 Método Sánchez-Fuentes para redes de distribución de agua

El método desarrollado en el Instituto de Ingeniería de la UNAM (Sánchez y Fuentes, 1991) considera que la ecuación f(Q), se desarrolla hasta la primera derivada mediante la serie de Taylor, entonces se obtiene la siguiente expresión:

$$f(Q + \Delta Q) = f(Q) + f'(Q)\Delta Q$$

Por otra parte, si de acuerdo a la ecuación de recurrencia, la pérdida de carga en los nudos se toma de la siguiente manera, considerando la ecuación de Darcy-Weisbach, incluyendo el valor absoluto para definir el sentido del flujo en el tubo P:

$$h_s - h_i = f(Q) = r_P Q_P |Q_P|$$

Obteniendo la primera derivada de la ecuación anterior:

$$f'(Q) = 2r_P|Q_P|$$

Sustituyendo Q= Q^k, y $Q^{k+1} = Q^k + \Delta Q$

$$h_s^k - h_i^k = f(Q^k) = r_P^k Q_P^k |Q_P^k|$$

$$f'(Q^k) = 2r_P^k |Q_P^k|$$

$$h_s^{k+1} - h_i^{k+1} = f(Q^{k+1}) = f(Q^k + \Delta Q) = f(Q^k) + f'(Q^k)\Delta Q$$

$$h_s^{k+1} - h_i^{k+1} = r_P^k Q_P^k |Q_P^k| + 2r_P^k |Q_P^k| (Q_P^{k+1} - Q_P^k)$$

Sea la función

$$f(Q) = C|Q|Q = h_s^{k+1} - h_i^{k+1}$$

Este método propone dos casos, cuando Q>0 y Q<0, para los cuales se obtiene una ecuación distinta para encontrar Q^{k+1}, a partir de la ecuación anterior

Caso 1: Q>0 $$Q^{k+1} = \frac{h_s^{k+1} - h_i^{k+1}}{2CQ^k} + \frac{Q^k}{2}$$

Caso 2: Q<0 $$Q^{k+1} = -\frac{h_s^{k+1} - h_i^{k+1}}{2CQ^k} - \frac{Q^k}{2}$$

Reuniéndolos en $$Q^{k+1} = \frac{h_s^{k+1} - h_i^{k+1}}{2C|Q^k|} + \frac{Q^k}{2}$$

Si se considera $$\propto^k = \frac{1}{2C|Q^k|}$$

Se obtiene la ecuación fundamental del método propuesto

$$Q^{k+1} = \propto^k \left(h_s^{k+1} - h_i^{k+1}\right) + \frac{Q^k}{2}$$

Nota: a medida que k aumenta Q^k y Q^{k+1} tienden a ser iguales

2.3.2 Sistema de ecuaciones lineales

Si el gasto (en el entendido que corresponden al valor en la iteración k) de cada tubería j de la red se expresan en términos de las cargas piezométricas, se forma un sistema de ecuaciones lineales cuyas incógnitas son las cargas de presión en la iteración k+1.

El sistema de ecuaciones será lineal, tendrá como incógnitas a h_n^{k+1}

Posteriormente se encuentra el valor de Q^{k+1}, comprobando que Q^k y Q^{k+1} sean parecidos, cuando sea así se detiene el proceso iterativo ya que se tendrán los valores finales de Q^{k+1} y h^{k+1}.

Se pueden seguir los siguientes pasos para formar el sistema de ecuaciones lineales para resolver la red de tuberías funcionando a presión.

1) Las variables serán las cargas totales en los nudos (h_n)
2) El sistema de ecuaciones lineales, expresado en forma matricial, tiene una matriz de coeficientes cuadrada (igual número de renglones y columnas, sus elementos son α_{nm}). Cada ecuación del sistema corresponde a un nudo (n)
3) El número de ecuaciones será siempre igual al número de nudos totales de la red menos el número de nudos en donde se conoce la carga (tanques).
4) El valor del coeficiente α_{nn} en la diagonal principal es igual a la suma de los factores "α" con signo negativo, de todos los tubos que se conectan al nudo en cuestión ($-\Sigma\alpha$)
5) En cada ecuación existirán tantos coeficientes distintos de cero (α_{nm}) como nudos se conecten al nudo de interés. Los demás coeficientes tendrán un valor de cero. En cada ecuación, se debe observar cuales son los nudos (m) a los que se conecta el nudo (n) que corresponde a la ecuación y en ese lugar se anotará el valor de "α_j" que corresponda al tubo "j" que une los dos nudos (n con m). Siempre con signo positivo.

6) El término independiente será siempre $q_n/2$ con signo positivo si el gasto de que sale el nudo (n) o con signo negativo si entra al nudo (n). Si el nudo al que corresponde la ecuación se une a otro en el que se conozca la carga (T), entonces en el término independiente se debe agregar el producto de la carga con el factor "α" que corresponde al tubo "j" con el que están unidos los dos tubos. Siempre con signo negativo ($-\alpha_j h_T$)
7) Revisar que la matriz de coeficientes formada sea simétrica (los elementos α_{nm} deben ser iguales a los α_{mn} para n distinta de m) y que la suma algebraica de los coeficientes de cada renglón sea cero, excepto cuando se trata de la ecuación de un nudo conectado a un nudo de carga conocida (tanque).

2.4 Aplicación del método numérico

En la siguiente figura se presenta el esquema representativo de una red de agua potable.

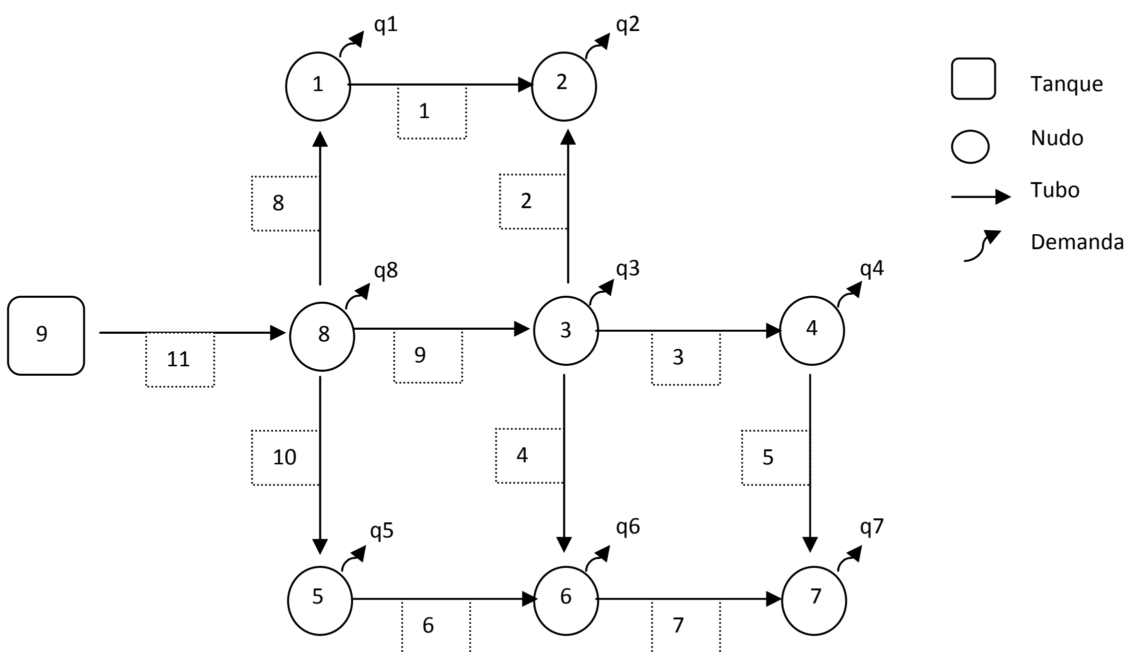


Fig.12 Esquema red, 9 nodos

De acuerdo al proceso mencionado anteriormente, el sistema de ecuaciones que se tendría que resolver para obtener las cargas y gastos de la red de abastecimiento anterior es:

$$(-\alpha_1-\alpha_8)\, h_1 + \alpha_1 h_2 + \alpha_8 h_8 = q_1/2$$

$$\alpha_1\, h_1 + (-\alpha_1-\alpha_2)\, h_2 + \alpha_2\, h_3 = q_2/2$$

$$\alpha_2\, h_2 + (-\alpha_2-\alpha_3-\alpha_4-\alpha_9)\, h_3 + \alpha_3\, h_4 + \alpha_4\, h_6 + \alpha_9\, h_8 = q_3/2$$

$$\alpha_3\, h_3 + (-\alpha_3-\alpha_5)\, h_4 + \alpha_5\, h_7 = -q_4/2$$

$$(-\alpha_6-\alpha_{10})\, h_5 + \alpha_6\, h_6 + \alpha_{10}\, h_8 = q_5/2$$

$$\alpha_4\, h_3 + \alpha_6\, h_5 + (-\alpha_4-\alpha_6-\alpha_7)\, h_6 + \alpha_7\, h_7 = q_6/2$$

$$\alpha_5\ h_4 + \alpha_7\ h_6 + (-\alpha_5-\alpha_7)\ h_7 = q_7/2$$

$$\alpha_8\ h_1 + \alpha_9\ h_3 + \alpha_{10}\ h_5 + (-\alpha_8-\alpha_9-\alpha_{10}-\alpha_{11})\ h_8 + (\alpha_{11}\ h_9) = q_8/2$$

Tomando en cuenta que la carga en el tanque (h_9) y α_{11} son conocidas, se consigue un sistema de ecuaciones lineales; a continuación se presenta en forma matricial dicho sistema lineal:

$$\begin{pmatrix} (-\alpha_1-\alpha_8) & \alpha_1 & 0 & 0 & 0 & 0 & 0 & \alpha_8 \\ \alpha_1 & (-\alpha_1-\alpha_2) & \alpha_2 & 0 & 0 & 0 & 0 & 0 \\ 0 & \alpha_2 & (-\alpha_2-\alpha_3-\alpha_4-\alpha_9) & \alpha_3 & 0 & \alpha_4 & 0 & \alpha_9 \\ 0 & 0 & \alpha_3 & (-\alpha_3-\alpha_5) & 0 & 0 & \alpha_5 & 0 \\ 0 & 0 & 0 & 0 & (-\alpha_6-\alpha_{10}) & \alpha_6 & 0 & \alpha_{10} \\ 0 & 0 & \alpha_4 & 0 & \alpha_6 & (-\alpha_4-\alpha_6-\alpha_7) & \alpha_7 & 0 \\ 0 & 0 & 0 & \alpha_5 & 0 & \alpha_7 & (-\alpha_5-\alpha_7) & 0 \\ \alpha_8 & 0 & \alpha_9 & 0 & \alpha_{10} & 0 & 0 & (-\alpha_8-\alpha_9-\alpha_{10}-\alpha_{11}) \end{pmatrix} \begin{pmatrix} h_1 \\ h_2 \\ h_3 \\ h_4 \\ h_5 \\ h_6 \\ h_7 \\ h_8 \end{pmatrix} = \begin{pmatrix} q_1/2 \\ q_2/2 \\ q_3/2 \\ -q_4/2 \\ q_5/2 \\ q_6/2 \\ q_7/2 \\ (q_8/2)-(\alpha_{11}\ h_9) \end{pmatrix}$$

También se podría tener una red como a continuación se muestra.

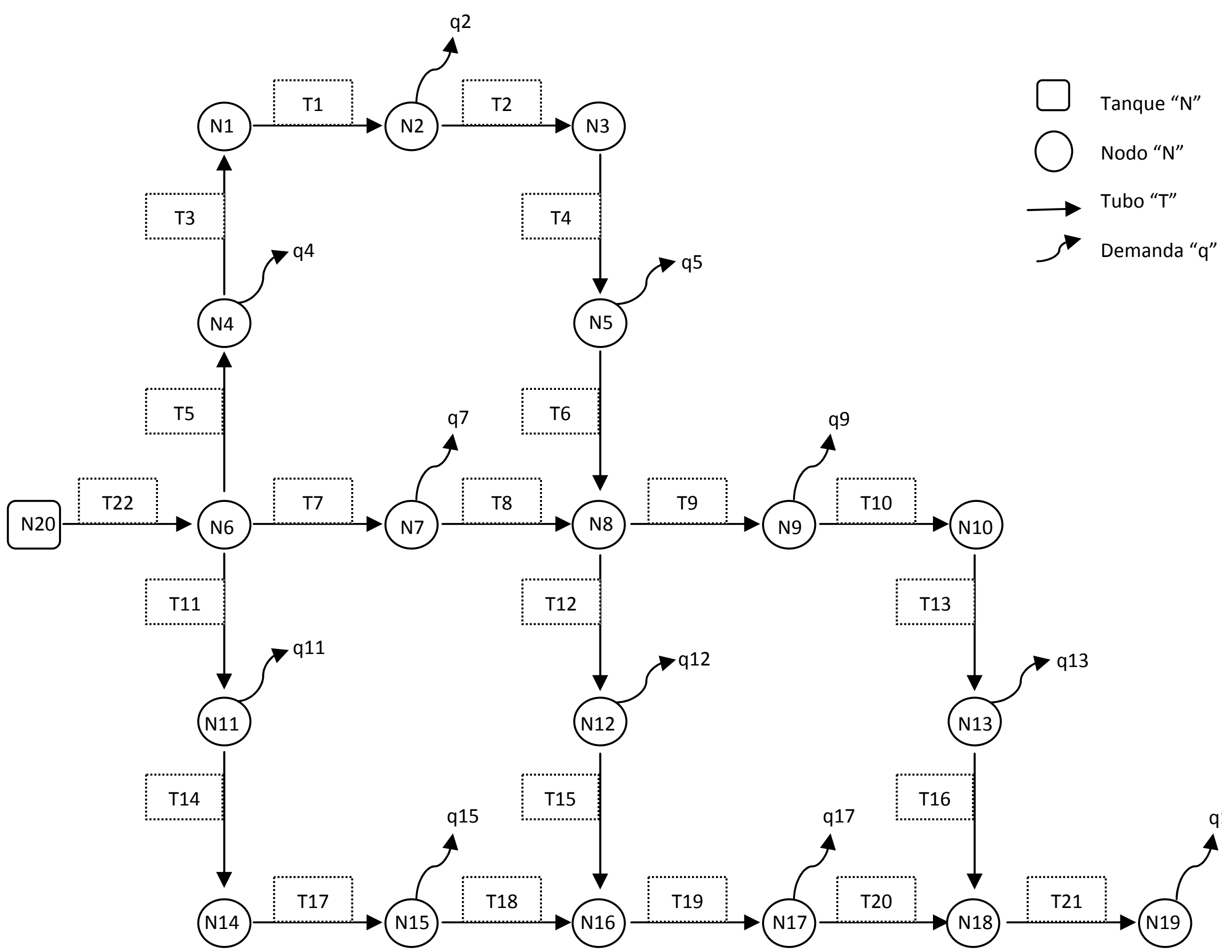


Fig.13 Esquema red, 20 nodos

$$(-\alpha1-\alpha3)\ h1 + \alpha1\ h2 + \alpha3\ h4 = 0$$

$$\alpha1\ h1 + (-\alpha1-\alpha2)\ h2 + \alpha2\ h3 = q1/2$$

$$\alpha2\ h2 + (-\alpha2-\alpha4)\ h3 + \alpha4\ h5 = 0$$

$$\alpha3\ h1 + (-\alpha3-\alpha5)\ h4 + \alpha5\ h6 = q2/2$$

$$\alpha4\ h3 + (-\alpha4-\alpha6)\ h5 + \alpha6\ h8 = q3/2$$

$$\alpha5\ h4 + (-\alpha5-\alpha7-\alpha11-\alpha22)\ h6 + \alpha7\ h7 + \alpha11\ h11 + \boldsymbol{\alpha22\ h20} = 0$$

$$\alpha7\ h6 + (-\alpha7-\alpha8)\ h7 + \alpha8\ h8 = q4/2$$

$$\alpha6\ h5 + \alpha8\ h7 + (-\alpha6-\alpha8-\alpha9-\alpha12)\ h8 + \alpha9\ h9 + \alpha12\ h12 = 0$$

$$\alpha9\ h8 + (-\alpha9-\alpha10)\ h9 + \alpha10\ h10 = q5/2$$

$$\alpha10\ h9 + (-\alpha10-\alpha13)\ h10 + \alpha13\ h13 = 0$$

$$\alpha11\ h6 + (-\alpha11-\alpha14)\ h11 + \alpha14\ h14 = q6/2$$

$$\alpha12\ h8 + (-\alpha12-\alpha15)\ h12 + \alpha15\ h16 = q7/2$$

$$\alpha13\ h10 + (-\alpha13-\alpha16)\ h13 + \alpha16\ h18 = q8/2$$

$$\alpha14\ h11 + (-\alpha14-\alpha17)\ h14 + \alpha17\ h15 = 0$$

$$\alpha17\ h14 + (-\alpha17-\alpha18)\ h15 + \alpha18\ h16 = q9/2$$

$$\alpha15\ h12 + \alpha18\ h15 + (-\alpha15-\alpha18-\alpha19)\ h16 + \alpha19\ h17 = 0$$

$$\alpha19\ h16 + (-\alpha19-\alpha20)\ h17 + \alpha20\ h18 = q10/2$$

$$\alpha16\ h13 + \alpha20\ h17 + (-\alpha16-\alpha20-\alpha21)\ h18 + \alpha21\ h19 = 0$$

$$\alpha21\ h18 + (-\alpha21)\ h19 = q11/2$$

De manera similar que la red anterior, en el sistema de ecuaciones anteriores se conocen los valores de a22 y h20, sintetizándola de manera matricial quedaría como a continuación se muestra:

$$\begin{bmatrix}
(-a_1-a_3) & a_1 & 0 & a_3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
a_1 & (-a_1-a_2) & a_2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & a_2 & (\ a_2\ a_4) & 0 & a_4 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
a_3 & 0 & 0 & (-a_3-a_5) & 0 & a_5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & a_4 & 0 & (-a_4-a_6) & 0 & 0 & a_6 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & a_5 & 0 & (-a_5-a_7-a_{11}-a_{22}) & a_7 & 0 & 0 & 0 & a_{11} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & a_7 & (-a_7-a_8) & a_8 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & a_6 & 0 & a_8 & (-a_6-a_8-a_9-a_{12}) & a_9 & 0 & 0 & a_{12} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & a_9 & (-a_9-a_{10}) & a_{10} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & a_{10} & (-a_{10}-a_{13}) & 0 & 0 & a_{13} & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & a_{11} & 0 & 0 & 0 & 0 & (-a_{11}-a_{14}) & 0 & 0 & a_{14} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & a_{12} & 0 & 0 & 0 & (-a_{12}-a_{15}) & 0 & 0 & 0 & a_{15} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & a_{13} & 0 & 0 & (-a_{13}-a_{16}) & 0 & 0 & 0 & 0 & a_{16} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & a_{14} & 0 & 0 & (-a_{14}-a_{17}) & a_{17} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & a_{17} & (-a_{17}-a_{18}) & a_{18} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & a_{15} & 0 & 0 & a_{18} & (-a_{15}-a_{18}-a_{19}) & a_{19} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & a_{19} & (-a_{19}-a_{20}) & a_{20} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & a_{16} & 0 & 0 & 0 & a_{20} & (-a_{16}-a_{20}-a_{21}) & a21 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & a_{21} & (-a21)
\end{bmatrix}
\begin{bmatrix} h_1 \\ h_2 \\ h_3 \\ h_4 \\ h_5 \\ h_6 \\ h_7 \\ h_8 \\ h_9 \\ h_{10} \\ h_{11} \\ h_{12} \\ h_{13} \\ h_{14} \\ h_{15} \\ h_{16} \\ h_{17} \\ h_{18} \\ h_{19} \end{bmatrix}
=
\begin{bmatrix} 0 \\ q_1/2 \\ 0 \\ q_2/7 \\ q_3/2 \\ (-a_{22})h_{20} \\ q_4/2 \\ 0 \\ q_5/2 \\ 0 \\ q_6/2 \\ q_7/2 \\ q_8/2 \\ 0 \\ q_9/2 \\ 0 \\ q_{10}/2 \\ 0 \\ q_{11}/2 \end{bmatrix}$$

Considerando la red de abastecimiento anterior y su sistema de ecuaciones lineales, se realizó el análisis bajo diferentes características, con la finalidad de observar la importancia que representan los factores que la componen en los resultados obtenidos.

La variación en la longitud, diámetro, y consideración de pérdidas locales se efectuaron para desarrollar el análisis deseado, ya que era necesario observar el comportamiento de las cargas conforme se aumentaba o disminuían dichas variables; sin embargo, la variación en el gasto de demanda se tuvo que realizar para observar el comportamiento en condiciones normales de demanda diaria horaria, determinando el nivel de carga en el tanque necesario para que el nivel en los nodos de toda la red tengan valores de 1m o mayores.

Se realizaron las siguientes variaciones:

- Carga en el tanque [h_{20}]:
  Se buscaron los valores que cumplieran con la condición de tener una carga aproximada de 1m en el nodo 19 (el más alejado). En el desarrollo del trabajo se observo la importancia de manejar valores mínimos en la carga del tanque, de esta manera se garantiza contar con la mayor diferencia entre considerar o no las pérdidas de carga menores.
- Longitudes de tubería:
  Se consideraron longitudes de 100, 300 y 600m
- Diámetros de tubería
  Se consideraron los diámetros comerciales de 4”, 6” y 8 “
- Gastos de demanda
  Considerando la curva de demanda diaria horaria propuesta por la CONAGUA para el DF, se obtuvieron los gastos de demanda en cada hora al afectar los coeficientes de variación tomando como mínimo: 2.5, 5 y 7.5 lts/s
- Factor de fricción
  Dependiendo del diámetro de la tubería se consideraron los factores de fricción: 0.021 (4”), 0.019 (6”) y 0.0165 (8”).
- Pérdidas de carga locales
  Consideración o no de pérdidas de carga producidas por piezas especiales (codos, tes y cruces)

Capítulo 3. Pérdidas de energía

Los cálculos de flujo en las tuberías se dirigen a determinar la suma de las pérdidas de energía; los factores que afectan a las pérdidas durante el flujo en las tuberías son independientes de la presión; sin embargo, los parámetros que más influyen sobre estas pérdidas son: la energía cinética, la longitud y el diámetro.

Existen dos clases de pérdidas de energía del flujo: pérdidas de fricción a lo largo de la tubería y pérdidas locales o menores debido a piezas especiales; ambas causadas por la resistencia viscosa del fluido.

En las tuberías, se presenta usualmente un flujo turbulento, es decir, las partículas del fluido siguen caminos independientes y al azar; este movimiento es la razón de gran parte de las pérdidas de energía en el flujo en las tuberías. El grado de turbulencia crece directamente con la velocidad.

En flujos donde el número de Reynolds es menor a 2000 se suprime la turbulencia, moviéndose las partículas de manera paralela y ordenada, es decir, en flujo laminar. Para valores mayores a 4000 se considera un flujo turbulento. Por lo tanto, los valores mayores que 2000 y menores de 4000 será flujo en transición.

La fórmula para determinar el número de Reynolds es el siguiente:

$$Re = \frac{F_I}{F_V} = \frac{V\,D}{\upsilon} = \frac{VD\rho}{\mu}$$

Donde:
FI Fuerza de inercia
FV Fuerza viscosa
Re Número de Reynolds, adimensional
V Velocidad media del flujo
D diámetro de la tubería
υ viscosidad cinemática del fluido, para agua a 20° = 10^{-6} m^2/s
ρ densidad, agua potable = 1000 kg/m^3
μ viscosidad dinámica, para agua a 20° = 0.001003 kg/(m s)

3.1 Pérdidas debidas a la fricción

La fórmula básica para el cálculo de las pérdidas de carga en las tuberías y conductos es la de Darcy-Weisbah, valida tanto para flujo laminar como para turbulento de cualquier líquido. Establece que la pérdida de energía h_L es una tubería se obtiene de la siguiente manera:

$$h_L = f\,\frac{L}{D}\,\frac{V^2}{2g}$$

Si se deja en función del gasto:

$$h_L = 0.0826\,f\,\frac{L\,Q^2}{D^5}$$

Donde:

h_L pérdida de energía [m]

f factor de fricción (constante de proporcionalidad) [adimensional]

L longitud [m]

D diámetro [m]

$\frac{V^2}{2g}$ energía cinética

V velocidad [m/s]

g aceleración de la gravedad [m/s^2]

Q gasto o caudal [m^3/s]

Nota:

$$V^2 = \frac{Q^2}{A^2} = \frac{Q^2}{\left(\pi \frac{D^2}{4}\right)^2} = \frac{Q^2}{\pi^2 \frac{D^4}{16}}$$

$$h_L = f\ \frac{L}{D}\ \frac{V^2}{2g} = f\ \frac{L}{D2g}\ \frac{Q^2}{\left(\pi^2 \frac{D^4}{16}\right)} = f\ \frac{LQ^2}{D^5}\ \frac{8}{(\pi^2 g)}$$

$$\frac{8}{(\pi^2 g)} = 0.08262686$$

$$h_L = 0.0826\ f\ \frac{L\ Q^2}{D^5}$$

Para flujo laminar, el coeficiente de fricción se puede obtener con la siguiente fórmula:

$$f = \frac{64}{Re}$$

Para flujo turbulento, existen diversos métodos con los que se puede obtener de manera aproximada el valor del coeficiente de fricción.

El que resulta más práctico es aquel que se obtiene al emplear el diagrama de Moody. Para emplear dicho diagrama se debe conocer el número de Reynolds y la rugosidad relativa "ε_r" de las paredes de la tubería, la cual se obtiene a partir de dividir la rugosidad absoluta "ε" de la tubería por su diámetro interior.

$$\varepsilon_r = \frac{\varepsilon}{D}$$

La rugosidad absoluta se puede obtener a partir de la siguiente tabla, tomando en cuenta el material de la tubería:

Tabla 05. Valores de rugosidad absoluta de dif. Mat (Moody)

Material	Rugosidad absoluta ε [mm]
Tubos de acero soldado de calidad normal	
Nuevo	0.05 – 0.10

Material	Rugosidad absoluta ε [mm]
Limpiado después de mucho uso	0.15 – 0.20
Moderadamente oxidado, con pocas incrustaciones	0.4
Con muchas incrustaciones	3.0
Con remaches transversales, en buen estado	0.1
Con costura longitudinal y una línea transversal de remaches en cada junta, o bien laqueado interiormente	0.3 – 0.4
Con líneas transversales de remaches, sencilla o doble; o tubos remachados con doble hilera longitudinal de remaches e hilera transversal sencilla, sin incrustaciones	0.6 – 0.7
Acero soldado, con una hilera transversal sencilla de pernos en cada junta, laqueado interior, sin oxidaciones, con circulación de agua turbia	1.0
Acero soldado, con doble hilera transversal de pernos, agua turbia, tuberías remachadas con doble costura longitudinal de remaches y transversal sencilla interior asfaltado o laqueado	1.2 – 1.3
Acero soldado con costura doble de remaches transversales, muy oxidado. Acero remachado, de cuatro a seis filas longitudinales de remaches, con mucho tiempo de servicio	2.0
Tubos remachados, con filas longitudinales y transversales	
- espesor de lámina < 5 mm	0.65
- espesor de lámina de 5 a 12 mm	1.95
- espesor de lámina > 12 mm, o entre 6 y 12 mm, si las hileras de pernos tienen cobrejuntas	3.0
- espesor de lámina > 12 mm con cobrejuntas	5.5
Tubos remachados, con 4 filas transversales y 6 longitudinales con cobrejuntas interiores	4.0
Concreto centrifugado, nuevo	0.16
Concreto centrifugado, con protección bituminosa	0.0015 – 0.125
Concreto en galerías, colado con cimbra normal de madera	1.0 – 2.0
Concreto en galerías, colado con cimbra rugosa de madera	10
Concreto armado en tubos y galerías, acabado interior terminado a mano	0.01
Concreto acabado liso	0.025
Conductos de concreto armado, con acabado liso y varios años de servicio	0.2 – 0.3
Concreto alisado interiormente con cemento	0.25
Galerías con acabado interior de cemento	1.5 – 1.6
Concreto con acabado normal	1.0 – 3.0
Concreto con acabado rugoso	10
Cemento liso	0.3 – 0.8
Cemento no pulido	1.0 – 2.0
Concreto presforzado Freyssinet	0.04
Concreto presforzado Cona y Socoman	0.25
Mampostería de piedra, bien junteada	1.2 – 2.5
Mampostería de piedra rugosa, sin juntear	8.0 – 15.0
Mampostería de piedra, mal acabada	1.5 – 3.0
Plástico (PE, PVC)	0.0015

Material	Rugosidad absoluta ε [mm]
Poliéster reforzado con fibra de vidrio	0.01
Tubos estirados de acero	0.0024
Tubos de latón o cobre	0.0015
Fundición revestida de cemento	0.0024
Fundición con revestimiento bituminoso	0.0024
Fundición centrifugada	0.003
Fundición asfaltada	0.06 – 0.18
Fundición	0.12 – 0.60
Acero comercial y soldado	0.03 – 0.09
Hierro forjado	0.03 – 0.09
Hierro galvanizado	0.06 – 0.24
Madera	0.18 – 0.90
Hormigón	0.30 – 3.00

A continuación se muestra el diagrama de Moody; con el valor de rugosidad relativa y el número de Reynolds, se obtiene el valor del coeficiente de fricción en el costado izquierdo.

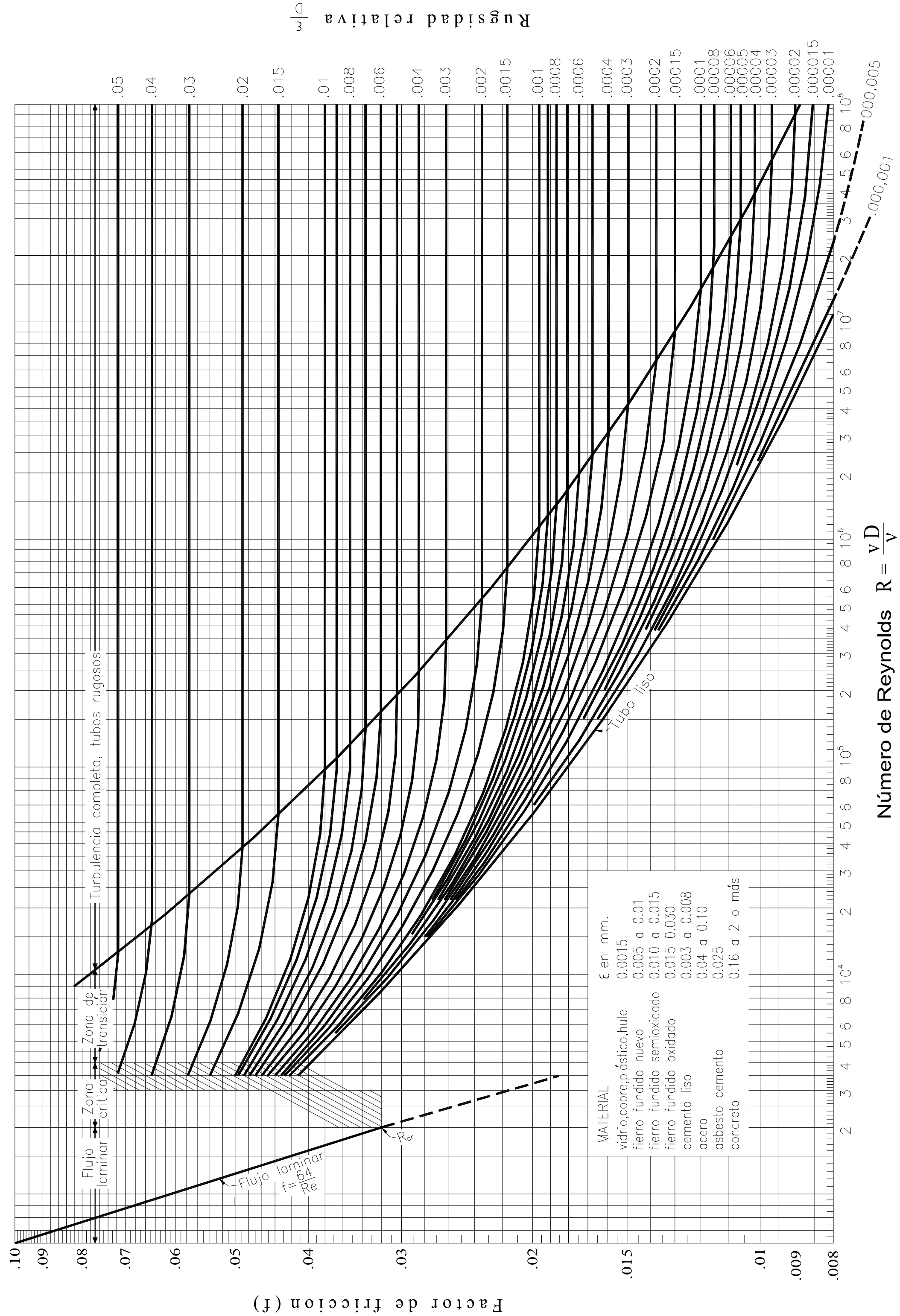


Fig.14 Diagrama de Moody

Este ábaco se obtuvo a partir de la ecuación de Colebrook-White (1939), la cual agrupa las expresiones de Nikuradse (1933) y Prandtl y Von-Karman (1930), haciéndola válida para todo tipo de flujos y rugosidades; es la más exacta y universal, aunque compleja. A continuación se presentan las ecuaciones mencionadas:

- Colebrook-White

$$\frac{1}{\sqrt{f}} = -2\log\left[\left(\frac{\varepsilon}{3.71\,D}\right) + \left(\frac{2.51}{Re\,\sqrt{f}}\right)\right]$$

Existen otras formulas para determinar la pérdida de carga en las tuberías, por ejemplo las ecuaciones de Manning (1890) son validas para tuberías con diámetro muy grande; empleando la siguiente fórmula:

$$h = 10.3\,n^2\,L\left(\frac{Q^2}{D^{5.33}}\right)$$

Donde:

h pérdida de carga [m]

n coeficiente de rugosidad [adimensional]

D diámetro interno de la tubería [m]

Q gasto o caudal [m^3/s]

L longitud de la tubería [m]

Para el caso de tuberías se puede obtener el valor de "n" en la siguiente tabla:

Tabla 06. Coeficiente de rugosidad n de Manning, dif.mat

Material	Coeficiente de rugosidad de Manning "n"
Plástico (PE, PVC)	0.006 – 0.010
Poliéster reforzado con fibra de vidrio	0.009
Acero	0.010 – 0.011
Hierro galvanizado	0.015 – 0.017
Fundición	0.012 – 0.015
Hormigón	0.012 – 0.017
Hormigón revestido con gunita	0.016 – 0.022
Revestimiento bituminoso	0.013 – 0.016

Otra manera de determinar las pérdidas de carga debido a la fricción, es la propuesta por Hazen-Williams (1905), limitándose para agua cuya temperatura fluctúe entre 5°C y 25°C; es útil para tuberías de fundición y acero.

$$h = 10.674\;L\;\left[\frac{Q^{1.852}}{(C^{1.852}\;D^{4.871})}\right]$$

Donde:

h pérdida de carga o de energía [m]

Q gasto o caudal [m^3/s]

C coeficiente de rugosidad [adimensional]

D diámetro interno de la tubería [m]

L longitud de la tubería [m]

Los valores del coeficiente de rugosidad de Hazen-Williams se pueden obtener de la siguiente tabla:

Tabla 07. Coeficiente de rugosidad C de Hazen-Williams, dif.mat.

Material	Coeficiente de rugosidad de Hazen-Williams C
Asbesto cemento	140
Latón	130 – 140
Ladrillo de saneamiento	100
Hierro fundido, nuevo	130
Hierro fundido, 10 años de edad	107 – 113
Hierro fundido, 20 años de edad	89 – 100
Hierro fundido, 30 años de edad	75 – 90
Hierro fundido, 40 años de edad	64 – 83
Concreto	120 – 140
Cobre	130 – 140
Hierro dúctil	120
Hierro galvanizado	120
Vidrio	140
Plomo	130 – 140
Plástico (PE, PVC)	140 – 150
Tubería lisa nueva	140
Acero nuevo	140 – 150
Acero	130
Acero rolado	110
Lata	130
Madera	120
Hormigón	120 – 140

Cuando se cuente con tuberías de fibrocemento, la fórmula de Scimeni (1925) sería válida:

$$h = (9.84\ X\ 10^{-4})\ L\ \left(\frac{Q^{1.786}}{D^{4.786}}\right)$$

Donde:

h pérdida de carga [m]

Q gasto o caudal [m^3/s]

D diámetro interno de la tubería [m]

L longitud de la tubería [m]

3.2 Pérdidas locales o menores

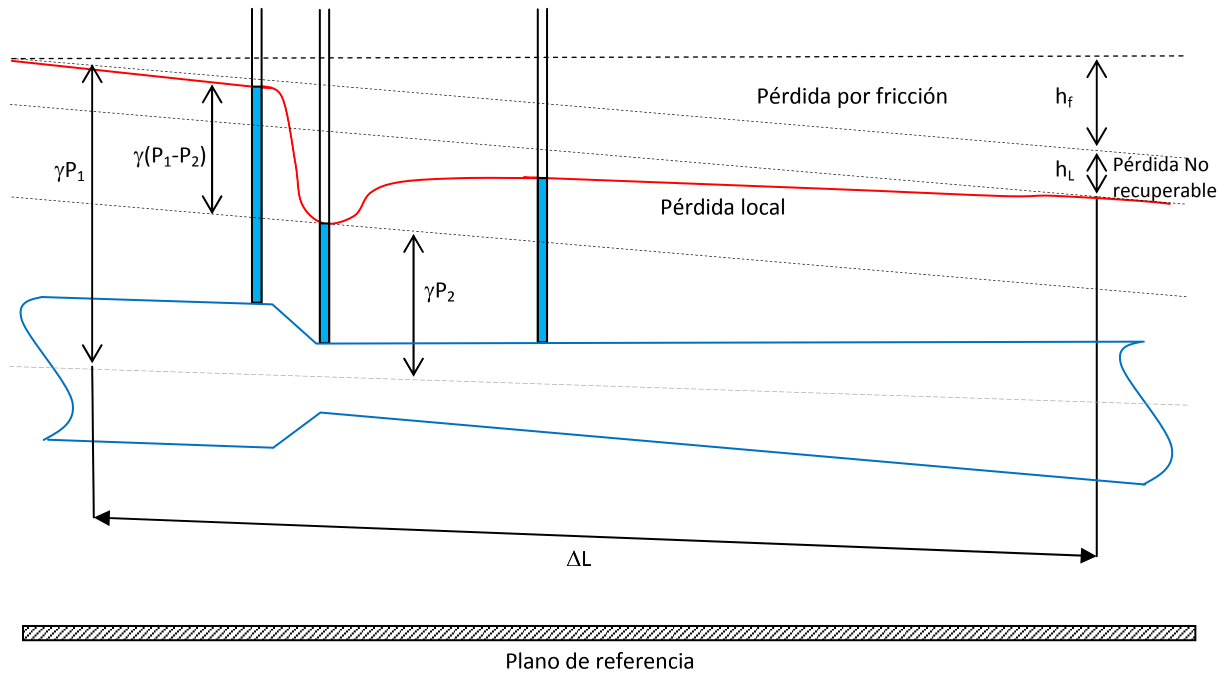


Fig.15 Pérdida de energía

La energía contenida en las redes de abastecimiento de agua potable se ve frecuentemente alterada por diversos factores, el más importante es aquel inducido por la fricción provocada entre el agua y el material interior de la tubería, pero también existen pérdidas en puntos específicos de la red por piezas especiales (accesorios), debido a curvaturas, cambios de dirección, reducciones, ampliaciones, etc.; con frecuencia son despreciadas en los cálculos hidráulicos, sin embargo existen condiciones bajo las cuales las pérdidas locales o menores son de suma importancia.

Generalmente se expresan las pérdidas menores bajo la siguiente fórmula:

$$h_L = K\frac{V^2}{2g}$$

Donde:

hL pérdida de carga local

K coeficiente de pérdida local

V velocidad media en el tubo

La obtención del coeficiente de pérdida local “K” es variable, dependiendo de la pieza especial es el valor de pérdida de energía que produce. En diversa bibliografía se pueden encontrar valores propuestos de “K” para accesorios específicos, a continuación se presentan algunos de ellos.

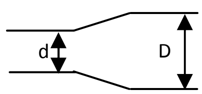
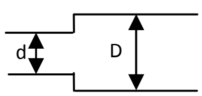
Tabla 08. Coeficiente de pérdida local K para dif. accesorios

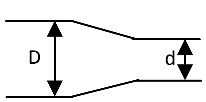
Accesorio: Válvulas	K
Esférica – totalmente abierta	10
En ángulo recto- totalmente abierta	5
De seguridad – totalmente abierta	2.5
De retención – totalmente abierta	2
De mariposa- totalmente abierta	0.3
De mariposa – ¾ abierta	2.5
De mariposa – ½ abierta	14.5
De mariposa – ¼ abierta	150
De compuerta – totalmente abierta	0.2
De compuerta – ¾ abierta	1.15
De compuerta – ½ abierta	5.6
De compuerta – ¼ abierta	24

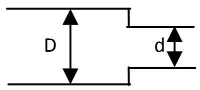
Accesorio: Codos	K
Hierro fundido (diámetro: 50-1200mm)	
Codo a 90°	0.40
Codo a 45°	0.20
Acero soldado (diámetro: 50-400 mm)	
Codo a 90° de radio corto	0.40
Codo a 45° de radio corto	0.20
Codo a 90° de radio largo	0.35
Codo a 45° de radio largo	0.17
PVC	
Codo a 90° (diámetro: 1/2” – 8”)	1.25
Codo a 45° (diámetro: 1/2” – 8”)	0.50
Codo a 90° de radio largo (diámetro: ½” – 4”)	0.45
Codo a 45° de radio largo (diámetro: ½” – 4”)	0.25
Codo a 90° de radio largo (diámetro: 150-600mm)	0.30
Codo a 45° de radio largo (diámetro: 150-600mm)	0.15
Codo a 22.5° de radio largo (d: 150-600mm)	0.10
Codo a 11.25° de radio largo (d: 150-600mm)	0.05
Acero roscado (diámetro: 1/2” – 6”)	
Codo a 90°	1.25
Codo a 45°	0.50
Codo a 90º de radio corto (con bridas)	0.90
Codo a 90º de radio normal (con bridas)	0.75

Accesorio: Codos	K
Codo a 90º de radio grande (con bridas)	0.60
Codo a 45º de radio corto (con bridas)	0.45
Codo a 45º de radio normal (con bridas)	0.40
Codo a 45º de radio grande (con bridas)	0.35

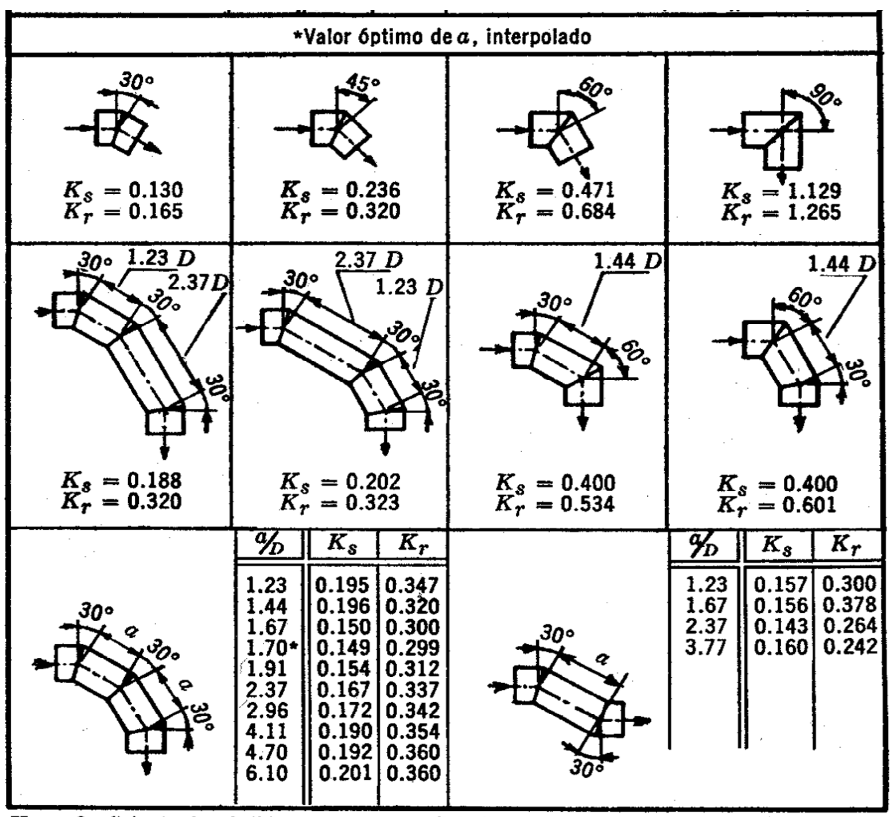
Accesorio: Entrada	K
Orillas afiladas	0.5
Tubo proyectado hacia adentro	0.8
Orilla ligeramente redondeada	0.25
Campana proyectada hacia adentro	0.2
Orilla completamente redondeada	0.1

Accesorio: Ampliación	d/D	K
Ampliación Gradual		
	0.5	0.75
	0.6	0.5
	0.7	0.25
	0.8	0.10
	0.9	0
Ampliación súbita		
	0.2	1.0
	0.35	0.8
	0.5	0.6
	0.65	0.35
	0.8	0.15
Ensanchamiento brusco		$\left[1-\left(\frac{D_1}{D_2}\right)^2\right]^2$

Accesorio: Reducción	d/D	K
Reducción Gradual		
	0.5	0.2
	0.6	0.17
	0.7	0.1
	0.8	0.05
	0.9	0

Accesorio: Reducción	d/D	K
Reducción súbita		
	0.5	0.5
	0.6	0.45
	0.7	0.35
	0.8	0.2
Reducción brusca de sección (contracción)		$0.5\left[1-\left(\frac{D_1}{D_2}\right)^2\right]^2$

Sin embargo, existe un sinfín de combinaciones que se encuentran en las redes de distribución; a continuación se muestran los coeficientes de pérdida para curvas compuestas y número de Reynolds de $2.25X10^5$. A partir de la cual se puede observar el coeficiente de pérdida de carga máxima que puede producir un codo con superficie rugosa; este fue el valor que se utilizó para considerar el caso más crítico en la red de distribución propuesta. Dicho valor es Kr=1.265.



K_s = Coeficiente de pérdida para una superficie lisa.

K_r = Coeficiente de pérdida para una superficie rugosa, $\frac{\epsilon}{D}=0.0022$.

Fig.16 Coeficiente de pérdida local K para codos-Sotelo

[Fuente: Sotelo, A.G., 1999. Hidráulica General, Vol.1. Limusa, México]

Por lo que respecta a las cruces, es decir, la unión de 4 tuberías, se considerarán las formulas y consideraciones propuestas por el M.I. Jaime Andrés Patiño Márquez en la tesis nombrada “Pérdidas menores de energía en redes de tubería de agua potable" (México- Junio 2011). Dicho documento analizó el comportamiento de las pérdidas locales al pasar por una cruz bajo diferentes combinaciones de factores, de esta manera se consiguió una formula general para calcular esta pérdida. A continuación se presenta la gráfica a partir de la cual se logró el resultado señalado.

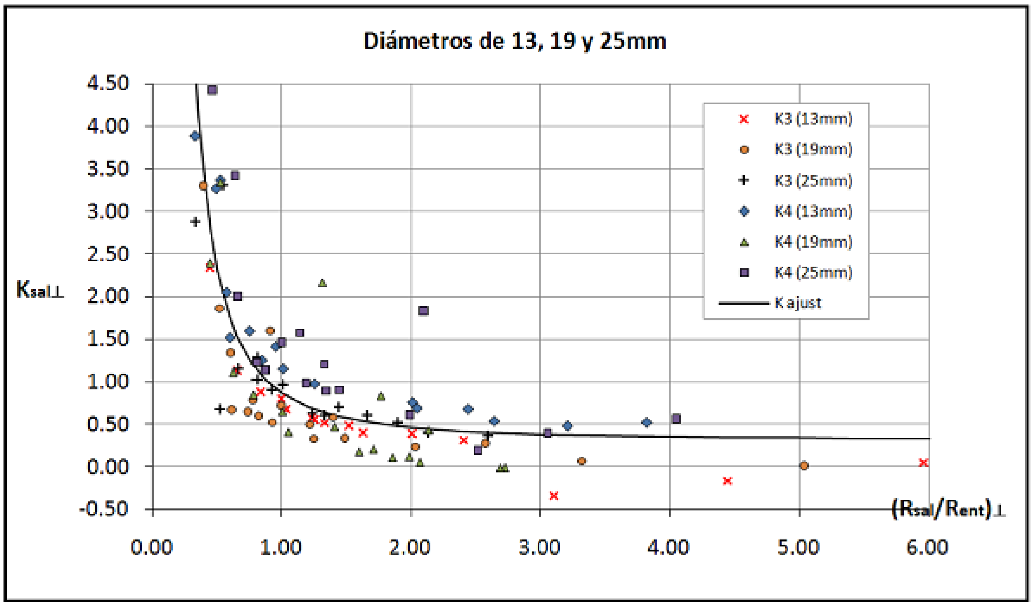


Fig.17 Grafica Coef. Pérdida local K unificadas para cruces- Patiño

[Fuente: Patiño, Jaime. UNAM-II. "Pérdidas menores de energía en redes de tubería de agua potable", México, 2011]

Resultando la formula que a continuación se muestra.

Tabla 09. Ecuación ajuste Coef. Pérdida local K para cruces- Patiño

Tabla 25. Ecuación de ajuste unificada para el *coeficientes de pérdidas K* para 13, 19 y 25mm.

Diámetro	*Figura*	*Coeficiente de pérdidas*	*Ecuación de mejor ajuste*	R^2
13, 19 y 25mm	39	K_{sal}	$K_{sal\perp} = \frac{0.558}{\left(\frac{Re_{sal}}{Re_{ent}}\right)_{\perp}^{1.872}} + 0.323$	0.81

[Fuente: Patiño, Jaime. UNAM-II. "Pérdidas menores de energía en redes de tubería de agua potable", México, 2011]

La formula anterior se sintetiza si consideramos que las tuberías tendrán el mismo diámetro, de esta manera podríamos sustituir el valor del número de Reynolds por el gasto que circulará por las tuberías involucradas:

$$\frac{Re_{salida}}{Re_{entrada}} = \frac{\frac{V_s D_s}{\nu}}{\frac{V_e D_e}{\nu}} = \frac{V_s D_s}{V_e D_e} = \frac{V_s}{V_e} = \frac{\left(\frac{Q_s}{A_s}\right)}{\left(\frac{Q_e}{A_e}\right)} = \frac{Q_s A_s}{Q_e A_e} = \frac{Q_{salida}}{Q_{entrada}}$$

Sin embargo, no se cuenta con un valor específico que represente el coeficiente de pérdida de carga por "tes". A partir de los valores propuestos por diversos autores, en las diversas combinaciones que se pueden presentar en su funcionamiento, se obtuvieron formulas genéricas que dependerán únicamente de la relación entre los gastos "Q" de entrada y salida que circulará a través de las piezas, suponiendo que el diámetro es el mismo en las tres conexiones.

A continuación se muestran los dos principales casos que se encuentran en el funcionamiento de las tuberías de abastecimiento. Como se puede observar, el ángulo "α" puede variar en 45° (π/4), 60° (π/3) y 90°(π/2).

a) Entrada o Unión   b) Salida o Separación

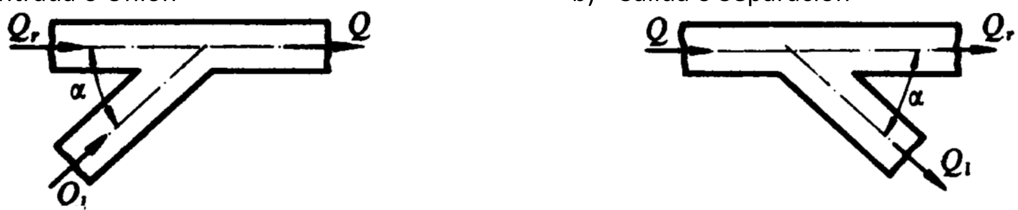


Fig.18 Esquema entrada y salida de tes en redes

[Fuente: artemisa.unicauca.edu.co]

Considerando cada uno de los casos, se obtuvieron las siguientes fórmulas:

Donde:
k coeficiente de pérdida local
Q_l gasto que sale o entra a la tubería secundaria
Q_r gasto de la tubería principal
Q gasto total, la suma de Qr y Ql, de la tubería que se unió o se separó

a) Entrada o Unión

Tabla 10. Formulas, Coef. Pérdida local K para entradas tes

Ángulo	Dirección	Fórmula
90°	Q_r - Q	$k = -0.795\left(\frac{Q_l}{Q}\right)^2 + 1.204\left(\frac{Q_l}{Q}\right) + 0.083$
	Q_l - Q	$k = -1.6775\left(\frac{Q_l}{Q}\right)^2 + 3.6678\left(\frac{Q_l}{Q}\right) - 0.9591$
60°	Q_r - Q	$k = -1.497\left(\frac{Q_l}{Q}\right)^2 + 1.1292\left(\frac{Q_l}{Q}\right) + 0.1393$
	Q_l - Q	$k = -1.6413\left(\frac{Q_l}{Q}\right)^2 + 3.1151\left(\frac{Q_l}{Q}\right) - 0.8277$
45°	Q_r - Q	$k = -1.4566\left(\frac{Q_l}{Q}\right)^2 + 0.8608\left(\frac{Q_l}{Q}\right) + 0.0639$
	Q_l - Q	$k = -1.7334\left(\frac{Q_l}{Q}\right)^2 + 2.9575\left(\frac{Q_l}{Q}\right) - 0.8888$

b) Salida o Separación

Tabla 11. Formulas, Coef. Pérdida local K para salidas tes

Ángulo	Dirección	Fórmula
90°	Q - Q_r	$k = 0.685\left(\frac{Q_l}{Q}\right)^2 - 0.3282\left(\frac{Q_l}{Q}\right) + 0.0142$
	Q - Q_l	$k = 0.9739\left(\frac{Q_l}{Q}\right)^2 - 0.6966\left(\frac{Q_l}{Q}\right) + 1.0205$
60°	Q - Q_r	$k = 0.658\left(\frac{Q_l}{Q}\right)^2 - 0.3033\left(\frac{Q_l}{Q}\right) + 0.0142$
	Q - Q_l	$k = 1.1383\left(\frac{Q_l}{Q}\right)^2 - 1.4599\left(\frac{Q_l}{Q}\right) + 1.0782$
45°	Q - Q_r	$k = 0.6653\left(\frac{Q_l}{Q}\right)^2 - 0.3161\left(\frac{Q_l}{Q}\right) + 0.015$
	Q - Q_l	$k = 1.2321\left(\frac{Q_l}{Q}\right)^2 - 1.7547\left(\frac{Q_l}{Q}\right) + 0.9723$

3.2.1 Longitud equivalente

Un método no completamente exacto pero válido a efectos de estimar las pérdidas de carga localizadas consiste en expresarlas en forma de longitud equivalente, es decir, calcular los metros de tubería del mismo diámetro que producen una pérdida de carga por fricción equivalente a la pérdida que se produce localmente por un accesorio.

Considerando la ecuación de Darcy-Weibach se obtiene la siguiente ecuación:

$$h_s = K\frac{V^2}{2g}$$

$$h_c = f\frac{L}{D}\frac{V^2}{2g}$$

$$h_s = h_c$$

$$f\frac{L}{D}\frac{V^2}{2g} = K\frac{V^2}{2g}$$

$$L_{eq} = \frac{KD}{f}$$

Donde:

f factor de fricción, depende del número de Reynolds (Re) y del gasto [adimensional]
V velocidad media [m/s]
K coeficiente de pérdida local [adimensional]
D diámetro interior de la tubería [m]
g aceleración de la gravedad [m/s2]
L_{eq} longitud equivalente [m]

La pérdida de carga total en una tubería de longitud "L" con piezas especiales de longitud equivalente "L_{eq}" cada una de ellas, será la que produce una tubería del mismo diámetro pero con una longitud total:

$$L_T = L + \sum L_{eq}$$

[fuente: www.uclm.es]

En los cálculos del presente documento no se requería obtener una longitud equivalente, sino una manera sencilla de obtener el factor de fricción correspondiente; por esta razón, se empleo la fórmula de “longitud equivalente” despejando “f”

$$L_{eq} = \frac{KD}{f} \quad \rightarrow \quad f = \frac{KD}{L}$$

Donde:

f factor de fricción, depende del número de Reynolds (Re) y del gasto [adimensional]

K coeficiente de pérdida local [adimensional]

D diámetro interior de la tubería [m]

L longitud equivalente [m]

Existen tablas donde se presentan las ecuaciones de longitud equivalente según la pieza especial, a continuación se presentan algunas de estas, considerando que el accesorio sea de acero galvanizado y fierro fundido.

Tabla 12. Ecuación longitud equivalente de piezas especiales

Accesorio	**Ecuación**
Codo de 90° (radio largo)	Le= 0.068 + 20.96 D
Codo de 90° (radio medio)	Le= 0.114 + 26.56 D
Codo de 90° (radio corto)	Le= 0.189 + 30.53 D
Codo de 45°	Le= 0.013 + 15.14 D
Curva de 90° (radio largo) R/D=1.5	Le= 0.036 + 12.15 D
Curva de 90° (radio corto) R/D=1	Le= 0.115 + 15.53 D
Curva de 45°	Le= 0.045 + 7.08 D
Salida normal con orillas afiladas	Le = - 0.230 + 18.63D
Salida con tubo proyectado hacia adentro	Le= - 0.050 + 30.98D
Válvula de compuerta abierta	Le= 0.010 + 6.89D
Válvula de globo abierta	Le=0.010 + 340.27D
Válvula de mariposa abierta	Le=0.050 + 170.69 D
Te de 90° pase directo	Le= 0.054 + 20.90 D
Te de 90° salida lateral	Le= 0.396 + 62.32 D
Te de 90° salida bilateral	Le= 0.396 + 62.32 D
Válvula de reducción	Le= 0.056 + 255.48 D
Entrada con tubo proyectado hacia adentro	Le= -0.050 + 30.98D

Capítulo 4. Análisis de resultados

En este capítulo se analizan las pérdidas de energía en una red de distribución de agua cuando se cambian algunos componentes.

Considerando la variación que se efectuó en la longitud de las tuberías que forman la red de distribución, para tomar la decisión de considerar o no las pérdidas locales producidas por piezas especiales como tes, codos, cruces, etc.

4.1 Variación del gasto de demanda para tres gastos medios

En la siguiente tabla se muestran los valores de gasto de demanda horaria que se emplearon para realizar el análisis. Recordando que se emplearon los factores de variación horaria correspondientes al D.F., considerando como gastos medios a 4.545, 9.901 y 13.636 litros por segundo.

Tabla 13. Gasto de demanda diaria horaria empleada [l/s]

Tiempo [horas]	q/qmed [DF]	q (nodos) [l/s]	q (nodos) [l/s]	q (nodos) [l/s]
1	0.570	2.591	5.182	7.773
2	0.560	2.545	5.091	7.636
3	0.550	2.500	5.000	7.500
4	0.560	2.545	5.091	7.636
5	0.580	2.636	5.273	7.909
6	0.650	2.955	5.909	8.864
7	0.800	3.636	7.273	10.909
8	1.000	**4.545**	**9.091**	**13.636**
9	1.300	5.909	11.818	17.727
10	1.425	6.477	12.955	19.432
11	1.475	6.705	13.409	20.114
12	1.500	6.818	13.636	20.455
13	1.495	6.795	13.591	20.386
14	1.430	6.500	13.000	19.500
15	1.350	6.136	12.273	18.409
16	1.250	5.682	11.364	17.045
17	1.175	5.341	10.682	16.023
18	1.125	5.114	10.227	15.341
19	1.100	5.000	10.000	15.000
20	1.075	4.886	9.773	14.659
21	1.000	**4.545**	**9.091**	**13.636**
22	0.780	3.545	7.091	10.636
23	0.650	2.955	5.909	8.864
24	0.600	2.727	5.455	8.182

Nota:
Las demandas correspondientes al consumo a las 3 y 12 horas, han sido resaltadas para enfatizar los valores mínimos y máximos respectivamente.

Como se puede observar, la variación del gasto en cada caso es directamente proporcional al incremento en el gasto de demanda mínima horaria diaria. Los valores de gasto en cada tubo para cada situación se presentarán en el Anexo 1-digital; en las graficas que a continuación se presentan se puede observar el comportamiento que satisface el gasto de demanda que tiene la red.

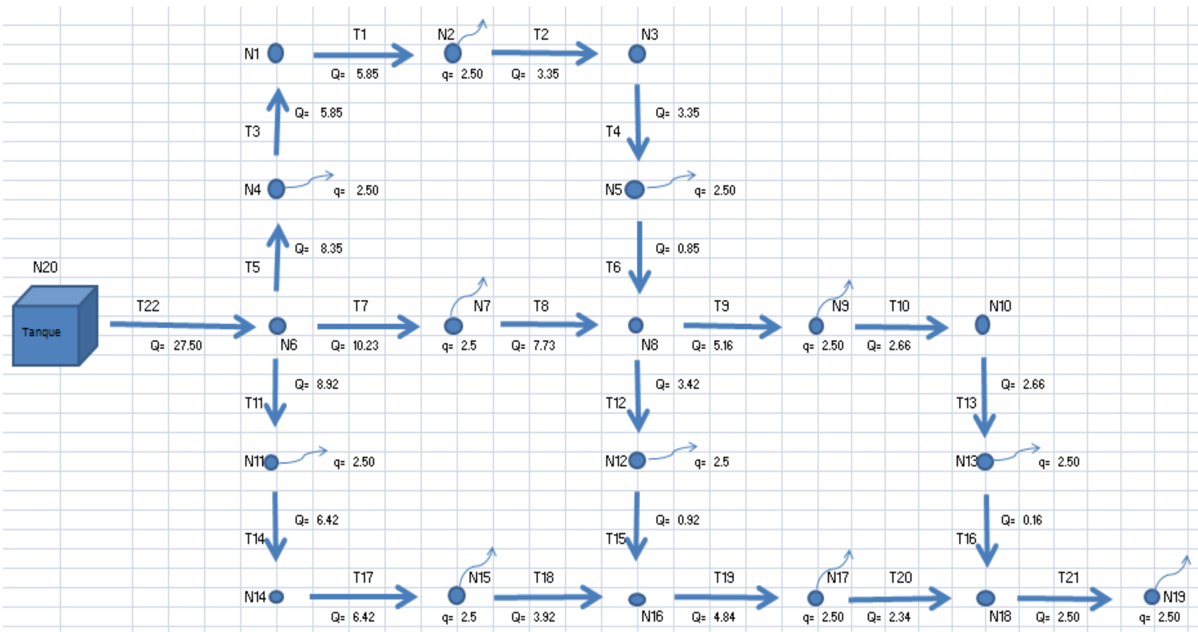


Fig.19 Red de distribución con gasto de demanda (q) de 2.5 l/s [3h]

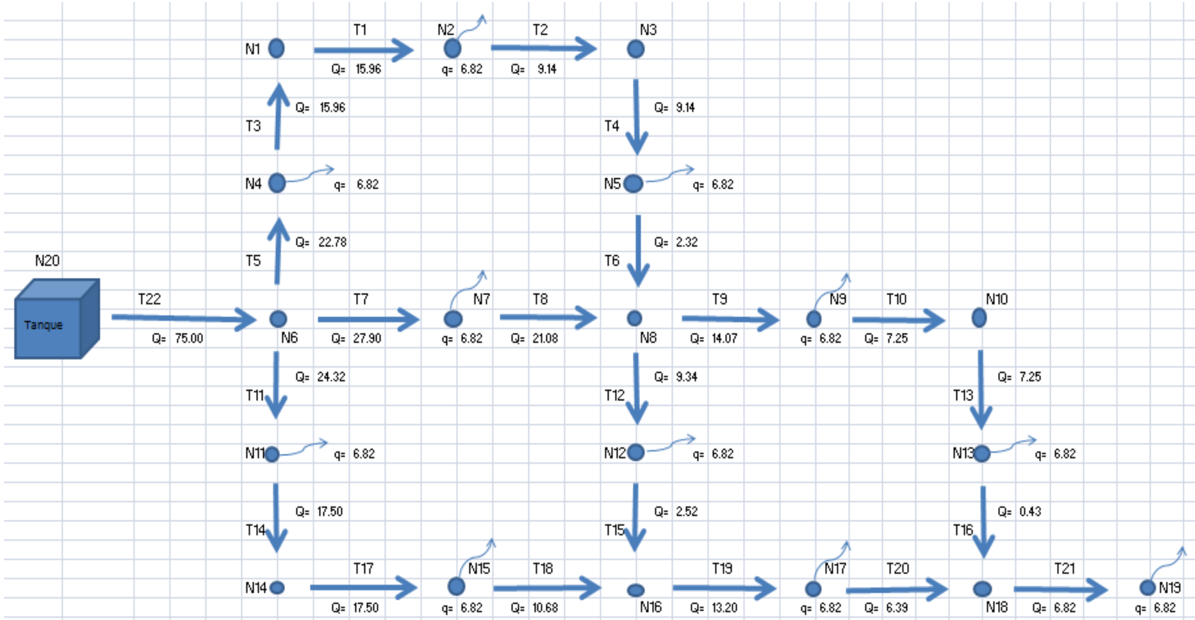


Fig.20 Red de distribución con gasto de demanda (q) de 6.818 l/s [12h]

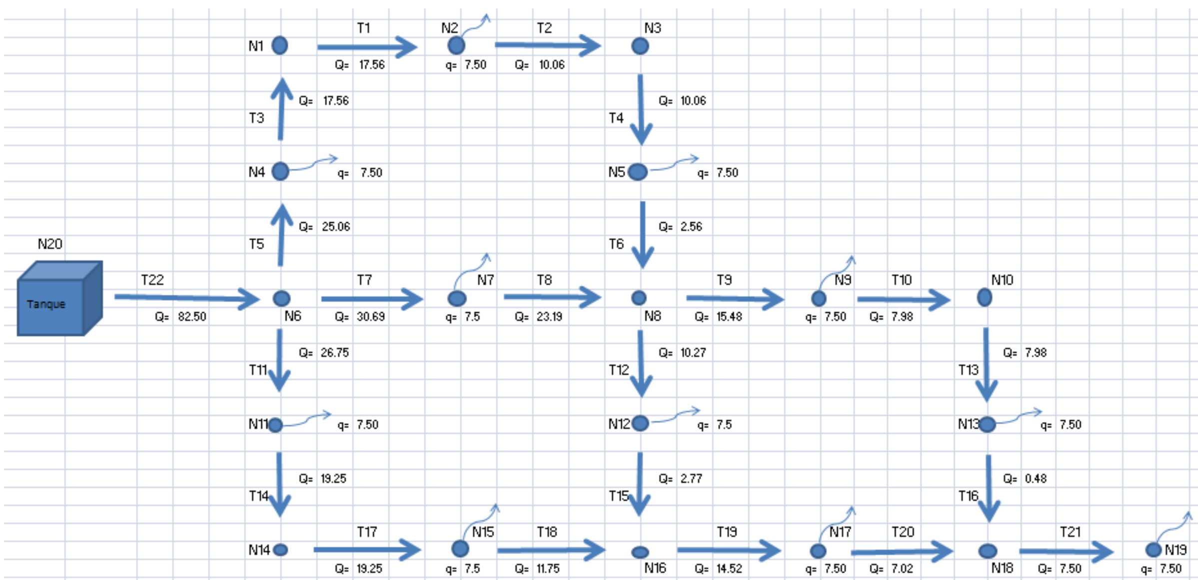


Fig.21 Red de distribución con gasto de demanda (q) de 7.5 l/s [3 h]

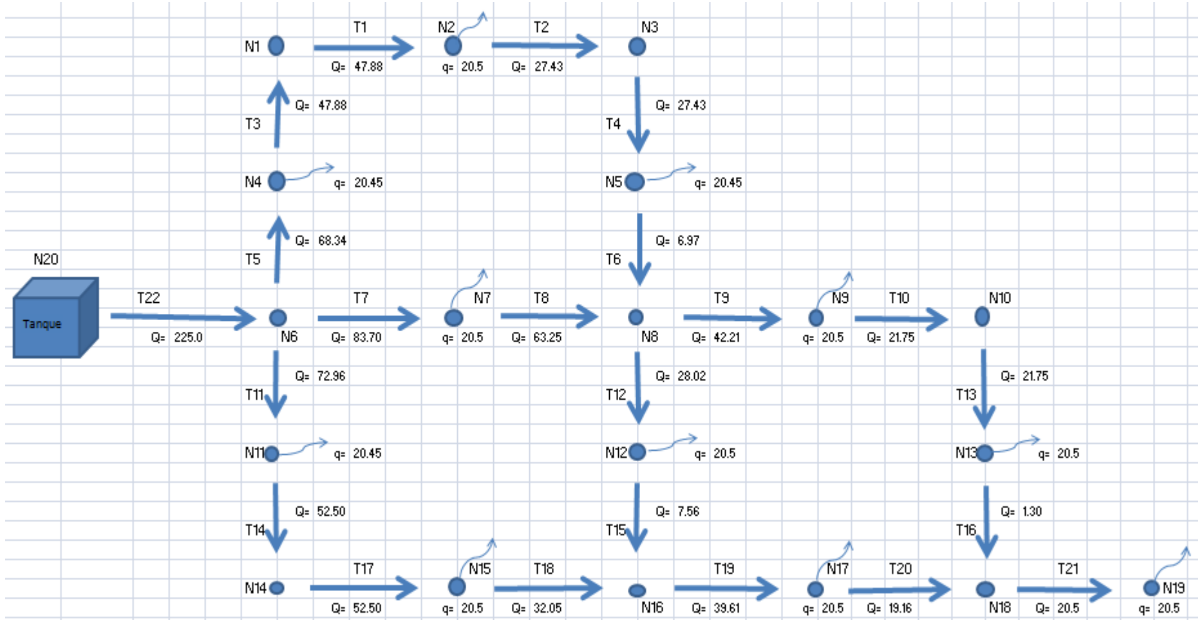


Fig.22 Red de distribución con gasto de demanda (q) de 20.455 l/s [12 h]

4.2 Variación de la carga en el tanque (h_{20})

Al analizar la variación de parámetros se observó la importancia de realizarlo bajo las mismas condiciones, observando que no se podía tener un valor fijo para todas las situaciones de estudio, es decir, se tuvo que buscar el valor mínimo de carga en el tanque de abastecimiento con el que se obtuviera una carga en el último nodo (nodo 19) de uno o mayor (>=1).

En el desarrollo del trabajo se observó que en la medida que la carga en el tanque se acercaba a un valor mínimo óptimo capaz de satisfacer la carga de presión establecida (aproximadamente 1m), se incrementaba el porcentaje de variación al considerar o no las pérdidas locales; por el contrario, cuando se presentaban valores excesivos, la importancia de esta consideración resultaba casi insignificante.

A continuación se presentan los valores de carga en el tanque "h_{20}" empleados para el cálculo de la red bajo las diversas características:

Tabla 14. Valores de carga en tanque con diversas características

L [m]	100								
d [pulg]	4			6			8		
q [l/s]	2.5	5	7.5	2.5	5	7.5	2.5	5	7.5
hora	Tanque h_{20} [m]								
1	19	70	155	4	10	20	2	3	5
2	18	67	149	3	9	19	2	3	5
3	17	65	144	3	9	19	2	3	5
4	18	67	149	3	9	19	2	3	5
5	19	72	160	4	10	21	2	3	6

L [m]	100								
d [pulg]	4			6			8		
q [l/s]	2.5	5	7.5	2.5	5	7.5	2.5	5	7.5
hora	Tanque h_{20} [m]								
6	24	90	201	4	12	26	2	4	7
7	35	136	304	6	18	38	2	5	9
8	54	211	473	8	27	59	3	7	13
9	90	356	799	12	44	98	4	11	22
10	108	427	960	14	53	117	4	12	26
11	116	458	1028	15	57	126	4	13	28
12	119	473	1063	16	59	130	4	13	28
13	119	470	1056	16	58	129	4	13	28
14	109	430	967	14	53	118	4	12	26
15	97	384	862	13	48	106	4	11	23
16	83	329	739	11	41	91	4	10	20
17	74	291	653	10	37	80	3	9	18
18	68	267	599	10	34	74	3	8	17
19	65	255	573	9	32	71	3	8	16
20	62	244	547	9	31	67	3	8	15
21	54	211	473	8	27	59	3	7	13
22	33	129	289	5	17	36	2	5	9
23	24	90	201	4	12	26	2	4	7
24	20	77	171	4	11	22	2	3	6

L [m]	300								
d [pulg]	4			6			8		
q [l/s]	2.5	5	7.5	2.5	5	7.5	2.5	5	7.5
hora	Tanque h_{20} [m]								
1	52	203	454	8	26	56	3	6	13
2	50	196	439	7	25	54	3	6	12
3	48	189	423	7	24	52	3	6	12
4	50	196	439	7	25	54	3	6	12
5	54	210	471	8	26	58	3	7	13
6	67	263	591	9	33	72	3	8	16
7	101	398	894	13	49	108	4	11	24
8	156	621	1396	20	76	168	5	17	36
9	263	1049	2358	33	127	284	8	28	60
10	316	1260	2833	39	152	341	9	33	72
11	339	1350	3035	42	163	365	10	35	77
12	350	1396	3138	43	168	377	10	36	79
13	348	1386	3118	43	167	375	10	36	79
14	318	1269	2853	39	153	343	9	33	72

L [m]	300								
d [pulg]	4			6			8		
q [l/s]	2.5	5	7.5	2.5	5	7.5	2.5	5	7.5
hora	Tanque h_{20} [m]								
15	284	1131	2542	35	137	306	9	30	65
16	244	970	2180	30	117	262	8	26	56
17	215	857	1926	27	104	232	7	23	49
18	198	786	1766	25	95	213	6	21	45
19	189	751	1689	24	91	204	6	20	43
20	181	718	1613	23	87	194	6	19	42
21	156	621	1396	20	76	168	5	17	36
22	96	378	850	13	47	103	4	11	23
23	67	263	591	9	33	72	3	8	16
24	57	225	503	8	28	62	3	7	14

L [m]	600								
d [pulg]	4			6			8		
q [l/s]	2.5	5	7.5	2.5	5	7.5	2.5	5	7.5
hora	Tanque h_{20} [m]								
1	102	403	904	13	49	109	4	11	24
2	98	389	873	13	48	106	4	11	23
3	95	375	842	13	46	102	4	11	22
4	98	389	873	13	48	106	4	11	23
5	105	417	936	14	51	113	4	12	25
6	132	523	1175	17	64	142	5	14	30
7	199	792	1779	25	96	214	6	21	45
8	310	1236	2779	38	149	333	9	32	70
9	523	2088	4696	64	251	562	14	53	117
10	628	2508	5642	76	301	675	17	63	141
11	673	2687	6045	82	322	723	18	68	151
12	696	2779	6251	84	333	748	19	70	156
13	691	2761	6210	84	331	743	19	70	155
14	633	2526	5682	77	303	680	17	64	142
15	564	2251	5064	69	270	606	15	57	127
16	484	1930	4342	59	232	520	13	49	109
17	428	1706	3836	52	205	460	12	44	96
18	392	1564	3517	48	188	421	11	40	88
19	375	1495	3362	46	180	403	11	38	85
20	358	1428	3211	44	172	385	10	37	81
21	310	1236	2779	38	149	333	9	32	70
22	189	753	1691	24	91	203	6	20	43
23	132	523	1175	17	64	142	5	14	30

L [m]	600								
d [pulg]	4			6			8		
q [l/s]	2.5	5	7.5	2.5	5	7.5	2.5	5	7.5
hora	Tanque h_{20} [m]								
24	113	446	1001	15	55	121	4	12	26

Se corrobora la relación directa que existe con el valor de carga en el tanque, disminuyendo conforme aumenta el diámetro y aumentando con respecto al gasto de demanda y con la longitud.

4.3 Variación de pérdidas locales

- Codos (4 piezas)
  Se consideró la situación más crítica que podría presentarse, con una superficie sumamente rugosa y características físicas abruptas para el flujo del líquido. Se consideró un K=1.265 para todos los codos en la red.
- Tes (2 piezas)
  Empleando las ecuaciones propuestas en el capítulo anterior, se propone emplear la siguiente para las "tes" existentes en la red, variando los coeficientes de pérdida en cada situación.

$$k = -0.795\left(\frac{Q_{salida}}{Q_{ent\ tot}}\right)^2 + 1.204\left(\frac{Q_{salida}}{Q_{ent\ tot}}\right) + 0.083$$

- Cruces (2 piezas)
  Como se señaló antes, se consideró la fórmula del M.I. Jaime Patiño válida para ser aplicada en el presente documento, variando su valor en relación al valor del gasto de entrada y salida al accesorio.

$$K_{salida} = \frac{0.558}{\left(\frac{Re_{salida}}{Re_{entrada}}\right)^{1.872}} + 0.323 = \frac{0.558}{\left(\frac{Q_{salida}}{Q_{entrada}}\right)^{1.872}} + 0.323$$

4.4 Variación de otros factores

La variación de los componentes de la red de distribución se hizo con los siguientes valores:

Longitud de la tubería	100 m	300 m	600 m

Diámetro	4"	6"	8"
Factor de fricción (depende del diámetro)	0.021	0.019	0.0165

Los que se vieron anteriormente:

Gasto de demanda , q	Se empleo la variación horaria del comportamiento del DF, considerando como mínimos

	$2.5\ m^3/s$	$5\ m^3/s$	$7.5\ m^3/s$

Carga de energía en Tanque, h_{20}	Varia con respecto a cada situación a fin de obtener en el último nodo de la red, nodo 29, carga de 1m.

	Cruz	Tes	Codos
Coeficiente de pérdida locales, k	1.265	Depende del gasto de salida y de entrada a la pieza especial	Depende del gasto de salida y de entrada a la pieza especial

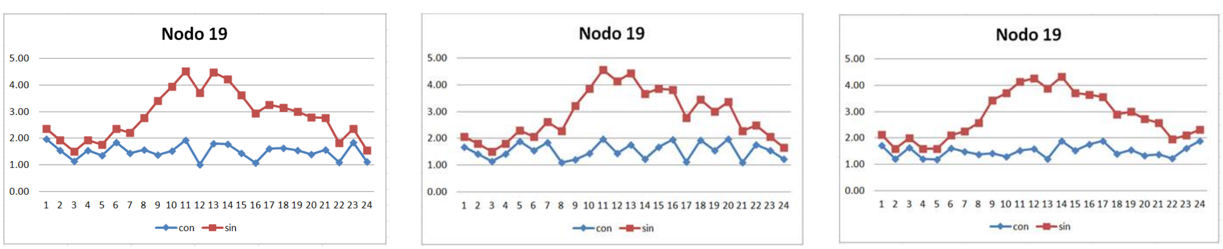
Nota: para el caso de no considerar las pérdidas locales, estos coeficientes valdrán cero.

4.5 Valores de las pérdidas locales

Para conocer la importancia en considerar las pérdidas locales en las redes de abastecimiento de agua potable, se determinó el porcentaje de variación en los valores de carga de la red al incluirlas o no en los cálculos de diseño.

En el Anexo 2-digital se presentan los valores de carga en cada nodo –expresado en metros-, para las 24 horas de demanda horaria diaria, con las variaciones de parámetros señalados.

Podríamos señalar de manera directa, a partir del siguiente gráfico, la importancia que tiene considerar las pérdidas locales, ya que se observa que al no considerarlas el cálculo supondría una carga suficiente para satisfacer la demanda principalmente en hora pico; sin embargo, se nota que en ningún momento sobrepasa los 2m. En el Anexo 3-digital se observan estas graficas para todos los nodos, bajo las diversas combinaciones de factores que se realizó.



(L=100m, d=4”, q=2.5 l/s) (L=300m, d=4”, q=2.5 l/s) (L=600m, d=4”, q=2.5 l/s)

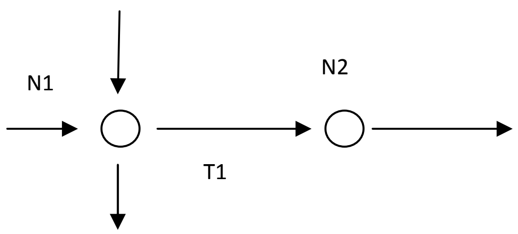
Fig.23 Comportamiento de carga en 24 horas, nodo 19.

A fin de determinar el porcentaje de variación al considerar o no las pérdidas locales por piezas especiales, se realizaron los siguientes pasos:

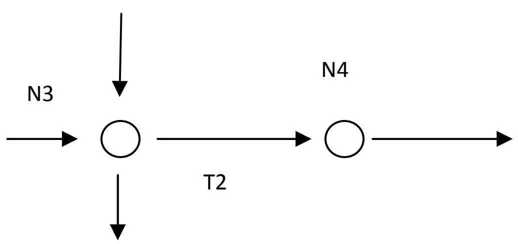
1. Se obtuvo la diferencia entre el nodo de entrada (N_1) y la de salida (N_2) del tubo en cuestión, considerando las pérdidas locales , siendo esta ΔT_1

2. Se obtuvo la diferencia entre el nodo de entrada (N_3) y de salida (N_4) del mismo tubo del paso anterior, SIN considerar las pérdidas locales, siendo ΔT_2
3. Se calcula el porcentaje de variación en la transformación de energía en el tubo, determinando la diferencia entre la variación existente al considerar la pérdida (ΔT_1) y la variación al no tomarla en cuenta (ΔT_2); finalmente dividir dicho valor entre el valor de variación de no tomar en cuenta la pérdida menor (ΔT_2)

Considerando pérdidas locales por cruz



Sin considerar la pérdida local



Proceso de cálculo

$$\Delta T_1 = N_1 - N_2$$

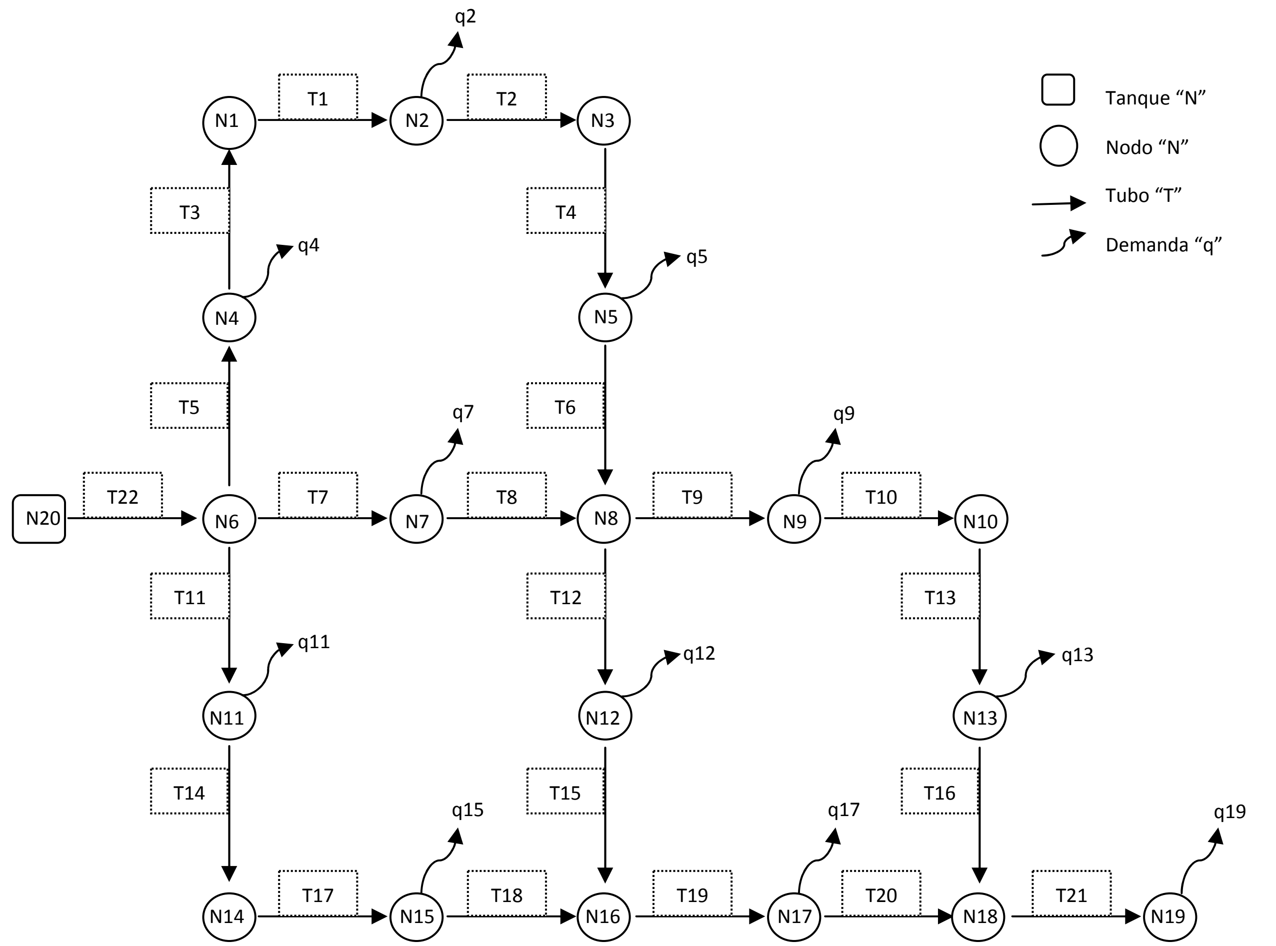
$$\Delta T_2 = N_3 - N_4$$

$$\Delta T[\%] = \frac{\Delta T_1 - \Delta T_2}{\Delta T_2}$$

Fig.24 Proceso de cálculo del porcentaje de variación de carga en tuberías

Debido a que los gastos de demanda dependen directamente de los factores de variación de demanda horaria diaria en el DF, el porcentaje en el que se altera es el mismo durante las 24 horas en cada tubo.

Para ubicar mejor cada nodo y tubo, se presenta a continuación la red en estudio. {Fig.13}



A continuación se presentarán los valores obtenidos para cada tubo. Es importante señalar que no se ha colocado el tubo 22, ya que su variación es de 0% por la ausencia de piezas especiales.

Tabla 15. Porcentaje de variación de pérdida de carga en tuberías

	L [m]	100								
	d [pulg]	4			6			8		
	q [l/s]	2.5	5	7.5	2.5	5	7.5	2.5	5	7.5
pieza	tubo	ΔT [%]								
codo	1	5.24%	5.24%	5.24%	8.67%	8.67%	8.67%	13.25%	13.25%	13.25%
--	2	-1.43%	-1.43%	-1.43%	-2.33%	-2.33%	-2.33%	-3.49%	-3.49%	-3.49%
--	3	-0.83%	-0.83%	-0.83%	-1.35%	-1.35%	-1.35%	-2.02%	-2.02%	-2.02%
codo	4	4.60%	4.60%	4.60%	7.58%	7.58%	7.58%	11.54%	11.54%	11.55%
cruz	5	25.87%	25.87%	25.87%	42.88%	42.88%	42.88%	65.83%	65.83%	65.83%
--	6	-5.39%	-5.39%	-5.39%	-8.71%	-8.71%	-8.71%	-12.94%	-12.94%	-12.94%
cruz	7	19.07%	19.07%	19.07%	31.62%	31.62%	31.62%	48.55%	48.55%	48.55%
--	8	0.33%	0.33%	0.33%	0.54%	0.54%	0.54%	0.81%	0.81%	0.81%
cruz	9	8.04%	8.04%	8.04%	13.31%	13.31%	13.31%	20.41%	20.41%	20.41%

	L [m]	100								
	d [pulg]	4			6			8		
	q [l/s]	2.5	5	7.5	2.5	5	7.5	2.5	5	7.5
pieza	tubo	ΔT [%]								
--	10	-0.92%	-0.92%	-0.92%	-1.50%	-1.50%	-1.50%	-2.25%	-2.25%	-2.25%
cruz	11	24.15%	24.15%	24.15%	40.04%	40.04%	40.04%	61.48%	61.48%	61.48%
cruz	12	16.71%	16.71%	16.71%	27.67%	27.67%	27.67%	42.42%	42.42%	42.42%
codo	13	5.15%	5.15%	5.15%	8.50%	8.50%	8.50%	12.97%	12.97%	12.97%
--	14	0.37%	0.37%	0.37%	0.60%	0.60%	0.60%	0.89%	0.89%	0.89%
--	15	0.12%	0.12%	0.12%	0.23%	0.23%	0.23%	0.41%	0.41%	0.41%
--	16	-13.29%	-13.29%	-13.29%	-21.25%	-21.25%	-21.25%	-31.08%	-31.08%	-31.08%
codo	17	6.51%	6.51%	6.51%	10.80%	10.80%	10.80%	16.61%	16.61%	16.61%
--	18	0.60%	0.60%	0.60%	0.98%	0.98%	0.98%	1.47%	1.47%	1.47%
tes	19	1.89%	1.89%	1.89%	3.13%	3.13%	3.13%	4.80%	4.80%	4.80%
--	20	1.06%	1.06%	1.06%	1.74%	1.74%	1.74%	2.63%	2.63%	2.63%
tes	21	0.77%	0.77%	0.77%	1.25%	1.25%	1.25%	1.87%	1.87%	1.87%

	L [m]	300								
	d [pulg]	4			6			8		
	q [m^3/s]	2.5	5	7.5	2.5	5	7.5	2.5	5	7.5
pieza	tubo	ΔT [%]								
codo	1	1.75%	1.75%	1.75%	2.90%	2.90%	2.90%	4.45%	4.45%	4.45%
--	2	-0.49%	-0.49%	-0.49%	-0.80%	-0.80%	-0.80%	-1.22%	-1.22%	-1.22%
--	3	-0.28%	-0.28%	-0.28%	-0.46%	-0.46%	-0.46%	-0.70%	-0.70%	-0.70%
codo	4	1.54%	1.54%	1.54%	2.55%	2.55%	2.55%	3.91%	3.91%	3.91%
cruz	5	8.62%	8.62%	8.62%	14.30%	14.30%	14.30%	21.95%	21.95%	21.95%
--	6	-1.85%	-1.85%	-1.85%	-3.03%	-3.03%	-3.03%	-4.60%	-4.60%	-4.60%
cruz	7	6.36%	6.36%	6.36%	10.54%	10.54%	10.54%	16.18%	16.18%	16.18%
--	8	0.11%	0.11%	0.11%	0.18%	0.18%	0.18%	0.28%	0.28%	0.28%
cruz	9	2.68%	2.68%	2.68%	4.45%	4.45%	4.45%	6.82%	6.82%	6.82%
--	10	-0.31%	-0.31%	-0.31%	-0.51%	-0.51%	-0.51%	-0.78%	-0.78%	-0.78%
cruz	11	8.05%	8.05%	8.05%	13.35%	13.35%	13.35%	20.49%	20.49%	20.49%
cruz	12	5.58%	5.58%	5.58%	9.24%	9.24%	9.24%	14.18%	14.18%	14.18%
codo	13	1.72%	1.72%	1.72%	2.85%	2.85%	2.85%	4.37%	4.37%	4.37%
--	14	0.13%	0.13%	0.13%	0.21%	0.21%	0.21%	0.31%	0.31%	0.31%
--	15	0.03%	0.03%	0.03%	0.06%	0.06%	0.06%	0.10%	0.10%	0.10%
--	16	-4.60%	-4.60%	-4.60%	-7.53%	-7.53%	-7.53%	-11.37%	-11.37%	-11.37%
codo	17	2.17%	2.17%	2.17%	3.60%	3.60%	3.60%	5.52%	5.52%	5.52%
--	18	0.21%	0.21%	0.21%	0.34%	0.34%	0.34%	0.52%	0.52%	0.52%
tes	19	0.63%	0.63%	0.63%	1.05%	1.05%	1.05%	1.61%	1.61%	1.61%
--	20	0.36%	0.36%	0.36%	0.59%	0.59%	0.59%	0.90%	0.90%	0.90%
tes	21	0.26%	0.26%	0.26%	0.43%	0.43%	0.43%	0.66%	0.66%	0.66%

	L [m]	600								
	d [pulg]	4			6			8		
	q [m^3/s]	2.5	5	7.5	2.5	5	7.5	2.5	5	7.5
pieza	tubo	ΔT [%]								
codo	1	0.88%	0.88%	0.88%	1.45%	1.45%	1.45%	2.23%	2.23%	2.23%
--	2	-0.24%	-0.24%	-0.24%	-0.40%	-0.40%	-0.40%	-0.62%	-0.62%	-0.62%
--	3	-0.14%	-0.14%	-0.14%	-0.23%	-0.23%	-0.23%	-0.36%	-0.36%	-0.36%
codo	4	0.77%	0.77%	0.77%	1.28%	1.28%	1.28%	1.96%	1.96%	1.96%
cruz	5	4.31%	4.31%	4.31%	7.15%	7.15%	7.15%	10.97%	10.97%	10.97%
--	6	-0.93%	-0.93%	-0.93%	-1.53%	-1.53%	-1.53%	-2.34%	-2.34%	-2.34%
cruz	7	3.18%	3.18%	3.18%	5.27%	5.27%	5.27%	8.09%	8.09%	8.09%
--	8	0.06%	0.06%	0.06%	0.09%	0.09%	0.09%	0.14%	0.14%	0.14%
cruz	9	1.34%	1.34%	1.34%	2.23%	2.23%	2.23%	3.42%	3.42%	3.42%
--	10	-0.16%	-0.16%	-0.16%	-0.26%	-0.26%	-0.26%	-0.39%	-0.39%	-0.39%
cruz	11	4.03%	4.03%	4.03%	6.67%	6.67%	6.67%	10.25%	10.25%	10.25%
cruz	12	2.79%	2.79%	2.79%	4.62%	4.62%	4.62%	7.09%	7.09%	7.09%
codo	13	0.86%	0.86%	0.86%	1.43%	1.43%	1.43%	2.19%	2.19%	2.19%
--	14	0.06%	0.06%	0.06%	0.10%	0.10%	0.10%	0.16%	0.16%	0.16%
--	15	0.02%	0.02%	0.02%	0.03%	0.03%	0.03%	0.04%	0.04%	0.04%
--	16	-2.32%	-2.32%	-2.32%	-3.82%	-3.82%	-3.82%	-5.82%	-5.82%	-5.82%
codo	17	1.08%	1.08%	1.08%	1.80%	1.80%	1.80%	2.76%	2.76%	2.76%
--	18	0.10%	0.10%	0.10%	0.17%	0.17%	0.17%	0.26%	0.26%	0.26%
tes	19	0.32%	0.32%	0.32%	0.52%	0.52%	0.52%	0.80%	0.80%	0.80%
--	20	0.18%	0.18%	0.18%	0.30%	0.30%	0.30%	0.46%	0.46%	0.46%
tes	21	0.13%	0.13%	0.13%	0.22%	0.22%	0.22%	0.33%	0.33%	0.33%

Se puede observar que existen porcentajes negativos en tubos que en primera instancia no presentaría influencia por piezas especiales; sin embargo, estos valores reflejan la no linealidad de las ecuaciones; la red es un sistema que influye en cada nodo y tubo, cuyas alteraciones repercuten hasta en los puntos más alejados de la zona de afectación, por lo cual, aunque por lógica se pudiese pensar en que deberían ser valores de cero (0%), la dependencia del sistema nos refleja una variación en diversos rangos.

Es fácil notar la poca importancia que presenta la variación en el gasto de demanda con respecto a la variación de los otros parámetros.

En la tabla que a continuación se muestra se presentan los máximos y mínimos porcentajes de variación de la carga de energía en los tubos y la combinación de factores que la produjo.

Se observa una clara tendencia a presentar los valores en dos variaciones únicamente, cuando se tiene una longitud grande y un diámetro pequeño, y viceversa; se enfatiza el máximo representativo de las tes, codos y cruces.

Para las tuberías que presentan una directa transformación de la energía directamente por piezas especiales, tiene los máximos porcentajes de variación, es decir, donde se presenta la mayor importancia en tomar en cuenta las pérdidas locales, cuando se tienen diámetros grandes (8”) y longitudes pequeñas (100 m).

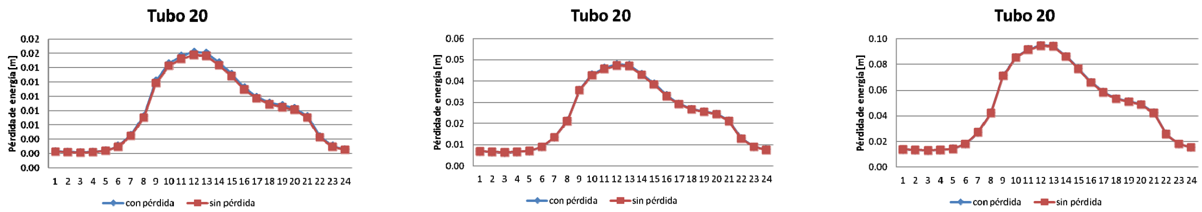
Tabla 16. Máximos y mínimos porcentajes de variación de cargas en tubos

	L [m]	100	600	100	600
	d [pulg]	8	4	8	4
	q [l/s]	2.5-7.5	2.5-7.5	2.5-7.5	2.5-7.5
pieza	tubo	**MÁX** ∆T [%]		**MÍN** ∆T [%]	
codo	1	13.25%			0.88%
--	2		-0.24%	-3.49%	
--	3		-0.14%	-2.02%	
codo	4	11.54%			0.77%
cruz	5	**65.83%**			4.31%
--	6		-0.93%	-12.94%	
cruz	7	48.55%			3.18%
--	8	0.81%			0.06%
cruz	9	20.41%			1.34%
--	10		-0.16%	-2.25%	
cruz	11	61.48%			4.03%
cruz	12	42.42%			2.79%
codo	13	12.97%			0.86%
--	14	0.89%			0.06%
--	15	0.41%			0.02%
--	16		-2.32%	-31.08%	
codo	17	**16.61%**			1.08%
--	18	1.47%			0.10%
tes	19	**4.80%**			0.32%
--	20	2.63%			0.18%
tes	21	1.87%			0.13%

También se observa que el mayor porcentaje de variación que se presenta es aquel derivado del paso de una “cruz” (interconexión de 4 tuberías), incrementándose de manera significativa con el aumento del caudal que circula a través de los ductos.

Una manera de apreciar el impacto de las diferentes piezas es dibujar los valores de carga que se transforma en la tubería (la diferencia de carga entre nodos), tomando como ejemplo la red de 100m de longitud, 8 pulgadas de diámetro y 2.5 l/s como gasto mínimo de demanda horaria diaria, en las tuberías que presentaron la máxima diferencia de variación porcentual. A continuación se presentan algunos casos:

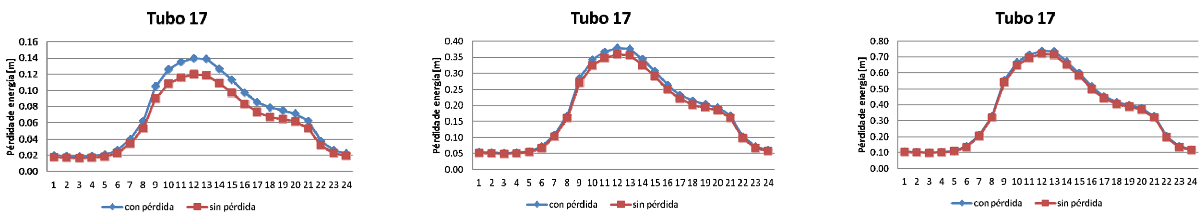
- Sin piezas especiales: no es apreciable la diferencia al considerar o no las pérdidas locales.



(L=100m, d=8", q=2.5 l/s) (L=300m, d=8", q=2.5 l/s) (L=600m, d=8", q=2.5 l/s)

Fig.25 Grafica comportamiento en tubos sin piezas especiales

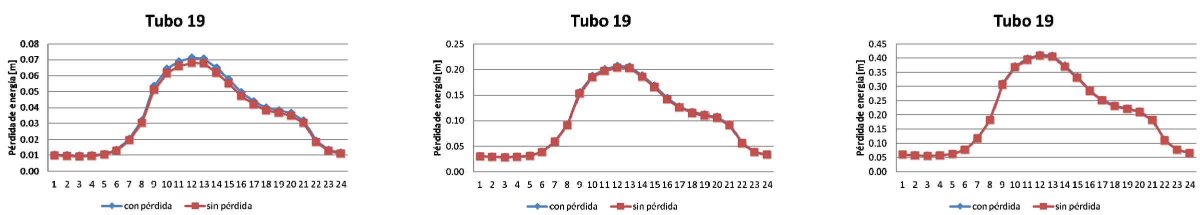
- Codos: resulta claro observar la diferencia entre valores, siendo mayor la diferencia al considerar la pérdida local.



(L=100m, d=8", q=2.5 l/s) (L=300m, d=8", q=2.5 l/s) (L=600m, d=8", q=2.5 l/s)

Fig.26 Grafica comportamiento en tubos con codos

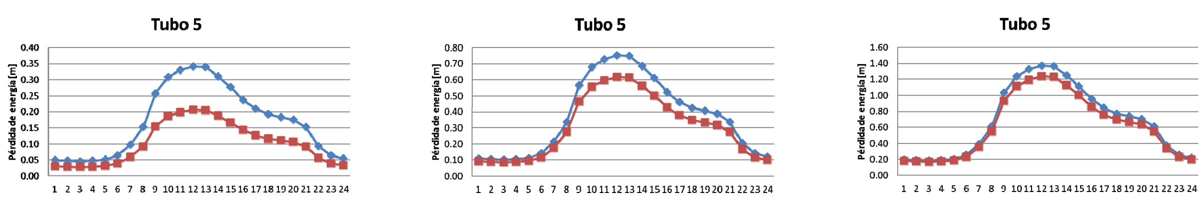
- Tes: es poca la variación que existe entre las diferencias



(L=100m, d=8", q=2.5 l/s) (L=300m, d=8", q=2.5 l/s) (L=600m, d=8", q=2.5 l/s)

Fig.27 Grafica comportamiento en tubos con tes

- Cruz: de todos los casos señalados es claro que la cruz resulta la pieza cuya pérdida local es más significativa. (empleando la fórmula obtenida por el M.I. Jaime Patiño)



(L=100m, d=8", q=2.5 l/s) (L=300m, d=8", q=2.5 l/s) (L=600m, d=8", q=2.5 l/s)

Fig.28 Grafica comportamiento en tubos con cruces

Se puede determinar que las tuberías que no cuentan con la influencia directa de piezas especiales, no son de gran relevancia en el presente análisis por lo inapreciable de su variación.

En el Anexo 4-digital, se puede apreciar el comportamiento de los 22 tubos, de la manera que anteriormente se mostro, presentando la transformación de energía en cada tubo.

A continuación, a manera de ejemplo, se muestran dos redes de abastecimiento de agua potable, en la primera el análisis contemplo las pérdidas locales producidas por las piezas especiales, en la segunda no se consideraron dichas pérdidas; en color rojo se observa la carga de energía en el tubo, obtenida a partir de obtener la diferencia entre las cargas de los nodos de entrada y salida, por lo tanto, este valor representa la energía que se perdió en dicho tramo de tubería.

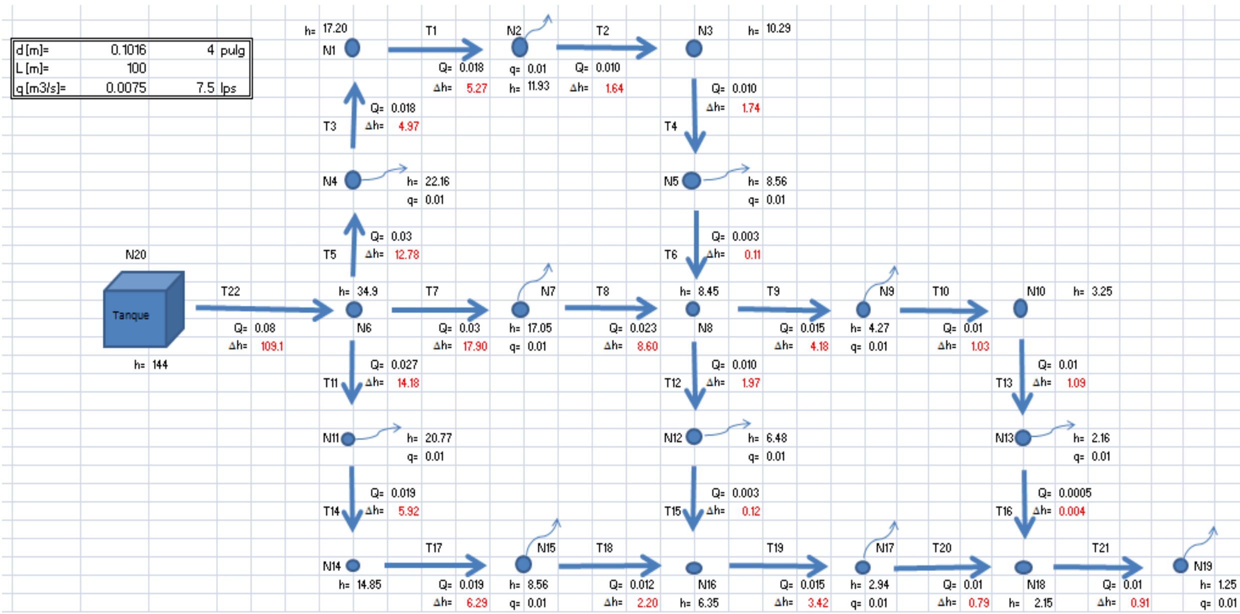


Fig.29 Esquema de red-cargas, considerando pérdidas locales

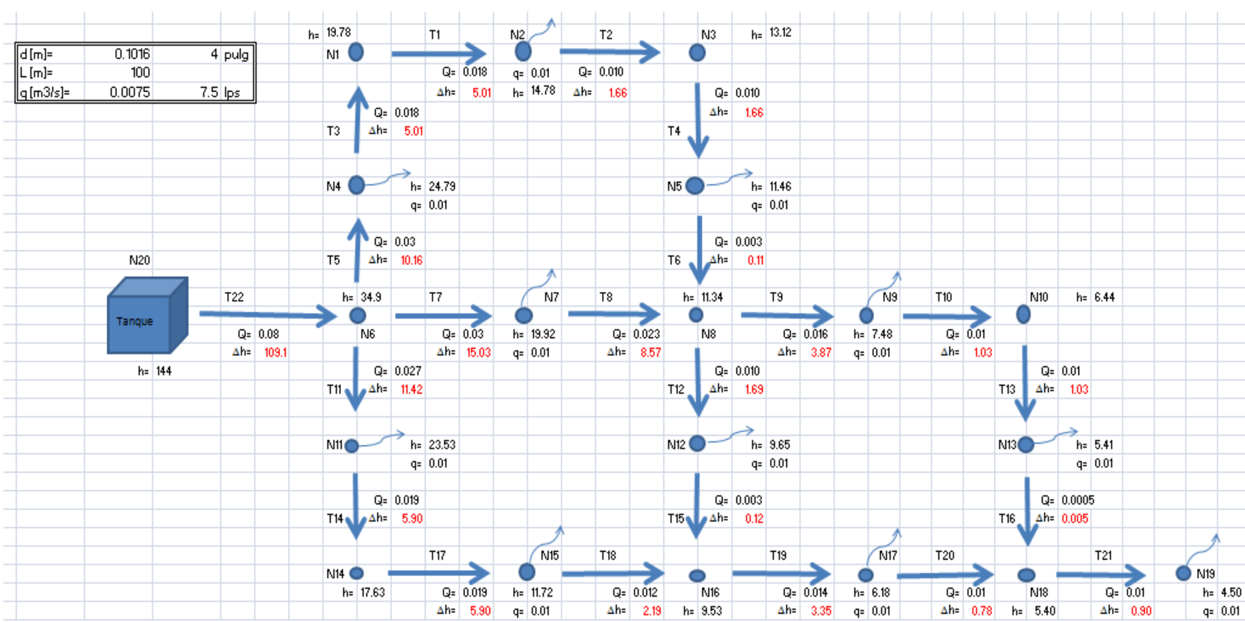


Fig.30 Esquema de red-cargas, sin considerar pérdidas locales

Ahora bien, si se enfoca la atención únicamente en las cargas existentes en la red, cuando se consideran las pérdidas locales y cuando no es así, se puede obtener la variación porcentual en los tubos al considerarla o no; a continuación se muestra la red con dicha información, destacando en color rojo los valores que se obtiene a partir de restar la carga de los nodos de entrada y salida, así mismo, en color amarillo se han resaltado los valores que reflejan la variación porcentual entre los valores anteriores.

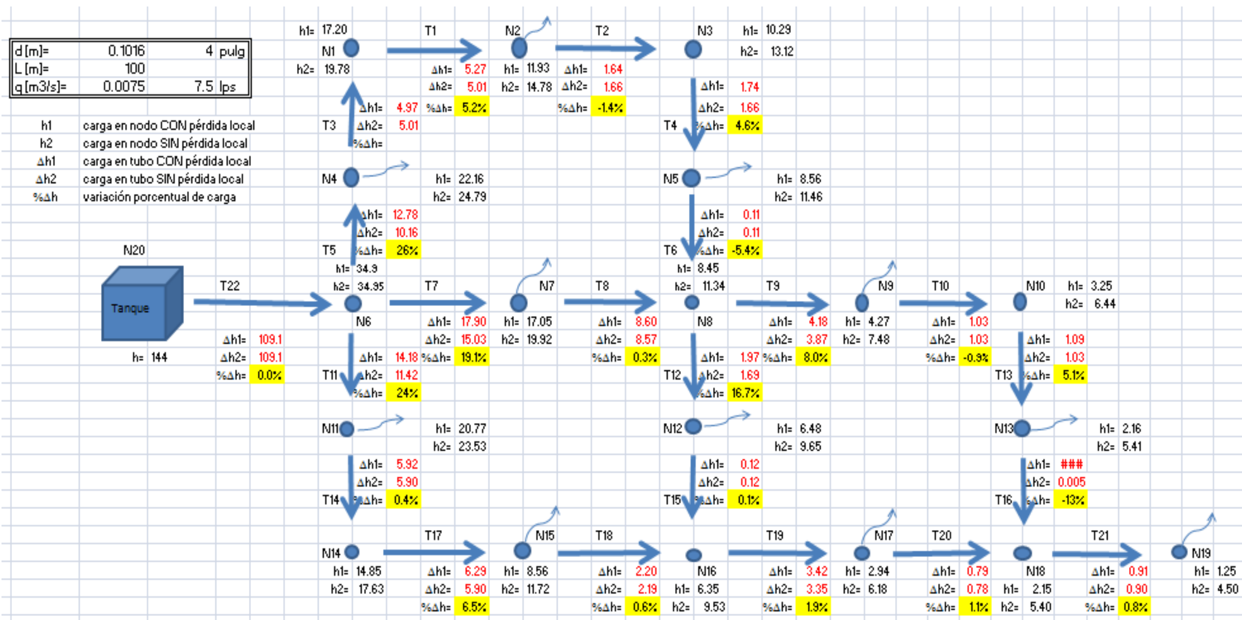


Fig.31 Esquema de red-variación porcentual de pérdida de carga

4.6 Conclusiones de los análisis anteriores

A continuación se presentará una síntesis de los puntos más importantes del análisis anterior.

1. Trabajar bajo cargas mínimas de funcionamiento en las fuentes de almacenamiento, incrementa la importancia de considerar las pérdidas locales (en este caso h_{20} mínima garantiza que el nodo 19 tenga una carga de energía aproximadamente de 1m).
2. Incrementar el gasto que circula por el sistema de abastecimiento, refleja un incremento en la transformación de energía en la red (se demostró que la pérdida de carga en el tubo 19 y 21 no es la misma, aunque presente los mismos componentes, variando únicamente el gasto que circula por estos).
3. Colocar piezas especiales complejas incrementa la transformación de energía en la red de abastecimiento (se observa que la "cruz" presenta mayor porcentaje de variación que las "tes" y "codos").
4. Tener un sistema de tuberías donde se combine longitudes cortas con diámetros grandes, provoca un aumento en la pérdida de carga (el caso crítico que se presentó fue una tubería con longitud de 100m y diámetro de 8 pulgadas).

5. La variación en el gasto de demanda, no es relevante en la consideración o no de las pérdidas locales (se observa en la tabla 15 la similitud en los valores porcentuales, bajo las mismas condiciones de longitud y diámetro).

Capítulo 5. Análisis con EPANET

Para corroborar la información anteriormente señalada, se empleo el programa de libre acceso EPANET. Obteniendo la siguiente información.

Recordando:

EPANET fue realizado por la U.S. Environmental Protection Agency (EPA).

EPANET es un modelo automatizado de simulación que predice el comportamiento dinámico de la calidad hidráulica del agua dentro de un sistema de la distribución del agua potable que funciona sobre un periodo de tiempo extendido. Dicho programa determina el caudal que circula por cada una de las conducciones, la presión en cada uno de los nudos, el nivel de agua en cada tanque y la concentración de diferentes componentes químicos a través de la red durante un determinado periodo de simulación.

Fuente: http://www.instagua.upv.es/Epanet/EpanetCastellano.htm

Mediante procesos muy sencillos, se esquematiza la red que se desea analizar, introduciendo en cada elemento las características y factores que queremos estudiar. A continuación se presenta el diseño de la red en EPANET.

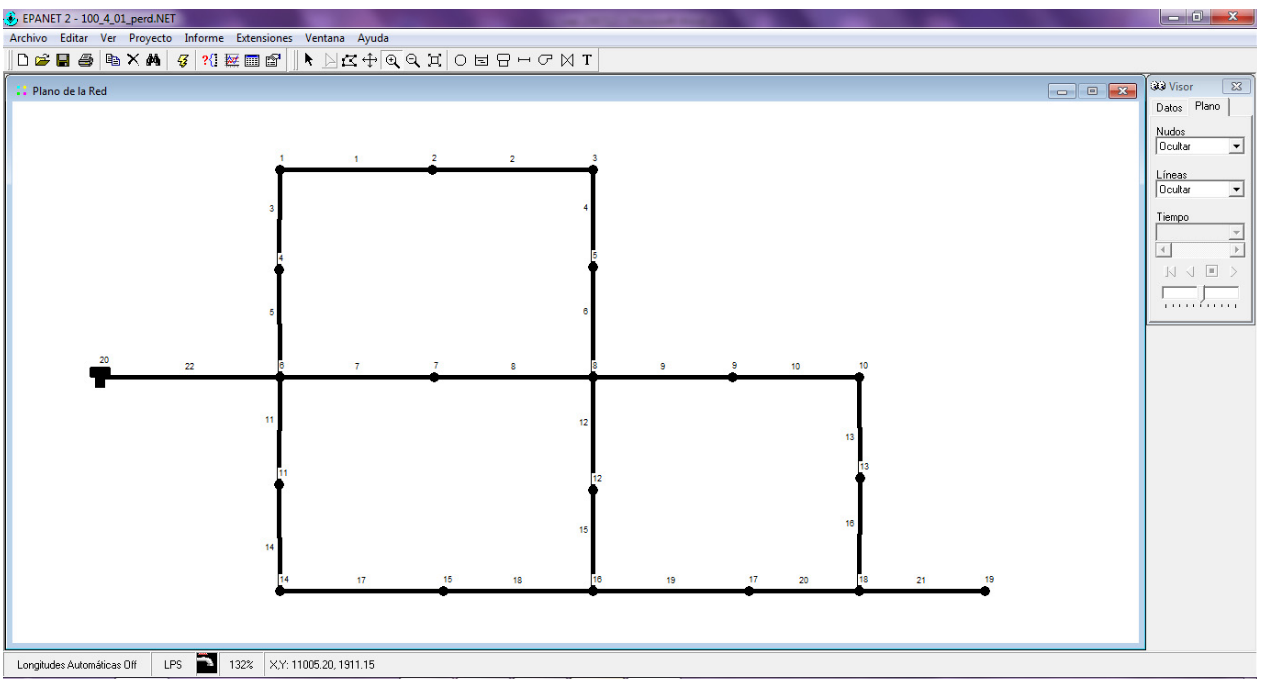


Fig.32 Esquema red 20 nodos diseñada en EPANET

De acuerdo al análisis que se lleva a cabo en el presente documento, en el EPANET se emplearon los mismos valores para la longitud, diámetro y gasto de demanda. En el Anexo 5-digital se presentan los valores obtenidos con el programa.

Considerando las combinaciones más críticas señaladas con el Método Sánchez-Fuentes, se realizaron los análisis con EPANET, observando que para la combinación de 600m de longitud, 4” de diámetro y 2.5 l/s de gasto mínimo, las cargas mínimas en el tanque (h_{20}) resultaron ser diferentes a las obtenidas en el Método S-F.

Tabla 17. Comparación de cargas mínimas h20

L [m]	100	600	100	600
d [pulg]	8	4	8	4
q [l/s]	2.5	2.5	2.5	2.5
horas	h_{20}-**Método S-F**		h_{20} **EPANET**	
1	2	102	2	75
2	2	98	2	70
3	2	95	2	70
4	2	98	2	70
5	2	105	2	75
6	2	132	2	97
7	2	199	2	134
8	3	310	3	201
9	4	523	4	331
10	4	628	4	395
11	4	673	4	418
12	4	696	4	430
13	4	691	4	430
14	4	633	4	395
15	4	564	4	352
16	4	484	4	310
17	3	428	3	272
18	3	392	3	253
19	3	375	3	244
20	3	358	3	235
21	3	310	3	201
22	2	189	2	127
23	2	132	2	97
24	2	113	2	80

En el presente documento, se realizaron los análisis con los dos valores de carga mínima h_{20} propuestos para la combinación 600, 4, 2.5. Presentando a continuación los valores obtenidos de carga en el nodo 19 para cada uno de los casos.

Tabla 18. Comparación de cargas h20 vs h19

L [m]	600			
d [pulg]	4			
q [l/s]	2.5			
horas	h20 mín con **M S-F**	h19	h_{20} mín con **EPANET**	h_{19}
1	102	28.78	75	1.78
2	98	29.83	70	1.78
3	95	26.83	70	1.78
4	98	29.83	70	1.78
5	105	31.78	75	1.78
6	132	36.94	97	1.78
7	199	66.33	134	1.78
8	310	110.19	201	1.78
9	523	193.84	331	1.78
10	628	234.29	395	1.78
11	673	256.57	418	1.78
12	696	267.99	430	1.78
13	691	262.99	430	1.78
14	633	239.29	395	1.78
15	564	213.92	352	1.78
16	484	175.15	310	1.78
17	428	157.94	272	1.78
18	392	140.43	253	1.78
19	375	132.44	244	1.78
20	358	124.3	235	1.78
21	310	110.19	201	1.78
22	189	63	127	1.78
23	132	36.94	97	1.78
24	113	34.57	80	1.78

Primero se presentaran los resultados obtenidos a partir de considerar en todo caso el valor mínimo de carga en el tanque, obtenido a partir del EPANET, con la finalidad de realizar la comparación directa del comportamiento en situaciones límite. Posteriormente se mostraran los valores adquiridos al estimar las cargas en la red a partir de suponer las mínimas h_{20} que se emplearon con el Método S-F, con el propósito de hacer una comparación de resultados con idénticos valores.

Se presentan a continuación los valores porcentuales de variación obtenidos con EPANET, considerando los valores h_{20} mínimos de carga (obtenidos con EPANET para el caso de 600, 4, 2.5).

Tabla 19. Máximas y mínimas variaciones porcentuales con EPANET

	L [m]	100	600	100	600
	d [pulg]	8	4	8	4
	q [l/s]	2.5	2.5	2.5	2.5
pieza	tubo	**MÁX** ∆T [%]		**MÍN** ∆T [%]	
codo	1	33.33%	0.68%	-25.0%	0.3%
--	2	0.00%	0.68%	-100.0%	0.0%
--	3	33.33%	0.32%	-50.0%	0.0%
codo	4	100.00%	0.95%	-50.0%	0.5%
cruz	5	33.33%	2.15%	14.3%	1.8%
--	6	-100.00%	6.67%	-100.0%	-8.3%
cruz	7	23.53%	1.96%	14.3%	1.5%
--	8	9.09%	0.00%	-16.7%	-0.3%
cruz	9	50.00%	1.78%	0.0%	1.1%
--	10	50.00%	1.23%	-50.0%	-1.1%
cruz	11	27.27%	2.20%	12.5%	1.9%
cruz	12	100.00%	1.88%	0.0%	0.7%
codo	13	100.00%	1.15%	-33.3%	-1.2%
--	14	33.33%	0.24%	-9.1%	0.0%
--	15	-100.00%	8.33%	-100.0%	-8.3%
--	16	0.00%	0.00%	0.0%	-100.0%
codo	17	25.00%	0.79%	0.0%	0.6%
--	18	33.33%	0.50%	-50.0%	0.0%
tes	19	50.00%	0.94%	0.0%	0.3%
--	20	100.00%	1.27%	-50.0%	0.0%
tes	21	100.00%	1.41%	-100.0%	0.0%

Si se comparan los valores de carga en los nodos, obtenidos a partir del Método S-F y con el EPANET, se observa una gran diferencia entre ellos. En el Anexo 6-digital se presenta la variación porcentual que existe. La variación se realizará empleando la siguiente fórmula:

$$\frac{(valor\ EPANET) - (valor\ método\ propio)}{(valor\ método\ propio)}$$

Tabla 20. Comparación porcentual de valores obtenidos

L [m]	100	600	100	600
d [pulg]	8	4	8	4
q [l/s]	2.5	2.5	2.5	2.5
nodo	Sin considerar pérdidas locales		Considerando pérdidas locales	
1	27.70%	-87.85%	37.04%	-87.62%
2	29.71%	-86.76%	40.65%	-86.35%

L [m]	100	600	100	600
d [pulg]	8	4	8	4
q [l/s]	2.5	2.5	2.5	2.5
nodo	Sin considerar pérdidas locales		Considerando pérdidas locales	
3	30.60%	-86.30%	41.67%	-85.80%
4	26.58%	-88.43%	34.48%	-88.26%
5	30.53%	-85.63%	43.10%	-84.97%
6	22.91%	-89.21%	22.91%	-89.21%
7	28.38%	-87.91%	37.59%	-87.68%
8	30.53%	-85.59%	42.24%	-84.92%
9	31.71%	-81.67%	46.23%	-79.50%
10	32.23%	-79.40%	46.15%	-75.71%
11	26.28%	-88.36%	36.17%	-88.19%
12	31.50%	-84.75%	44.14%	-83.73%
13	31.93%	-74.52%	46.08%	-65.23%
14	27.78%	-87.66%	38.76%	-87.38%
15	30.30%	-85.91%	43.48%	-85.23%
16	30.71%	-84.77%	44.14%	-83.69%
17	32.50%	-78.51%	46.15%	-73.99%
18	31.93%	-74.47%	46.08%	-65.13%
19	31.62%	-60.28%	47.00%	81.31%

Ahora, empleando los valores de carga en el tanque mínimos obtenidos con el Método S-F, se obtendrían los siguientes porcentajes de variación máximos y mínimos:

Tabla 21. Máximos y mínimos porcentajes de variación, con la misma h20

	L [m]	600	600
	d [pulg]	4	4
	q [l/s]	2.5	2.5
pieza	tubo	**MÁX** ∆T [%]	**MÍN** ∆T [%]
codo	1	0.68%	0.3%
--	2	0.68%	0.0%
--	3	0.32%	0.0%
codo	4	0.95%	0.5%
cruz	5	2.15%	1.8%
--	6	6.67%	-8.3%
cruz	7	1.96%	1.5%
--	8	0.00%	-0.3%
cruz	9	1.78%	1.1%
--	10	1.23%	-1.1%
cruz	11	2.20%	1.9%
cruz	12	1.88%	0.7%

	L [m]	600	600
	d [pulg]	4	4
	q [l/s]	2.5	2.5
pieza	tubo	**MÁX** ∆T [%]	**MÍN** ∆T [%]
codo	13	1.15%	-1.2%
--	14	0.24%	0.0%
--	15	8.33%	-8.3%
--	16	0.00%	-100.0%
codo	17	0.79%	0.6%
--	18	0.50%	0.0%
tes	19	0.94%	0.3%
--	20	1.27%	0.0%
tes	21	1.41%	0.0%

En comparación, la tabla 19 y la tabla 21, presentan los mismos porcentajes de variación al considerar o no las pérdidas locales, con diferentes valores de carga en el Tanque (h_{20}). Sin embargo, la comparación de valores de carga en cada nodo, obtenido a partir de los dos métodos empleando las mismas cargas en el Tanque, nos demuestran que se las cargas con EPANET se exceden de los valores obtenidos con el Método S-F, reflejando una sobrepresión en la red.

A continuación se presentan la diferencia porcentual de cargas en los nodos obtenidas con el Método Sánchez-Fuentes y con EPANET.

Tabla 22. Diferencia porcentual de valores en nodos, con la misma h20

L [m]	600	600
d [pulg]	4	4
q [l/s]	2.5	2.5
nodo	Sin pérdidas locales	Con pérdidas locales
1	-53.62%	-52.44%
2	-35.90%	-33.16%
3	-25.88%	-22.11%
4	-62.84%	-62.12%
5	-11.44%	-5.66%
6	-72.52%	-72.52%
7	-53.96%	-52.69%
8	-10.22%	-4.27%
9	78.37%	109.15%
10	147.85%	213.25%
11	-61.00%	-60.16%
12	13.57%	24.69%
13	314.74%	552.30%
14	-47.70%	-46.02%

L [m]	600	600
d [pulg]	4	4
q [l/s]	2.5	2.5
nodo	Sin pérdidas locales	Con pérdidas locales
15	-14.26%	-8.36%
16	15.79%	27.42%
17	175.63%	261.23%
18	315.93%	555.35%
19	957.72%	21866.39%

Existe una diferencia al comparar los porcentajes en la tabla 20 y 22.

A pesar de la complicación en comparar los valores obtenidos por cada método, también se pudo observar que el caudal que circula por la tubería provoca el incremento en los porcentajes diferenciales.

5.1 Conclusiones EPANET

1. La comparación de resultados, se hizo considerando diferentes circunstancias, ya que los valores mínimos de carga en el tanque no resultaron ser los mismos entre los empleados en el Método Sánchez-Fuentes y EPANET. Observando que no fueron los mismos tubos ni porcentajes los máximos.
2. La estimación de la carga necesaria en el tanque de almacenamiento al sistema asegura un funcionamiento adecuado en todo momento; se observó que para la combinación de L=100m, d=8” y q=2.5 l/s, fueron los mismos valores de carga en el tanque; sin embargo, la comparación para la combinación L=600m, d=4” y q=2.5 l/s, la diferencia de carga mínima h_{20} no tuvo que incrementarse tanto en el programa EPANET.
3. Se observó que al cambiar los valores de carga en el tanque para la combinación L=600m, d=4” y q=2.5 l/s, los porcentajes de variación al considerar o no las pérdidas locales, resulto ser el mismo. Sin embargo, al hacer la comparación de valores en cada nodo, es notorio que al incrementar el valor de carga en el tanque la diferencia de porcentajes presenta una dispersión muy alta.
4. El mantener fijo el valor de los coeficientes de pérdidas locales, o cambiándolo manualmente para cada instante que sean modificadas las condiciones de funcionamiento, implica una desventaja en el empleo del programa EPANET (en comparación con el Método Sánchez-Fuentes, que se calcula de manera automática para cada situación).
5. En comparación con la información aportada por el Método S-F, con el EPANET no se presentó ningún máximo para la combinación L=600m, d=4” yd=2.5 l/s.
6. El hecho de que los porcentajes de variación de considerar o no las pérdidas locales no representen diferencia alguna al modificar la carga en el tanque (h_{20}), podría generar dudas sobre la exactitud y confiabilidad de algunos resultados aportados por el programa EPANET.

6. CONCLUSIÓNES Y RECOMENDACIONES

1) Es importante tomar en cuenta las pérdidas locales en los cálculo de redes de tuberías a presión. Los sistemas de abastecimiento de las ciudades, durante su funcionamiento se ven sujetos a variaciones considerables de niveles de carga; es importante tomar en cuenta dichas pérdidas sobre todo cuando los tanques tienen niveles bajos.

2) Se recomienda realizar un análisis bajo la consideración de un flujo no permanente, y aumentar las condiciones de funcionamiento, para determinar que variable sería necesario modificar.

3) Se propone estudiar la importancia de considerar la presión que genera el aire, bajo el funcionamiento de abastecimiento por tandeo, y bajo qué criterio este cálculo es fundamental.

4) La comparación realizada con los resultados obtenidos con el Método Sánchez-Fuentes y EPANET, demostró una variación considerable en los valores de carga en el tanque al incrementar la longitud de la tubería y disminuir el diámetro; es decir, los valores de h_{20} mínimos para L=100m, d=8" y q=2.5 l/s fueron los mismos para los dos métodos, siendo menores los empleados en EPANET para L=600m, d=4" y q=2.5 l/s. Aunque la diferencia en la carga h20, no afecto el porcentaje de variación al estimar o no las pérdidas locales.

5) En los dos métodos empleados, la combinación más crítica es L=100m, d=8" y d=2.5 l/s, empleando la misma carga mínima en el tanque.

6) Se propone realizar comparaciones de los resultados obtenidos con el Método del Instituto de Ingeniería-UNAM con programas existentes que faciliten el cálculo y diseño de redes de abastecimiento de agua potable, a fin de perfeccionar el programa.

7) Se sugiere realizar comprobaciones con otros casos de estudio empleando el programa EPANET, para definir bajo qué condiciones una red puede ser modelada con resultados confiables.

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ANEXOS

ANEXO 1. GASTO EN TUBERÍAS [m^3/s]

Método Sánchez- Fuentes

Anexo 1. Gasto en tuberías de la red [m3/s] {M S-F}

Gasto de demanda mínimo en nodos de salida: 2.5 l/s (0.0025 m3/s)

		Tuberías																					
Caso	q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
horas	[m3/s]	Q [m3/s]																					
1	0.0026	0.0061	0.0035	0.0061	0.0035	0.0087	0.0009	0.0106	0.0080	0.0054	0.0028	0.0092	0.0035	0.0028	0.0066	0.0010	0.0002	0.0066	0.0041	0.0050	0.0024	0.0026	0.0285
2	0.0025	0.0060	0.0034	0.0060	0.0034	0.0085	0.0009	0.0104	0.0079	0.0053	0.0027	0.0091	0.0035	0.0027	0.0065	0.0009	0.0002	0.0065	0.0040	0.0049	0.0024	0.0025	0.0280
3	0.0025	0.0059	0.0034	0.0059	0.0034	0.0084	0.0009	0.0102	0.0077	0.0052	0.0027	0.0089	0.0034	0.0027	0.0064	0.0009	0.0002	0.0064	0.0039	0.0048	0.0023	0.0025	0.0275
4	0.0025	0.0060	0.0034	0.0060	0.0034	0.0085	0.0009	0.0104	0.0079	0.0053	0.0027	0.0091	0.0035	0.0027	0.0065	0.0009	0.0002	0.0065	0.0040	0.0049	0.0024	0.0025	0.0280
5	0.0026	0.0062	0.0036	0.0062	0.0036	0.0088	0.0009	0.0108	0.0081	0.0054	0.0028	0.0094	0.0036	0.0028	0.0068	0.0010	0.0002	0.0068	0.0041	0.0051	0.0025	0.0026	0.0290
6	0.0030	0.0069	0.0040	0.0069	0.0040	0.0099	0.0010	0.0121	0.0091	0.0061	0.0032	0.0105	0.0040	0.0032	0.0076	0.0011	0.0002	0.0076	0.0046	0.0057	0.0028	0.0030	0.0325
7	0.0036	0.0085	0.0049	0.0085	0.0049	0.0122	0.0013	0.0149	0.0112	0.0075	0.0039	0.0130	0.0050	0.0039	0.0093	0.0013	0.0002	0.0093	0.0057	0.0070	0.0034	0.0036	0.0400
8	0.0045	0.0107	0.0061	0.0107	0.0061	0.0152	0.0016	0.0186	0.0140	0.0094	0.0048	0.0162	0.0062	0.0048	0.0117	0.0017	0.0003	0.0117	0.0071	0.0088	0.0042	0.0045	0.0500
9	0.0059	0.0139	0.0080	0.0139	0.0080	0.0198	0.0021	0.0242	0.0183	0.0122	0.0063	0.0211	0.0081	0.0063	0.0152	0.0022	0.0004	0.0152	0.0092	0.0114	0.0055	0.0059	0.0650
10	0.0065	0.0152	0.0087	0.0152	0.0087	0.0217	0.0022	0.0265	0.0200	0.0134	0.0069	0.0231	0.0089	0.0069	0.0166	0.0024	0.0004	0.0166	0.0101	0.0125	0.0060	0.0065	0.0712
11	0.0067	0.0157	0.0090	0.0157	0.0090	0.0224	0.0023	0.0274	0.0207	0.0139	0.0072	0.0239	0.0092	0.0072	0.0172	0.0025	0.0004	0.0172	0.0105	0.0130	0.0063	0.0067	0.0737
12	0.0068	0.0160	0.0092	0.0160	0.0092	0.0228	0.0024	0.0279	0.0211	0.0141	0.0073	0.0243	0.0093	0.0073	0.0175	0.0025	0.0005	0.0175	0.0107	0.0132	0.0064	0.0068	0.0750
13	0.0068	0.0159	0.0092	0.0159	0.0092	0.0227	0.0024	0.0278	0.0210	0.0140	0.0072	0.0242	0.0093	0.0072	0.0174	0.0025	0.0005	0.0174	0.0106	0.0131	0.0063	0.0068	0.0747
14	0.0065	0.0153	0.0088	0.0153	0.0088	0.0218	0.0023	0.0266	0.0201	0.0134	0.0069	0.0232	0.0089	0.0069	0.0167	0.0024	0.0004	0.0167	0.0102	0.0126	0.0061	0.0065	0.0715
15	0.0061	0.0144	0.0083	0.0144	0.0083	0.0205	0.0021	0.0251	0.0190	0.0127	0.0065	0.0219	0.0084	0.0065	0.0157	0.0023	0.0004	0.0157	0.0096	0.0119	0.0057	0.0061	0.0675
16	0.0057	0.0133	0.0077	0.0133	0.0077	0.0190	0.0020	0.0232	0.0176	0.0117	0.0061	0.0202	0.0078	0.0061	0.0146	0.0021	0.0004	0.0146	0.0089	0.0110	0.0053	0.0057	0.0625
17	0.0053	0.0125	0.0072	0.0125	0.0072	0.0179	0.0019	0.0218	0.0165	0.0110	0.0057	0.0190	0.0073	0.0057	0.0137	0.0020	0.0004	0.0137	0.0084	0.0103	0.0050	0.0053	0.0587
18	0.0051	0.0120	0.0069	0.0120	0.0069	0.0171	0.0018	0.0209	0.0158	0.0106	0.0055	0.0182	0.0070	0.0055	0.0131	0.0019	0.0003	0.0131	0.0080	0.0099	0.0048	0.0051	0.0562
19	0.0050	0.0117	0.0067	0.0117	0.0067	0.0167	0.0017	0.0204	0.0154	0.0103	0.0053	0.0178	0.0068	0.0053	0.0128	0.0018	0.0003	0.0128	0.0078	0.0097	0.0047	0.0050	0.0550
20	0.0049	0.0115	0.0066	0.0115	0.0066	0.0164	0.0017	0.0200	0.0151	0.0101	0.0052	0.0174	0.0067	0.0052	0.0125	0.0018	0.0003	0.0125	0.0076	0.0094	0.0046	0.0049	0.0537
21	0.0045	0.0107	0.0061	0.0107	0.0061	0.0152	0.0016	0.0186	0.0140	0.0094	0.0048	0.0162	0.0062	0.0048	0.0117	0.0017	0.0003	0.0117	0.0071	0.0088	0.0042	0.0045	0.0500
22	0.0035	0.0083	0.0048	0.0083	0.0048	0.0119	0.0012	0.0145	0.0110	0.0073	0.0038	0.0126	0.0049	0.0038	0.0091	0.0013	0.0002	0.0091	0.0055	0.0069	0.0033	0.0035	0.0390
23	0.0030	0.0069	0.0040	0.0069	0.0040	0.0099	0.0010	0.0121	0.0091	0.0061	0.0032	0.0105	0.0040	0.0032	0.0076	0.0011	0.0002	0.0076	0.0046	0.0057	0.0028	0.0030	0.0325
24	0.0027	0.0064	0.0037	0.0064	0.0037	0.0091	0.0009	0.0112	0.0084	0.0056	0.0029	0.0097	0.0037	0.0029	0.0070	0.0010	0.0002	0.0070	0.0043	0.0053	0.0025	0.0027	0.0300

Anexo 1. Gasto en tuberías de la red [m3/s] {M S-F}

Gasto de demanda mínimo en nodos de salida: 5 l/s (0.005 m3/s)

		Tuberías																					
Caso	q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
horas	[m3/s]	Q [m3/s]																					
1	0.0052	0.0122	0.0070	0.0122	0.0070	0.0173	0.0018	0.0212	0.0160	0.0107	0.0055	0.0185	0.0071	0.0055	0.0133	0.0019	0.0003	0.0133	0.0081	0.0100	0.0048	0.0052	0.0570
2	0.0051	0.0119	0.0069	0.0119	0.0069	0.0170	0.0018	0.0208	0.0157	0.0105	0.0054	0.0181	0.0070	0.0054	0.0131	0.0019	0.0003	0.0131	0.0080	0.0098	0.0048	0.0051	0.0560
3	0.0050	0.0117	0.0067	0.0117	0.0067	0.0167	0.0017	0.0204	0.0154	0.0103	0.0053	0.0178	0.0068	0.0053	0.0128	0.0018	0.0003	0.0128	0.0078	0.0097	0.0047	0.0050	0.0550
4	0.0051	0.0119	0.0069	0.0119	0.0069	0.0170	0.0018	0.0208	0.0157	0.0105	0.0054	0.0181	0.0070	0.0054	0.0131	0.0019	0.0003	0.0131	0.0080	0.0098	0.0048	0.0051	0.0560
5	0.0053	0.0124	0.0071	0.0124	0.0071	0.0176	0.0018	0.0216	0.0163	0.0109	0.0056	0.0188	0.0072	0.0056	0.0135	0.0019	0.0004	0.0135	0.0082	0.0102	0.0049	0.0053	0.0580
6	0.0059	0.0139	0.0080	0.0139	0.0080	0.0198	0.0021	0.0242	0.0183	0.0122	0.0063	0.0211	0.0081	0.0063	0.0152	0.0022	0.0004	0.0152	0.0092	0.0114	0.0055	0.0059	0.0650
7	0.0073	0.0171	0.0098	0.0171	0.0098	0.0243	0.0025	0.0297	0.0225	0.0150	0.0078	0.0259	0.0100	0.0078	0.0186	0.0027	0.0005	0.0186	0.0114	0.0141	0.0068	0.0073	0.0800
8	0.0091	0.0213	0.0122	0.0213	0.0122	0.0304	0.0032	0.0372	0.0281	0.0188	0.0097	0.0324	0.0124	0.0097	0.0233	0.0034	0.0006	0.0233	0.0142	0.0176	0.0085	0.0091	0.1000
9	0.0118	0.0277	0.0159	0.0277	0.0159	0.0396	0.0041	0.0483	0.0365	0.0244	0.0126	0.0421	0.0162	0.0126	0.0303	0.0044	0.0008	0.0303	0.0185	0.0228	0.0110	0.0118	0.1300
10	0.0130	0.0304	0.0175	0.0304	0.0175	0.0434	0.0045	0.0530	0.0400	0.0268	0.0138	0.0462	0.0177	0.0138	0.0332	0.0048	0.0009	0.0332	0.0203	0.0250	0.0121	0.0130	0.1425
11	0.0134	0.0315	0.0181	0.0315	0.0181	0.0449	0.0047	0.0548	0.0414	0.0277	0.0143	0.0478	0.0184	0.0143	0.0344	0.0050	0.0009	0.0344	0.0210	0.0259	0.0125	0.0134	0.1475
12	0.0136	0.0320	0.0184	0.0320	0.0184	0.0456	0.0047	0.0558	0.0421	0.0282	0.0145	0.0486	0.0187	0.0145	0.0350	0.0050	0.0009	0.0350	0.0213	0.0264	0.0127	0.0136	0.1500
13	0.0136	0.0319	0.0183	0.0319	0.0183	0.0455	0.0047	0.0556	0.0420	0.0281	0.0145	0.0484	0.0186	0.0145	0.0348	0.0050	0.0009	0.0348	0.0213	0.0263	0.0127	0.0136	0.1495
14	0.0130	0.0305	0.0175	0.0305	0.0175	0.0435	0.0045	0.0532	0.0402	0.0269	0.0139	0.0463	0.0178	0.0139	0.0333	0.0048	0.0009	0.0333	0.0203	0.0251	0.0121	0.0130	0.1430
15	0.0123	0.0288	0.0165	0.0288	0.0165	0.0411	0.0043	0.0502	0.0379	0.0254	0.0131	0.0437	0.0168	0.0131	0.0315	0.0045	0.0008	0.0315	0.0192	0.0237	0.0115	0.0123	0.1350
16	0.0114	0.0267	0.0153	0.0267	0.0153	0.0380	0.0039	0.0465	0.0351	0.0235	0.0121	0.0405	0.0156	0.0121	0.0291	0.0042	0.0008	0.0291	0.0178	0.0220	0.0106	0.0114	0.1250
17	0.0107	0.0251	0.0144	0.0251	0.0144	0.0358	0.0037	0.0437	0.0330	0.0221	0.0114	0.0381	0.0146	0.0114	0.0274	0.0039	0.0007	0.0274	0.0167	0.0207	0.0100	0.0107	0.1175
18	0.0102	0.0240	0.0138	0.0240	0.0138	0.0342	0.0036	0.0418	0.0316	0.0211	0.0109	0.0364	0.0140	0.0109	0.0262	0.0038	0.0007	0.0262	0.0160	0.0198	0.0095	0.0102	0.1125
19	0.0100	0.0235	0.0135	0.0235	0.0135	0.0335	0.0035	0.0409	0.0309	0.0207	0.0107	0.0356	0.0137	0.0107	0.0256	0.0037	0.0007	0.0256	0.0156	0.0193	0.0093	0.0100	0.1100
20	0.0098	0.0229	0.0132	0.0229	0.0132	0.0327	0.0034	0.0400	0.0302	0.0202	0.0104	0.0348	0.0134	0.0104	0.0251	0.0036	0.0007	0.0251	0.0153	0.0189	0.0091	0.0098	0.1075
21	0.0091	0.0213	0.0122	0.0213	0.0122	0.0304	0.0032	0.0372	0.0281	0.0188	0.0097	0.0324	0.0124	0.0097	0.0233	0.0034	0.0006	0.0233	0.0142	0.0176	0.0085	0.0091	0.1000
22	0.0071	0.0166	0.0096	0.0166	0.0096	0.0237	0.0025	0.0290	0.0219	0.0147	0.0076	0.0253	0.0097	0.0076	0.0182	0.0026	0.0005	0.0182	0.0111	0.0137	0.0066	0.0071	0.0780
23	0.0059	0.0139	0.0080	0.0139	0.0080	0.0198	0.0021	0.0242	0.0183	0.0122	0.0063	0.0211	0.0081	0.0063	0.0152	0.0022	0.0004	0.0152	0.0092	0.0114	0.0055	0.0059	0.0650
24	0.0055	0.0128	0.0073	0.0128	0.0073	0.0183	0.0019	0.0223	0.0168	0.0113	0.0058	0.0194	0.0075	0.0058	0.0140	0.0020	0.0004	0.0140	0.0085	0.0105	0.0051	0.0055	0.0600

Anexo 1. Gasto en tuberías de la red [m3/s] {M S-F}

Gasto de demanda mínimo en nodos de salida: 7.5 l/s (0.0075 m3/s)

		Tuberías																					
Caso	q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
horas	[m3/s]	Q [m3/s]																					
1	0.0078	0.0182	0.0105	0.0182	0.0105	0.0260	0.0027	0.0318	0.0240	0.0161	0.0083	0.0277	0.0106	0.0083	0.0199	0.0029	0.0005	0.0199	0.0122	0.0150	0.0073	0.0078	0.0855
2	0.0076	0.0179	0.0103	0.0179	0.0103	0.0256	0.0027	0.0312	0.0236	0.0158	0.0081	0.0272	0.0105	0.0081	0.0196	0.0028	0.0005	0.0196	0.0119	0.0148	0.0071	0.0076	0.0840
3	0.0075	0.0176	0.0101	0.0176	0.0101	0.0251	0.0026	0.0307	0.0232	0.0155	0.0080	0.0267	0.0103	0.0080	0.0192	0.0028	0.0005	0.0192	0.0117	0.0145	0.0070	0.0075	0.0825
4	0.0076	0.0179	0.0103	0.0179	0.0103	0.0256	0.0027	0.0312	0.0236	0.0158	0.0081	0.0272	0.0105	0.0081	0.0196	0.0028	0.0005	0.0196	0.0119	0.0148	0.0071	0.0076	0.0840
5	0.0079	0.0186	0.0107	0.0186	0.0107	0.0265	0.0027	0.0323	0.0244	0.0163	0.0084	0.0282	0.0108	0.0084	0.0203	0.0029	0.0005	0.0203	0.0124	0.0153	0.0074	0.0079	0.0870
6	0.0089	0.0208	0.0119	0.0208	0.0119	0.0297	0.0031	0.0362	0.0274	0.0183	0.0095	0.0316	0.0121	0.0095	0.0227	0.0033	0.0006	0.0227	0.0139	0.0171	0.0083	0.0089	0.0975
7	0.0109	0.0256	0.0147	0.0256	0.0147	0.0365	0.0038	0.0446	0.0337	0.0225	0.0116	0.0389	0.0149	0.0116	0.0280	0.0040	0.0007	0.0280	0.0171	0.0211	0.0102	0.0109	0.1200
8	0.0136	0.0320	0.0184	0.0320	0.0184	0.0456	0.0047	0.0558	0.0421	0.0282	0.0145	0.0486	0.0187	0.0145	0.0350	0.0050	0.0009	0.0350	0.0213	0.0264	0.0127	0.0136	0.1500
9	0.0177	0.0416	0.0239	0.0416	0.0239	0.0593	0.0062	0.0725	0.0548	0.0366	0.0189	0.0632	0.0243	0.0189	0.0455	0.0065	0.0012	0.0455	0.0277	0.0343	0.0165	0.0177	0.1950
10	0.0194	0.0456	0.0262	0.0456	0.0262	0.0650	0.0067	0.0795	0.0600	0.0402	0.0207	0.0693	0.0266	0.0207	0.0498	0.0072	0.0013	0.0498	0.0304	0.0376	0.0181	0.0194	0.2137
11	0.0201	0.0472	0.0271	0.0472	0.0271	0.0673	0.0070	0.0822	0.0621	0.0416	0.0215	0.0717	0.0275	0.0215	0.0516	0.0074	0.0013	0.0516	0.0315	0.0389	0.0188	0.0201	0.2212
12	0.0205	0.0480	0.0276	0.0480	0.0276	0.0685	0.0071	0.0836	0.0632	0.0423	0.0218	0.0729	0.0280	0.0218	0.0524	0.0076	0.0014	0.0524	0.0320	0.0395	0.0191	0.0205	0.2250
13	0.0204	0.0478	0.0275	0.0478	0.0275	0.0682	0.0071	0.0834	0.0630	0.0421	0.0217	0.0727	0.0279	0.0217	0.0523	0.0075	0.0014	0.0523	0.0319	0.0394	0.0190	0.0204	0.2242
14	0.0195	0.0458	0.0263	0.0458	0.0263	0.0653	0.0068	0.0797	0.0602	0.0403	0.0208	0.0695	0.0267	0.0208	0.0500	0.0072	0.0013	0.0500	0.0305	0.0377	0.0182	0.0195	0.2145
15	0.0184	0.0432	0.0248	0.0432	0.0248	0.0616	0.0064	0.0753	0.0569	0.0380	0.0196	0.0656	0.0252	0.0196	0.0472	0.0068	0.0012	0.0472	0.0288	0.0356	0.0172	0.0184	0.2025
16	0.0170	0.0400	0.0230	0.0400	0.0230	0.0571	0.0059	0.0697	0.0527	0.0352	0.0182	0.0607	0.0233	0.0182	0.0437	0.0063	0.0011	0.0437	0.0267	0.0330	0.0159	0.0170	0.1875
17	0.0160	0.0376	0.0216	0.0376	0.0216	0.0536	0.0056	0.0655	0.0495	0.0331	0.0171	0.0571	0.0219	0.0171	0.0411	0.0059	0.0011	0.0411	0.0251	0.0310	0.0150	0.0160	0.1762
18	0.0153	0.0360	0.0207	0.0360	0.0207	0.0513	0.0053	0.0627	0.0474	0.0317	0.0164	0.0547	0.0210	0.0164	0.0393	0.0057	0.0010	0.0393	0.0240	0.0297	0.0143	0.0153	0.1687
19	0.0150	0.0352	0.0202	0.0352	0.0202	0.0502	0.0052	0.0613	0.0463	0.0310	0.0160	0.0535	0.0205	0.0160	0.0385	0.0055	0.0010	0.0385	0.0235	0.0290	0.0140	0.0150	0.1650
20	0.0147	0.0344	0.0197	0.0344	0.0197	0.0491	0.0051	0.0599	0.0453	0.0303	0.0156	0.0522	0.0201	0.0156	0.0376	0.0054	0.0010	0.0376	0.0229	0.0283	0.0137	0.0147	0.1612
21	0.0136	0.0320	0.0184	0.0320	0.0184	0.0456	0.0047	0.0558	0.0421	0.0282	0.0145	0.0486	0.0187	0.0145	0.0350	0.0050	0.0009	0.0350	0.0213	0.0264	0.0127	0.0136	0.1500
22	0.0106	0.0250	0.0143	0.0250	0.0143	0.0356	0.0037	0.0435	0.0329	0.0220	0.0113	0.0379	0.0146	0.0113	0.0273	0.0039	0.0007	0.0273	0.0166	0.0206	0.0099	0.0106	0.1170
23	0.0089	0.0208	0.0119	0.0208	0.0119	0.0297	0.0031	0.0362	0.0274	0.0183	0.0095	0.0316	0.0121	0.0095	0.0227	0.0033	0.0006	0.0227	0.0139	0.0171	0.0083	0.0089	0.0975
24	0.0082	0.0192	0.0110	0.0192	0.0110	0.0274	0.0028	0.0335	0.0253	0.0169	0.0087	0.0292	0.0112	0.0087	0.0210	0.0030	0.0005	0.0210	0.0128	0.0158	0.0076	0.0082	0.0900

ANEXO 2. VALORES DE CARGA EN NODO [m]

Método Sánchez- Fuentes

Anexo 2. Valores de carga en nodo [m]   {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	100	4	0.1016	0.021	0.0026	1	19	3.87	3.24	3.04	4.46	2.84	5.99	3.85	2.82	2.32	2.20	4.29	2.59	2.07	3.59	2.84	2.57	2.17	2.07	1.96
2	100	4	0.1016	0.021	0.0025	1	18	3.39	2.79	2.60	3.97	2.40	5.44	3.38	2.39	1.90	1.79	3.81	2.16	1.66	3.12	2.40	2.14	1.75	1.66	1.56
3	100	4	0.1016	0.021	0.0025	1	17	2.91	2.33	2.14	3.46	1.95	4.88	2.89	1.94	1.47	1.36	3.31	1.72	1.24	2.65	1.95	1.71	1.33	1.24	1.14
4	100	4	0.1016	0.021	0.0025	1	18	3.39	2.79	2.60	3.97	2.40	5.44	3.38	2.39	1.90	1.79	3.81	2.16	1.66	3.12	2.40	2.14	1.75	1.66	1.56
5	100	4	0.1016	0.021	0.0026	1	19	3.33	2.68	2.48	3.95	2.26	5.53	3.31	2.25	1.73	1.61	3.77	2.01	1.47	3.04	2.26	1.99	1.57	1.47	1.36
6	100	4	0.1016	0.021	0.0030	1	24	4.32	3.50	3.25	5.09	2.98	7.08	4.30	2.96	2.32	2.16	4.88	2.66	1.99	3.96	2.98	2.64	2.11	1.99	1.85
7	100	4	0.1016	0.021	0.0036	1	35	5.19	3.95	3.57	6.36	3.16	9.36	5.16	3.14	2.15	1.91	6.03	2.67	1.66	4.64	3.16	2.64	1.84	1.66	1.44
8	100	4	0.1016	0.021	0.0045	1	54	7.42	5.49	4.89	9.25	4.25	13.94	7.37	4.21	2.68	2.30	8.74	3.49	1.90	6.56	4.25	3.44	2.19	1.90	1.57
9	100	4	0.1016	0.021	0.0059	1	90	11.29	8.02	7.00	14.37	5.92	22.30	11.19	5.86	3.26	2.63	13.51	4.63	1.95	9.83	5.92	4.56	2.44	1.95	1.38
10	100	4	0.1016	0.021	0.0065	1	108	13.42	9.49	8.27	17.13	6.98	26.66	13.31	6.90	3.78	3.02	16.09	5.43	2.20	11.67	6.98	5.33	2.79	2.20	1.52
11	100	4	0.1016	0.021	0.0067	1	116	14.67	10.46	9.15	18.64	7.76	28.85	14.55	7.68	4.34	3.52	17.52	6.10	2.65	12.79	7.77	6.00	3.27	2.65	1.92
12	100	4	0.1016	0.021	0.0068	1	119	14.21	9.85	8.50	18.31	7.06	28.87	14.08	6.97	3.52	2.67	17.16	5.35	1.78	12.26	7.07	5.24	2.42	1.77	1.02
13	100	4	0.1016	0.021	0.0068	1	119	14.90	10.58	9.23	18.98	7.81	29.47	14.78	7.72	4.29	3.45	17.84	6.10	2.56	12.97	7.81	6.00	3.20	2.55	1.81
14	100	4	0.1016	0.021	0.0065	1	109	13.76	9.80	8.57	17.49	7.27	27.09	13.65	7.19	4.05	3.28	16.44	5.71	2.46	11.99	7.27	5.61	3.05	2.46	1.78
15	100	4	0.1016	0.021	0.0061	1	97	12.12	8.59	7.49	15.44	6.33	24.00	12.02	6.26	3.46	2.78	14.51	4.94	2.05	10.54	6.33	4.86	2.57	2.05	1.44
16	100	4	0.1016	0.021	0.0057	1	83	10.23	7.20	6.26	13.08	5.27	20.41	10.14	5.20	2.81	2.22	12.28	4.07	1.59	8.88	5.27	4.00	2.04	1.59	1.07
17	100	4	0.1016	0.021	0.0053	1	74	9.70	7.02	6.20	12.21	5.32	18.70	9.62	5.26	3.14	2.62	11.51	4.26	2.07	8.50	5.32	4.20	2.47	2.07	1.61
18	100	4	0.1016	0.021	0.0051	1	68	9.05	6.60	5.84	11.36	5.04	17.30	8.98	4.99	3.04	2.57	10.71	4.07	2.06	7.96	5.04	4.01	2.42	2.06	1.64
19	100	4	0.1016	0.021	0.0050	1	65	8.64	6.30	5.58	10.85	4.80	16.53	8.58	4.76	2.90	2.44	10.23	3.88	1.96	7.60	4.80	3.82	2.31	1.96	1.55
20	100	4	0.1016	0.021	0.0049	1	62	8.18	5.94	5.25	10.28	4.51	15.71	8.11	4.46	2.69	2.25	9.69	3.63	1.79	7.18	4.51	3.57	2.12	1.79	1.40
21	100	4	0.1016	0.021	0.0045	1	54	7.42	5.49	4.89	9.25	4.25	13.94	7.37	4.21	2.68	2.30	8.74	3.49	1.90	6.56	4.25	3.44	2.19	1.90	1.57
22	100	4	0.1016	0.021	0.0035	1	33	4.66	3.49	3.12	5.77	2.73	8.63	4.63	2.71	1.77	1.55	5.46	2.27	1.30	4.14	2.73	2.24	1.48	1.30	1.10
23	100	4	0.1016	0.021	0.0030	1	24	4.32	3.50	3.25	5.09	2.98	7.08	4.30	2.96	2.32	2.16	4.88	2.66	1.99	3.96	2.98	2.64	2.11	1.99	1.85
24	100	4	0.1016	0.021	0.0027	1	20	3.23	2.54	2.32	3.89	2.09	5.58	3.21	2.08	1.52	1.39	3.71	1.82	1.24	2.92	2.09	1.80	1.35	1.24	1.12

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	100	4	0.1016	0.021	0.0026	0	19	4.18	3.58	3.38	4.77	3.18	5.99	4.19	3.17	2.71	2.58	4.62	2.97	2.46	3.92	3.21	2.95	2.55	2.46	2.35
26	100	4	0.1016	0.021	0.0025	0	18	3.69	3.12	2.92	4.27	2.73	5.44	3.71	2.72	2.27	2.15	4.12	2.52	2.04	3.44	2.76	2.51	2.12	2.04	1.93
27	100	4	0.1016	0.021	0.0025	0	17	3.20	2.64	2.46	3.75	2.27	4.88	3.21	2.26	1.83	1.72	3.61	2.07	1.60	2.96	2.30	2.06	1.69	1.60	1.50
28	100	4	0.1016	0.021	0.0025	0	18	3.69	3.12	2.92	4.27	2.73	5.44	3.71	2.72	2.27	2.15	4.12	2.52	2.04	3.44	2.76	2.51	2.12	2.04	1.93
29	100	4	0.1016	0.021	0.0026	0	19	3.65	3.03	2.83	4.27	2.62	5.53	3.67	2.61	2.13	2.00	4.11	2.40	1.88	3.38	2.66	2.38	1.97	1.87	1.76
30	100	4	0.1016	0.021	0.0030	0	24	4.72	3.95	3.69	5.50	3.43	7.08	4.74	3.41	2.81	2.65	5.30	3.15	2.49	4.39	3.47	3.13	2.61	2.49	2.35
31	100	4	0.1016	0.021	0.0036	0	35	5.80	4.62	4.23	6.98	3.84	9.36	5.83	3.82	2.91	2.66	6.68	3.42	2.42	5.29	3.90	3.39	2.60	2.42	2.21
32	100	4	0.1016	0.021	0.0045	0	54	8.37	6.54	5.93	10.21	5.32	13.94	8.42	5.27	3.85	3.47	9.75	4.65	3.09	7.58	5.41	4.61	3.38	3.09	2.76
33	100	4	0.1016	0.021	0.0059	0	90	12.89	9.78	8.75	16.00	7.72	22.30	12.97	7.65	5.25	4.61	15.22	6.60	3.97	11.55	7.89	6.53	4.45	3.97	3.41
34	100	4	0.1016	0.021	0.0065	0	108	15.35	11.62	10.38	19.09	9.14	26.66	15.45	9.06	6.17	5.40	18.14	7.80	4.63	13.74	9.34	7.70	5.20	4.62	3.95
35	100	4	0.1016	0.021	0.0067	0	116	16.74	12.73	11.41	20.74	10.08	28.85	16.84	9.99	6.90	6.07	19.73	8.64	5.25	15.01	10.29	8.54	5.86	5.24	4.52
36	100	4	0.1016	0.021	0.0068	0	119	16.34	12.20	10.83	20.48	9.46	28.87	16.45	9.37	6.17	5.32	19.44	7.97	4.46	14.56	9.68	7.87	5.10	4.46	3.71
37	100	4	0.1016	0.021	0.0068	0	119	17.03	12.92	11.55	21.14	10.19	29.47	17.13	10.10	6.92	6.07	20.10	8.71	5.22	15.25	10.41	8.61	5.86	5.22	4.48
38	100	4	0.1016	0.021	0.0065	0	109	15.70	11.94	10.69	19.46	9.45	27.09	15.80	9.36	6.46	5.68	18.51	8.09	4.90	14.08	9.65	8.00	5.48	4.90	4.22
39	100	4	0.1016	0.021	0.0061	0	97	13.85	10.50	9.39	17.20	8.27	24.00	13.94	8.20	5.61	4.92	16.35	7.07	4.22	12.40	8.45	6.98	4.74	4.22	3.62
40	100	4	0.1016	0.021	0.0057	0	83	11.71	8.84	7.88	14.58	6.93	20.41	11.79	6.87	4.65	4.05	13.86	5.90	3.46	10.47	7.08	5.83	3.90	3.46	2.94
41	100	4	0.1016	0.021	0.0053	0	74	11.01	8.47	7.63	13.55	6.79	18.70	11.07	6.73	4.77	4.24	12.91	5.87	3.72	9.91	6.92	5.81	4.11	3.72	3.26
42	100	4	0.1016	0.021	0.0051	0	68	10.26	7.93	7.16	12.58	6.38	17.30	10.32	6.33	4.53	4.05	12.00	5.55	3.57	9.25	6.51	5.49	3.93	3.57	3.15
43	100	4	0.1016	0.021	0.0050	0	65	9.79	7.57	6.83	12.02	6.09	16.53	9.85	6.04	4.32	3.86	11.46	5.29	3.40	8.83	6.21	5.24	3.75	3.40	3.00
44	100	4	0.1016	0.021	0.0049	0	62	9.27	7.15	6.44	11.40	5.74	15.71	9.33	5.69	4.05	3.61	10.86	4.97	3.17	8.36	5.85	4.92	3.50	3.17	2.79
45	100	4	0.1016	0.021	0.0045	0	54	8.37	6.54	5.93	10.21	5.32	13.94	8.42	5.27	3.85	3.47	9.75	4.65	3.09	7.58	5.41	4.61	3.38	3.09	2.76
46	100	4	0.1016	0.021	0.0035	0	33	5.24	4.12	3.75	6.36	3.38	8.63	5.27	3.36	2.49	2.26	6.08	2.98	2.03	4.76	3.44	2.95	2.20	2.03	1.83
47	100	4	0.1016	0.021	0.0030	0	24	4.72	3.95	3.69	5.50	3.43	7.08	4.74	3.41	2.81	2.65	5.30	3.15	2.49	4.39	3.47	3.13	2.61	2.49	2.35
48	100	4	0.1016	0.021	0.0027	0	20	3.57	2.91	2.69	4.24	2.47	5.58	3.59	2.46	1.95	1.81	4.07	2.24	1.67	3.29	2.51	2.22	1.78	1.67	1.55

Anexo 2. Valores de carga en nodo [m]   {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	100	4	0.1016	0.021	0.0052	1	70	9.47	6.96	6.17	11.84	5.35	17.94	9.40	5.29	3.30	2.81	11.18	4.35	2.29	8.35	5.35	4.29	2.66	2.29	1.86
2	100	4	0.1016	0.021	0.0051	1	67	8.58	6.15	5.39	10.86	4.59	16.75	8.51	4.54	2.62	2.15	10.22	3.64	1.65	7.49	4.60	3.58	2.01	1.64	1.23
3	100	4	0.1016	0.021	0.0050	1	65	8.64	6.30	5.58	10.85	4.80	16.53	8.58	4.76	2.90	2.44	10.23	3.88	1.96	7.60	4.80	3.82	2.31	1.96	1.55
4	100	4	0.1016	0.021	0.0051	1	67	8.58	6.15	5.39	10.86	4.59	16.75	8.51	4.54	2.62	2.15	10.22	3.64	1.65	7.49	4.60	3.58	2.01	1.64	1.23
5	100	4	0.1016	0.021	0.0053	1	72	9.33	6.72	5.92	11.78	5.06	18.10	9.25	5.00	2.94	2.43	11.09	4.03	1.89	8.17	5.06	3.97	2.28	1.89	1.44
6	100	4	0.1016	0.021	0.0059	1	90	11.29	8.02	7.00	14.37	5.92	22.30	11.19	5.86	3.26	2.63	13.51	4.63	1.95	9.83	5.92	4.56	2.44	1.95	1.38
7	100	4	0.1016	0.021	0.0073	1	136	16.77	11.81	10.27	21.44	8.64	33.46	16.63	8.54	4.61	3.65	20.13	6.69	2.62	14.56	8.64	6.57	3.36	2.62	1.77
8	100	4	0.1016	0.021	0.0091	1	211	24.70	16.96	14.55	31.99	12.00	50.77	24.48	11.84	5.71	4.20	29.95	8.95	2.60	21.24	12.01	8.77	3.75	2.59	1.26
9	100	4	0.1016	0.021	0.0118	1	356	41.15	28.07	24.01	53.48	19.70	85.22	40.78	19.43	9.05	6.51	50.02	14.53	3.80	35.31	19.70	14.23	5.74	3.79	1.54
10	100	4	0.1016	0.021	0.0130	1	427	48.69	32.97	28.09	63.50	22.91	101.64	48.25	22.59	10.12	7.06	59.35	16.71	3.82	41.67	22.92	16.34	6.15	3.81	1.10
11	100	4	0.1016	0.021	0.0134	1	458	52.68	35.84	30.61	68.55	25.06	109.41	52.20	24.71	11.36	8.08	64.10	18.41	4.60	45.16	25.06	18.02	7.10	4.59	1.68
12	100	4	0.1016	0.021	0.0136	1	473	53.82	36.40	31.00	70.24	25.26	112.49	53.33	24.90	11.09	7.70	65.63	18.38	4.10	46.05	25.26	17.97	6.68	4.09	1.09
13	100	4	0.1016	0.021	0.0136	1	470	53.61	36.31	30.94	69.92	25.24	111.89	53.12	24.88	11.16	7.79	65.34	18.41	4.22	45.89	25.24	18.00	6.79	4.21	1.23
14	100	4	0.1016	0.021	0.0130	1	430	49.03	33.20	28.29	63.95	23.07	102.36	48.58	22.75	10.19	7.11	59.77	16.82	3.84	41.97	23.08	16.45	6.19	3.83	1.10
15	100	4	0.1016	0.021	0.0123	1	384	44.47	30.36	25.98	57.76	21.33	91.99	44.07	21.04	9.85	7.11	54.03	15.76	4.19	38.17	21.33	15.43	6.28	4.18	1.75
16	100	4	0.1016	0.021	0.0114	1	329	37.90	25.81	22.05	49.30	18.07	78.65	37.56	17.82	8.23	5.87	46.11	13.29	3.38	32.50	18.07	13.01	5.17	3.37	1.28
17	100	4	0.1016	0.021	0.0107	1	291	33.79	23.10	19.78	43.86	16.26	69.79	33.48	16.04	7.57	5.49	41.04	12.04	3.28	29.02	16.26	11.79	4.86	3.27	1.43
18	100	4	0.1016	0.021	0.0102	1	267	31.21	21.41	18.37	40.44	15.15	64.21	30.93	14.94	7.17	5.27	37.86	11.28	3.24	26.84	15.15	11.05	4.70	3.24	1.55
19	100	4	0.1016	0.021	0.0100	1	255	29.58	20.21	17.30	38.40	14.21	61.13	29.31	14.02	6.59	4.77	35.93	10.52	2.84	25.39	14.22	10.30	4.23	2.83	1.21
20	100	4	0.1016	0.021	0.0098	1	244	28.71	19.76	16.98	37.14	14.04	58.84	28.45	13.85	6.76	5.02	34.77	10.50	3.17	24.71	14.04	10.29	4.49	3.16	1.62
21	100	4	0.1016	0.021	0.0091	1	211	24.70	16.96	14.55	31.99	12.00	50.77	24.48	11.84	5.71	4.20	29.95	8.95	2.60	21.24	12.01	8.77	3.75	2.59	1.26
22	100	4	0.1016	0.021	0.0071	1	129	15.65	10.94	9.48	20.09	7.93	31.52	15.52	7.83	4.10	3.18	18.85	6.07	2.21	13.55	7.93	5.96	2.91	2.21	1.39
23	100	4	0.1016	0.021	0.0059	1	90	11.29	8.02	7.00	14.37	5.92	22.30	11.19	5.86	3.26	2.63	13.51	4.63	1.95	9.83	5.92	4.56	2.44	1.95	1.38
24	100	4	0.1016	0.021	0.0055	1	77	9.93	7.14	6.28	12.56	5.36	19.32	9.85	5.30	3.09	2.55	11.82	4.26	1.98	8.69	5.36	4.20	2.39	1.97	1.49

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	100	4	0.1016	0.021	0.0052	0	70	10.70	8.32	7.52	13.09	6.73	17.94	10.77	6.68	4.83	4.34	12.49	5.87	3.84	9.67	6.86	5.81	4.21	3.84	3.41
26	100	4	0.1016	0.021	0.0051	0	67	9.77	7.46	6.70	12.07	5.93	16.75	9.83	5.88	4.10	3.62	11.49	5.10	3.14	8.77	6.05	5.04	3.50	3.14	2.73
27	100	4	0.1016	0.021	0.0050	0	65	9.79	7.57	6.83	12.02	6.09	16.53	9.85	6.04	4.32	3.86	11.46	5.29	3.40	8.83	6.21	5.24	3.75	3.40	3.00
28	100	4	0.1016	0.021	0.0051	0	67	9.77	7.46	6.70	12.07	5.93	16.75	9.83	5.88	4.10	3.62	11.49	5.10	3.14	8.77	6.05	5.04	3.50	3.14	2.73
29	100	4	0.1016	0.021	0.0053	0	72	10.61	8.13	7.31	13.08	6.49	18.10	10.67	6.43	4.52	4.01	12.46	5.60	3.50	9.54	6.62	5.54	3.88	3.50	3.05
30	100	4	0.1016	0.021	0.0059	0	90	12.89	9.78	8.75	16.00	7.72	22.30	12.97	7.65	5.25	4.61	15.22	6.60	3.97	11.55	7.89	6.53	4.45	3.97	3.41
31	100	4	0.1016	0.021	0.0073	0	136	19.20	14.49	12.93	23.91	11.37	33.46	19.32	11.26	7.63	6.65	22.72	9.67	5.68	17.17	11.62	9.56	6.41	5.68	4.83
32	100	4	0.1016	0.021	0.0091	0	211	28.50	21.14	18.70	35.85	16.27	50.77	28.69	16.10	10.42	8.89	34.00	13.61	7.37	25.33	16.65	13.43	8.51	7.37	6.04
33	100	4	0.1016	0.021	0.0118	0	356	47.57	35.14	31.02	60.00	26.90	85.22	47.90	26.61	17.01	14.44	56.87	22.42	11.87	42.21	27.55	22.11	13.79	11.86	9.62
34	100	4	0.1016	0.021	0.0130	0	427	56.41	41.47	36.52	71.34	31.57	101.64	56.80	31.23	19.69	16.60	67.58	26.18	13.51	49.97	32.36	25.82	15.82	13.50	10.81
35	100	4	0.1016	0.021	0.0134	0	458	60.94	44.94	39.64	76.95	34.33	109.41	61.36	33.96	21.60	18.29	72.91	28.56	14.99	54.04	35.17	28.17	17.46	14.97	12.09
36	100	4	0.1016	0.021	0.0136	0	473	62.37	45.82	40.33	78.92	34.85	112.49	62.80	34.47	21.68	18.26	74.75	28.88	14.84	55.23	35.72	28.48	17.40	14.83	11.85
37	100	4	0.1016	0.021	0.0136	0	470	62.10	45.66	40.21	78.54	34.76	111.89	62.53	34.39	21.69	18.29	74.40	28.84	14.89	55.02	35.63	28.44	17.43	14.88	11.92
38	100	4	0.1016	0.021	0.0130	0	430	56.80	41.76	36.77	71.84	31.79	102.36	57.20	31.44	19.82	16.72	68.05	26.37	13.61	50.32	32.58	26.00	15.93	13.59	10.88
39	100	4	0.1016	0.021	0.0123	0	384	51.39	37.98	33.54	64.79	29.10	91.99	51.74	28.79	18.43	15.66	61.42	24.27	12.89	45.61	29.80	23.94	14.96	12.88	10.47
40	100	4	0.1016	0.021	0.0114	0	329	43.84	32.35	28.54	55.33	24.73	78.65	44.14	24.46	15.59	13.21	52.44	20.59	10.84	38.89	25.33	20.30	12.61	10.82	8.76
41	100	4	0.1016	0.021	0.0107	0	291	39.03	28.88	25.51	49.19	22.15	69.79	39.30	21.91	14.07	11.97	46.63	18.48	9.87	34.65	22.68	18.24	11.44	9.86	8.03
42	100	4	0.1016	0.021	0.0102	0	267	36.02	26.71	23.63	45.33	20.54	64.21	36.26	20.33	13.13	11.21	42.98	17.18	9.29	32.01	21.03	16.96	10.72	9.28	7.60
43	100	4	0.1016	0.021	0.0100	0	255	34.17	25.27	22.32	43.07	19.37	61.13	34.41	19.17	12.29	10.45	40.83	16.16	8.61	30.34	19.84	15.95	9.99	8.60	7.00
44	100	4	0.1016	0.021	0.0098	0	244	33.10	24.60	21.78	41.60	18.96	58.84	33.32	18.77	12.20	10.44	39.45	15.90	8.69	29.43	19.41	15.69	10.00	8.68	7.15
45	100	4	0.1016	0.021	0.0091	0	211	28.50	21.14	18.70	35.85	16.27	50.77	28.69	16.10	10.42	8.89	34.00	13.61	7.37	25.33	16.65	13.43	8.51	7.37	6.04
46	100	4	0.1016	0.021	0.0071	0	129	17.97	13.49	12.01	22.44	10.52	31.52	18.08	10.42	6.96	6.04	21.31	8.91	5.11	16.04	10.76	8.80	5.80	5.11	4.30
47	100	4	0.1016	0.021	0.0059	0	90	12.89	9.78	8.75	16.00	7.72	22.30	12.97	7.65	5.25	4.61	15.22	6.60	3.97	11.55	7.89	6.53	4.45	3.97	3.41
48	100	4	0.1016	0.021	0.0055	0	77	11.30	8.65	7.77	13.95	6.90	19.32	11.37	6.83	4.79	4.24	13.28	5.94	3.69	10.16	7.04	5.88	4.10	3.69	3.22

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	100	4	0.1016	0.021	0.0078	1	155	18.81	13.15	11.39	24.14	9.53	37.87	18.65	9.41	4.92	3.82	22.65	7.29	2.65	16.28	9.53	7.16	3.49	2.65	1.67
2	100	4	0.1016	0.021	0.0076	1	149	17.55	12.08	10.39	22.69	8.59	35.95	17.39	8.48	4.14	3.08	21.25	6.43	1.95	15.11	8.59	6.30	2.76	1.95	1.01
3	100	4	0.1016	0.021	0.0075	1	144	17.20	11.93	10.29	22.16	8.56	34.95	17.05	8.45	4.27	3.25	20.77	6.48	2.16	14.85	8.56	6.35	2.94	2.15	1.25
4	100	4	0.1016	0.021	0.0076	1	149	17.55	12.08	10.39	22.69	8.59	35.95	17.39	8.48	4.14	3.08	21.25	6.43	1.95	15.11	8.59	6.30	2.76	1.95	1.01
5	100	4	0.1016	0.021	0.0079	1	160	18.99	13.13	11.31	24.51	9.38	38.73	18.82	9.26	4.61	3.47	22.96	7.07	2.26	16.37	9.38	6.93	3.13	2.26	1.25
6	100	4	0.1016	0.021	0.0089	1	201	23.90	16.54	14.25	30.83	11.83	48.69	23.69	11.68	5.84	4.41	28.89	8.92	2.89	20.61	11.83	8.75	3.98	2.88	1.62
7	100	4	0.1016	0.021	0.0109	1	304	35.73	24.58	21.12	46.23	17.45	73.28	35.41	17.22	8.38	6.21	43.29	13.04	3.90	30.75	17.45	12.78	5.56	3.90	1.97
8	100	4	0.1016	0.021	0.0136	1	473	53.82	36.40	31.00	70.24	25.26	112.49	53.33	24.90	11.09	7.70	65.63	18.38	4.10	46.05	25.26	17.97	6.68	4.09	1.09
9	100	4	0.1016	0.021	0.0177	1	799	90.59	61.15	52.01	118.33	42.32	189.74	89.75	41.71	18.37	12.64	110.55	30.69	6.56	77.45	42.32	30.01	10.93	6.54	1.46
10	100	4	0.1016	0.021	0.0194	1	960	108.81	73.44	62.46	142.14	50.81	227.95	107.80	50.08	22.03	15.15	132.79	36.84	7.84	93.02	50.81	36.01	13.09	7.82	1.72
11	100	4	0.1016	0.021	0.0201	1	1028	116.03	78.13	66.37	151.73	53.88	243.67	114.95	53.10	23.05	15.68	141.72	38.92	7.85	99.11	53.89	38.03	13.47	7.82	1.29
12	100	4	0.1016	0.021	0.0205	1	1063	119.85	80.66	68.49	156.78	55.58	251.86	118.74	54.77	23.70	16.07	146.42	40.11	7.98	102.36	55.59	39.19	13.79	7.95	1.19
13	100	4	0.1016	0.021	0.0204	1	1056	119.13	80.20	68.11	155.81	55.29	250.26	118.02	54.49	23.61	16.04	145.52	39.91	8.00	101.75	55.29	39.01	13.77	7.97	1.26
14	100	4	0.1016	0.021	0.0195	1	967	109.82	74.20	63.15	143.39	51.41	229.80	108.81	50.68	22.43	15.50	133.98	37.35	8.15	93.92	51.42	36.52	13.43	8.12	1.98
15	100	4	0.1016	0.021	0.0184	1	862	98.05	66.30	56.45	127.96	45.99	204.98	97.15	45.34	20.16	13.99	119.57	33.46	7.43	83.88	46.00	32.72	12.14	7.41	1.94
16	100	4	0.1016	0.021	0.0170	1	739	84.03	56.82	48.37	109.68	39.40	175.71	83.26	38.84	17.26	11.97	102.49	28.66	6.35	71.89	39.41	28.02	10.38	6.32	1.63
17	100	4	0.1016	0.021	0.0160	1	653	74.27	50.22	42.76	96.93	34.84	155.28	73.59	34.34	15.27	10.59	90.58	25.34	5.63	63.54	34.84	24.78	9.19	5.61	1.46
18	100	4	0.1016	0.021	0.0153	1	599	68.48	46.43	39.59	89.25	32.33	142.73	67.85	31.87	14.39	10.10	83.43	23.62	5.55	58.64	32.33	23.11	8.82	5.53	1.73
19	100	4	0.1016	0.021	0.0150	1	573	65.79	44.72	38.18	85.65	31.23	136.79	65.20	30.80	14.09	9.98	80.09	22.91	5.63	56.39	31.24	22.42	8.76	5.62	1.98
20	100	4	0.1016	0.021	0.0147	1	547	62.59	42.46	36.21	81.55	29.58	130.39	62.02	29.16	13.20	9.29	76.24	21.63	5.13	53.60	29.58	21.16	8.11	5.11	1.64
21	100	4	0.1016	0.021	0.0136	1	473	53.82	36.40	31.00	70.24	25.26	112.49	53.33	24.90	11.09	7.70	65.63	18.38	4.10	46.05	25.26	17.97	6.68	4.09	1.09
22	100	4	0.1016	0.021	0.0106	1	289	33.97	23.37	20.09	43.96	16.59	69.67	33.67	16.38	7.97	5.91	41.16	12.41	3.72	29.24	16.60	12.16	5.29	3.71	1.89
23	100	4	0.1016	0.021	0.0089	1	201	23.90	16.54	14.25	30.83	11.83	48.69	23.69	11.68	5.84	4.41	28.89	8.92	2.89	20.61	11.83	8.75	3.98	2.88	1.62
24	100	4	0.1016	0.021	0.0082	1	171	20.10	13.83	11.88	26.00	9.81	41.22	19.92	9.68	4.71	3.49	24.35	7.34	2.20	17.30	9.81	7.19	3.13	2.19	1.11

Anexo 2. Valores de carga en nodo [m]   {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	100	4	0.1016	0.021	0.0078	0	155	21.59	16.21	14.43	26.96	12.64	37.87	21.73	12.52	8.37	7.26	25.61	10.71	6.14	19.27	12.93	10.57	6.97	6.14	5.17
26	100	4	0.1016	0.021	0.0076	0	149	20.23	15.04	13.32	25.42	11.60	35.95	20.36	11.48	7.47	6.39	24.11	9.72	5.32	17.99	11.87	9.60	6.12	5.32	4.38
27	100	4	0.1016	0.021	0.0075	0	144	19.78	14.78	13.12	24.79	11.46	34.95	19.92	11.34	7.48	6.44	23.53	9.65	5.41	17.63	11.72	9.53	6.18	5.40	4.50
28	100	4	0.1016	0.021	0.0076	0	149	20.23	15.04	13.32	25.42	11.60	35.95	20.36	11.48	7.47	6.39	24.11	9.72	5.32	17.99	11.87	9.60	6.12	5.32	4.38
29	100	4	0.1016	0.021	0.0079	0	160	21.86	16.30	14.45	27.43	12.61	38.73	22.01	12.48	8.18	7.03	26.03	10.60	5.88	19.46	12.90	10.46	6.73	5.87	4.87
30	100	4	0.1016	0.021	0.0089	0	201	27.51	20.52	18.20	34.50	15.88	48.69	27.69	15.72	10.32	8.87	32.74	13.36	7.43	24.49	16.25	13.19	8.51	7.42	6.16
31	100	4	0.1016	0.021	0.0109	0	304	41.20	30.60	27.09	51.79	23.58	73.28	41.47	23.34	15.16	12.97	49.12	19.77	10.78	36.63	24.14	19.51	12.41	10.77	8.86
32	100	4	0.1016	0.021	0.0136	0	473	62.37	45.82	40.33	78.92	34.85	112.49	62.80	34.47	21.68	18.26	74.75	28.88	14.84	55.23	35.72	28.48	17.40	14.83	11.85
33	100	4	0.1016	0.021	0.0177	0	799	105.03	77.06	67.79	133.00	58.52	189.74	105.77	57.88	36.28	30.49	125.96	48.44	24.71	92.98	60.00	47.76	29.03	24.69	19.65
34	100	4	0.1016	0.021	0.0194	0	960	126.16	92.56	81.42	159.77	70.28	227.95	127.04	69.51	43.55	36.60	151.30	58.16	29.65	111.68	72.05	57.34	34.84	29.62	23.57
35	100	4	0.1016	0.021	0.0201	0	1028	134.62	98.61	86.68	170.63	74.75	243.67	135.57	73.92	46.11	38.66	161.56	61.77	31.22	119.10	76.64	60.88	36.78	31.19	24.71
36	100	4	0.1016	0.021	0.0205	0	1063	139.08	101.84	89.50	176.32	77.16	251.86	140.06	76.30	47.54	39.84	166.94	63.74	32.15	123.03	79.12	62.82	37.89	32.11	25.41
37	100	4	0.1016	0.021	0.0204	0	1056	138.23	101.24	88.98	175.22	76.72	250.26	139.20	75.87	47.30	39.65	165.90	63.39	32.01	122.28	78.67	62.48	37.71	31.97	25.31
38	100	4	0.1016	0.021	0.0195	0	967	127.30	93.46	82.24	161.14	71.02	229.80	128.19	70.25	44.10	37.11	152.62	58.82	30.11	112.71	72.81	57.99	35.34	30.08	23.99
39	100	4	0.1016	0.021	0.0184	0	862	113.63	83.46	73.47	143.79	63.47	204.98	114.42	62.78	39.48	33.24	136.19	52.60	27.01	100.62	65.06	51.86	31.66	26.98	21.55
40	100	4	0.1016	0.021	0.0170	0	739	97.39	71.53	62.96	123.25	54.39	175.71	98.07	53.79	33.82	28.47	116.73	45.07	23.13	86.24	55.75	44.43	27.12	23.11	18.45
41	100	4	0.1016	0.021	0.0160	0	653	86.07	63.22	55.65	108.92	48.08	155.28	86.67	47.55	29.90	25.18	103.17	39.84	20.46	76.22	49.28	39.28	23.98	20.44	16.32
42	100	4	0.1016	0.021	0.0153	0	599	79.30	58.35	51.41	100.24	44.46	142.73	79.84	43.98	27.80	23.47	94.96	36.91	19.14	70.27	45.57	36.40	22.38	19.13	15.35
43	100	4	0.1016	0.021	0.0150	0	573	76.14	56.11	49.47	96.16	42.84	136.79	76.66	42.38	26.91	22.77	91.12	35.62	18.63	67.50	43.89	35.13	21.72	18.61	15.01
44	100	4	0.1016	0.021	0.0147	0	547	72.46	53.34	47.00	91.59	40.66	130.39	72.97	40.22	25.45	21.49	86.77	33.77	17.54	64.22	41.67	33.30	20.49	17.52	14.08
45	100	4	0.1016	0.021	0.0136	0	473	62.37	45.82	40.33	78.92	34.85	112.49	62.80	34.47	21.68	18.26	74.75	28.88	14.84	55.23	35.72	28.48	17.40	14.83	11.85
46	100	4	0.1016	0.021	0.0106	0	289	39.17	29.10	25.77	49.24	22.43	69.67	39.44	22.20	14.42	12.34	46.70	18.80	10.26	34.83	22.96	18.55	11.81	10.25	8.44
47	100	4	0.1016	0.021	0.0089	0	201	27.51	20.52	18.20	34.50	15.88	48.69	27.69	15.72	10.32	8.87	32.74	13.36	7.43	24.49	16.25	13.19	8.51	7.42	6.16
48	100	4	0.1016	0.021	0.0082	0	171	23.17	17.21	15.24	29.13	13.27	41.22	23.33	13.13	8.53	7.29	27.63	11.12	6.06	20.60	13.58	10.97	6.98	6.06	4.99

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	100	6	0.1524	0.019	0.0026	1	4	2.17	2.10	2.07	2.24	2.05	2.45	2.17	2.05	1.98	1.97	2.22	2.01	1.95	2.14	2.04	2.01	1.96	1.95	1.94
2	100	6	0.1524	0.019	0.0025	1	3	1.24	1.16	1.14	1.30	1.11	1.50	1.23	1.11	1.05	1.04	1.28	1.08	1.02	1.20	1.11	1.08	1.03	1.02	1.01
3	100	6	0.1524	0.019	0.0025	1	3	1.30	1.23	1.21	1.36	1.18	1.56	1.29	1.18	1.12	1.11	1.34	1.15	1.09	1.27	1.18	1.15	1.10	1.09	1.08
4	100	6	0.1524	0.019	0.0025	1	3	1.24	1.16	1.14	1.30	1.11	1.50	1.23	1.11	1.05	1.04	1.28	1.08	1.02	1.20	1.11	1.08	1.03	1.02	1.01
5	100	6	0.1524	0.019	0.0026	1	4	2.11	2.03	2.00	2.18	1.98	2.39	2.10	1.98	1.91	1.90	2.16	1.94	1.88	2.07	1.98	1.94	1.89	1.88	1.87
6	100	6	0.1524	0.019	0.0030	1	4	1.62	1.52	1.49	1.72	1.46	1.98	1.62	1.46	1.38	1.36	1.69	1.42	1.34	1.58	1.46	1.42	1.35	1.34	1.32
7	100	6	0.1524	0.019	0.0036	1	6	2.40	2.25	2.20	2.54	2.15	2.95	2.39	2.15	2.03	2.00	2.50	2.09	1.97	2.33	2.15	2.09	1.99	1.97	1.94
8	100	6	0.1524	0.019	0.0045	1	8	2.38	2.14	2.07	2.59	1.99	3.23	2.36	1.98	1.79	1.75	2.53	1.89	1.70	2.27	1.98	1.88	1.73	1.70	1.66
9	100	6	0.1524	0.019	0.0059	1	12	2.50	2.09	1.97	2.86	1.84	3.93	2.47	1.83	1.51	1.43	2.75	1.67	1.35	2.31	1.83	1.67	1.41	1.35	1.28
10	100	6	0.1524	0.019	0.0065	1	14	2.58	2.10	1.95	3.02	1.79	4.31	2.55	1.78	1.40	1.30	2.89	1.59	1.21	2.36	1.78	1.58	1.28	1.20	1.12
11	100	6	0.1524	0.019	0.0067	1	15	2.76	2.25	2.09	3.24	1.92	4.62	2.73	1.91	1.50	1.40	3.09	1.71	1.29	2.53	1.91	1.70	1.37	1.29	1.20
12	100	6	0.1524	0.019	0.0068	1	16	3.35	2.81	2.65	3.83	2.48	5.26	3.31	2.47	2.03	1.93	3.69	2.25	1.82	3.10	2.46	2.24	1.90	1.82	1.73
13	100	6	0.1524	0.019	0.0068	1	16	3.43	2.90	2.74	3.91	2.57	5.33	3.40	2.56	2.13	2.03	3.77	2.34	1.92	3.19	2.55	2.33	1.99	1.92	1.83
14	100	6	0.1524	0.019	0.0065	1	14	2.50	2.01	1.87	2.94	1.71	4.24	2.47	1.70	1.31	1.22	2.81	1.51	1.12	2.28	1.69	1.49	1.19	1.11	1.03
15	100	6	0.1524	0.019	0.0061	1	13	2.75	2.32	2.19	3.14	2.05	4.30	2.72	2.04	1.69	1.61	3.03	1.86	1.52	2.55	2.03	1.85	1.58	1.52	1.44
16	100	6	0.1524	0.019	0.0057	1	11	2.21	1.84	1.73	2.55	1.61	3.54	2.19	1.60	1.30	1.23	2.45	1.45	1.15	2.04	1.60	1.44	1.21	1.15	1.09
17	100	6	0.1524	0.019	0.0053	1	10	2.24	1.91	1.81	2.53	1.70	3.41	2.22	1.69	1.43	1.37	2.44	1.56	1.30	2.09	1.69	1.56	1.35	1.30	1.25
18	100	6	0.1524	0.019	0.0051	1	10	2.88	2.58	2.49	3.16	2.39	3.96	2.86	2.39	2.14	2.09	3.07	2.27	2.03	2.75	2.38	2.26	2.07	2.03	1.97
19	100	6	0.1524	0.019	0.0050	1	9	2.20	1.91	1.82	2.46	1.73	3.23	2.18	1.72	1.49	1.44	2.38	1.61	1.38	2.06	1.72	1.60	1.42	1.38	1.33
20	100	6	0.1524	0.019	0.0049	1	9	2.50	2.23	2.14	2.75	2.05	3.48	2.48	2.05	1.83	1.78	2.68	1.94	1.72	2.38	2.04	1.93	1.76	1.72	1.67
21	100	6	0.1524	0.019	0.0045	1	8	2.38	2.14	2.07	2.59	1.99	3.23	2.36	1.98	1.79	1.75	2.53	1.89	1.70	2.27	1.98	1.88	1.73	1.70	1.66
22	100	6	0.1524	0.019	0.0035	1	5	1.58	1.43	1.39	1.71	1.34	2.10	1.57	1.34	1.22	1.20	1.67	1.28	1.17	1.51	1.34	1.28	1.19	1.17	1.14
23	100	6	0.1524	0.019	0.0030	1	4	1.62	1.52	1.49	1.72	1.46	1.98	1.62	1.46	1.38	1.36	1.69	1.42	1.34	1.58	1.46	1.42	1.35	1.34	1.32
24	100	6	0.1524	0.019	0.0027	1	4	1.98	1.89	1.86	2.05	1.84	2.28	1.97	1.83	1.77	1.75	2.03	1.80	1.73	1.94	1.83	1.80	1.74	1.73	1.72

Anexo 2. Valores de carga en nodo [m]   {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	100	6	0.1524	0.019	0.0026	0	4	2.23	2.16	2.14	2.30	2.12	2.45	2.24	2.11	2.06	2.04	2.29	2.09	2.03	2.20	2.12	2.09	2.04	2.03	2.02
26	100	6	0.1524	0.019	0.0025	0	3	1.30	1.23	1.20	1.36	1.18	1.50	1.30	1.18	1.13	1.11	1.35	1.16	1.10	1.27	1.18	1.15	1.11	1.10	1.09
27	100	6	0.1524	0.019	0.0025	0	3	1.36	1.29	1.27	1.42	1.25	1.56	1.36	1.24	1.19	1.18	1.41	1.22	1.17	1.33	1.25	1.22	1.18	1.17	1.15
28	100	6	0.1524	0.019	0.0025	0	3	1.30	1.23	1.20	1.36	1.18	1.50	1.30	1.18	1.13	1.11	1.35	1.16	1.10	1.27	1.18	1.15	1.11	1.10	1.09
29	100	6	0.1524	0.019	0.0026	0	4	2.17	2.10	2.07	2.25	2.05	2.39	2.17	2.05	1.99	1.97	2.23	2.02	1.96	2.14	2.05	2.02	1.97	1.96	1.95
30	100	6	0.1524	0.019	0.0030	0	4	1.70	1.61	1.58	1.80	1.55	1.98	1.71	1.55	1.48	1.46	1.77	1.52	1.44	1.66	1.55	1.51	1.45	1.44	1.42
31	100	6	0.1524	0.019	0.0036	0	6	2.52	2.38	2.33	2.66	2.29	2.95	2.52	2.28	2.18	2.15	2.63	2.24	2.12	2.46	2.30	2.23	2.14	2.12	2.09
32	100	6	0.1524	0.019	0.0045	0	8	2.56	2.34	2.27	2.78	2.20	3.23	2.57	2.19	2.03	1.98	2.73	2.12	1.93	2.47	2.21	2.12	1.97	1.93	1.90
33	100	6	0.1524	0.019	0.0059	0	12	2.81	2.44	2.32	3.18	2.20	3.93	2.82	2.19	1.90	1.83	3.09	2.06	1.75	2.65	2.22	2.05	1.81	1.75	1.68
34	100	6	0.1524	0.019	0.0065	0	14	2.96	2.52	2.37	3.41	2.22	4.31	2.97	2.21	1.87	1.78	3.29	2.06	1.68	2.77	2.24	2.05	1.75	1.68	1.60
35	100	6	0.1524	0.019	0.0067	0	15	3.17	2.70	2.54	3.65	2.38	4.62	3.19	2.37	2.00	1.90	3.53	2.21	1.80	2.97	2.41	2.20	1.88	1.80	1.72
36	100	6	0.1524	0.019	0.0068	0	16	3.77	3.28	3.11	4.26	2.95	5.26	3.78	2.94	2.56	2.46	4.14	2.77	2.35	3.56	2.98	2.76	2.43	2.35	2.26
37	100	6	0.1524	0.019	0.0068	0	16	3.85	3.36	3.20	4.34	3.04	5.33	3.86	3.02	2.65	2.55	4.22	2.86	2.44	3.64	3.06	2.85	2.52	2.44	2.36
38	100	6	0.1524	0.019	0.0065	0	14	2.88	2.44	2.29	3.33	2.14	4.24	2.90	2.13	1.78	1.69	3.22	1.98	1.60	2.69	2.16	1.97	1.67	1.60	1.52
39	100	6	0.1524	0.019	0.0061	0	13	3.09	2.69	2.56	3.49	2.43	4.30	3.10	2.42	2.11	2.03	3.39	2.28	1.95	2.92	2.45	2.27	2.01	1.95	1.87
40	100	6	0.1524	0.019	0.0057	0	11	2.51	2.16	2.05	2.85	1.94	3.54	2.52	1.93	1.66	1.59	2.76	1.81	1.52	2.36	1.95	1.81	1.58	1.52	1.46
41	100	6	0.1524	0.019	0.0053	0	10	2.49	2.19	2.09	2.80	1.99	3.41	2.50	1.98	1.75	1.69	2.72	1.88	1.63	2.36	2.01	1.88	1.67	1.63	1.57
42	100	6	0.1524	0.019	0.0051	0	10	3.12	2.84	2.75	3.40	2.66	3.96	3.13	2.65	2.44	2.38	3.33	2.56	2.32	3.00	2.67	2.55	2.37	2.32	2.27
43	100	6	0.1524	0.019	0.0050	0	9	2.42	2.16	2.07	2.69	1.98	3.23	2.43	1.98	1.77	1.72	2.62	1.89	1.66	2.31	2.00	1.88	1.70	1.66	1.61
44	100	6	0.1524	0.019	0.0049	0	9	2.72	2.46	2.38	2.97	2.30	3.48	2.72	2.29	2.10	2.04	2.91	2.21	1.99	2.61	2.31	2.20	2.03	1.99	1.95
45	100	6	0.1524	0.019	0.0045	0	8	2.56	2.34	2.27	2.78	2.20	3.23	2.57	2.19	2.03	1.98	2.73	2.12	1.93	2.47	2.21	2.12	1.97	1.93	1.90
46	100	6	0.1524	0.019	0.0035	0	5	1.69	1.56	1.52	1.83	1.47	2.10	1.70	1.47	1.36	1.34	1.79	1.42	1.31	1.64	1.48	1.42	1.33	1.31	1.29
47	100	6	0.1524	0.019	0.0030	0	4	1.70	1.61	1.58	1.80	1.55	1.98	1.71	1.55	1.48	1.46	1.77	1.52	1.44	1.66	1.55	1.51	1.45	1.44	1.42
48	100	6	0.1524	0.019	0.0027	0	4	2.04	1.96	1.94	2.12	1.91	2.28	2.05	1.91	1.85	1.83	2.10	1.88	1.82	2.01	1.92	1.88	1.83	1.82	1.80

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	100	6	0.1524	0.019	0.0052	1	10	2.69	2.38	2.29	2.97	2.19	3.80	2.67	2.18	1.93	1.88	2.89	2.06	1.81	2.55	2.18	2.05	1.86	1.81	1.76
2	100	6	0.1524	0.019	0.0051	1	9	1.95	1.65	1.56	2.22	1.46	3.01	1.93	1.45	1.21	1.16	2.14	1.34	1.10	1.81	1.45	1.33	1.14	1.10	1.05
3	100	6	0.1524	0.019	0.0050	1	9	2.20	1.91	1.82	2.46	1.73	3.23	2.18	1.72	1.49	1.44	2.38	1.61	1.38	2.06	1.72	1.60	1.42	1.38	1.33
4	100	6	0.1524	0.019	0.0051	1	9	1.95	1.65	1.56	2.22	1.46	3.01	1.93	1.45	1.21	1.16	2.14	1.34	1.10	1.81	1.45	1.33	1.14	1.10	1.05
5	100	6	0.1524	0.019	0.0053	1	10	2.43	2.11	2.02	2.72	1.91	3.58	2.41	1.91	1.65	1.59	2.64	1.78	1.52	2.29	1.90	1.77	1.57	1.52	1.47
6	100	6	0.1524	0.019	0.0059	1	12	2.50	2.09	1.97	2.86	1.84	3.93	2.47	1.83	1.51	1.43	2.75	1.67	1.35	2.31	1.83	1.67	1.41	1.35	1.28
7	100	6	0.1524	0.019	0.0073	1	18	3.60	2.99	2.81	4.16	2.61	5.78	3.57	2.60	2.11	2.00	3.99	2.36	1.87	3.33	2.59	2.34	1.96	1.87	1.77
8	100	6	0.1524	0.019	0.0091	1	27	4.51	3.55	3.27	5.37	2.96	7.91	4.45	2.94	2.17	1.99	5.11	2.56	1.80	4.07	2.93	2.54	1.93	1.80	1.64
9	100	6	0.1524	0.019	0.0118	1	44	5.98	4.37	3.89	7.44	3.37	11.74	5.88	3.34	2.04	1.74	7.01	2.70	1.41	5.25	3.32	2.66	1.64	1.40	1.13
10	100	6	0.1524	0.019	0.0130	1	53	7.32	5.39	4.81	9.08	4.18	14.24	7.20	4.14	2.58	2.22	8.55	3.37	1.82	6.44	4.12	3.33	2.10	1.82	1.49
11	100	6	0.1524	0.019	0.0134	1	57	8.06	5.99	5.37	9.94	4.69	15.47	7.93	4.65	2.98	2.59	9.38	3.83	2.17	7.12	4.62	3.78	2.47	2.16	1.82
12	100	6	0.1524	0.019	0.0136	1	59	8.39	6.24	5.61	10.33	4.90	16.05	8.25	4.86	3.13	2.73	9.75	4.01	2.29	7.41	4.83	3.96	2.60	2.29	1.93
13	100	6	0.1524	0.019	0.0136	1	58	7.72	5.59	4.96	9.66	4.26	15.33	7.59	4.22	2.51	2.11	9.08	3.38	1.67	6.75	4.19	3.33	1.98	1.67	1.31
14	100	6	0.1524	0.019	0.0130	1	53	7.00	5.05	4.47	8.77	3.83	13.96	6.88	3.80	2.23	1.86	8.24	3.02	1.46	6.11	3.77	2.98	1.74	1.46	1.13
15	100	6	0.1524	0.019	0.0123	1	48	7.00	5.27	4.75	8.58	4.18	13.21	6.90	4.15	2.75	2.42	8.11	3.46	2.07	6.21	4.13	3.42	2.32	2.06	1.77
16	100	6	0.1524	0.019	0.0114	1	41	5.85	4.36	3.92	7.20	3.43	11.17	5.76	3.40	2.20	1.93	6.80	2.81	1.62	5.17	3.38	2.78	1.83	1.62	1.37
17	100	6	0.1524	0.019	0.0107	1	37	5.94	4.63	4.24	7.14	3.80	10.64	5.86	3.78	2.72	2.47	6.78	3.26	2.20	5.34	3.76	3.23	2.39	2.20	1.98
18	100	6	0.1524	0.019	0.0102	1	34	5.53	4.32	3.97	6.62	3.57	9.84	5.46	3.55	2.58	2.35	6.30	3.07	2.10	4.98	3.53	3.04	2.28	2.10	1.90
19	100	6	0.1524	0.019	0.0100	1	32	4.78	3.63	3.29	5.83	2.91	8.90	4.71	2.89	1.96	1.74	5.51	2.43	1.50	4.26	2.87	2.40	1.67	1.50	1.31
20	100	6	0.1524	0.019	0.0098	1	31	5.00	3.90	3.58	6.00	3.21	8.94	4.94	3.19	2.31	2.10	5.70	2.76	1.87	4.50	3.18	2.73	2.03	1.87	1.69
21	100	6	0.1524	0.019	0.0091	1	27	4.51	3.55	3.27	5.37	2.96	7.91	4.45	2.94	2.17	1.99	5.11	2.56	1.80	4.07	2.93	2.54	1.93	1.80	1.64
22	100	6	0.1524	0.019	0.0071	1	17	3.31	2.73	2.56	3.84	2.37	5.39	3.28	2.36	1.89	1.79	3.68	2.13	1.67	3.05	2.35	2.12	1.75	1.67	1.57
23	100	6	0.1524	0.019	0.0059	1	12	2.50	2.09	1.97	2.86	1.84	3.93	2.47	1.83	1.51	1.43	2.75	1.67	1.35	2.31	1.83	1.67	1.41	1.35	1.28
24	100	6	0.1524	0.019	0.0055	1	11	2.90	2.56	2.46	3.21	2.34	4.13	2.88	2.34	2.06	2.00	3.12	2.20	1.93	2.75	2.33	2.19	1.98	1.93	1.87

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	100	6	0.1524	0.019	0.0052	0	10	2.94	2.65	2.56	3.22	2.46	3.80	2.94	2.46	2.24	2.18	3.15	2.36	2.12	2.81	2.48	2.35	2.16	2.12	2.07
26	100	6	0.1524	0.019	0.0051	0	9	2.18	1.91	1.82	2.46	1.72	3.01	2.19	1.72	1.51	1.45	2.39	1.62	1.39	2.06	1.74	1.62	1.43	1.39	1.34
27	100	6	0.1524	0.019	0.0050	0	9	2.42	2.16	2.07	2.69	1.98	3.23	2.43	1.98	1.77	1.72	2.62	1.89	1.66	2.31	2.00	1.88	1.70	1.66	1.61
28	100	6	0.1524	0.019	0.0051	0	9	2.18	1.91	1.82	2.46	1.72	3.01	2.19	1.72	1.51	1.45	2.39	1.62	1.39	2.06	1.74	1.62	1.43	1.39	1.34
29	100	6	0.1524	0.019	0.0053	0	10	2.69	2.39	2.29	2.98	2.19	3.58	2.69	2.19	1.96	1.90	2.91	2.09	1.84	2.56	2.21	2.08	1.88	1.84	1.79
30	100	6	0.1524	0.019	0.0059	0	12	2.81	2.44	2.32	3.18	2.20	3.93	2.82	2.19	1.90	1.83	3.09	2.06	1.75	2.65	2.22	2.05	1.81	1.75	1.68
31	100	6	0.1524	0.019	0.0073	0	18	4.08	3.52	3.34	4.64	3.15	5.78	4.10	3.14	2.70	2.59	4.50	2.95	2.47	3.84	3.18	2.93	2.56	2.47	2.37
32	100	6	0.1524	0.019	0.0091	0	27	5.26	4.38	4.09	6.13	3.80	7.91	5.28	3.78	3.10	2.92	5.91	3.48	2.74	4.88	3.84	3.46	2.87	2.74	2.58
33	100	6	0.1524	0.019	0.0118	0	44	7.25	5.77	5.28	8.73	4.79	11.74	7.29	4.76	3.61	3.30	8.36	4.26	3.00	6.61	4.87	4.22	3.23	3.00	2.73
34	100	6	0.1524	0.019	0.0130	0	53	8.85	7.07	6.48	10.62	5.89	14.24	8.89	5.85	4.47	4.10	10.18	5.24	3.73	8.08	5.98	5.20	4.01	3.73	3.41
35	100	6	0.1524	0.019	0.0134	0	57	9.69	7.79	7.15	11.60	6.52	15.47	9.74	6.48	5.01	4.61	11.12	5.83	4.22	8.87	6.62	5.79	4.51	4.22	3.87
36	100	6	0.1524	0.019	0.0136	0	59	10.08	8.10	7.45	12.05	6.80	16.05	10.13	6.75	5.23	4.82	11.55	6.09	4.41	9.23	6.90	6.04	4.72	4.41	4.06
37	100	6	0.1524	0.019	0.0136	0	58	9.40	7.44	6.79	11.36	6.14	15.33	9.45	6.10	4.59	4.18	10.87	5.44	3.78	8.56	6.25	5.39	4.08	3.77	3.42
38	100	6	0.1524	0.019	0.0130	0	53	8.53	6.74	6.15	10.33	5.55	13.96	8.58	5.51	4.13	3.76	9.88	4.91	3.39	7.76	5.65	4.86	3.66	3.39	3.06
39	100	6	0.1524	0.019	0.0123	0	48	8.37	6.77	6.24	9.97	5.71	13.21	8.41	5.68	4.44	4.11	9.57	5.14	3.78	7.68	5.80	5.10	4.03	3.78	3.50
40	100	6	0.1524	0.019	0.0114	0	41	7.02	5.66	5.20	8.39	4.75	11.17	7.06	4.72	3.66	3.38	8.05	4.25	3.09	6.43	4.82	4.22	3.30	3.09	2.84
41	100	6	0.1524	0.019	0.0107	0	37	6.98	5.77	5.37	8.19	4.97	10.64	7.01	4.94	4.00	3.75	7.88	4.53	3.50	6.46	5.03	4.50	3.69	3.50	3.29
42	100	6	0.1524	0.019	0.0102	0	34	6.48	5.37	5.00	7.59	4.64	9.84	6.51	4.61	3.75	3.52	7.31	4.24	3.29	6.00	4.69	4.21	3.47	3.29	3.09
43	100	6	0.1524	0.019	0.0100	0	32	5.69	4.63	4.28	6.75	3.93	8.90	5.72	3.90	3.08	2.86	6.48	3.54	2.64	5.23	3.98	3.52	2.81	2.64	2.45
44	100	6	0.1524	0.019	0.0098	0	31	5.87	4.86	4.52	6.88	4.19	8.94	5.90	4.16	3.38	3.17	6.63	3.82	2.96	5.44	4.24	3.80	3.12	2.96	2.78
45	100	6	0.1524	0.019	0.0091	0	27	5.26	4.38	4.09	6.13	3.80	7.91	5.28	3.78	3.10	2.92	5.91	3.48	2.74	4.88	3.84	3.46	2.87	2.74	2.58
46	100	6	0.1524	0.019	0.0071	0	17	3.77	3.24	3.06	4.30	2.88	5.39	3.78	2.87	2.46	2.35	4.17	2.69	2.24	3.54	2.91	2.68	2.32	2.24	2.14
47	100	6	0.1524	0.019	0.0059	0	12	2.81	2.44	2.32	3.18	2.20	3.93	2.82	2.19	1.90	1.83	3.09	2.06	1.75	2.65	2.22	2.05	1.81	1.75	1.68
48	100	6	0.1524	0.019	0.0055	0	11	3.17	2.86	2.75	3.49	2.65	4.13	3.18	2.64	2.40	2.33	3.41	2.53	2.27	3.04	2.66	2.53	2.31	2.27	2.21

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	100	6	0.1524	0.019	0.0078	1	20	3.56	2.86	2.65	4.19	2.42	6.04	3.51	2.41	1.85	1.72	4.00	2.13	1.58	3.24	2.40	2.12	1.68	1.57	1.46
2	100	6	0.1524	0.019	0.0076	1	19	3.13	2.46	2.26	3.74	2.03	5.53	3.09	2.02	1.48	1.35	3.56	1.76	1.22	2.82	2.01	1.74	1.31	1.22	1.10
3	100	6	0.1524	0.019	0.0075	1	19	3.69	3.04	2.85	4.28	2.64	6.01	3.65	2.62	2.10	1.98	4.10	2.37	1.85	3.39	2.61	2.35	1.94	1.85	1.74
4	100	6	0.1524	0.019	0.0076	1	19	3.13	2.46	2.26	3.74	2.03	5.53	3.09	2.02	1.48	1.35	3.56	1.76	1.22	2.82	2.01	1.74	1.31	1.22	1.10
5	100	6	0.1524	0.019	0.0079	1	21	3.97	3.25	3.04	4.63	2.80	6.55	3.93	2.79	2.21	2.07	4.43	2.50	1.92	3.65	2.78	2.49	2.03	1.92	1.80
6	100	6	0.1524	0.019	0.0089	1	26	4.62	3.71	3.44	5.44	3.14	7.85	4.56	3.13	2.40	2.23	5.19	2.77	2.04	4.20	3.11	2.75	2.17	2.04	1.89
7	100	6	0.1524	0.019	0.0109	1	38	5.61	4.24	3.83	6.85	3.38	10.51	5.52	3.35	2.25	1.99	6.48	2.81	1.71	4.98	3.33	2.78	1.90	1.71	1.48
8	100	6	0.1524	0.019	0.0136	1	59	8.39	6.24	5.61	10.33	4.90	16.05	8.25	4.86	3.13	2.73	9.75	4.01	2.29	7.41	4.83	3.96	2.60	2.29	1.93
9	100	6	0.1524	0.019	0.0177	1	98	12.46	8.84	7.76	15.75	6.57	25.41	12.24	6.50	3.59	2.91	14.77	5.07	2.16	10.81	6.46	4.99	2.69	2.16	1.55
10	100	6	0.1524	0.019	0.0194	1	117	14.22	9.87	8.58	18.17	7.15	29.78	13.96	7.06	3.56	2.74	16.99	5.34	1.85	12.24	7.01	5.24	2.48	1.84	1.11
11	100	6	0.1524	0.019	0.0201	1	126	15.88	11.22	9.83	20.12	8.30	32.55	15.60	8.21	4.46	3.58	18.85	6.37	2.62	13.76	8.16	6.26	3.30	2.62	1.84
12	100	6	0.1524	0.019	0.0205	1	130	16.12	11.30	9.86	20.50	8.28	33.36	15.82	8.19	4.30	3.40	19.19	6.28	2.41	13.92	8.13	6.17	3.10	2.40	1.59
13	100	6	0.1524	0.019	0.0204	1	129	15.88	11.09	9.66	20.23	8.09	33.00	15.58	8.00	4.14	3.24	18.92	6.10	2.25	13.70	7.94	5.99	2.95	2.25	1.45
14	100	6	0.1524	0.019	0.0195	1	118	14.50	10.12	8.81	18.48	7.38	30.17	14.23	7.29	3.76	2.94	17.29	5.55	2.04	12.50	7.24	5.45	2.67	2.03	1.30
15	100	6	0.1524	0.019	0.0184	1	106	13.76	9.85	8.69	17.30	7.41	27.72	13.52	7.33	4.19	3.45	16.24	5.78	2.65	11.98	7.28	5.69	3.21	2.65	1.99
16	100	6	0.1524	0.019	0.0170	1	91	11.92	8.57	7.57	14.96	6.47	23.89	11.71	6.41	3.71	3.08	14.05	5.08	2.39	10.39	6.37	5.00	2.88	2.39	1.83
17	100	6	0.1524	0.019	0.0160	1	80	10.12	7.16	6.28	12.81	5.31	20.70	9.94	5.25	2.87	2.32	12.00	4.08	1.71	8.77	5.22	4.01	2.13	1.70	1.21
18	100	6	0.1524	0.019	0.0153	1	74	9.94	7.23	6.42	12.40	5.53	19.64	9.78	5.48	3.30	2.79	11.67	4.40	2.23	8.71	5.45	4.34	2.62	2.23	1.77
19	100	6	0.1524	0.019	0.0150	1	71	9.76	7.16	6.39	12.11	5.54	19.03	9.60	5.49	3.40	2.92	11.41	4.46	2.38	8.58	5.46	4.40	2.76	2.38	1.95
20	100	6	0.1524	0.019	0.0147	1	67	8.51	6.03	5.30	10.76	4.48	17.36	8.36	4.44	2.44	1.98	10.08	3.45	1.47	7.38	4.40	3.40	1.82	1.46	1.05
21	100	6	0.1524	0.019	0.0136	1	59	8.39	6.24	5.61	10.33	4.90	16.05	8.25	4.86	3.13	2.73	9.75	4.01	2.29	7.41	4.83	3.96	2.60	2.29	1.93
22	100	6	0.1524	0.019	0.0106	1	36	5.21	3.90	3.51	6.39	3.09	9.87	5.13	3.06	2.01	1.77	6.04	2.54	1.50	4.61	3.05	2.52	1.69	1.50	1.28
23	100	6	0.1524	0.019	0.0089	1	26	4.62	3.71	3.44	5.44	3.14	7.85	4.56	3.13	2.40	2.23	5.19	2.77	2.04	4.20	3.11	2.75	2.17	2.04	1.89
24	100	6	0.1524	0.019	0.0082	1	22	3.78	3.01	2.78	4.48	2.52	6.54	3.73	2.51	1.89	1.74	4.27	2.20	1.58	3.43	2.50	2.19	1.70	1.58	1.45

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	100	6	0.1524	0.019	0.0078	0	20	4.10	3.46	3.25	4.74	3.04	6.04	4.12	3.02	2.53	2.40	4.58	2.81	2.26	3.83	3.07	2.79	2.36	2.26	2.15
26	100	6	0.1524	0.019	0.0076	0	19	3.66	3.04	2.83	4.28	2.63	5.53	3.67	2.61	2.14	2.01	4.12	2.41	1.88	3.39	2.66	2.39	1.98	1.88	1.77
27	100	6	0.1524	0.019	0.0075	0	19	4.20	3.60	3.41	4.80	3.21	6.01	4.22	3.19	2.73	2.61	4.65	2.99	2.49	3.94	3.24	2.98	2.58	2.49	2.38
28	100	6	0.1524	0.019	0.0076	0	19	3.66	3.04	2.83	4.28	2.63	5.53	3.67	2.61	2.14	2.01	4.12	2.41	1.88	3.39	2.66	2.39	1.98	1.88	1.77
29	100	6	0.1524	0.019	0.0079	0	21	4.54	3.88	3.66	5.21	3.44	6.55	4.56	3.42	2.91	2.77	5.04	3.20	2.64	4.26	3.47	3.18	2.74	2.64	2.52
30	100	6	0.1524	0.019	0.0089	0	26	5.33	4.50	4.22	6.16	3.94	7.85	5.35	3.92	3.28	3.11	5.95	3.64	2.94	4.97	3.99	3.62	3.07	2.94	2.79
31	100	6	0.1524	0.019	0.0109	0	38	6.69	5.43	5.01	7.95	4.59	10.51	6.72	4.56	3.59	3.32	7.63	4.13	3.06	6.14	4.66	4.10	3.26	3.06	2.84
32	100	6	0.1524	0.019	0.0136	0	59	10.08	8.10	7.45	12.05	6.80	16.05	10.13	6.75	5.23	4.82	11.55	6.09	4.41	9.23	6.90	6.04	4.72	4.41	4.06
33	100	6	0.1524	0.019	0.0177	0	98	15.32	11.98	10.88	18.65	9.78	25.41	15.40	9.70	7.12	6.44	17.81	8.57	5.75	13.88	9.95	8.49	6.26	5.74	5.14
34	100	6	0.1524	0.019	0.0194	0	117	17.65	13.65	12.32	21.66	10.99	29.78	17.76	10.90	7.81	6.98	20.65	9.55	6.15	15.93	11.20	9.45	6.77	6.15	5.43
35	100	6	0.1524	0.019	0.0201	0	126	19.56	15.27	13.85	23.85	12.42	32.55	19.67	12.33	9.01	8.12	22.77	10.88	7.24	17.71	12.65	10.77	7.90	7.23	6.46
36	100	6	0.1524	0.019	0.0205	0	130	19.92	15.48	14.01	24.36	12.54	33.36	20.04	12.44	9.01	8.10	23.24	10.94	7.18	18.01	12.78	10.83	7.86	7.17	6.38
37	100	6	0.1524	0.019	0.0204	0	129	19.65	15.24	13.78	24.06	12.32	33.00	19.77	12.22	8.82	7.91	22.95	10.73	7.00	17.75	12.56	10.63	7.68	6.99	6.20
38	100	6	0.1524	0.019	0.0195	0	118	17.95	13.92	12.58	21.99	11.25	30.17	18.06	11.16	8.04	7.21	20.97	9.79	6.37	16.22	11.46	9.70	7.00	6.37	5.64
39	100	6	0.1524	0.019	0.0184	0	106	16.83	13.24	12.05	20.43	10.86	27.72	16.93	10.78	8.00	7.26	19.52	9.56	6.51	15.29	11.05	9.47	7.07	6.51	5.86
40	100	6	0.1524	0.019	0.0170	0	91	14.55	11.47	10.45	17.64	9.43	23.89	14.64	9.36	6.98	6.34	16.86	8.32	5.71	13.23	9.59	8.25	6.18	5.70	5.15
41	100	6	0.1524	0.019	0.0160	0	80	12.45	9.73	8.83	15.18	7.93	20.70	12.52	7.86	5.76	5.20	14.49	6.94	4.64	11.28	8.07	6.88	5.06	4.63	4.14
42	100	6	0.1524	0.019	0.0153	0	74	12.08	9.58	8.76	14.58	7.93	19.64	12.14	7.87	5.94	5.43	13.95	7.03	4.91	11.00	8.06	6.97	5.30	4.91	4.46
43	100	6	0.1524	0.019	0.0150	0	71	11.80	9.41	8.62	14.19	7.83	19.03	11.86	7.78	5.94	5.44	13.59	6.97	4.95	10.77	7.96	6.91	5.32	4.95	4.52
44	100	6	0.1524	0.019	0.0147	0	67	10.46	8.18	7.43	12.74	6.67	17.36	10.52	6.62	4.86	4.39	12.17	5.85	3.92	9.48	6.79	5.79	4.27	3.92	3.51
45	100	6	0.1524	0.019	0.0136	0	59	10.08	8.10	7.45	12.05	6.80	16.05	10.13	6.75	5.23	4.82	11.55	6.09	4.41	9.23	6.90	6.04	4.72	4.41	4.06
46	100	6	0.1524	0.019	0.0106	0	36	6.23	5.03	4.64	7.43	4.24	9.87	6.27	4.21	3.28	3.04	7.13	3.81	2.79	5.72	4.30	3.78	2.97	2.79	2.57
47	100	6	0.1524	0.019	0.0089	0	26	5.33	4.50	4.22	6.16	3.94	7.85	5.35	3.92	3.28	3.11	5.95	3.64	2.94	4.97	3.99	3.62	3.07	2.94	2.79
48	100	6	0.1524	0.019	0.0082	0	22	4.39	3.68	3.44	5.10	3.21	6.54	4.41	3.19	2.64	2.50	4.92	2.95	2.35	4.08	3.24	2.93	2.46	2.35	2.22

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	100	8	0.2032	0.0165	0.0026	1	2	1.62	1.60	1.60	1.63	1.59	1.68	1.62	1.59	1.58	1.57	1.63	1.58	1.57	1.61	1.59	1.58	1.57	1.57	1.57
2	100	8	0.2032	0.0165	0.0025	1	2	1.63	1.61	1.61	1.64	1.60	1.69	1.63	1.60	1.59	1.59	1.64	1.60	1.58	1.62	1.60	1.60	1.59	1.58	1.58
3	100	8	0.2032	0.0165	0.0025	1	2	1.64	1.63	1.62	1.66	1.62	1.70	1.64	1.62	1.61	1.60	1.65	1.61	1.60	1.64	1.62	1.61	1.60	1.60	1.60
4	100	8	0.2032	0.0165	0.0025	1	2	1.63	1.61	1.61	1.64	1.60	1.69	1.63	1.60	1.59	1.59	1.64	1.60	1.58	1.62	1.60	1.60	1.59	1.58	1.58
5	100	8	0.2032	0.0165	0.0026	1	2	1.60	1.59	1.58	1.62	1.58	1.67	1.60	1.58	1.56	1.56	1.61	1.57	1.55	1.60	1.57	1.57	1.56	1.55	1.55
6	100	8	0.2032	0.0165	0.0030	1	2	1.50	1.48	1.47	1.52	1.47	1.58	1.50	1.47	1.45	1.44	1.51	1.46	1.44	1.49	1.47	1.46	1.44	1.44	1.44
7	100	8	0.2032	0.0165	0.0036	1	2	1.25	1.21	1.20	1.27	1.19	1.37	1.24	1.19	1.16	1.16	1.26	1.18	1.15	1.23	1.19	1.18	1.16	1.15	1.15
8	100	8	0.2032	0.0165	0.0045	1	3	1.82	1.77	1.75	1.86	1.74	2.02	1.82	1.74	1.70	1.69	1.85	1.72	1.68	1.80	1.73	1.71	1.68	1.68	1.67
9	100	8	0.2032	0.0165	0.0059	1	4	2.01	1.92	1.90	2.08	1.87	2.34	2.00	1.87	1.79	1.78	2.06	1.83	1.76	1.97	1.86	1.83	1.77	1.76	1.75
10	100	8	0.2032	0.0165	0.0065	1	4	1.60	1.50	1.47	1.69	1.44	2.00	1.59	1.44	1.35	1.33	1.67	1.39	1.31	1.56	1.43	1.39	1.32	1.31	1.29
11	100	8	0.2032	0.0165	0.0067	1	4	1.43	1.32	1.29	1.53	1.25	1.86	1.42	1.25	1.16	1.14	1.50	1.21	1.12	1.38	1.25	1.20	1.13	1.12	1.10
12	100	8	0.2032	0.0165	0.0068	1	4	1.35	1.23	1.20	1.45	1.16	1.79	1.33	1.16	1.06	1.04	1.41	1.11	1.02	1.29	1.15	1.11	1.04	1.02	1.00
13	100	8	0.2032	0.0165	0.0068	1	4	1.36	1.25	1.22	1.46	1.18	1.80	1.35	1.18	1.08	1.06	1.43	1.13	1.04	1.31	1.17	1.13	1.06	1.04	1.02
14	100	8	0.2032	0.0165	0.0065	1	4	1.59	1.48	1.45	1.68	1.42	1.99	1.58	1.42	1.33	1.31	1.65	1.37	1.29	1.54	1.41	1.37	1.31	1.29	1.27
15	100	8	0.2032	0.0165	0.0061	1	4	1.85	1.76	1.73	1.93	1.70	2.21	1.84	1.70	1.62	1.61	1.90	1.66	1.59	1.81	1.69	1.66	1.60	1.59	1.57
16	100	8	0.2032	0.0165	0.0057	1	4	2.16	2.08	2.05	2.23	2.03	2.46	2.15	2.03	1.96	1.95	2.20	1.99	1.93	2.12	2.02	1.99	1.94	1.93	1.92
17	100	8	0.2032	0.0165	0.0053	1	3	1.37	1.30	1.28	1.43	1.26	1.64	1.36	1.26	1.20	1.19	1.41	1.23	1.17	1.34	1.25	1.23	1.18	1.17	1.16
18	100	8	0.2032	0.0165	0.0051	1	3	1.51	1.44	1.42	1.56	1.40	1.76	1.50	1.40	1.35	1.34	1.54	1.37	1.32	1.48	1.40	1.37	1.33	1.32	1.31
19	100	8	0.2032	0.0165	0.0050	1	3	1.57	1.51	1.49	1.63	1.47	1.81	1.57	1.47	1.42	1.41	1.61	1.45	1.40	1.54	1.47	1.44	1.41	1.40	1.39
20	100	8	0.2032	0.0165	0.0049	1	3	1.64	1.58	1.56	1.69	1.54	1.86	1.63	1.54	1.49	1.48	1.67	1.52	1.47	1.61	1.54	1.51	1.48	1.47	1.46
21	100	8	0.2032	0.0165	0.0045	1	3	1.82	1.77	1.75	1.86	1.74	2.02	1.82	1.74	1.70	1.69	1.85	1.72	1.68	1.80	1.73	1.71	1.68	1.68	1.67
22	100	8	0.2032	0.0165	0.0035	1	2	1.28	1.25	1.24	1.31	1.23	1.40	1.28	1.23	1.21	1.20	1.30	1.22	1.19	1.27	1.23	1.22	1.20	1.19	1.19
23	100	8	0.2032	0.0165	0.0030	1	2	1.50	1.48	1.47	1.52	1.47	1.58	1.50	1.47	1.45	1.44	1.51	1.46	1.44	1.49	1.47	1.46	1.44	1.44	1.44
24	100	8	0.2032	0.0165	0.0027	1	2	1.58	1.56	1.55	1.59	1.55	1.65	1.57	1.55	1.53	1.53	1.59	1.54	1.52	1.57	1.54	1.54	1.53	1.52	1.52

Anexo 2. Valores de carga en nodo [m]   {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	100	8	0.2032	0.0165	0.0026	0	2	1.64	1.62	1.62	1.65	1.61	1.68	1.64	1.61	1.60	1.60	1.65	1.61	1.59	1.63	1.61	1.61	1.60	1.59	1.59
26	100	8	0.2032	0.0165	0.0025	0	2	1.65	1.63	1.63	1.66	1.63	1.69	1.65	1.62	1.61	1.61	1.66	1.62	1.61	1.64	1.63	1.62	1.61	1.61	1.61
27	100	8	0.2032	0.0165	0.0025	0	2	1.66	1.65	1.64	1.67	1.64	1.70	1.66	1.64	1.63	1.62	1.67	1.63	1.62	1.66	1.64	1.63	1.62	1.62	1.62
28	100	8	0.2032	0.0165	0.0025	0	2	1.65	1.63	1.63	1.66	1.63	1.69	1.65	1.62	1.61	1.61	1.66	1.62	1.61	1.64	1.63	1.62	1.61	1.61	1.61
29	100	8	0.2032	0.0165	0.0026	0	2	1.62	1.61	1.60	1.64	1.60	1.67	1.62	1.60	1.59	1.58	1.63	1.59	1.58	1.62	1.60	1.59	1.58	1.58	1.58
30	100	8	0.2032	0.0165	0.0030	0	2	1.53	1.51	1.50	1.55	1.49	1.58	1.53	1.49	1.48	1.48	1.54	1.49	1.47	1.52	1.50	1.49	1.47	1.47	1.47
31	100	8	0.2032	0.0165	0.0036	0	2	1.28	1.25	1.24	1.31	1.23	1.37	1.28	1.23	1.21	1.21	1.30	1.22	1.20	1.27	1.24	1.22	1.20	1.20	1.19
32	100	8	0.2032	0.0165	0.0045	0	3	1.88	1.83	1.82	1.92	1.80	2.02	1.88	1.80	1.77	1.76	1.91	1.79	1.75	1.86	1.81	1.79	1.76	1.75	1.74
33	100	8	0.2032	0.0165	0.0059	0	4	2.11	2.03	2.01	2.18	1.98	2.34	2.11	1.98	1.92	1.90	2.16	1.95	1.89	2.07	1.98	1.95	1.90	1.89	1.87
34	100	8	0.2032	0.0165	0.0065	0	4	1.73	1.63	1.60	1.82	1.57	2.00	1.73	1.57	1.50	1.48	1.79	1.54	1.46	1.69	1.58	1.54	1.48	1.46	1.45
35	100	8	0.2032	0.0165	0.0067	0	4	1.56	1.46	1.43	1.66	1.40	1.86	1.57	1.40	1.32	1.30	1.64	1.36	1.28	1.52	1.40	1.36	1.30	1.28	1.26
36	100	8	0.2032	0.0165	0.0068	0	4	1.48	1.38	1.34	1.58	1.31	1.79	1.48	1.31	1.23	1.21	1.56	1.27	1.19	1.44	1.32	1.27	1.20	1.19	1.17
37	100	8	0.2032	0.0165	0.0068	0	4	1.50	1.40	1.36	1.60	1.33	1.80	1.50	1.33	1.25	1.23	1.57	1.29	1.21	1.45	1.33	1.29	1.22	1.21	1.19
38	100	8	0.2032	0.0165	0.0065	0	4	1.71	1.62	1.59	1.80	1.56	1.99	1.71	1.55	1.48	1.46	1.78	1.52	1.44	1.67	1.56	1.52	1.46	1.44	1.43
39	100	8	0.2032	0.0165	0.0061	0	4	1.96	1.88	1.85	2.04	1.82	2.21	1.96	1.82	1.76	1.74	2.02	1.79	1.72	1.92	1.83	1.79	1.73	1.72	1.71
40	100	8	0.2032	0.0165	0.0057	0	4	2.25	2.18	2.16	2.32	2.13	2.46	2.25	2.13	2.08	2.06	2.30	2.11	2.05	2.22	2.14	2.11	2.06	2.05	2.03
41	100	8	0.2032	0.0165	0.0053	0	3	1.45	1.39	1.37	1.52	1.35	1.64	1.45	1.35	1.30	1.29	1.50	1.33	1.27	1.43	1.35	1.33	1.28	1.27	1.26
42	100	8	0.2032	0.0165	0.0051	0	3	1.58	1.53	1.51	1.64	1.49	1.76	1.58	1.49	1.44	1.43	1.62	1.47	1.42	1.56	1.49	1.47	1.43	1.42	1.41
43	100	8	0.2032	0.0165	0.0050	0	3	1.64	1.59	1.57	1.70	1.55	1.81	1.65	1.55	1.51	1.50	1.69	1.53	1.49	1.62	1.56	1.53	1.50	1.49	1.48
44	100	8	0.2032	0.0165	0.0049	0	3	1.71	1.65	1.64	1.76	1.62	1.86	1.71	1.62	1.58	1.57	1.74	1.60	1.56	1.68	1.62	1.60	1.56	1.56	1.55
45	100	8	0.2032	0.0165	0.0045	0	3	1.88	1.83	1.82	1.92	1.80	2.02	1.88	1.80	1.77	1.76	1.91	1.79	1.75	1.86	1.81	1.79	1.76	1.75	1.74
46	100	8	0.2032	0.0165	0.0035	0	2	1.32	1.29	1.28	1.35	1.27	1.40	1.32	1.27	1.25	1.25	1.34	1.26	1.24	1.31	1.27	1.26	1.24	1.24	1.23
47	100	8	0.2032	0.0165	0.0030	0	2	1.53	1.51	1.50	1.55	1.49	1.58	1.53	1.49	1.48	1.48	1.54	1.49	1.47	1.52	1.50	1.49	1.47	1.47	1.47
48	100	8	0.2032	0.0165	0.0027	0	2	1.60	1.58	1.58	1.61	1.57	1.65	1.60	1.57	1.56	1.55	1.61	1.56	1.55	1.59	1.57	1.56	1.55	1.55	1.55

Anexo 2. Valores de carga en nodo [m]   {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	100	8	0.2032	0.0165	0.0052	1	3	1.47	1.40	1.38	1.52	1.36	1.72	1.46	1.36	1.30	1.29	1.51	1.33	1.28	1.44	1.36	1.33	1.29	1.28	1.27
2	100	8	0.2032	0.0165	0.0051	1	3	1.52	1.46	1.44	1.58	1.42	1.77	1.51	1.42	1.36	1.35	1.56	1.39	1.34	1.49	1.41	1.39	1.35	1.34	1.33
3	100	8	0.2032	0.0165	0.0050	1	3	1.57	1.51	1.49	1.63	1.47	1.81	1.57	1.47	1.42	1.41	1.61	1.45	1.40	1.54	1.47	1.44	1.41	1.40	1.39
4	100	8	0.2032	0.0165	0.0051	1	3	1.52	1.46	1.44	1.58	1.42	1.77	1.51	1.42	1.36	1.35	1.56	1.39	1.34	1.49	1.41	1.39	1.35	1.34	1.33
5	100	8	0.2032	0.0165	0.0053	1	3	1.41	1.34	1.32	1.47	1.30	1.68	1.41	1.30	1.24	1.23	1.45	1.27	1.22	1.38	1.30	1.27	1.23	1.22	1.21
6	100	8	0.2032	0.0165	0.0059	1	4	2.01	1.92	1.90	2.08	1.87	2.34	2.00	1.87	1.79	1.78	2.06	1.83	1.76	1.97	1.86	1.83	1.77	1.76	1.75
7	100	8	0.2032	0.0165	0.0073	1	5	1.98	1.85	1.81	2.09	1.77	2.48	1.97	1.77	1.66	1.64	2.06	1.71	1.61	1.92	1.76	1.71	1.63	1.61	1.59
8	100	8	0.2032	0.0165	0.0091	1	7	2.28	2.08	2.02	2.46	1.95	3.07	2.26	1.95	1.78	1.74	2.40	1.86	1.70	2.19	1.94	1.86	1.73	1.70	1.67
9	100	8	0.2032	0.0165	0.0118	1	11	3.03	2.68	2.58	3.32	2.47	4.35	2.99	2.46	2.18	2.12	3.23	2.32	2.05	2.86	2.44	2.31	2.09	2.05	1.99
10	100	8	0.2032	0.0165	0.0130	1	12	2.42	2.00	1.89	2.78	1.75	4.01	2.38	1.74	1.40	1.33	2.66	1.57	1.24	2.22	1.72	1.56	1.30	1.24	1.17
11	100	8	0.2032	0.0165	0.0134	1	13	2.73	2.29	2.16	3.12	2.02	4.44	2.69	2.01	1.64	1.57	2.99	1.82	1.47	2.53	1.99	1.81	1.54	1.47	1.40
12	100	8	0.2032	0.0165	0.0136	1	13	2.38	1.92	1.79	2.78	1.64	4.15	2.34	1.63	1.26	1.17	2.65	1.44	1.08	2.17	1.61	1.43	1.14	1.08	1.00
13	100	8	0.2032	0.0165	0.0136	1	13	2.45	2.00	1.87	2.85	1.72	4.21	2.41	1.71	1.33	1.25	2.72	1.52	1.16	2.24	1.69	1.51	1.22	1.16	1.08
14	100	8	0.2032	0.0165	0.0130	1	12	2.35	1.93	1.81	2.71	1.68	3.96	2.31	1.67	1.33	1.25	2.60	1.49	1.17	2.16	1.65	1.48	1.22	1.17	1.10
15	100	8	0.2032	0.0165	0.0123	1	11	2.40	2.03	1.92	2.72	1.80	3.83	2.36	1.79	1.49	1.42	2.62	1.64	1.34	2.23	1.77	1.63	1.40	1.34	1.28
16	100	8	0.2032	0.0165	0.0114	1	10	2.63	2.31	2.22	2.90	2.11	3.85	2.59	2.11	1.84	1.79	2.81	1.97	1.72	2.48	2.09	1.96	1.77	1.72	1.67
17	100	8	0.2032	0.0165	0.0107	1	9	2.49	2.20	2.12	2.73	2.03	3.57	2.46	2.03	1.79	1.74	2.65	1.91	1.69	2.35	2.01	1.90	1.73	1.69	1.64
18	100	8	0.2032	0.0165	0.0102	1	8	2.03	1.77	1.70	2.25	1.61	3.02	2.00	1.61	1.39	1.35	2.18	1.50	1.29	1.91	1.59	1.49	1.33	1.29	1.25
19	100	8	0.2032	0.0165	0.0100	1	8	2.29	2.04	1.97	2.50	1.89	3.24	2.27	1.89	1.68	1.64	2.43	1.78	1.59	2.17	1.87	1.78	1.62	1.59	1.55
20	100	8	0.2032	0.0165	0.0098	1	8	2.55	2.31	2.24	2.75	2.17	3.45	2.52	2.16	1.97	1.93	2.69	2.06	1.88	2.44	2.15	2.06	1.91	1.88	1.84
21	100	8	0.2032	0.0165	0.0091	1	7	2.28	2.08	2.02	2.46	1.95	3.07	2.26	1.95	1.78	1.74	2.40	1.86	1.70	2.19	1.94	1.86	1.73	1.70	1.67
22	100	8	0.2032	0.0165	0.0071	1	5	2.13	2.00	1.97	2.24	1.93	2.61	2.12	1.93	1.82	1.80	2.20	1.87	1.78	2.07	1.92	1.87	1.79	1.78	1.76
23	100	8	0.2032	0.0165	0.0059	1	4	2.01	1.92	1.90	2.08	1.87	2.34	2.00	1.87	1.79	1.78	2.06	1.83	1.76	1.97	1.86	1.83	1.77	1.76	1.75
24	100	8	0.2032	0.0165	0.0055	1	3	1.30	1.23	1.21	1.36	1.18	1.58	1.29	1.18	1.12	1.11	1.34	1.15	1.09	1.27	1.18	1.15	1.10	1.09	1.08

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	100	8	0.2032	0.0165	0.0052	0	3	1.54	1.49	1.47	1.60	1.45	1.72	1.55	1.45	1.40	1.39	1.59	1.43	1.38	1.52	1.45	1.42	1.38	1.38	1.36
26	100	8	0.2032	0.0165	0.0051	0	3	1.59	1.54	1.52	1.65	1.50	1.77	1.60	1.50	1.46	1.44	1.64	1.48	1.43	1.57	1.50	1.48	1.44	1.43	1.42
27	100	8	0.2032	0.0165	0.0050	0	3	1.64	1.59	1.57	1.70	1.55	1.81	1.65	1.55	1.51	1.50	1.69	1.53	1.49	1.62	1.56	1.53	1.50	1.49	1.48
28	100	8	0.2032	0.0165	0.0051	0	3	1.59	1.54	1.52	1.65	1.50	1.77	1.60	1.50	1.46	1.44	1.64	1.48	1.43	1.57	1.50	1.48	1.44	1.43	1.42
29	100	8	0.2032	0.0165	0.0053	0	3	1.49	1.43	1.41	1.55	1.39	1.68	1.49	1.39	1.34	1.33	1.54	1.37	1.32	1.47	1.39	1.37	1.33	1.32	1.31
30	100	8	0.2032	0.0165	0.0059	0	4	2.11	2.03	2.01	2.18	1.98	2.34	2.11	1.98	1.92	1.90	2.16	1.95	1.89	2.07	1.98	1.95	1.90	1.89	1.87
31	100	8	0.2032	0.0165	0.0073	0	5	2.13	2.02	1.98	2.25	1.94	2.48	2.14	1.94	1.85	1.82	2.22	1.90	1.80	2.08	1.95	1.90	1.82	1.80	1.78
32	100	8	0.2032	0.0165	0.0091	0	7	2.52	2.34	2.28	2.70	2.22	3.07	2.52	2.21	2.07	2.04	2.65	2.15	2.00	2.44	2.23	2.15	2.03	2.00	1.97
33	100	8	0.2032	0.0165	0.0118	0	11	3.43	3.12	3.02	3.73	2.92	4.35	3.43	2.91	2.68	2.61	3.66	2.81	2.55	3.30	2.94	2.80	2.60	2.55	2.50
34	100	8	0.2032	0.0165	0.0130	0	12	2.90	2.53	2.41	3.27	2.29	4.01	2.91	2.28	2.00	1.92	3.17	2.16	1.85	2.74	2.31	2.15	1.90	1.85	1.78
35	100	8	0.2032	0.0165	0.0134	0	13	3.25	2.86	2.73	3.64	2.60	4.44	3.26	2.59	2.28	2.20	3.54	2.46	2.12	3.08	2.62	2.45	2.18	2.12	2.05
36	100	8	0.2032	0.0165	0.0136	0	13	2.92	2.51	2.38	3.32	2.24	4.15	2.93	2.23	1.92	1.83	3.22	2.10	1.75	2.74	2.26	2.09	1.81	1.75	1.68
37	100	8	0.2032	0.0165	0.0136	0	13	2.98	2.58	2.45	3.39	2.31	4.21	3.00	2.30	1.99	1.91	3.29	2.17	1.83	2.81	2.33	2.16	1.89	1.83	1.75
38	100	8	0.2032	0.0165	0.0130	0	12	2.84	2.47	2.34	3.21	2.22	3.96	2.85	2.21	1.93	1.85	3.11	2.09	1.78	2.68	2.24	2.08	1.83	1.78	1.71
39	100	8	0.2032	0.0165	0.0123	0	11	2.83	2.50	2.39	3.16	2.29	3.83	2.84	2.28	2.02	1.96	3.08	2.17	1.89	2.69	2.30	2.16	1.94	1.89	1.83
40	100	8	0.2032	0.0165	0.0114	0	10	3.00	2.72	2.62	3.28	2.53	3.85	3.01	2.52	2.30	2.25	3.21	2.43	2.19	2.88	2.54	2.42	2.23	2.19	2.14
41	100	8	0.2032	0.0165	0.0107	0	9	2.81	2.56	2.48	3.06	2.40	3.57	2.82	2.39	2.20	2.15	3.00	2.31	2.10	2.71	2.41	2.30	2.14	2.10	2.05
42	100	8	0.2032	0.0165	0.0102	0	8	2.33	2.10	2.02	2.56	1.95	3.02	2.33	1.94	1.77	1.72	2.50	1.87	1.67	2.23	1.96	1.86	1.71	1.67	1.63
43	100	8	0.2032	0.0165	0.0100	0	8	2.58	2.36	2.29	2.80	2.21	3.24	2.58	2.21	2.04	2.00	2.74	2.14	1.95	2.48	2.23	2.13	1.98	1.95	1.91
44	100	8	0.2032	0.0165	0.0098	0	8	2.82	2.61	2.54	3.03	2.47	3.45	2.83	2.47	2.31	2.27	2.98	2.40	2.22	2.73	2.49	2.39	2.25	2.22	2.18
45	100	8	0.2032	0.0165	0.0091	0	7	2.52	2.34	2.28	2.70	2.22	3.07	2.52	2.21	2.07	2.04	2.65	2.15	2.00	2.44	2.23	2.15	2.03	2.00	1.97
46	100	8	0.2032	0.0165	0.0071	0	5	2.27	2.16	2.13	2.38	2.09	2.61	2.28	2.09	2.00	1.98	2.36	2.05	1.96	2.23	2.10	2.05	1.98	1.96	1.94
47	100	8	0.2032	0.0165	0.0059	0	4	2.11	2.03	2.01	2.18	1.98	2.34	2.11	1.98	1.92	1.90	2.16	1.95	1.89	2.07	1.98	1.95	1.90	1.89	1.87
48	100	8	0.2032	0.0165	0.0055	0	3	1.39	1.32	1.30	1.45	1.28	1.58	1.39	1.28	1.23	1.21	1.44	1.26	1.20	1.36	1.28	1.25	1.21	1.20	1.19

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	100	8	0.2032	0.0165	0.0078	1	5	1.55	1.40	1.36	1.68	1.31	2.12	1.54	1.31	1.18	1.16	1.64	1.24	1.13	1.48	1.30	1.24	1.15	1.13	1.10
2	100	8	0.2032	0.0165	0.0076	1	5	1.67	1.53	1.49	1.80	1.44	2.22	1.66	1.44	1.32	1.29	1.75	1.37	1.26	1.60	1.43	1.37	1.28	1.26	1.24
3	100	8	0.2032	0.0165	0.0075	1	5	1.79	1.65	1.61	1.91	1.56	2.32	1.77	1.56	1.45	1.42	1.87	1.50	1.39	1.72	1.55	1.50	1.41	1.39	1.37
4	100	8	0.2032	0.0165	0.0076	1	5	1.67	1.53	1.49	1.80	1.44	2.22	1.66	1.44	1.32	1.29	1.75	1.37	1.26	1.60	1.43	1.37	1.28	1.26	1.24
5	100	8	0.2032	0.0165	0.0079	1	6	2.43	2.27	2.23	2.56	2.18	3.02	2.41	2.18	2.05	2.02	2.52	2.11	1.99	2.36	2.17	2.11	2.01	1.99	1.96
6	100	8	0.2032	0.0165	0.0089	1	7	2.51	2.32	2.26	2.68	2.20	3.26	2.49	2.20	2.04	2.00	2.63	2.12	1.96	2.42	2.19	2.11	1.99	1.96	1.93
7	100	8	0.2032	0.0165	0.0109	1	9	2.21	1.91	1.83	2.46	1.73	3.33	2.17	1.73	1.48	1.43	2.38	1.60	1.37	2.07	1.71	1.59	1.41	1.37	1.32
8	100	8	0.2032	0.0165	0.0136	1	13	2.38	1.92	1.79	2.78	1.64	4.15	2.34	1.63	1.26	1.17	2.65	1.44	1.08	2.17	1.61	1.43	1.14	1.08	1.00
9	100	8	0.2032	0.0165	0.0177	1	22	4.06	3.28	3.06	4.73	2.81	7.04	3.98	2.79	2.15	2.01	4.51	2.46	1.85	3.69	2.75	2.45	1.96	1.85	1.73
10	100	8	0.2032	0.0165	0.0194	1	26	4.44	3.51	3.24	5.25	2.94	8.03	4.35	2.92	2.15	1.99	4.99	2.52	1.79	4.01	2.87	2.50	1.92	1.79	1.64
11	100	8	0.2032	0.0165	0.0201	1	28	4.90	3.90	3.62	5.77	3.29	8.74	4.80	3.27	2.45	2.27	5.49	2.85	2.07	4.43	3.22	2.83	2.21	2.07	1.90
12	100	8	0.2032	0.0165	0.0205	1	28	4.11	3.08	2.78	5.01	2.45	8.08	4.01	2.43	1.58	1.39	4.72	1.99	1.18	3.63	2.37	1.97	1.32	1.18	1.01
13	100	8	0.2032	0.0165	0.0204	1	28	4.27	3.24	2.95	5.16	2.62	8.22	4.17	2.60	1.75	1.57	4.87	2.16	1.36	3.79	2.54	2.14	1.50	1.36	1.19
14	100	8	0.2032	0.0165	0.0195	1	26	4.29	3.35	3.08	5.10	2.78	7.90	4.19	2.76	1.99	1.82	4.84	2.36	1.62	3.85	2.71	2.34	1.76	1.62	1.47
15	100	8	0.2032	0.0165	0.0184	1	23	3.65	2.81	2.57	4.38	2.30	6.87	3.56	2.29	1.60	1.45	4.14	1.93	1.27	3.26	2.24	1.91	1.39	1.27	1.14
16	100	8	0.2032	0.0165	0.0170	1	20	3.41	2.69	2.49	4.03	2.25	6.17	3.34	2.24	1.65	1.52	3.83	1.94	1.37	3.08	2.20	1.92	1.48	1.37	1.26
17	100	8	0.2032	0.0165	0.0160	1	18	3.34	2.71	2.53	3.89	2.32	5.78	3.28	2.31	1.79	1.67	3.71	2.04	1.54	3.05	2.27	2.03	1.63	1.54	1.44
18	100	8	0.2032	0.0165	0.0153	1	17	3.56	2.98	2.82	4.07	2.63	5.80	3.50	2.62	2.14	2.03	3.90	2.37	1.91	3.29	2.58	2.36	1.99	1.91	1.82
19	100	8	0.2032	0.0165	0.0150	1	16	3.15	2.60	2.44	3.64	2.26	5.29	3.10	2.25	1.79	1.69	3.48	2.01	1.58	2.89	2.22	2.00	1.65	1.58	1.49
20	100	8	0.2032	0.0165	0.0147	1	15	2.73	2.20	2.05	3.19	1.88	4.77	2.68	1.87	1.43	1.33	3.04	1.64	1.22	2.48	1.84	1.63	1.30	1.22	1.14
21	100	8	0.2032	0.0165	0.0136	1	13	2.38	1.92	1.79	2.78	1.64	4.15	2.34	1.63	1.26	1.17	2.65	1.44	1.08	2.17	1.61	1.43	1.14	1.08	1.00
22	100	8	0.2032	0.0165	0.0106	1	9	2.54	2.26	2.18	2.78	2.09	3.61	2.51	2.09	1.86	1.81	2.70	1.97	1.75	2.41	2.07	1.96	1.79	1.75	1.70
23	100	8	0.2032	0.0165	0.0089	1	7	2.51	2.32	2.26	2.68	2.20	3.26	2.49	2.20	2.04	2.00	2.63	2.12	1.96	2.42	2.19	2.11	1.99	1.96	1.93
24	100	8	0.2032	0.0165	0.0082	1	6	2.18	2.01	1.97	2.32	1.91	2.81	2.16	1.91	1.77	1.74	2.27	1.84	1.71	2.10	1.90	1.83	1.73	1.71	1.68

Anexo 2. Valores de carga en nodo [m]   {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	100	8	0.2032	0.0165	0.0078	0	5	1.72	1.59	1.55	1.86	1.50	2.12	1.73	1.50	1.40	1.37	1.82	1.46	1.35	1.67	1.51	1.45	1.37	1.34	1.32
26	100	8	0.2032	0.0165	0.0076	0	5	1.84	1.71	1.67	1.97	1.63	2.22	1.84	1.62	1.52	1.50	1.93	1.58	1.47	1.78	1.63	1.58	1.49	1.47	1.45
27	100	8	0.2032	0.0165	0.0075	0	5	1.95	1.83	1.79	2.07	1.75	2.32	1.95	1.74	1.65	1.62	2.04	1.70	1.60	1.90	1.75	1.70	1.62	1.60	1.57
28	100	8	0.2032	0.0165	0.0076	0	5	1.84	1.71	1.67	1.97	1.63	2.22	1.84	1.62	1.52	1.50	1.93	1.58	1.47	1.78	1.63	1.58	1.49	1.47	1.45
29	100	8	0.2032	0.0165	0.0079	0	6	2.61	2.47	2.43	2.74	2.38	3.02	2.61	2.38	2.27	2.24	2.71	2.33	2.22	2.55	2.39	2.33	2.24	2.22	2.19
30	100	8	0.2032	0.0165	0.0089	0	7	2.74	2.57	2.51	2.91	2.45	3.26	2.74	2.45	2.32	2.28	2.87	2.39	2.25	2.67	2.46	2.39	2.27	2.25	2.22
31	100	8	0.2032	0.0165	0.0109	0	9	2.55	2.29	2.20	2.81	2.11	3.33	2.55	2.11	1.91	1.85	2.74	2.02	1.80	2.44	2.13	2.01	1.84	1.80	1.75
32	100	8	0.2032	0.0165	0.0136	0	13	2.92	2.51	2.38	3.32	2.24	4.15	2.93	2.23	1.92	1.83	3.22	2.10	1.75	2.74	2.26	2.09	1.81	1.75	1.68
33	100	8	0.2032	0.0165	0.0177	0	22	4.96	4.27	4.05	5.65	3.82	7.04	4.98	3.80	3.27	3.13	5.47	3.57	2.99	4.66	3.85	3.55	3.09	2.99	2.86
34	100	8	0.2032	0.0165	0.0194	0	26	5.53	4.70	4.43	6.35	4.15	8.03	5.55	4.14	3.50	3.33	6.14	3.86	3.16	5.17	4.20	3.84	3.28	3.16	3.01
35	100	8	0.2032	0.0165	0.0201	0	28	6.06	5.18	4.89	6.95	4.59	8.74	6.09	4.57	3.89	3.71	6.73	4.28	3.53	5.68	4.64	4.25	3.66	3.52	3.37
36	100	8	0.2032	0.0165	0.0205	0	28	5.31	4.40	4.10	6.23	3.79	8.08	5.34	3.77	3.07	2.88	6.00	3.46	2.69	4.92	3.84	3.44	2.83	2.69	2.52
37	100	8	0.2032	0.0165	0.0204	0	28	5.47	4.56	4.26	6.37	3.96	8.22	5.49	3.93	3.23	3.05	6.14	3.63	2.86	5.07	4.00	3.61	3.00	2.86	2.69
38	100	8	0.2032	0.0165	0.0195	0	26	5.38	4.55	4.28	6.21	4.00	7.90	5.40	3.98	3.34	3.17	6.00	3.70	3.00	5.02	4.04	3.68	3.12	3.00	2.85
39	100	8	0.2032	0.0165	0.0184	0	23	4.62	3.88	3.64	5.37	3.39	6.87	4.64	3.38	2.80	2.65	5.18	3.13	2.50	4.31	3.43	3.11	2.61	2.50	2.36
40	100	8	0.2032	0.0165	0.0170	0	20	4.25	3.61	3.40	4.88	3.19	6.17	4.26	3.18	2.69	2.55	4.72	2.96	2.42	3.97	3.22	2.95	2.52	2.42	2.31
41	100	8	0.2032	0.0165	0.0160	0	18	4.08	3.52	3.33	4.64	3.15	5.78	4.09	3.13	2.70	2.58	4.50	2.94	2.47	3.84	3.18	2.93	2.56	2.47	2.37
42	100	8	0.2032	0.0165	0.0153	0	17	4.24	3.73	3.55	4.75	3.38	5.80	4.25	3.37	2.98	2.87	4.62	3.20	2.76	4.02	3.41	3.19	2.84	2.76	2.67
43	100	8	0.2032	0.0165	0.0150	0	16	3.80	3.31	3.15	4.29	2.98	5.29	3.81	2.97	2.59	2.49	4.17	2.81	2.39	3.59	3.01	2.79	2.46	2.39	2.30
44	100	8	0.2032	0.0165	0.0147	0	15	3.35	2.88	2.72	3.82	2.57	4.77	3.36	2.56	2.19	2.10	3.70	2.40	2.00	3.15	2.59	2.39	2.07	2.00	1.91
45	100	8	0.2032	0.0165	0.0136	0	13	2.92	2.51	2.38	3.32	2.24	4.15	2.93	2.23	1.92	1.83	3.22	2.10	1.75	2.74	2.26	2.09	1.81	1.75	1.68
46	100	8	0.2032	0.0165	0.0106	0	9	2.87	2.62	2.54	3.11	2.45	3.61	2.87	2.45	2.26	2.21	3.05	2.37	2.16	2.76	2.47	2.36	2.19	2.16	2.11
47	100	8	0.2032	0.0165	0.0089	0	7	2.74	2.57	2.51	2.91	2.45	3.26	2.74	2.45	2.32	2.28	2.87	2.39	2.25	2.67	2.46	2.39	2.27	2.25	2.22
48	100	8	0.2032	0.0165	0.0082	0	6	2.37	2.22	2.18	2.52	2.13	2.81	2.37	2.12	2.01	1.98	2.48	2.07	1.95	2.31	2.13	2.07	1.97	1.95	1.92

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	300	4	0.1016	0.021	0.0026	1	52	7.22	5.40	4.81	9.01	4.20	12.96	7.23	4.16	2.74	2.37	8.54	3.52	1.99	6.42	4.27	3.48	2.27	1.99	1.67
2	300	4	0.1016	0.021	0.0025	1	50	6.78	5.02	4.45	8.50	3.86	12.32	6.79	3.83	2.45	2.10	8.05	3.21	1.73	6.01	3.93	3.17	2.00	1.73	1.42
3	300	4	0.1016	0.021	0.0025	1	48	6.31	4.61	4.06	7.97	3.50	11.65	6.32	3.46	2.14	1.79	7.54	2.87	1.44	5.57	3.56	2.82	1.70	1.44	1.14
4	300	4	0.1016	0.021	0.0025	1	50	6.78	5.02	4.45	8.50	3.86	12.32	6.79	3.83	2.45	2.10	8.05	3.21	1.73	6.01	3.93	3.17	2.00	1.73	1.42
5	300	4	0.1016	0.021	0.0026	1	54	7.64	5.75	5.13	9.49	4.51	13.58	7.65	4.47	3.00	2.61	9.00	3.81	2.22	6.81	4.58	3.76	2.51	2.22	1.89
6	300	4	0.1016	0.021	0.0030	1	67	8.77	6.40	5.63	11.09	4.84	16.23	8.79	4.79	2.94	2.46	10.49	3.96	1.97	7.73	4.93	3.90	2.33	1.97	1.55
7	300	4	0.1016	0.021	0.0036	1	101	12.79	9.20	8.03	16.31	6.85	24.09	12.82	6.77	3.97	3.24	15.39	5.51	2.50	11.22	6.97	5.42	3.04	2.49	1.86
8	300	4	0.1016	0.021	0.0045	1	156	18.17	12.56	10.74	23.67	8.88	35.83	18.21	8.76	4.38	3.25	22.24	6.79	2.09	15.72	9.08	6.66	2.94	2.08	1.09
9	300	4	0.1016	0.021	0.0059	1	263	30.07	20.59	17.51	39.37	14.37	59.91	30.14	14.16	6.77	4.85	36.94	10.84	2.89	25.93	14.70	10.61	4.33	2.88	1.20
10	300	4	0.1016	0.021	0.0065	1	316	36.13	24.73	21.03	47.30	17.26	71.98	36.21	17.01	8.12	5.82	44.38	13.02	3.46	31.15	17.66	12.74	5.20	3.45	1.43
11	300	4	0.1016	0.021	0.0067	1	339	39.14	26.93	22.97	51.11	18.93	77.56	39.23	18.66	9.14	6.67	47.98	14.38	4.14	33.81	19.35	14.09	6.00	4.13	1.97
12	300	4	0.1016	0.021	0.0068	1	350	39.89	27.26	23.17	52.27	18.99	79.62	39.98	18.71	8.86	6.31	49.03	14.29	3.70	34.38	19.43	13.98	5.62	3.69	1.44
13	300	4	0.1016	0.021	0.0068	1	348	39.95	27.41	23.34	52.25	19.19	79.42	40.05	18.91	9.13	6.59	49.04	14.52	4.00	34.48	19.63	14.22	5.91	3.99	1.76
14	300	4	0.1016	0.021	0.0065	1	318	36.16	24.68	20.96	47.41	17.16	72.27	36.24	16.91	7.96	5.64	44.47	12.89	3.26	31.15	17.56	12.61	5.01	3.25	1.22
15	300	4	0.1016	0.021	0.0061	1	284	32.81	22.58	19.26	42.84	15.88	64.99	32.89	15.65	7.68	5.61	40.22	12.07	3.49	28.35	16.23	11.83	5.05	3.48	1.67
16	300	4	0.1016	0.021	0.0057	1	244	28.65	19.88	17.03	37.24	14.13	56.24	28.71	13.94	7.10	5.32	35.00	10.87	3.51	24.82	14.43	10.65	4.85	3.50	1.95
17	300	4	0.1016	0.021	0.0053	1	215	24.71	16.96	14.45	32.31	11.89	49.09	24.77	11.72	5.67	4.11	30.32	9.00	2.50	21.33	12.16	8.82	3.68	2.50	1.12
18	300	4	0.1016	0.021	0.0051	1	198	23.56	16.46	14.16	30.53	11.81	45.91	23.62	11.65	6.11	4.67	28.71	9.16	3.20	20.46	12.05	8.99	4.29	3.20	1.94
19	300	4	0.1016	0.021	0.0050	1	189	22.23	15.44	13.24	28.89	10.99	43.60	22.28	10.84	5.54	4.17	27.15	8.46	2.77	19.27	11.22	8.30	3.80	2.76	1.55
20	300	4	0.1016	0.021	0.0049	1	181	21.72	15.24	13.13	28.08	10.99	42.13	21.77	10.85	5.79	4.47	26.42	8.57	3.13	18.89	11.21	8.42	4.12	3.13	1.98
21	300	4	0.1016	0.021	0.0045	1	156	18.17	12.56	10.74	23.67	8.88	35.83	18.21	8.76	4.38	3.25	22.24	6.79	2.09	15.72	9.08	6.66	2.94	2.08	1.09
22	300	4	0.1016	0.021	0.0035	1	96	12.15	8.73	7.62	15.49	6.49	22.89	12.17	6.42	3.76	3.07	14.62	5.22	2.36	10.66	6.61	5.14	2.88	2.36	1.75
23	300	4	0.1016	0.021	0.0030	1	67	8.77	6.40	5.63	11.09	4.84	16.23	8.79	4.79	2.94	2.46	10.49	3.96	1.97	7.73	4.93	3.90	2.33	1.97	1.55
24	300	4	0.1016	0.021	0.0027	1	57	7.38	5.36	4.71	9.36	4.04	13.74	7.40	3.99	2.42	2.01	8.85	3.29	1.59	6.50	4.11	3.24	1.90	1.59	1.23

Anexo 2. Valores de carga en nodo [m]   {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	300	4	0.1016	0.021	0.0026	0	52	7.53	5.74	5.14	9.32	4.55	12.96	7.58	4.51	3.12	2.75	8.87	3.90	2.38	6.76	4.64	3.86	2.66	2.38	2.06
26	300	4	0.1016	0.021	0.0025	0	50	7.08	5.35	4.77	8.81	4.20	12.32	7.12	4.16	2.82	2.46	8.37	3.57	2.11	6.33	4.29	3.53	2.37	2.11	1.79
27	300	4	0.1016	0.021	0.0025	0	48	6.59	4.93	4.37	8.26	3.82	11.65	6.64	3.78	2.49	2.15	7.84	3.22	1.80	5.88	3.91	3.18	2.06	1.80	1.50
28	300	4	0.1016	0.021	0.0025	0	50	7.08	5.35	4.77	8.81	4.20	12.32	7.12	4.16	2.82	2.46	8.37	3.57	2.11	6.33	4.29	3.53	2.37	2.11	1.79
29	300	4	0.1016	0.021	0.0026	0	54	7.95	6.10	5.48	9.81	4.87	13.58	8.00	4.83	3.39	3.01	9.34	4.20	2.63	7.15	4.97	4.15	2.91	2.62	2.29
30	300	4	0.1016	0.021	0.0030	0	67	9.17	6.84	6.07	11.50	5.29	16.23	9.23	5.24	3.44	2.96	10.91	4.45	2.48	8.16	5.42	4.40	2.84	2.47	2.05
31	300	4	0.1016	0.021	0.0036	0	101	13.40	9.87	8.70	16.93	7.53	24.09	13.49	7.45	4.72	3.99	16.04	6.26	3.26	11.88	7.71	6.17	3.80	3.26	2.62
32	300	4	0.1016	0.021	0.0045	0	156	19.12	13.61	11.78	24.64	9.95	35.83	19.27	9.82	5.56	4.42	23.25	7.96	3.28	16.74	10.24	7.83	4.13	3.28	2.28
33	300	4	0.1016	0.021	0.0059	0	263	31.68	22.35	19.26	41.00	16.17	59.91	31.92	15.96	8.76	6.83	38.65	12.81	4.90	27.66	16.67	12.59	6.34	4.90	3.22
34	300	4	0.1016	0.021	0.0065	0	316	38.05	26.85	23.14	49.26	19.43	71.98	38.35	19.17	10.52	8.20	46.43	15.39	5.88	33.23	20.02	15.11	7.61	5.87	3.86
35	300	4	0.1016	0.021	0.0067	0	339	41.21	29.20	25.23	53.21	21.25	77.56	41.52	20.97	11.70	9.22	50.19	16.92	6.74	36.03	21.88	16.63	8.59	6.73	4.57
36	300	4	0.1016	0.021	0.0068	0	350	42.03	29.61	25.50	54.44	21.39	79.62	42.35	21.10	11.51	8.95	51.31	16.91	6.38	36.68	22.04	16.61	8.30	6.37	4.14
37	300	4	0.1016	0.021	0.0068	0	348	42.08	29.75	25.66	54.41	21.57	79.42	42.40	21.29	11.77	9.22	51.30	17.13	6.67	36.76	22.22	16.83	8.57	6.66	4.44
38	300	4	0.1016	0.021	0.0065	0	318	38.10	26.82	23.08	49.38	19.34	72.27	38.40	19.08	10.37	8.04	46.54	15.27	5.70	33.24	19.94	15.00	7.45	5.69	3.66
39	300	4	0.1016	0.021	0.0061	0	284	34.54	24.49	21.16	44.60	17.82	64.99	34.81	17.59	9.83	7.75	42.06	14.20	5.67	30.21	18.35	13.95	7.22	5.66	3.85
40	300	4	0.1016	0.021	0.0057	0	244	30.13	21.51	18.65	38.75	15.80	56.24	30.36	15.60	8.94	7.16	36.58	12.69	5.38	26.41	16.25	12.48	6.71	5.37	3.82
41	300	4	0.1016	0.021	0.0053	0	215	26.02	18.41	15.88	33.64	13.36	49.09	26.22	13.18	7.30	5.73	31.72	10.61	4.15	22.74	13.76	10.43	5.33	4.15	2.77
42	300	4	0.1016	0.021	0.0051	0	198	24.77	17.78	15.47	31.75	13.15	45.91	24.95	12.99	7.60	6.16	29.99	10.64	4.71	21.76	13.52	10.47	5.79	4.71	3.45
43	300	4	0.1016	0.021	0.0050	0	189	23.38	16.70	14.49	30.05	12.28	43.60	23.55	12.13	6.97	5.59	28.37	9.87	4.21	20.50	12.63	9.71	5.24	4.20	3.00
44	300	4	0.1016	0.021	0.0049	0	181	22.82	16.45	14.33	29.20	12.22	42.13	22.99	12.07	7.15	5.83	27.59	9.92	4.51	20.07	12.56	9.77	5.50	4.51	3.36
45	300	4	0.1016	0.021	0.0045	0	156	19.12	13.61	11.78	24.64	9.95	35.83	19.27	9.82	5.56	4.42	23.25	7.96	3.28	16.74	10.24	7.83	4.13	3.28	2.28
46	300	4	0.1016	0.021	0.0035	0	96	12.72	9.37	8.26	16.08	7.14	22.89	12.81	7.07	4.47	3.78	15.23	5.93	3.09	11.28	7.32	5.85	3.60	3.08	2.48
47	300	4	0.1016	0.021	0.0030	0	67	9.17	6.84	6.07	11.50	5.29	16.23	9.23	5.24	3.44	2.96	10.91	4.45	2.48	8.16	5.42	4.40	2.84	2.47	2.05
48	300	4	0.1016	0.021	0.0027	0	57	7.72	5.74	5.08	9.71	4.42	13.74	7.78	4.38	2.84	2.43	9.21	3.71	2.02	6.87	4.53	3.66	2.33	2.02	1.66

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	300	4	0.1016	0.021	0.0052	1	203	23.88	16.59	14.22	31.03	11.81	46.83	23.93	11.65	5.96	4.48	29.16	9.09	2.97	20.70	12.06	8.92	4.09	2.97	1.67
2	300	4	0.1016	0.021	0.0051	1	196	23.11	16.07	13.79	30.01	11.46	45.26	23.16	11.30	5.81	4.39	28.21	8.84	2.93	20.04	11.70	8.67	4.00	2.93	1.68
3	300	4	0.1016	0.021	0.0050	1	189	22.23	15.44	13.24	28.89	10.99	43.60	22.28	10.84	5.54	4.17	27.15	8.46	2.77	19.27	11.22	8.30	3.80	2.76	1.55
4	300	4	0.1016	0.021	0.0051	1	196	23.11	16.07	13.79	30.01	11.46	45.26	23.16	11.30	5.81	4.39	28.21	8.84	2.93	20.04	11.70	8.67	4.00	2.93	1.68
5	300	4	0.1016	0.021	0.0053	1	210	24.54	16.99	14.54	31.94	12.04	48.30	24.60	11.87	5.99	4.46	30.01	9.23	2.89	21.24	12.30	9.05	4.04	2.89	1.55
6	300	4	0.1016	0.021	0.0059	1	263	30.07	20.59	17.51	39.37	14.37	59.91	30.14	14.16	6.77	4.85	36.94	10.84	2.89	25.93	14.70	10.61	4.33	2.88	1.20
7	300	4	0.1016	0.021	0.0073	1	398	45.16	30.79	26.14	59.25	21.38	90.37	45.27	21.06	9.86	6.95	55.57	16.03	3.98	38.89	21.88	15.69	6.17	3.97	1.42
8	300	4	0.1016	0.021	0.0091	1	621	69.69	47.24	39.96	91.70	32.54	140.32	69.86	32.04	14.53	9.99	85.95	24.18	5.35	59.90	33.31	23.63	8.77	5.33	1.35
9	300	4	0.1016	0.021	0.0118	1	1049	117.29	79.35	67.05	154.48	54.49	236.66	117.57	53.66	24.07	16.39	144.76	40.37	8.55	100.73	55.81	39.45	14.32	8.52	1.78
10	300	4	0.1016	0.021	0.0130	1	1260	140.51	94.91	80.13	185.19	65.05	283.93	140.84	64.04	28.50	19.26	173.51	48.07	9.84	120.61	66.63	46.97	16.78	9.80	1.72
11	300	4	0.1016	0.021	0.0134	1	1350	150.57	101.71	85.88	198.44	69.72	304.23	150.93	68.64	30.56	20.67	185.93	51.53	10.57	129.25	71.41	50.36	18.01	10.53	1.87
12	300	4	0.1016	0.021	0.0136	1	1396	155.56	105.04	88.66	205.07	71.95	314.48	155.93	70.84	31.45	21.22	192.13	53.15	10.78	133.51	73.70	51.93	18.47	10.74	1.78
13	300	4	0.1016	0.021	0.0136	1	1386	153.82	103.63	87.37	203.00	70.77	311.68	154.19	69.66	30.53	20.37	190.14	52.08	10.00	131.92	72.50	50.87	17.64	9.96	1.06
14	300	4	0.1016	0.021	0.0130	1	1269	141.64	95.72	80.84	186.63	65.65	286.07	141.97	64.63	28.84	19.54	174.87	48.55	10.05	121.60	67.24	47.45	17.04	10.01	1.87
15	300	4	0.1016	0.021	0.0123	1	1131	126.25	85.32	72.06	166.35	58.52	254.97	126.55	57.62	25.72	17.43	155.87	43.29	8.98	108.39	59.94	42.30	15.20	8.94	1.68
16	300	4	0.1016	0.021	0.0114	1	970	108.58	73.50	62.13	142.97	50.52	218.94	108.84	49.75	22.40	15.29	133.98	37.46	8.04	93.27	51.74	36.62	13.38	8.01	1.79
17	300	4	0.1016	0.021	0.0107	1	857	95.85	64.85	54.80	126.23	44.55	193.37	96.08	43.87	19.70	13.42	118.29	33.01	7.02	82.33	45.62	32.26	11.73	6.99	1.49
18	300	4	0.1016	0.021	0.0102	1	786	88.25	59.84	50.62	116.10	41.22	177.64	88.46	40.60	18.44	12.69	108.82	30.64	6.82	75.85	42.21	29.96	11.14	6.79	1.75
19	300	4	0.1016	0.021	0.0100	1	751	83.92	56.75	47.94	110.55	38.96	169.38	84.12	38.36	17.18	11.68	103.59	28.84	6.06	72.06	39.90	28.19	10.20	6.04	1.22
20	300	4	0.1016	0.021	0.0098	1	718	80.90	54.95	46.54	106.33	37.96	162.52	81.09	37.38	17.15	11.90	99.68	28.29	6.54	69.57	38.85	27.67	10.49	6.52	1.91
21	300	4	0.1016	0.021	0.0091	1	621	69.69	47.24	39.96	91.70	32.54	140.32	69.86	32.04	14.53	9.99	85.95	24.18	5.35	59.90	33.31	23.63	8.77	5.33	1.35
22	300	4	0.1016	0.021	0.0071	1	378	42.59	28.92	24.50	55.97	19.98	85.56	42.69	19.68	9.03	6.26	52.47	14.89	3.44	36.62	20.45	14.56	5.52	3.43	1.00
23	300	4	0.1016	0.021	0.0059	1	263	30.07	20.59	17.51	39.37	14.37	59.91	30.14	14.16	6.77	4.85	36.94	10.84	2.89	25.93	14.70	10.61	4.33	2.88	1.20
24	300	4	0.1016	0.021	0.0055	1	225	26.53	18.45	15.83	34.45	13.15	51.96	26.59	12.97	6.67	5.04	32.38	10.14	3.37	23.00	13.43	9.95	4.60	3.36	1.92

Anexo 2. Valores de carga en nodo [m]   {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	300	4	0.1016	0.021	0.0052	0	203	25.11	17.95	15.57	32.28	13.19	46.83	25.30	13.03	7.49	6.01	30.48	10.61	4.53	22.02	13.57	10.43	5.63	4.52	3.23
26	300	4	0.1016	0.021	0.0051	0	196	24.30	17.38	15.09	31.22	12.79	45.26	24.48	12.64	7.29	5.86	29.48	10.30	4.43	21.32	13.16	10.13	5.50	4.42	3.18
27	300	4	0.1016	0.021	0.0050	0	189	23.38	16.70	14.49	30.05	12.28	43.60	23.55	12.13	6.97	5.59	28.37	9.87	4.21	20.50	12.63	9.71	5.24	4.20	3.00
28	300	4	0.1016	0.021	0.0051	0	196	24.30	17.38	15.09	31.22	12.79	45.26	24.48	12.64	7.29	5.86	29.48	10.30	4.43	21.32	13.16	10.13	5.50	4.42	3.18
29	300	4	0.1016	0.021	0.0053	0	210	25.82	18.40	15.93	33.24	13.47	48.30	26.01	13.30	7.57	6.04	31.37	10.80	4.50	22.62	13.87	10.62	5.65	4.49	3.16
30	300	4	0.1016	0.021	0.0059	0	263	31.68	22.35	19.26	41.00	16.17	59.91	31.92	15.96	8.76	6.83	38.65	12.81	4.90	27.66	16.67	12.59	6.34	4.90	3.22
31	300	4	0.1016	0.021	0.0073	0	398	47.60	33.47	28.79	61.72	24.11	90.37	47.97	23.79	12.88	9.96	58.16	19.02	7.04	41.51	24.85	18.67	9.22	7.03	4.48
32	300	4	0.1016	0.021	0.0091	0	621	73.49	51.43	44.11	95.56	36.80	140.32	74.07	36.29	19.25	14.68	90.00	28.84	10.12	63.98	37.96	28.30	13.53	10.10	6.13
33	300	4	0.1016	0.021	0.0118	0	1049	123.71	86.42	74.06	161.01	61.70	236.66	124.69	60.84	32.03	24.33	151.61	48.26	16.62	107.64	63.66	47.34	22.37	16.58	9.87
34	300	4	0.1016	0.021	0.0130	0	1260	148.22	103.41	88.56	193.03	73.70	283.93	149.39	72.68	38.06	28.80	181.74	57.55	19.54	128.90	76.07	56.45	26.45	19.50	11.43
35	300	4	0.1016	0.021	0.0134	0	1350	158.83	110.82	94.91	206.84	78.99	304.23	160.09	77.89	40.81	30.88	194.74	61.69	20.96	138.13	81.52	60.51	28.37	20.92	12.27
36	300	4	0.1016	0.021	0.0136	0	1396	164.11	114.46	98.00	213.76	81.54	314.48	165.41	80.41	42.05	31.79	201.25	63.65	21.53	142.70	84.16	62.43	29.19	21.48	12.54
37	300	4	0.1016	0.021	0.0136	0	1386	162.31	112.99	96.64	211.63	80.29	311.68	163.60	79.16	41.06	30.87	199.20	62.52	20.68	141.05	82.89	61.31	28.28	20.63	11.75
38	300	4	0.1016	0.021	0.0130	0	1269	149.40	104.28	89.32	194.53	74.36	286.07	150.59	73.33	38.47	29.15	183.16	58.10	19.82	129.95	76.74	56.99	26.78	19.78	11.65
39	300	4	0.1016	0.021	0.0123	0	1131	133.17	92.95	79.62	173.38	66.29	254.97	134.22	65.37	34.30	25.99	163.25	51.80	17.68	115.83	68.41	50.81	23.88	17.64	10.40
40	300	4	0.1016	0.021	0.0114	0	970	114.52	80.04	68.61	149.00	57.18	218.94	115.42	56.39	29.76	22.63	140.31	44.76	15.51	99.66	59.00	43.91	20.82	15.47	9.27
41	300	4	0.1016	0.021	0.0107	0	857	101.10	70.63	60.53	131.56	50.44	193.37	101.90	49.74	26.20	19.91	123.89	39.45	13.61	87.96	52.04	38.71	18.31	13.58	8.10
42	300	4	0.1016	0.021	0.0102	0	786	93.06	65.13	55.88	120.99	46.62	177.64	93.79	45.98	24.40	18.63	113.95	36.55	12.86	81.02	48.09	35.87	17.17	12.83	7.81
43	300	4	0.1016	0.021	0.0100	0	751	88.52	61.81	52.96	115.22	44.12	169.38	89.22	43.50	22.88	17.36	108.49	34.49	11.84	77.01	45.52	33.84	15.96	11.81	7.01
44	300	4	0.1016	0.021	0.0098	0	718	85.29	59.79	51.33	110.79	42.88	162.52	85.96	42.30	22.60	17.33	104.36	33.69	12.06	74.29	44.23	33.06	15.99	12.03	7.44
45	300	4	0.1016	0.021	0.0091	0	621	73.49	51.43	44.11	95.56	36.80	140.32	74.07	36.29	19.25	14.68	90.00	28.84	10.12	63.98	37.96	28.30	13.53	10.10	6.13
46	300	4	0.1016	0.021	0.0071	0	378	44.90	31.47	27.02	58.32	22.57	85.56	45.25	22.26	11.89	9.12	54.94	17.73	6.34	39.11	23.28	17.40	8.41	6.33	3.91
47	300	4	0.1016	0.021	0.0059	0	263	31.68	22.35	19.26	41.00	16.17	59.91	31.92	15.96	8.76	6.83	38.65	12.81	4.90	27.66	16.67	12.59	6.34	4.90	3.22
48	300	4	0.1016	0.021	0.0055	0	225	27.90	19.95	17.32	35.84	14.69	51.96	28.11	14.50	8.37	6.73	33.84	11.82	5.08	24.47	15.11	11.63	6.31	5.08	3.65

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	300	4	0.1016	0.021	0.0078	1	454	50.98	34.57	29.25	67.07	23.82	102.61	51.10	23.45	10.66	7.33	62.86	17.71	3.94	43.82	24.39	17.31	6.44	3.93	1.02
2	300	4	0.1016	0.021	0.0076	1	439	50.00	34.16	29.02	65.53	23.78	99.84	50.12	23.43	11.08	7.87	61.47	17.88	4.60	43.08	24.33	17.50	7.01	4.58	1.77
3	300	4	0.1016	0.021	0.0075	1	423	47.77	32.48	27.53	62.74	22.48	95.84	47.88	22.14	10.22	7.13	58.83	16.79	3.97	41.10	23.00	16.42	6.30	3.96	1.25
4	300	4	0.1016	0.021	0.0076	1	439	50.00	34.16	29.02	65.53	23.78	99.84	50.12	23.43	11.08	7.87	61.47	17.88	4.60	43.08	24.33	17.50	7.01	4.58	1.77
5	300	4	0.1016	0.021	0.0079	1	471	53.72	36.72	31.21	70.37	25.59	107.18	53.84	25.22	11.97	8.52	66.02	19.26	5.01	46.30	26.18	18.85	7.60	5.00	1.98
6	300	4	0.1016	0.021	0.0089	1	591	66.92	45.57	38.65	87.83	31.59	134.06	67.07	31.12	14.48	10.16	82.37	23.64	5.75	57.60	32.33	23.13	9.00	5.73	1.94
7	300	4	0.1016	0.021	0.0109	1	894	100.12	67.79	57.31	131.81	46.61	201.83	100.36	45.90	20.69	14.14	123.52	34.57	7.46	86.01	47.73	33.79	12.38	7.43	1.70
8	300	4	0.1016	0.021	0.0136	1	1396	155.56	105.04	88.66	205.07	71.95	314.48	155.93	70.84	31.45	21.22	192.13	53.15	10.78	133.51	73.70	51.93	18.47	10.74	1.78
9	300	4	0.1016	0.021	0.0177	1	2358	261.66	176.28	148.60	345.33	120.36	530.23	262.29	118.47	51.92	34.63	323.46	88.58	16.99	224.40	123.32	86.52	29.98	16.91	1.77
10	300	4	0.1016	0.021	0.0194	1	2833	314.14	211.55	178.29	414.68	144.36	636.84	314.89	142.09	62.12	41.34	388.39	106.17	20.15	269.37	147.91	103.69	35.76	20.06	1.86
11	300	4	0.1016	0.021	0.0201	1	3035	336.27	226.36	190.73	443.99	154.37	682.02	337.08	151.94	66.26	44.00	415.83	113.45	21.29	288.31	158.18	110.80	38.02	21.19	1.70
12	300	4	0.1016	0.021	0.0205	1	3138	347.02	233.34	196.50	458.42	158.90	704.58	347.85	156.38	67.77	44.75	429.30	116.58	21.26	297.41	162.83	113.83	38.57	21.17	1.00
13	300	4	0.1016	0.021	0.0204	1	3118	345.59	232.67	196.07	456.25	158.73	700.78	346.42	156.23	68.20	45.34	427.32	116.69	22.01	296.31	162.63	113.96	39.19	21.91	1.88
14	300	4	0.1016	0.021	0.0195	1	2853	316.43	213.12	179.63	417.67	145.46	641.40	317.19	143.17	62.64	41.72	391.21	107.00	20.37	271.34	149.03	104.50	36.10	20.28	1.96
15	300	4	0.1016	0.021	0.0184	1	2542	281.30	189.23	159.38	371.54	128.93	570.93	281.98	126.89	55.11	36.47	347.95	94.65	17.44	241.12	132.11	92.43	31.46	17.36	1.03
16	300	4	0.1016	0.021	0.0170	1	2180	241.82	162.88	137.29	319.18	111.18	490.12	242.40	109.43	47.90	31.91	298.96	81.79	15.60	207.37	113.91	79.88	27.62	15.53	1.53
17	300	4	0.1016	0.021	0.0160	1	1926	213.42	143.67	121.06	281.78	97.99	432.83	213.93	96.45	42.07	27.95	263.91	72.02	13.54	182.98	100.40	70.34	24.15	13.48	1.10
18	300	4	0.1016	0.021	0.0153	1	1766	196.07	132.13	111.40	258.73	90.25	397.20	196.54	88.84	39.00	26.05	242.35	66.45	12.84	168.17	92.47	64.91	22.57	12.78	1.44
19	300	4	0.1016	0.021	0.0150	1	1689	188.07	126.94	107.12	247.98	86.90	380.36	188.52	85.55	37.90	25.52	232.32	64.15	12.89	161.39	89.02	62.67	22.19	12.84	1.99
20	300	4	0.1016	0.021	0.0147	1	1613	179.52	121.14	102.21	236.74	82.90	363.17	179.95	81.61	36.10	24.27	221.78	61.16	12.21	154.04	84.92	59.75	21.10	12.16	1.80
21	300	4	0.1016	0.021	0.0136	1	1396	155.56	105.04	88.66	205.07	71.95	314.48	155.93	70.84	31.45	21.22	192.13	53.15	10.78	133.51	73.70	51.93	18.47	10.74	1.78
22	300	4	0.1016	0.021	0.0106	1	850	95.32	64.58	54.62	125.44	44.45	192.00	95.54	43.77	19.81	13.59	117.57	33.01	7.23	81.90	45.51	32.27	11.91	7.21	1.76
23	300	4	0.1016	0.021	0.0089	1	591	66.92	45.57	38.65	87.83	31.59	134.06	67.07	31.12	14.48	10.16	82.37	23.64	5.75	57.60	32.33	23.13	9.00	5.73	1.94
24	300	4	0.1016	0.021	0.0082	1	503	56.44	38.25	32.36	74.27	26.34	113.65	56.58	25.94	11.76	8.08	69.61	19.57	4.32	48.51	26.97	19.13	7.09	4.31	1.08

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	300	4	0.1016	0.021	0.0078	0	454	53.76	37.63	32.28	69.89	26.93	102.61	54.18	26.56	14.10	10.77	65.83	21.12	7.43	46.80	27.78	20.72	9.92	7.42	4.52
26	300	4	0.1016	0.021	0.0076	0	439	52.68	37.11	31.95	68.25	26.79	99.84	53.09	26.43	14.40	11.18	64.33	21.17	7.97	45.97	27.61	20.79	10.37	7.95	5.15
27	300	4	0.1016	0.021	0.0075	0	423	50.35	35.33	30.36	65.37	25.38	95.84	50.75	25.03	13.43	10.33	61.59	19.96	7.22	43.88	26.17	19.60	9.54	7.21	4.50
28	300	4	0.1016	0.021	0.0076	0	439	52.68	37.11	31.95	68.25	26.79	99.84	53.09	26.43	14.40	11.18	64.33	21.17	7.97	45.97	27.61	20.79	10.37	7.95	5.15
29	300	4	0.1016	0.021	0.0079	0	471	56.59	39.89	34.35	73.29	28.82	107.18	57.03	28.43	15.53	12.08	69.09	22.80	8.63	49.39	29.70	22.39	11.20	8.61	5.61
30	300	4	0.1016	0.021	0.0089	0	591	70.53	49.55	42.60	91.50	35.64	134.06	71.08	35.16	18.96	14.62	86.22	28.08	10.29	61.48	36.75	27.57	13.52	10.27	6.49
31	300	4	0.1016	0.021	0.0109	0	894	105.59	73.81	63.28	137.37	52.75	201.83	106.42	52.02	27.47	20.91	129.36	41.30	14.34	91.89	54.42	40.52	19.24	14.31	8.59
32	300	4	0.1016	0.021	0.0136	0	1396	164.11	114.46	98.00	213.76	81.54	314.48	165.41	80.41	42.05	31.79	201.25	63.65	21.53	142.70	84.16	62.43	29.19	21.48	12.54
33	300	4	0.1016	0.021	0.0177	0	2358	276.10	192.19	164.38	360.01	136.57	530.23	278.30	134.65	69.83	52.48	338.87	106.33	35.14	239.93	140.99	104.27	48.09	35.06	19.96
34	300	4	0.1016	0.021	0.0194	0	2833	331.49	230.67	197.25	432.31	163.83	636.84	334.13	161.52	83.64	62.80	406.91	127.49	41.96	288.03	169.15	125.02	57.52	41.87	23.72
35	300	4	0.1016	0.021	0.0201	0	3035	354.86	246.84	211.04	462.89	175.24	682.02	357.70	172.76	89.32	66.99	435.67	136.30	44.66	308.30	180.93	133.65	61.33	44.56	25.12
36	300	4	0.1016	0.021	0.0205	0	3138	366.24	254.53	217.50	477.96	180.48	704.58	369.17	177.91	91.62	68.53	449.81	140.21	45.44	318.09	186.36	137.47	62.67	45.33	25.22
37	300	4	0.1016	0.021	0.0204	0	3118	364.69	253.72	216.94	475.66	180.16	700.78	367.60	177.62	91.89	68.96	447.70	140.16	46.02	316.85	186.01	137.44	63.14	45.92	25.94
38	300	4	0.1016	0.021	0.0195	0	2853	333.90	232.37	198.72	435.43	165.07	641.40	336.57	162.74	84.31	63.33	409.85	128.47	42.34	290.14	170.42	125.98	58.01	42.25	23.97
39	300	4	0.1016	0.021	0.0184	0	2542	296.88	206.39	176.40	387.37	146.41	570.93	299.25	144.33	74.43	55.73	364.56	113.79	37.02	257.87	151.17	111.57	50.98	36.94	20.65
40	300	4	0.1016	0.021	0.0170	0	2180	255.17	177.59	151.88	332.75	126.16	490.12	257.20	124.38	64.46	48.42	313.20	98.20	32.39	221.73	130.25	96.30	44.36	32.32	18.35
41	300	4	0.1016	0.021	0.0160	0	1926	225.22	156.67	133.95	293.77	111.23	432.83	227.02	109.66	56.71	42.54	276.50	86.52	28.37	195.67	114.84	84.84	38.94	28.31	15.97
42	300	4	0.1016	0.021	0.0153	0	1766	206.89	144.05	123.22	269.73	102.39	397.20	208.53	100.95	52.41	39.42	253.89	79.74	26.43	179.80	105.70	78.20	36.13	26.38	15.06
43	300	4	0.1016	0.021	0.0150	0	1689	198.41	138.33	118.42	258.49	98.51	380.36	199.99	97.13	50.72	38.31	243.35	76.85	25.89	172.51	101.68	75.38	35.16	25.83	15.02
44	300	4	0.1016	0.021	0.0147	0	1613	189.39	132.02	113.00	246.77	93.98	363.17	190.90	92.67	48.34	36.48	232.31	73.30	24.63	164.66	97.01	71.89	33.48	24.57	14.24
45	300	4	0.1016	0.021	0.0136	0	1396	164.11	114.46	98.00	213.76	81.54	314.48	165.41	80.41	42.05	31.79	201.25	63.65	21.53	142.70	84.16	62.43	29.19	21.48	12.54
46	300	4	0.1016	0.021	0.0106	0	850	100.52	70.31	60.30	130.72	50.29	192.00	101.31	49.59	26.26	20.01	123.11	39.40	13.77	87.50	51.88	38.66	18.43	13.74	8.31
47	300	4	0.1016	0.021	0.0089	0	591	70.53	49.55	42.60	91.50	35.64	134.06	71.08	35.16	18.96	14.62	86.22	28.08	10.29	61.48	36.75	27.57	13.52	10.27	6.49
48	300	4	0.1016	0.021	0.0082	0	503	59.52	41.64	35.72	77.39	29.80	113.65	59.99	29.39	15.58	11.88	72.89	23.35	8.19	51.81	30.74	22.91	10.95	8.17	4.96

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	300	6	0.1524	0.019	0.0026	1	8	2.64	2.42	2.35	2.85	2.28	3.35	2.64	2.27	2.10	2.06	2.80	2.19	2.01	2.54	2.28	2.19	2.04	2.01	1.97
2	300	6	0.1524	0.019	0.0025	1	7	1.83	1.61	1.55	2.03	1.48	2.51	1.83	1.47	1.31	1.26	1.98	1.40	1.22	1.73	1.48	1.39	1.25	1.22	1.18
3	300	6	0.1524	0.019	0.0025	1	7	2.01	1.81	1.74	2.21	1.67	2.67	2.01	1.67	1.51	1.47	2.15	1.59	1.42	1.92	1.68	1.59	1.46	1.42	1.39
4	300	6	0.1524	0.019	0.0025	1	7	1.83	1.61	1.55	2.03	1.48	2.51	1.83	1.47	1.31	1.26	1.98	1.40	1.22	1.73	1.48	1.39	1.25	1.22	1.18
5	300	6	0.1524	0.019	0.0026	1	8	2.45	2.22	2.15	2.67	2.08	3.18	2.45	2.07	1.89	1.85	2.61	1.99	1.80	2.35	2.08	1.98	1.83	1.80	1.76
6	300	6	0.1524	0.019	0.0030	1	9	2.03	1.74	1.65	2.31	1.56	2.95	2.03	1.55	1.33	1.27	2.23	1.45	1.21	1.90	1.57	1.44	1.26	1.21	1.16
7	300	6	0.1524	0.019	0.0036	1	13	2.44	2.01	1.87	2.86	1.73	3.84	2.44	1.72	1.38	1.29	2.75	1.56	1.20	2.25	1.74	1.55	1.27	1.20	1.13
8	300	6	0.1524	0.019	0.0045	1	20	3.50	2.83	2.61	4.16	2.39	5.68	3.50	2.37	1.84	1.71	3.98	2.13	1.57	3.21	2.40	2.12	1.67	1.57	1.45
9	300	6	0.1524	0.019	0.0059	1	33	5.12	3.98	3.61	6.23	3.24	8.80	5.12	3.21	2.32	2.09	5.93	2.80	1.85	4.62	3.26	2.77	2.02	1.85	1.65
10	300	6	0.1524	0.019	0.0065	1	39	5.50	4.13	3.69	6.83	3.24	9.93	5.50	3.21	2.13	1.86	6.48	2.72	1.57	4.90	3.27	2.68	1.78	1.57	1.33
11	300	6	0.1524	0.019	0.0067	1	42	6.11	4.64	4.17	7.53	3.68	10.85	6.10	3.65	2.50	2.20	7.15	3.12	1.90	5.46	3.72	3.09	2.12	1.90	1.64
12	300	6	0.1524	0.019	0.0068	1	43	5.88	4.36	3.88	7.36	3.37	10.79	5.88	3.34	2.15	1.84	6.96	2.80	1.53	5.22	3.41	2.76	1.76	1.53	1.26
13	300	6	0.1524	0.019	0.0068	1	43	6.13	4.62	4.14	7.59	3.64	11.00	6.12	3.60	2.42	2.12	7.20	3.06	1.80	5.47	3.67	3.03	2.03	1.80	1.54
14	300	6	0.1524	0.019	0.0065	1	39	5.27	3.88	3.44	6.61	2.99	9.72	5.26	2.96	1.87	1.59	6.25	2.46	1.31	4.66	3.02	2.43	1.52	1.31	1.07
15	300	6	0.1524	0.019	0.0061	1	35	4.94	3.70	3.31	6.13	2.90	8.91	4.93	2.88	1.91	1.66	5.81	2.43	1.41	4.39	2.93	2.40	1.59	1.41	1.19
16	300	6	0.1524	0.019	0.0057	1	30	4.23	3.17	2.83	5.25	2.48	7.63	4.22	2.46	1.63	1.42	4.97	2.08	1.20	3.76	2.51	2.05	1.36	1.20	1.01
17	300	6	0.1524	0.019	0.0053	1	27	4.23	3.29	2.99	5.13	2.68	7.23	4.22	2.66	1.93	1.75	4.89	2.33	1.55	3.81	2.71	2.31	1.69	1.55	1.39
18	300	6	0.1524	0.019	0.0051	1	25	4.12	3.27	2.99	4.95	2.71	6.88	4.12	2.69	2.02	1.85	4.73	2.38	1.67	3.75	2.73	2.36	1.80	1.67	1.52
19	300	6	0.1524	0.019	0.0050	1	24	4.04	3.22	2.96	4.83	2.69	6.68	4.04	2.67	2.03	1.87	4.62	2.38	1.70	3.68	2.71	2.36	1.82	1.70	1.55
20	300	6	0.1524	0.019	0.0049	1	23	3.94	3.16	2.91	4.69	2.65	6.45	3.93	2.63	2.02	1.86	4.49	2.35	1.70	3.59	2.67	2.33	1.82	1.70	1.56
21	300	6	0.1524	0.019	0.0045	1	20	3.50	2.83	2.61	4.16	2.39	5.68	3.50	2.37	1.84	1.71	3.98	2.13	1.57	3.21	2.40	2.12	1.67	1.57	1.45
22	300	6	0.1524	0.019	0.0035	1	13	2.96	2.55	2.42	3.36	2.29	4.29	2.96	2.28	1.95	1.87	3.26	2.13	1.79	2.78	2.29	2.12	1.85	1.79	1.71
23	300	6	0.1524	0.019	0.0030	1	9	2.03	1.74	1.65	2.31	1.56	2.95	2.03	1.55	1.33	1.27	2.23	1.45	1.21	1.90	1.57	1.44	1.26	1.21	1.16
24	300	6	0.1524	0.019	0.0027	1	8	2.06	1.82	1.74	2.30	1.66	2.85	2.06	1.65	1.46	1.41	2.23	1.57	1.36	1.95	1.67	1.56	1.40	1.36	1.32

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	300	6	0.1524	0.019	0.0026	0	8	2.70	2.49	2.42	2.91	2.35	3.35	2.71	2.34	2.18	2.13	2.86	2.27	2.09	2.61	2.36	2.26	2.12	2.09	2.05
26	300	6	0.1524	0.019	0.0025	0	7	1.89	1.68	1.61	2.09	1.54	2.51	1.89	1.54	1.38	1.34	2.04	1.47	1.29	1.80	1.55	1.46	1.33	1.29	1.26
27	300	6	0.1524	0.019	0.0025	0	7	2.07	1.87	1.80	2.27	1.74	2.67	2.07	1.73	1.58	1.54	2.22	1.66	1.50	1.98	1.75	1.66	1.53	1.50	1.46
28	300	6	0.1524	0.019	0.0025	0	7	1.89	1.68	1.61	2.09	1.54	2.51	1.89	1.54	1.38	1.34	2.04	1.47	1.29	1.80	1.55	1.46	1.33	1.29	1.26
29	300	6	0.1524	0.019	0.0026	0	8	2.51	2.29	2.22	2.74	2.15	3.18	2.52	2.14	1.97	1.92	2.68	2.07	1.88	2.42	2.16	2.06	1.91	1.88	1.84
30	300	6	0.1524	0.019	0.0030	0	9	2.11	1.83	1.74	2.39	1.65	2.95	2.12	1.64	1.43	1.37	2.32	1.55	1.31	1.99	1.66	1.54	1.36	1.31	1.26
31	300	6	0.1524	0.019	0.0036	0	13	2.56	2.14	2.00	2.98	1.86	3.84	2.57	1.85	1.53	1.44	2.88	1.71	1.35	2.38	1.89	1.70	1.42	1.35	1.28
32	300	6	0.1524	0.019	0.0045	0	20	3.69	3.03	2.82	4.35	2.60	5.68	3.71	2.58	2.08	1.94	4.18	2.36	1.80	3.41	2.63	2.35	1.91	1.80	1.69
33	300	6	0.1524	0.019	0.0059	0	33	5.44	4.33	3.96	6.55	3.59	8.80	5.47	3.57	2.71	2.48	6.27	3.19	2.25	4.96	3.65	3.16	2.42	2.25	2.05
34	300	6	0.1524	0.019	0.0065	0	39	5.88	4.55	4.11	7.22	3.66	9.93	5.92	3.63	2.60	2.33	6.88	3.18	2.05	5.31	3.73	3.15	2.26	2.05	1.81
35	300	6	0.1524	0.019	0.0067	0	42	6.52	5.09	4.62	7.95	4.14	10.85	6.56	4.11	3.00	2.71	7.59	3.63	2.41	5.90	4.22	3.59	2.63	2.41	2.15
36	300	6	0.1524	0.019	0.0068	0	43	6.31	4.83	4.34	7.79	3.85	10.79	6.35	3.81	2.67	2.37	7.41	3.31	2.06	5.67	3.93	3.28	2.29	2.06	1.79
37	300	6	0.1524	0.019	0.0068	0	43	6.55	5.08	4.59	8.02	4.11	11.00	6.59	4.07	2.94	2.64	7.65	3.58	2.33	5.92	4.19	3.54	2.56	2.33	2.07
38	300	6	0.1524	0.019	0.0065	0	39	5.65	4.31	3.86	7.00	3.42	9.72	5.69	3.39	2.35	2.07	6.66	2.93	1.79	5.07	3.49	2.90	2.00	1.79	1.55
39	300	6	0.1524	0.019	0.0061	0	35	5.28	4.08	3.68	6.48	3.29	8.91	5.31	3.26	2.33	2.09	6.17	2.85	1.84	4.76	3.35	2.82	2.02	1.84	1.62
40	300	6	0.1524	0.019	0.0057	0	30	4.52	3.49	3.15	5.55	2.81	7.63	4.55	2.79	1.99	1.78	5.29	2.44	1.57	4.08	2.86	2.42	1.73	1.57	1.38
41	300	6	0.1524	0.019	0.0053	0	27	4.48	3.58	3.28	5.39	2.98	7.23	4.51	2.95	2.25	2.07	5.16	2.65	1.88	4.09	3.02	2.63	2.02	1.88	1.71
42	300	6	0.1524	0.019	0.0051	0	25	4.36	3.53	3.25	5.19	2.98	6.88	4.38	2.96	2.31	2.14	4.98	2.68	1.97	4.00	3.02	2.66	2.10	1.97	1.82
43	300	6	0.1524	0.019	0.0050	0	24	4.27	3.47	3.21	5.06	2.94	6.68	4.29	2.93	2.31	2.15	4.86	2.66	1.98	3.92	2.99	2.64	2.11	1.98	1.84
44	300	6	0.1524	0.019	0.0049	0	23	4.15	3.39	3.14	4.91	2.89	6.45	4.17	2.87	2.29	2.13	4.72	2.62	1.97	3.83	2.93	2.60	2.09	1.97	1.84
45	300	6	0.1524	0.019	0.0045	0	20	3.69	3.03	2.82	4.35	2.60	5.68	3.71	2.58	2.08	1.94	4.18	2.36	1.80	3.41	2.63	2.35	1.91	1.80	1.69
46	300	6	0.1524	0.019	0.0035	0	13	3.08	2.68	2.55	3.48	2.41	4.29	3.09	2.40	2.09	2.01	3.38	2.27	1.93	2.91	2.43	2.26	1.99	1.93	1.86
47	300	6	0.1524	0.019	0.0030	0	9	2.11	1.83	1.74	2.39	1.65	2.95	2.12	1.64	1.43	1.37	2.32	1.55	1.31	1.99	1.66	1.54	1.36	1.31	1.26
48	300	6	0.1524	0.019	0.0027	0	8	2.13	1.89	1.81	2.37	1.74	2.85	2.14	1.73	1.55	1.50	2.31	1.65	1.45	2.03	1.75	1.64	1.49	1.45	1.41

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	300	6	0.1524	0.019	0.0052	1	26	4.56	3.68	3.40	5.41	3.11	7.39	4.56	3.09	2.40	2.23	5.18	2.78	2.05	4.18	3.13	2.76	2.18	2.05	1.89
2	300	6	0.1524	0.019	0.0051	1	25	4.31	3.46	3.19	5.13	2.91	7.04	4.30	2.89	2.22	2.05	4.91	2.59	1.88	3.93	2.93	2.57	2.01	1.88	1.73
3	300	6	0.1524	0.019	0.0050	1	24	4.04	3.22	2.96	4.83	2.69	6.68	4.04	2.67	2.03	1.87	4.62	2.38	1.70	3.68	2.71	2.36	1.82	1.70	1.55
4	300	6	0.1524	0.019	0.0051	1	25	4.31	3.46	3.19	5.13	2.91	7.04	4.30	2.89	2.22	2.05	4.91	2.59	1.88	3.93	2.93	2.57	2.01	1.88	1.73
5	300	6	0.1524	0.019	0.0053	1	26	3.80	2.89	2.60	4.68	2.30	6.73	3.80	2.28	1.57	1.39	4.45	1.96	1.20	3.40	2.32	1.93	1.34	1.20	1.04
6	300	6	0.1524	0.019	0.0059	1	33	5.12	3.98	3.61	6.23	3.24	8.80	5.12	3.21	2.32	2.09	5.93	2.80	1.85	4.62	3.26	2.77	2.02	1.85	1.65
7	300	6	0.1524	0.019	0.0073	1	49	6.77	5.04	4.49	8.45	3.91	12.35	6.76	3.88	2.52	2.17	8.00	3.26	1.82	6.01	3.95	3.21	2.08	1.81	1.51
8	300	6	0.1524	0.019	0.0091	1	76	10.02	7.31	6.45	12.63	5.55	18.73	10.00	5.49	3.37	2.83	11.93	4.53	2.27	8.83	5.62	4.46	2.68	2.27	1.80
9	300	6	0.1524	0.019	0.0118	1	127	15.49	10.92	9.45	19.91	7.94	30.21	15.47	7.85	4.26	3.35	18.73	6.21	2.40	13.48	8.05	6.10	3.09	2.40	1.60
10	300	6	0.1524	0.019	0.0130	1	152	18.01	12.52	10.76	23.33	8.95	35.71	17.99	8.83	4.52	3.42	21.90	6.86	2.29	15.60	9.07	6.73	3.12	2.28	1.32
11	300	6	0.1524	0.019	0.0134	1	163	19.44	13.56	11.68	25.14	9.73	38.40	19.42	9.61	4.99	3.82	23.61	7.50	2.60	16.86	9.87	7.36	3.49	2.59	1.56
12	300	6	0.1524	0.019	0.0136	1	168	19.54	13.45	11.50	25.43	9.49	39.14	19.51	9.36	4.59	3.37	23.85	7.18	2.12	16.86	9.63	7.04	3.03	2.11	1.04
13	300	6	0.1524	0.019	0.0136	1	167	19.53	13.48	11.55	25.37	9.55	39.00	19.50	9.42	4.68	3.47	23.81	7.25	2.22	16.87	9.69	7.11	3.13	2.21	1.15
14	300	6	0.1524	0.019	0.0130	1	153	18.07	12.54	10.77	23.42	8.94	35.89	18.04	8.82	4.49	3.38	21.99	6.84	2.24	15.64	9.07	6.71	3.07	2.23	1.26
15	300	6	0.1524	0.019	0.0123	1	137	16.75	11.81	10.24	21.51	8.61	32.62	16.72	8.50	4.64	3.65	20.24	6.74	2.63	14.58	8.72	6.62	3.38	2.63	1.76
16	300	6	0.1524	0.019	0.0114	1	117	13.90	9.67	8.32	17.99	6.93	27.52	13.88	6.84	3.52	2.68	16.90	5.32	1.80	12.04	7.02	5.22	2.44	1.80	1.06
17	300	6	0.1524	0.019	0.0107	1	104	12.90	9.17	7.97	16.51	6.74	24.93	12.88	6.66	3.73	2.98	15.55	5.32	2.21	11.26	6.82	5.23	2.78	2.21	1.55
18	300	6	0.1524	0.019	0.0102	1	95	11.49	8.07	6.97	14.80	5.84	22.52	11.47	5.77	3.08	2.40	13.92	4.54	1.69	9.98	5.92	4.46	2.21	1.69	1.09
19	300	6	0.1524	0.019	0.0100	1	91	11.16	7.89	6.84	14.33	5.76	21.70	11.14	5.69	3.12	2.47	13.48	4.52	1.79	9.72	5.83	4.44	2.29	1.79	1.21
20	300	6	0.1524	0.019	0.0098	1	87	10.75	7.62	6.62	13.77	5.59	20.82	10.73	5.52	3.07	2.45	12.96	4.40	1.80	9.37	5.66	4.33	2.27	1.80	1.25
21	300	6	0.1524	0.019	0.0091	1	76	10.02	7.31	6.45	12.63	5.55	18.73	10.00	5.49	3.37	2.83	11.93	4.53	2.27	8.83	5.62	4.46	2.68	2.27	1.80
22	300	6	0.1524	0.019	0.0071	1	47	6.86	5.21	4.68	8.45	4.14	12.16	6.85	4.10	2.81	2.48	8.02	3.51	2.14	6.13	4.18	3.48	2.39	2.14	1.85
23	300	6	0.1524	0.019	0.0059	1	33	5.12	3.98	3.61	6.23	3.24	8.80	5.12	3.21	2.32	2.09	5.93	2.80	1.85	4.62	3.26	2.77	2.02	1.85	1.65
24	300	6	0.1524	0.019	0.0055	1	28	4.25	3.27	2.96	5.19	2.64	7.38	4.24	2.62	1.85	1.66	4.94	2.27	1.46	3.82	2.66	2.25	1.61	1.46	1.29

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	300	6	0.1524	0.019	0.0052	0	26	4.81	3.95	3.67	5.66	3.39	7.39	4.83	3.37	2.71	2.53	5.44	3.08	2.35	4.44	3.43	3.06	2.48	2.35	2.20
26	300	6	0.1524	0.019	0.0051	0	25	4.54	3.72	3.45	5.37	3.17	7.04	4.56	3.15	2.52	2.35	5.16	2.87	2.18	4.19	3.22	2.85	2.30	2.17	2.03
27	300	6	0.1524	0.019	0.0050	0	24	4.27	3.47	3.21	5.06	2.94	6.68	4.29	2.93	2.31	2.15	4.86	2.66	1.98	3.92	2.99	2.64	2.11	1.98	1.84
28	300	6	0.1524	0.019	0.0051	0	25	4.54	3.72	3.45	5.37	3.17	7.04	4.56	3.15	2.52	2.35	5.16	2.87	2.18	4.19	3.22	2.85	2.30	2.17	2.03
29	300	6	0.1524	0.019	0.0053	0	26	4.06	3.17	2.88	4.94	2.58	6.73	4.08	2.56	1.88	1.70	4.72	2.27	1.52	3.67	2.63	2.24	1.65	1.51	1.36
30	300	6	0.1524	0.019	0.0059	0	33	5.44	4.33	3.96	6.55	3.59	8.80	5.47	3.57	2.71	2.48	6.27	3.19	2.25	4.96	3.65	3.16	2.42	2.25	2.05
31	300	6	0.1524	0.019	0.0073	0	49	7.25	5.57	5.01	8.93	4.45	12.35	7.29	4.41	3.11	2.77	8.51	3.85	2.42	6.53	4.54	3.80	2.68	2.42	2.11
32	300	6	0.1524	0.019	0.0091	0	76	10.77	8.14	7.27	13.40	6.39	18.73	10.84	6.33	4.30	3.76	12.73	5.45	3.22	9.63	6.53	5.38	3.62	3.21	2.74
33	300	6	0.1524	0.019	0.0118	0	127	16.76	12.31	10.84	21.20	9.37	30.21	16.87	9.27	5.83	4.91	20.08	7.77	4.00	14.84	9.60	7.66	4.68	3.99	3.19
34	300	6	0.1524	0.019	0.0130	0	152	19.54	14.20	12.43	24.87	10.66	35.71	19.68	10.54	6.41	5.31	23.53	8.73	4.20	17.23	10.94	8.60	5.03	4.20	3.24
35	300	6	0.1524	0.019	0.0134	0	163	21.08	15.36	13.46	26.80	11.57	38.40	21.23	11.43	7.02	5.83	25.36	9.50	4.65	18.61	11.87	9.36	5.53	4.65	3.62
36	300	6	0.1524	0.019	0.0136	0	168	21.23	15.31	13.35	27.14	11.39	39.14	21.38	11.25	6.68	5.46	25.65	9.26	4.24	18.68	11.70	9.11	5.15	4.23	3.17
37	300	6	0.1524	0.019	0.0136	0	167	21.20	15.33	13.38	27.08	11.43	39.00	21.36	11.30	6.76	5.54	25.60	9.31	4.33	18.67	11.74	9.17	5.23	4.32	3.26
38	300	6	0.1524	0.019	0.0130	0	153	19.60	14.23	12.45	24.98	10.66	35.89	19.75	10.54	6.39	5.28	23.63	8.73	4.17	17.29	10.95	8.59	4.99	4.16	3.19
39	300	6	0.1524	0.019	0.0123	0	137	18.11	13.32	11.73	22.90	10.14	32.62	18.24	10.03	6.33	5.34	21.70	8.42	4.35	16.05	10.40	8.30	5.09	4.35	3.49
40	300	6	0.1524	0.019	0.0114	0	117	15.07	10.97	9.60	19.18	8.24	27.52	15.18	8.15	4.97	4.13	18.15	6.76	3.28	13.30	8.46	6.66	3.91	3.27	2.53
41	300	6	0.1524	0.019	0.0107	0	104	13.94	10.31	9.10	17.57	7.90	24.93	14.03	7.82	5.01	4.26	16.65	6.59	3.51	12.37	8.09	6.50	4.07	3.51	2.86
42	300	6	0.1524	0.019	0.0102	0	95	12.44	9.11	8.01	15.77	6.91	22.52	12.53	6.83	4.26	3.57	14.93	5.71	2.88	11.00	7.08	5.62	3.40	2.88	2.28
43	300	6	0.1524	0.019	0.0100	0	91	12.07	8.89	7.83	15.25	6.78	21.70	12.15	6.70	4.25	3.59	14.45	5.63	2.93	10.70	6.95	5.55	3.42	2.93	2.36
44	300	6	0.1524	0.019	0.0098	0	87	11.61	8.58	7.57	14.65	6.56	20.82	11.69	6.49	4.15	3.52	13.89	5.47	2.89	10.31	6.72	5.39	3.36	2.89	2.34
45	300	6	0.1524	0.019	0.0091	0	76	10.77	8.14	7.27	13.40	6.39	18.73	10.84	6.33	4.30	3.76	12.73	5.45	3.22	9.63	6.53	5.38	3.62	3.21	2.74
46	300	6	0.1524	0.019	0.0071	0	47	7.31	5.71	5.18	8.91	4.65	12.16	7.35	4.62	3.38	3.05	8.51	4.08	2.72	6.62	4.74	4.04	2.97	2.72	2.43
47	300	6	0.1524	0.019	0.0059	0	33	5.44	4.33	3.96	6.55	3.59	8.80	5.47	3.57	2.71	2.48	6.27	3.19	2.25	4.96	3.65	3.16	2.42	2.25	2.05
48	300	6	0.1524	0.019	0.0055	0	28	4.52	3.57	3.26	5.46	2.94	7.38	4.54	2.92	2.19	1.99	5.22	2.60	1.80	4.11	2.99	2.58	1.94	1.80	1.63

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	300	6	0.1524	0.019	0.0078	1	56	7.76	5.79	5.15	9.68	4.50	14.13	7.76	4.46	2.91	2.51	9.17	3.75	2.10	6.89	4.55	3.70	2.40	2.10	1.76
2	300	6	0.1524	0.019	0.0076	1	54	7.44	5.53	4.92	9.29	4.29	13.59	7.43	4.25	2.75	2.37	8.79	3.57	1.98	6.60	4.34	3.52	2.27	1.98	1.64
3	300	6	0.1524	0.019	0.0075	1	52	7.09	5.25	4.66	8.87	4.05	13.02	7.08	4.01	2.57	2.20	8.39	3.35	1.82	6.28	4.09	3.31	2.10	1.82	1.49
4	300	6	0.1524	0.019	0.0076	1	54	7.44	5.53	4.92	9.29	4.29	13.59	7.43	4.25	2.75	2.37	8.79	3.57	1.98	6.60	4.34	3.52	2.27	1.98	1.64
5	300	6	0.1524	0.019	0.0079	1	58	8.06	6.01	5.36	10.04	4.68	14.65	8.05	4.63	3.03	2.62	9.51	3.90	2.20	7.16	4.73	3.85	2.51	2.19	1.84
6	300	6	0.1524	0.019	0.0089	1	72	9.27	6.70	5.88	11.76	5.03	17.56	9.26	4.98	2.96	2.45	11.10	4.05	1.91	8.14	5.09	3.99	2.30	1.91	1.46
7	300	6	0.1524	0.019	0.0109	1	108	12.98	9.09	7.84	16.75	6.56	25.53	12.97	6.47	3.42	2.64	15.74	5.08	1.83	11.27	6.65	4.98	2.42	1.83	1.15
8	300	6	0.1524	0.019	0.0136	1	168	19.54	13.45	11.50	25.43	9.49	39.14	19.51	9.36	4.59	3.37	23.85	7.18	2.12	16.86	9.63	7.04	3.03	2.11	1.04
9	300	6	0.1524	0.019	0.0177	1	284	33.10	22.81	19.52	43.05	16.13	66.23	33.05	15.90	7.84	5.78	40.39	12.22	3.66	28.57	16.36	11.97	5.21	3.65	1.84
10	300	6	0.1524	0.019	0.0194	1	341	39.53	27.17	23.22	51.48	19.13	79.34	39.47	18.87	9.17	6.70	48.28	14.44	4.15	34.09	19.42	14.14	6.02	4.14	1.97
11	300	6	0.1524	0.019	0.0201	1	365	42.00	28.76	24.53	54.81	20.15	84.65	41.94	19.86	9.48	6.83	51.38	15.12	4.10	36.18	20.46	14.80	6.10	4.09	1.76
12	300	6	0.1524	0.019	0.0205	1	377	42.96	29.26	24.89	56.21	20.36	87.07	42.90	20.07	9.33	6.59	52.66	15.16	3.76	36.94	20.68	14.83	5.83	3.75	1.34
13	300	6	0.1524	0.019	0.0204	1	375	43.18	29.58	25.23	56.34	20.74	87.00	43.12	20.44	9.77	7.05	52.82	15.57	4.24	37.20	21.05	15.24	6.30	4.23	1.84
14	300	6	0.1524	0.019	0.0195	1	343	39.41	26.96	22.98	51.45	18.87	79.50	39.35	18.60	8.84	6.35	48.23	14.14	3.78	33.93	19.16	13.85	5.66	3.77	1.59
15	300	6	0.1524	0.019	0.0184	1	306	35.43	24.33	20.79	46.16	17.12	71.16	35.37	16.88	8.18	5.97	43.29	12.91	3.68	30.55	17.38	12.64	5.35	3.67	1.72
16	300	6	0.1524	0.019	0.0170	1	262	30.03	20.52	17.48	39.23	14.33	60.66	29.98	14.13	6.67	4.77	36.77	10.72	2.81	25.84	14.55	10.49	4.24	2.80	1.13
17	300	6	0.1524	0.019	0.0160	1	232	27.03	18.62	15.94	35.16	13.16	54.09	26.99	12.98	6.39	4.71	32.98	9.97	2.98	23.33	13.36	9.77	4.24	2.97	1.49
18	300	6	0.1524	0.019	0.0153	1	213	25.10	17.40	14.94	32.55	12.39	49.91	25.07	12.22	6.18	4.64	30.56	9.46	3.05	21.71	12.57	9.28	4.22	3.05	1.69
19	300	6	0.1524	0.019	0.0150	1	204	24.36	16.99	14.64	31.49	12.21	48.08	24.33	12.05	6.27	4.80	29.58	9.41	3.28	21.12	12.38	9.23	4.39	3.27	1.98
20	300	6	0.1524	0.019	0.0147	1	194	22.43	15.40	13.15	29.24	10.83	45.09	22.40	10.67	5.16	3.75	27.42	8.15	2.30	19.34	10.99	7.99	3.36	2.29	1.06
21	300	6	0.1524	0.019	0.0136	1	168	19.54	13.45	11.50	25.43	9.49	39.14	19.51	9.36	4.59	3.37	23.85	7.18	2.12	16.86	9.63	7.04	3.03	2.11	1.04
22	300	6	0.1524	0.019	0.0106	1	103	12.68	8.97	7.79	16.26	6.57	24.60	12.66	6.49	3.58	2.84	15.30	5.16	2.08	11.05	6.65	5.07	2.63	2.07	1.42
23	300	6	0.1524	0.019	0.0089	1	72	9.27	6.70	5.88	11.76	5.03	17.56	9.26	4.98	2.96	2.45	11.10	4.05	1.91	8.14	5.09	3.99	2.30	1.91	1.46
24	300	6	0.1524	0.019	0.0082	1	62	8.55	6.36	5.66	10.67	4.94	15.61	8.54	4.89	3.17	2.73	10.11	4.11	2.28	7.59	4.99	4.05	2.61	2.28	1.89

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	300	6	0.1524	0.019	0.0078	0	56	8.31	6.39	5.75	10.23	5.12	14.13	8.36	5.07	3.59	3.19	9.75	4.42	2.79	7.48	5.22	4.38	3.09	2.79	2.45
26	300	6	0.1524	0.019	0.0076	0	54	7.97	6.12	5.50	9.83	4.89	13.59	8.02	4.84	3.41	3.03	9.36	4.22	2.64	7.17	4.98	4.17	2.93	2.64	2.31
27	300	6	0.1524	0.019	0.0075	0	52	7.60	5.81	5.22	9.39	4.62	13.02	7.65	4.58	3.20	2.83	8.94	3.98	2.46	6.83	4.72	3.94	2.74	2.46	2.14
28	300	6	0.1524	0.019	0.0076	0	54	7.97	6.12	5.50	9.83	4.89	13.59	8.02	4.84	3.41	3.03	9.36	4.22	2.64	7.17	4.98	4.17	2.93	2.64	2.31
29	300	6	0.1524	0.019	0.0079	0	58	8.63	6.64	5.98	10.62	5.32	14.65	8.68	5.27	3.73	3.32	10.11	4.60	2.91	7.77	5.42	4.55	3.22	2.91	2.55
30	300	6	0.1524	0.019	0.0089	0	72	9.99	7.49	6.66	12.49	5.83	17.56	10.05	5.77	3.84	3.33	11.86	4.93	2.81	8.91	5.96	4.87	3.20	2.81	2.36
31	300	6	0.1524	0.019	0.0109	0	108	14.06	10.28	9.02	17.85	7.77	25.53	14.16	7.68	4.76	3.97	16.90	6.40	3.19	12.43	7.97	6.31	3.78	3.19	2.51
32	300	6	0.1524	0.019	0.0136	0	168	21.23	15.31	13.35	27.14	11.39	39.14	21.38	11.25	6.68	5.46	25.65	9.26	4.24	18.68	11.70	9.11	5.15	4.23	3.17
33	300	6	0.1524	0.019	0.0177	0	284	35.95	25.95	22.64	45.95	19.33	66.23	36.21	19.10	11.37	9.31	43.43	15.72	7.24	31.64	19.85	15.48	8.78	7.23	5.43
34	300	6	0.1524	0.019	0.0194	0	341	42.96	30.94	26.96	54.97	22.98	79.34	43.27	22.71	13.43	10.94	51.94	18.65	8.46	37.78	23.61	18.36	10.31	8.45	6.29
35	300	6	0.1524	0.019	0.0201	0	365	45.67	32.80	28.54	58.54	24.27	84.65	46.01	23.98	14.03	11.37	55.30	19.63	8.71	40.13	24.95	19.32	10.70	8.70	6.39
36	300	6	0.1524	0.019	0.0205	0	377	46.76	33.45	29.04	60.07	24.62	87.07	47.11	24.32	14.04	11.29	56.71	19.83	8.53	41.02	25.33	19.50	10.59	8.52	6.13
37	300	6	0.1524	0.019	0.0204	0	375	46.96	33.73	29.35	60.18	24.97	87.00	47.30	24.67	14.45	11.72	56.85	20.20	8.99	41.26	25.67	19.88	11.03	8.97	6.59
38	300	6	0.1524	0.019	0.0195	0	343	42.86	30.76	26.75	54.96	22.74	79.50	43.18	22.47	13.12	10.62	51.91	18.38	8.12	37.65	23.38	18.09	9.99	8.11	5.93
39	300	6	0.1524	0.019	0.0184	0	306	38.50	27.72	24.15	49.28	20.58	71.16	38.79	20.33	12.00	9.77	46.57	16.69	7.54	33.86	21.14	16.42	9.21	7.53	5.59
40	300	6	0.1524	0.019	0.0170	0	262	32.66	23.42	20.36	41.91	17.29	60.66	32.91	17.08	9.94	8.03	39.58	13.96	6.12	28.68	17.78	13.74	7.55	6.11	4.45
41	300	6	0.1524	0.019	0.0160	0	232	29.36	21.19	18.49	37.53	15.78	54.09	29.57	15.59	9.28	7.59	35.47	12.83	5.91	25.84	16.21	12.63	7.17	5.90	4.43
42	300	6	0.1524	0.019	0.0153	0	213	27.24	19.75	17.27	34.73	14.79	49.91	27.43	14.62	8.83	7.29	32.84	12.09	5.74	24.01	15.18	11.91	6.89	5.73	4.38
43	300	6	0.1524	0.019	0.0150	0	204	26.40	19.24	16.87	33.56	14.50	48.08	26.59	14.34	8.81	7.33	31.76	11.92	5.85	23.32	14.88	11.74	6.95	5.84	4.55
44	300	6	0.1524	0.019	0.0147	0	194	24.38	17.55	15.28	31.22	13.02	45.09	24.56	12.86	7.58	6.17	29.50	10.55	4.75	21.44	13.38	10.38	5.81	4.75	3.52
45	300	6	0.1524	0.019	0.0136	0	168	21.23	15.31	13.35	27.14	11.39	39.14	21.38	11.25	6.68	5.46	25.65	9.26	4.24	18.68	11.70	9.11	5.15	4.23	3.17
46	300	6	0.1524	0.019	0.0106	0	103	13.70	10.10	8.91	17.30	7.72	24.60	13.80	7.63	4.85	4.11	16.39	6.42	3.37	12.15	7.91	6.33	3.92	3.36	2.72
47	300	6	0.1524	0.019	0.0089	0	72	9.99	7.49	6.66	12.49	5.83	17.56	10.05	5.77	3.84	3.33	11.86	4.93	2.81	8.91	5.96	4.87	3.20	2.81	2.36
48	300	6	0.1524	0.019	0.0082	0	62	9.16	7.03	6.33	11.29	5.62	15.61	9.22	5.57	3.93	3.49	10.75	4.85	3.05	8.24	5.73	4.80	3.37	3.04	2.66

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	300	8	0.2032	0.0165	0.0026	1	3	1.89	1.84	1.83	1.93	1.81	2.04	1.89	1.81	1.78	1.77	1.92	1.80	1.76	1.87	1.81	1.79	1.76	1.76	1.75
2	300	8	0.2032	0.0165	0.0025	1	3	1.93	1.88	1.87	1.97	1.85	2.07	1.93	1.85	1.82	1.81	1.96	1.84	1.80	1.91	1.85	1.84	1.81	1.80	1.79
3	300	8	0.2032	0.0165	0.0025	1	3	1.97	1.92	1.91	2.01	1.90	2.11	1.96	1.89	1.86	1.85	1.99	1.88	1.84	1.95	1.90	1.88	1.85	1.84	1.84
4	300	8	0.2032	0.0165	0.0025	1	3	1.93	1.88	1.87	1.97	1.85	2.07	1.93	1.85	1.82	1.81	1.96	1.84	1.80	1.91	1.85	1.84	1.81	1.80	1.79
5	300	8	0.2032	0.0165	0.0026	1	3	1.85	1.80	1.79	1.89	1.77	2.01	1.85	1.77	1.73	1.72	1.88	1.75	1.71	1.83	1.77	1.75	1.72	1.71	1.71
6	300	8	0.2032	0.0165	0.0030	1	3	1.55	1.50	1.48	1.61	1.46	1.75	1.55	1.46	1.41	1.40	1.60	1.43	1.38	1.53	1.46	1.43	1.39	1.38	1.37
7	300	8	0.2032	0.0165	0.0036	1	4	1.81	1.72	1.69	1.90	1.66	2.11	1.81	1.66	1.59	1.57	1.87	1.63	1.55	1.77	1.66	1.62	1.57	1.55	1.54
8	300	8	0.2032	0.0165	0.0045	1	5	1.58	1.44	1.39	1.71	1.35	2.05	1.58	1.34	1.23	1.20	1.68	1.29	1.18	1.52	1.35	1.29	1.20	1.18	1.15
9	300	8	0.2032	0.0165	0.0059	1	8	2.22	1.98	1.91	2.45	1.83	3.01	2.22	1.82	1.63	1.59	2.38	1.73	1.54	2.11	1.83	1.73	1.57	1.54	1.50
10	300	8	0.2032	0.0165	0.0065	1	9	2.05	1.77	1.68	2.33	1.58	3.01	2.05	1.58	1.35	1.29	2.25	1.47	1.23	1.93	1.59	1.46	1.28	1.23	1.18
11	300	8	0.2032	0.0165	0.0067	1	10	2.56	2.25	2.15	2.85	2.05	3.58	2.55	2.05	1.80	1.74	2.77	1.93	1.68	2.42	2.06	1.93	1.73	1.68	1.63
12	300	8	0.2032	0.0165	0.0068	1	10	2.30	1.99	1.89	2.61	1.78	3.36	2.30	1.77	1.52	1.46	2.52	1.66	1.40	2.16	1.78	1.65	1.44	1.39	1.34
13	300	8	0.2032	0.0165	0.0068	1	10	2.36	2.04	1.94	2.66	1.84	3.41	2.35	1.83	1.58	1.52	2.57	1.71	1.45	2.22	1.84	1.71	1.50	1.45	1.40
14	300	8	0.2032	0.0165	0.0065	1	9	2.01	1.72	1.63	2.28	1.53	2.97	2.00	1.52	1.30	1.24	2.21	1.42	1.18	1.88	1.53	1.41	1.22	1.18	1.13
15	300	8	0.2032	0.0165	0.0061	1	9	2.77	2.51	2.43	3.01	2.34	3.62	2.76	2.34	2.13	2.08	2.94	2.24	2.03	2.65	2.35	2.24	2.07	2.03	1.99
16	300	8	0.2032	0.0165	0.0057	1	8	2.66	2.43	2.37	2.87	2.29	3.39	2.65	2.29	2.11	2.07	2.81	2.21	2.02	2.56	2.29	2.20	2.06	2.02	1.99
17	300	8	0.2032	0.0165	0.0053	1	7	2.28	2.08	2.02	2.46	1.96	2.93	2.27	1.95	1.80	1.76	2.41	1.88	1.72	2.19	1.96	1.88	1.75	1.72	1.69
18	300	8	0.2032	0.0165	0.0051	1	6	1.67	1.49	1.44	1.84	1.38	2.27	1.67	1.37	1.23	1.20	1.79	1.31	1.16	1.59	1.38	1.30	1.19	1.16	1.13
19	300	8	0.2032	0.0165	0.0050	1	6	1.86	1.69	1.64	2.02	1.58	2.43	1.86	1.58	1.44	1.41	1.98	1.51	1.37	1.79	1.58	1.51	1.40	1.37	1.34
20	300	8	0.2032	0.0165	0.0049	1	6	2.05	1.88	1.83	2.20	1.78	2.59	2.04	1.78	1.65	1.61	2.16	1.72	1.58	1.97	1.78	1.71	1.60	1.58	1.55
21	300	8	0.2032	0.0165	0.0045	1	5	1.58	1.44	1.39	1.71	1.35	2.05	1.58	1.34	1.23	1.20	1.68	1.29	1.18	1.52	1.35	1.29	1.20	1.18	1.15
22	300	8	0.2032	0.0165	0.0035	1	4	1.92	1.83	1.81	2.00	1.78	2.20	1.92	1.78	1.71	1.69	1.98	1.74	1.67	1.88	1.78	1.74	1.69	1.67	1.66
23	300	8	0.2032	0.0165	0.0030	1	3	1.55	1.50	1.48	1.61	1.46	1.75	1.55	1.46	1.41	1.40	1.60	1.43	1.38	1.53	1.46	1.43	1.39	1.38	1.37
24	300	8	0.2032	0.0165	0.0027	1	3	1.77	1.72	1.70	1.82	1.69	1.94	1.77	1.68	1.64	1.63	1.80	1.67	1.62	1.75	1.69	1.66	1.63	1.62	1.61

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	300	8	0.2032	0.0165	0.0026	0	3	1.91	1.86	1.85	1.95	1.83	2.04	1.91	1.83	1.80	1.79	1.94	1.82	1.78	1.89	1.84	1.82	1.79	1.78	1.77
26	300	8	0.2032	0.0165	0.0025	0	3	1.95	1.90	1.89	1.99	1.88	2.07	1.95	1.87	1.84	1.83	1.98	1.86	1.82	1.93	1.88	1.86	1.83	1.82	1.82
27	300	8	0.2032	0.0165	0.0025	0	3	1.98	1.94	1.93	2.02	1.92	2.11	1.98	1.91	1.88	1.87	2.01	1.90	1.87	1.97	1.92	1.90	1.87	1.87	1.86
28	300	8	0.2032	0.0165	0.0025	0	3	1.95	1.90	1.89	1.99	1.88	2.07	1.95	1.87	1.84	1.83	1.98	1.86	1.82	1.93	1.88	1.86	1.83	1.82	1.82
29	300	8	0.2032	0.0165	0.0026	0	3	1.87	1.82	1.81	1.91	1.79	2.01	1.87	1.79	1.76	1.75	1.90	1.78	1.74	1.85	1.80	1.78	1.75	1.74	1.73
30	300	8	0.2032	0.0165	0.0030	0	3	1.58	1.52	1.50	1.64	1.48	1.75	1.58	1.48	1.44	1.43	1.62	1.46	1.42	1.56	1.49	1.46	1.42	1.42	1.41
31	300	8	0.2032	0.0165	0.0036	0	4	1.85	1.76	1.73	1.94	1.70	2.11	1.85	1.70	1.64	1.62	1.91	1.67	1.60	1.81	1.71	1.67	1.61	1.60	1.58
32	300	8	0.2032	0.0165	0.0045	0	5	1.64	1.50	1.46	1.77	1.41	2.05	1.64	1.41	1.31	1.28	1.74	1.37	1.25	1.58	1.42	1.36	1.27	1.25	1.23
33	300	8	0.2032	0.0165	0.0059	0	8	2.32	2.09	2.02	2.55	1.94	3.01	2.33	1.93	1.76	1.71	2.49	1.86	1.66	2.22	1.95	1.85	1.70	1.66	1.62
34	300	8	0.2032	0.0165	0.0065	0	9	2.18	1.90	1.81	2.45	1.72	3.01	2.18	1.71	1.50	1.44	2.38	1.62	1.39	2.06	1.73	1.61	1.43	1.39	1.34
35	300	8	0.2032	0.0165	0.0067	0	10	2.69	2.39	2.30	2.98	2.20	3.58	2.70	2.19	1.96	1.90	2.91	2.09	1.84	2.56	2.21	2.08	1.89	1.84	1.79
36	300	8	0.2032	0.0165	0.0068	0	10	2.44	2.13	2.03	2.74	1.93	3.36	2.45	1.92	1.69	1.63	2.67	1.82	1.56	2.31	1.95	1.81	1.61	1.56	1.51
37	300	8	0.2032	0.0165	0.0068	0	10	2.49	2.19	2.09	2.79	1.99	3.41	2.50	1.98	1.74	1.68	2.71	1.88	1.62	2.36	2.00	1.87	1.67	1.62	1.56
38	300	8	0.2032	0.0165	0.0065	0	9	2.13	1.85	1.76	2.40	1.67	2.97	2.13	1.66	1.45	1.39	2.33	1.57	1.33	2.01	1.68	1.56	1.37	1.33	1.28
39	300	8	0.2032	0.0165	0.0061	0	9	2.87	2.63	2.55	3.12	2.46	3.62	2.88	2.46	2.27	2.22	3.06	2.38	2.17	2.77	2.48	2.37	2.20	2.17	2.12
40	300	8	0.2032	0.0165	0.0057	0	8	2.75	2.54	2.47	2.96	2.40	3.39	2.75	2.39	2.23	2.18	2.91	2.32	2.14	2.66	2.41	2.32	2.17	2.14	2.10
41	300	8	0.2032	0.0165	0.0053	0	7	2.36	2.17	2.11	2.55	2.05	2.93	2.36	2.04	1.90	1.86	2.50	1.98	1.82	2.28	2.06	1.98	1.85	1.82	1.79
42	300	8	0.2032	0.0165	0.0051	0	6	1.75	1.58	1.52	1.92	1.46	2.27	1.75	1.46	1.33	1.29	1.87	1.40	1.25	1.67	1.47	1.40	1.28	1.25	1.22
43	300	8	0.2032	0.0165	0.0050	0	6	1.93	1.77	1.72	2.10	1.66	2.43	1.94	1.66	1.53	1.50	2.06	1.60	1.46	1.86	1.67	1.60	1.49	1.46	1.43
44	300	8	0.2032	0.0165	0.0049	0	6	2.12	1.96	1.91	2.27	1.86	2.59	2.12	1.85	1.73	1.70	2.23	1.80	1.67	2.05	1.86	1.80	1.69	1.67	1.64
45	300	8	0.2032	0.0165	0.0045	0	5	1.64	1.50	1.46	1.77	1.41	2.05	1.64	1.41	1.31	1.28	1.74	1.37	1.25	1.58	1.42	1.36	1.27	1.25	1.23
46	300	8	0.2032	0.0165	0.0035	0	4	1.96	1.87	1.85	2.04	1.82	2.20	1.96	1.82	1.75	1.74	2.02	1.79	1.72	1.92	1.82	1.79	1.73	1.72	1.70
47	300	8	0.2032	0.0165	0.0030	0	3	1.58	1.52	1.50	1.64	1.48	1.75	1.58	1.48	1.44	1.43	1.62	1.46	1.42	1.56	1.49	1.46	1.42	1.42	1.41
48	300	8	0.2032	0.0165	0.0027	0	3	1.79	1.74	1.73	1.84	1.71	1.94	1.79	1.71	1.67	1.66	1.83	1.69	1.65	1.77	1.71	1.69	1.66	1.65	1.64

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	300	8	0.2032	0.0165	0.0052	1	6	1.56	1.37	1.31	1.73	1.25	2.17	1.55	1.25	1.10	1.07	1.68	1.18	1.03	1.47	1.25	1.18	1.06	1.03	1.00
2	300	8	0.2032	0.0165	0.0051	1	6	1.71	1.53	1.48	1.88	1.42	2.30	1.71	1.41	1.27	1.24	1.83	1.35	1.20	1.63	1.42	1.34	1.23	1.20	1.17
3	300	8	0.2032	0.0165	0.0050	1	6	1.86	1.69	1.64	2.02	1.58	2.43	1.86	1.58	1.44	1.41	1.98	1.51	1.37	1.79	1.58	1.51	1.40	1.37	1.34
4	300	8	0.2032	0.0165	0.0051	1	6	1.71	1.53	1.48	1.88	1.42	2.30	1.71	1.41	1.27	1.24	1.83	1.35	1.20	1.63	1.42	1.34	1.23	1.20	1.17
5	300	8	0.2032	0.0165	0.0053	1	7	2.40	2.21	2.15	2.58	2.08	3.03	2.39	2.08	1.93	1.89	2.53	2.01	1.85	2.31	2.09	2.01	1.88	1.85	1.82
6	300	8	0.2032	0.0165	0.0059	1	8	2.22	1.98	1.91	2.45	1.83	3.01	2.22	1.82	1.63	1.59	2.38	1.73	1.54	2.11	1.83	1.73	1.57	1.54	1.50
7	300	8	0.2032	0.0165	0.0073	1	11	2.24	1.88	1.77	2.59	1.65	3.45	2.24	1.64	1.36	1.28	2.49	1.51	1.21	2.08	1.65	1.50	1.26	1.21	1.15
8	300	8	0.2032	0.0165	0.0091	1	17	3.32	2.75	2.58	3.86	2.39	5.20	3.31	2.38	1.93	1.82	3.71	2.17	1.70	3.07	2.39	2.16	1.79	1.70	1.60
9	300	8	0.2032	0.0165	0.0118	1	28	4.88	3.92	3.62	5.79	3.31	8.05	4.86	3.29	2.53	2.34	5.54	2.94	2.15	4.45	3.32	2.91	2.29	2.15	1.98
10	300	8	0.2032	0.0165	0.0130	1	33	5.22	4.07	3.71	6.31	3.33	9.03	5.20	3.31	2.40	2.17	6.01	2.88	1.94	4.71	3.34	2.86	2.11	1.94	1.74
11	300	8	0.2032	0.0165	0.0134	1	35	5.24	4.00	3.62	6.41	3.21	9.32	5.21	3.19	2.21	1.97	6.08	2.73	1.72	4.69	3.22	2.70	1.90	1.72	1.50
12	300	8	0.2032	0.0165	0.0136	1	36	5.22	3.95	3.55	6.43	3.13	9.44	5.19	3.10	2.09	1.84	6.09	2.63	1.58	4.65	3.14	2.60	1.77	1.58	1.36
13	300	8	0.2032	0.0165	0.0136	1	36	5.42	4.16	3.76	6.63	3.34	9.62	5.40	3.32	2.32	2.07	6.29	2.85	1.81	4.86	3.35	2.82	2.00	1.81	1.59
14	300	8	0.2032	0.0165	0.0130	1	33	5.02	3.87	3.50	6.12	3.12	8.87	5.00	3.10	2.18	1.96	5.82	2.67	1.72	4.51	3.13	2.64	1.89	1.72	1.52
15	300	8	0.2032	0.0165	0.0123	1	30	5.07	4.04	3.71	6.05	3.37	8.49	5.05	3.35	2.54	2.33	5.78	2.97	2.12	4.61	3.38	2.95	2.27	2.12	1.94
16	300	8	0.2032	0.0165	0.0114	1	26	4.62	3.74	3.46	5.46	3.17	7.56	4.61	3.15	2.45	2.28	5.23	2.83	2.10	4.23	3.18	2.81	2.23	2.10	1.94
17	300	8	0.2032	0.0165	0.0107	1	23	4.11	3.33	3.09	4.85	2.83	6.71	4.10	2.81	2.19	2.04	4.65	2.52	1.88	3.77	2.83	2.51	2.00	1.88	1.74
18	300	8	0.2032	0.0165	0.0102	1	21	3.69	2.97	2.74	4.37	2.51	6.06	3.67	2.49	1.93	1.79	4.18	2.23	1.64	3.37	2.51	2.21	1.75	1.64	1.51
19	300	8	0.2032	0.0165	0.0100	1	20	3.45	2.76	2.55	4.10	2.32	5.72	3.43	2.31	1.77	1.63	3.92	2.05	1.49	3.14	2.33	2.04	1.59	1.49	1.37
20	300	8	0.2032	0.0165	0.0098	1	19	3.19	2.54	2.33	3.81	2.12	5.36	3.18	2.10	1.59	1.46	3.64	1.86	1.32	2.90	2.12	1.85	1.42	1.32	1.21
21	300	8	0.2032	0.0165	0.0091	1	17	3.32	2.75	2.58	3.86	2.39	5.20	3.31	2.38	1.93	1.82	3.71	2.17	1.70	3.07	2.39	2.16	1.79	1.70	1.60
22	300	8	0.2032	0.0165	0.0071	1	11	2.68	2.33	2.22	3.00	2.11	3.82	2.67	2.10	1.83	1.76	2.91	1.98	1.69	2.52	2.11	1.97	1.74	1.69	1.63
23	300	8	0.2032	0.0165	0.0059	1	8	2.22	1.98	1.91	2.45	1.83	3.01	2.22	1.82	1.63	1.59	2.38	1.73	1.54	2.11	1.83	1.73	1.57	1.54	1.50
24	300	8	0.2032	0.0165	0.0055	1	7	2.07	1.87	1.81	2.27	1.74	2.75	2.07	1.74	1.57	1.53	2.22	1.66	1.49	1.98	1.74	1.66	1.52	1.49	1.46

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	300	8	0.2032	0.0165	0.0052	0	6	1.63	1.46	1.40	1.81	1.34	2.17	1.64	1.34	1.20	1.16	1.76	1.28	1.13	1.56	1.35	1.27	1.15	1.13	1.09
26	300	8	0.2032	0.0165	0.0051	0	6	1.78	1.61	1.56	1.95	1.50	2.30	1.79	1.50	1.37	1.33	1.91	1.44	1.30	1.71	1.51	1.44	1.32	1.30	1.27
27	300	8	0.2032	0.0165	0.0050	0	6	1.93	1.77	1.72	2.10	1.66	2.43	1.94	1.66	1.53	1.50	2.06	1.60	1.46	1.86	1.67	1.60	1.49	1.46	1.43
28	300	8	0.2032	0.0165	0.0051	0	6	1.78	1.61	1.56	1.95	1.50	2.30	1.79	1.50	1.37	1.33	1.91	1.44	1.30	1.71	1.51	1.44	1.32	1.30	1.27
29	300	8	0.2032	0.0165	0.0053	0	7	2.48	2.30	2.24	2.66	2.17	3.03	2.48	2.17	2.03	1.99	2.61	2.11	1.95	2.40	2.18	2.10	1.98	1.95	1.92
30	300	8	0.2032	0.0165	0.0059	0	8	2.32	2.09	2.02	2.55	1.94	3.01	2.33	1.93	1.76	1.71	2.49	1.86	1.66	2.22	1.95	1.85	1.70	1.66	1.62
31	300	8	0.2032	0.0165	0.0073	0	11	2.40	2.05	1.93	2.74	1.82	3.45	2.41	1.81	1.54	1.47	2.66	1.69	1.40	2.25	1.84	1.69	1.45	1.40	1.34
32	300	8	0.2032	0.0165	0.0091	0	17	3.56	3.01	2.84	4.10	2.66	5.20	3.57	2.64	2.22	2.11	3.96	2.46	2.00	3.32	2.68	2.45	2.08	2.00	1.90
33	300	8	0.2032	0.0165	0.0118	0	28	5.28	4.37	4.06	6.20	3.76	8.05	5.30	3.74	3.03	2.84	5.97	3.43	2.65	4.89	3.81	3.41	2.79	2.65	2.49
34	300	8	0.2032	0.0165	0.0130	0	33	5.70	4.60	4.24	6.80	3.87	9.03	5.73	3.85	3.00	2.77	6.52	3.48	2.54	5.23	3.93	3.45	2.71	2.54	2.34
35	300	8	0.2032	0.0165	0.0134	0	35	5.75	4.57	4.18	6.93	3.79	9.32	5.78	3.77	2.85	2.61	6.63	3.37	2.37	5.24	3.85	3.34	2.55	2.37	2.15
36	300	8	0.2032	0.0165	0.0136	0	36	5.75	4.53	4.13	6.97	3.73	9.44	5.78	3.70	2.76	2.50	6.66	3.29	2.25	5.23	3.79	3.26	2.44	2.25	2.03
37	300	8	0.2032	0.0165	0.0136	0	36	5.95	4.74	4.34	7.16	3.94	9.62	5.99	3.91	2.98	2.73	6.86	3.50	2.48	5.43	4.00	3.47	2.66	2.48	2.26
38	300	8	0.2032	0.0165	0.0130	0	33	5.51	4.40	4.03	6.62	3.67	8.87	5.54	3.64	2.79	2.56	6.34	3.27	2.33	5.03	3.73	3.24	2.50	2.33	2.13
39	300	8	0.2032	0.0165	0.0123	0	30	5.50	4.51	4.18	6.49	3.86	8.49	5.53	3.83	3.07	2.87	6.24	3.50	2.66	5.07	3.91	3.48	2.82	2.66	2.49
40	300	8	0.2032	0.0165	0.0114	0	26	4.99	4.15	3.87	5.84	3.59	7.56	5.02	3.57	2.91	2.74	5.63	3.28	2.56	4.63	3.63	3.26	2.69	2.56	2.41
41	300	8	0.2032	0.0165	0.0107	0	23	4.44	3.69	3.44	5.19	3.20	6.71	4.46	3.18	2.60	2.45	5.00	2.93	2.29	4.12	3.24	2.91	2.41	2.29	2.16
42	300	8	0.2032	0.0165	0.0102	0	21	3.99	3.30	3.07	4.67	2.85	6.06	4.00	2.83	2.30	2.16	4.50	2.60	2.02	3.69	2.88	2.58	2.12	2.02	1.89
43	300	8	0.2032	0.0165	0.0100	0	20	3.73	3.08	2.86	4.39	2.64	5.72	3.75	2.63	2.12	1.99	4.22	2.41	1.85	3.45	2.68	2.39	1.95	1.85	1.73
44	300	8	0.2032	0.0165	0.0098	0	19	3.46	2.84	2.63	4.09	2.42	5.36	3.48	2.41	1.93	1.80	3.93	2.20	1.67	3.19	2.46	2.18	1.76	1.67	1.55
45	300	8	0.2032	0.0165	0.0091	0	17	3.56	3.01	2.84	4.10	2.66	5.20	3.57	2.64	2.22	2.11	3.96	2.46	2.00	3.32	2.68	2.45	2.08	2.00	1.90
46	300	8	0.2032	0.0165	0.0071	0	11	2.82	2.49	2.38	3.15	2.27	3.82	2.83	2.27	2.01	1.94	3.07	2.15	1.87	2.68	2.29	2.15	1.93	1.87	1.81
47	300	8	0.2032	0.0165	0.0059	0	8	2.32	2.09	2.02	2.55	1.94	3.01	2.33	1.93	1.76	1.71	2.49	1.86	1.66	2.22	1.95	1.85	1.70	1.66	1.62
48	300	8	0.2032	0.0165	0.0055	0	7	2.16	1.97	1.90	2.36	1.84	2.75	2.17	1.83	1.68	1.64	2.31	1.77	1.60	2.08	1.85	1.76	1.63	1.60	1.56

Anexo 2. Valores de carga en nodo [m]   {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	300	8	0.2032	0.0165	0.0078	1	13	3.00	2.59	2.46	3.39	2.32	4.37	2.99	2.31	1.98	1.90	3.28	2.16	1.82	2.82	2.32	2.15	1.88	1.82	1.74
2	300	8	0.2032	0.0165	0.0076	1	12	2.35	1.95	1.82	2.73	1.69	3.67	2.34	1.68	1.37	1.29	2.62	1.54	1.21	2.17	1.69	1.53	1.27	1.21	1.14
3	300	8	0.2032	0.0165	0.0075	1	12	2.69	2.30	2.18	3.05	2.06	3.97	2.68	2.05	1.74	1.67	2.95	1.91	1.59	2.52	2.06	1.90	1.65	1.59	1.52
4	300	8	0.2032	0.0165	0.0076	1	12	2.35	1.95	1.82	2.73	1.69	3.67	2.34	1.68	1.37	1.29	2.62	1.54	1.21	2.17	1.69	1.53	1.27	1.21	1.14
5	300	8	0.2032	0.0165	0.0079	1	13	2.65	2.22	2.08	3.05	1.94	4.07	2.64	1.93	1.59	1.51	2.94	1.77	1.42	2.45	1.94	1.76	1.49	1.42	1.35
6	300	8	0.2032	0.0165	0.0089	1	16	2.99	2.46	2.29	3.51	2.11	4.78	2.98	2.10	1.67	1.57	3.37	1.90	1.46	2.76	2.11	1.89	1.54	1.46	1.36
7	300	8	0.2032	0.0165	0.0109	1	24	4.30	3.48	3.23	5.07	2.96	7.00	4.28	2.94	2.30	2.14	4.86	2.64	1.97	3.94	2.97	2.62	2.09	1.97	1.83
8	300	8	0.2032	0.0165	0.0136	1	36	5.22	3.95	3.55	6.43	3.13	9.44	5.19	3.10	2.09	1.84	6.09	2.63	1.58	4.65	3.14	2.60	1.77	1.58	1.36
9	300	8	0.2032	0.0165	0.0177	1	60	7.98	5.83	5.15	10.02	4.44	15.12	7.94	4.40	2.70	2.28	9.46	3.60	1.83	7.02	4.46	3.55	2.15	1.83	1.46
10	300	8	0.2032	0.0165	0.0194	1	72	9.49	6.91	6.10	11.95	5.25	18.08	9.44	5.19	3.15	2.64	11.27	4.24	2.11	8.35	5.27	4.18	2.49	2.10	1.66
11	300	8	0.2032	0.0165	0.0201	1	77	10.03	7.26	6.39	12.66	5.48	19.23	9.97	5.42	3.23	2.69	11.94	4.40	2.12	8.80	5.50	4.33	2.53	2.11	1.63
12	300	8	0.2032	0.0165	0.0205	1	79	9.74	6.88	5.98	12.47	5.03	19.25	9.68	4.97	2.71	2.15	11.71	3.92	1.56	8.47	5.06	3.85	1.98	1.55	1.06
13	300	8	0.2032	0.0165	0.0204	1	79	10.20	7.36	6.46	12.91	5.53	19.65	10.14	5.47	3.22	2.66	12.16	4.42	2.07	8.94	5.55	4.35	2.50	2.07	1.58
14	300	8	0.2032	0.0165	0.0195	1	72	9.05	6.45	5.63	11.53	4.78	17.70	9.00	4.72	2.66	2.15	10.85	3.76	1.62	7.90	4.80	3.70	2.00	1.61	1.16
15	300	8	0.2032	0.0165	0.0184	1	65	8.90	6.58	5.85	11.11	5.09	16.60	8.85	5.04	3.21	2.75	10.50	4.18	2.27	7.87	5.11	4.13	2.62	2.27	1.87
16	300	8	0.2032	0.0165	0.0170	1	56	7.90	5.91	5.29	9.80	4.63	14.51	7.86	4.59	3.02	2.63	9.27	3.86	2.22	7.02	4.65	3.81	2.52	2.22	1.87
17	300	8	0.2032	0.0165	0.0160	1	49	6.50	4.74	4.19	8.17	3.61	12.34	6.47	3.58	2.19	1.84	7.71	2.93	1.48	5.72	3.63	2.89	1.74	1.48	1.17
18	300	8	0.2032	0.0165	0.0153	1	45	6.04	4.43	3.93	7.57	3.39	11.39	6.01	3.36	2.09	1.77	7.15	2.77	1.44	5.33	3.41	2.73	1.68	1.44	1.16
19	300	8	0.2032	0.0165	0.0150	1	43	5.75	4.21	3.73	7.22	3.22	10.87	5.72	3.19	1.97	1.67	6.81	2.62	1.35	5.07	3.23	2.59	1.58	1.35	1.08
20	300	8	0.2032	0.0165	0.0147	1	42	6.43	4.96	4.50	7.83	4.01	11.31	6.40	3.98	2.82	2.53	7.44	3.44	2.22	5.77	4.02	3.40	2.44	2.22	1.97
21	300	8	0.2032	0.0165	0.0136	1	36	5.22	3.95	3.55	6.43	3.13	9.44	5.19	3.10	2.09	1.84	6.09	2.63	1.58	4.65	3.14	2.60	1.77	1.58	1.36
22	300	8	0.2032	0.0165	0.0106	1	23	4.27	3.50	3.25	5.01	3.00	6.84	4.26	2.98	2.37	2.22	4.81	2.70	2.06	3.93	3.01	2.68	2.17	2.06	1.92
23	300	8	0.2032	0.0165	0.0089	1	16	2.99	2.46	2.29	3.51	2.11	4.78	2.98	2.10	1.67	1.57	3.37	1.90	1.46	2.76	2.11	1.89	1.54	1.46	1.36
24	300	8	0.2032	0.0165	0.0082	1	14	2.92	2.46	2.32	3.35	2.17	4.44	2.91	2.16	1.79	1.70	3.23	1.99	1.61	2.72	2.17	1.98	1.68	1.61	1.53

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	300	8	0.2032	0.0165	0.0078	0	13	3.17	2.78	2.65	3.57	2.51	4.37	3.18	2.50	2.20	2.12	3.47	2.37	2.04	3.00	2.53	2.36	2.10	2.03	1.96
26	300	8	0.2032	0.0165	0.0076	0	12	2.51	2.13	2.01	2.90	1.88	3.67	2.52	1.87	1.57	1.50	2.80	1.74	1.42	2.35	1.90	1.73	1.48	1.42	1.35
27	300	8	0.2032	0.0165	0.0075	0	12	2.85	2.48	2.36	3.22	2.24	3.97	2.86	2.23	1.94	1.87	3.13	2.10	1.79	2.69	2.26	2.09	1.85	1.79	1.72
28	300	8	0.2032	0.0165	0.0076	0	12	2.51	2.13	2.01	2.90	1.88	3.67	2.52	1.87	1.57	1.50	2.80	1.74	1.42	2.35	1.90	1.73	1.48	1.42	1.35
29	300	8	0.2032	0.0165	0.0079	0	13	2.82	2.41	2.28	3.23	2.14	4.07	2.84	2.13	1.82	1.73	3.13	2.00	1.65	2.65	2.16	1.98	1.71	1.65	1.57
30	300	8	0.2032	0.0165	0.0089	0	16	3.22	2.71	2.53	3.74	2.36	4.78	3.23	2.35	1.95	1.85	3.61	2.18	1.74	3.00	2.39	2.17	1.82	1.74	1.65
31	300	8	0.2032	0.0165	0.0109	0	24	4.64	3.86	3.60	5.42	3.34	7.00	4.66	3.33	2.72	2.56	5.23	3.06	2.40	4.31	3.39	3.04	2.52	2.40	2.26
32	300	8	0.2032	0.0165	0.0136	0	36	5.75	4.53	4.13	6.97	3.73	9.44	5.78	3.70	2.76	2.50	6.66	3.29	2.25	5.23	3.79	3.26	2.44	2.25	2.03
33	300	8	0.2032	0.0165	0.0177	0	60	8.88	6.82	6.14	10.94	5.46	15.12	8.94	5.41	3.82	3.39	10.42	4.71	2.97	7.99	5.56	4.66	3.28	2.96	2.59
34	300	8	0.2032	0.0165	0.0194	0	72	10.58	8.10	7.28	13.05	6.46	18.08	10.64	6.41	4.49	3.98	12.43	5.57	3.47	9.51	6.59	5.51	3.85	3.47	3.02
35	300	8	0.2032	0.0165	0.0201	0	77	11.19	8.54	7.66	13.85	6.78	19.23	11.26	6.72	4.67	4.12	13.18	5.83	3.58	10.05	6.92	5.76	3.99	3.57	3.10
36	300	8	0.2032	0.0165	0.0205	0	79	10.94	8.20	7.29	13.69	6.38	19.25	11.02	6.32	4.20	3.63	13.00	5.39	3.07	9.76	6.53	5.33	3.49	3.06	2.57
37	300	8	0.2032	0.0165	0.0204	0	79	11.40	8.67	7.77	14.12	6.87	19.65	11.47	6.80	4.70	4.14	13.43	5.88	3.57	10.22	7.01	5.82	3.99	3.57	3.08
38	300	8	0.2032	0.0165	0.0195	0	72	10.15	7.65	6.83	12.64	6.00	17.70	10.21	5.94	4.02	3.50	12.01	5.10	2.99	9.07	6.13	5.04	3.37	2.99	2.54
39	300	8	0.2032	0.0165	0.0184	0	65	9.87	7.65	6.92	12.10	6.18	16.60	9.93	6.13	4.41	3.95	11.54	5.38	3.49	8.92	6.30	5.32	3.84	3.49	3.09
40	300	8	0.2032	0.0165	0.0170	0	56	8.74	6.83	6.20	10.64	5.57	14.51	8.79	5.53	4.06	3.66	10.16	4.88	3.27	7.92	5.67	4.84	3.56	3.27	2.92
41	300	8	0.2032	0.0165	0.0160	0	49	7.24	5.56	5.00	8.92	4.44	12.34	7.28	4.40	3.10	2.75	8.50	3.83	2.41	6.51	4.53	3.79	2.67	2.40	2.10
42	300	8	0.2032	0.0165	0.0153	0	45	6.72	5.18	4.66	8.26	4.15	11.39	6.76	4.12	2.93	2.61	7.87	3.60	2.29	6.05	4.23	3.56	2.53	2.29	2.01
43	300	8	0.2032	0.0165	0.0150	0	43	6.40	4.93	4.44	7.88	3.95	10.87	6.44	3.91	2.77	2.47	7.50	3.42	2.16	5.76	4.03	3.38	2.39	2.16	1.90
44	300	8	0.2032	0.0165	0.0147	0	42	7.05	5.64	5.17	8.45	4.70	11.31	7.08	4.67	3.58	3.29	8.10	4.19	3.00	6.44	4.78	4.16	3.22	3.00	2.74
45	300	8	0.2032	0.0165	0.0136	0	36	5.75	4.53	4.13	6.97	3.73	9.44	5.78	3.70	2.76	2.50	6.66	3.29	2.25	5.23	3.79	3.26	2.44	2.25	2.03
46	300	8	0.2032	0.0165	0.0106	0	23	4.60	3.86	3.61	5.34	3.36	6.84	4.62	3.35	2.77	2.62	5.15	3.10	2.47	4.28	3.40	3.08	2.58	2.47	2.33
47	300	8	0.2032	0.0165	0.0089	0	16	3.22	2.71	2.53	3.74	2.36	4.78	3.23	2.35	1.95	1.85	3.61	2.18	1.74	3.00	2.39	2.17	1.82	1.74	1.65
48	300	8	0.2032	0.0165	0.0082	0	14	3.11	2.67	2.53	3.55	2.38	4.44	3.12	2.37	2.03	1.94	3.44	2.22	1.85	2.92	2.40	2.21	1.92	1.85	1.77

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	600	4	0.1016	0.021	0.0026	1	102	12.75	9.13	7.95	16.33	6.75	23.91	12.81	6.67	3.86	3.12	15.41	5.43	2.38	11.18	6.91	5.34	2.93	2.37	1.73
2	600	4	0.1016	0.021	0.0025	1	98	11.85	8.36	7.22	15.31	6.06	22.63	11.91	5.98	3.28	2.56	14.42	4.78	1.84	10.34	6.21	4.70	2.38	1.84	1.21
3	600	4	0.1016	0.021	0.0025	1	95	11.90	8.54	7.43	15.24	6.32	22.30	11.96	6.24	3.63	2.94	14.38	5.08	2.24	10.44	6.46	5.00	2.76	2.24	1.64
4	600	4	0.1016	0.021	0.0025	1	98	11.85	8.36	7.22	15.31	6.06	22.63	11.91	5.98	3.28	2.56	14.42	4.78	1.84	10.34	6.21	4.70	2.38	1.84	1.21
5	600	4	0.1016	0.021	0.0026	1	105	12.59	8.85	7.62	16.30	6.38	24.15	12.65	6.29	3.39	2.62	15.34	5.01	1.85	10.97	6.54	4.92	2.42	1.85	1.18
6	600	4	0.1016	0.021	0.0030	1	132	15.94	11.24	9.69	20.59	8.14	30.46	16.02	8.03	4.38	3.42	19.40	6.41	2.45	13.90	8.34	6.30	3.17	2.44	1.60
7	600	4	0.1016	0.021	0.0036	1	199	23.19	16.07	13.73	30.24	11.37	45.18	23.31	11.21	5.68	4.23	28.43	8.76	2.76	20.10	11.68	8.59	3.85	2.75	1.48
8	600	4	0.1016	0.021	0.0045	1	310	35.30	24.17	20.52	46.31	16.83	69.66	35.48	16.58	7.94	5.67	43.49	12.75	3.37	30.47	17.32	12.48	5.07	3.36	1.37
9	600	4	0.1016	0.021	0.0059	1	523	58.75	39.94	33.78	77.37	27.55	116.83	59.07	27.12	12.53	8.68	72.59	20.66	4.79	50.59	28.37	20.20	7.67	4.78	1.41
10	600	4	0.1016	0.021	0.0065	1	628	70.18	47.58	40.17	92.55	32.69	139.96	70.56	32.18	14.64	10.02	86.81	24.41	5.35	60.38	33.67	23.86	8.81	5.33	1.29
11	600	4	0.1016	0.021	0.0067	1	673	75.35	51.13	43.20	99.32	35.18	150.12	75.75	34.63	15.84	10.89	93.17	26.31	5.88	64.84	36.23	25.72	9.59	5.86	1.53
12	600	4	0.1016	0.021	0.0068	1	696	77.92	52.87	44.67	102.71	36.37	155.24	78.34	35.81	16.38	11.25	96.34	27.20	6.08	67.05	37.47	26.59	9.92	6.06	1.58
13	600	4	0.1016	0.021	0.0068	1	691	77.03	52.15	44.00	101.66	35.76	153.84	77.45	35.20	15.90	10.81	95.34	26.65	5.67	66.24	36.85	26.04	9.48	5.65	1.20
14	600	4	0.1016	0.021	0.0065	1	633	71.26	48.50	41.04	93.79	33.50	141.53	71.64	32.99	15.33	10.67	88.01	25.16	5.97	61.39	34.49	24.61	9.46	5.95	1.88
15	600	4	0.1016	0.021	0.0061	1	564	63.35	43.07	36.42	83.43	29.70	125.98	63.69	29.25	13.50	9.35	78.28	22.27	5.16	54.55	30.59	21.78	8.27	5.14	1.52
16	600	4	0.1016	0.021	0.0057	1	484	54.78	37.39	31.69	71.99	25.93	108.47	55.07	25.54	12.04	8.48	67.57	19.55	4.89	47.23	26.68	19.13	7.55	4.87	1.76
17	600	4	0.1016	0.021	0.0053	1	428	48.74	33.37	28.33	63.95	23.25	96.18	48.99	22.90	10.98	7.83	60.04	17.62	4.66	42.07	23.92	17.24	7.01	4.64	1.90
18	600	4	0.1016	0.021	0.0051	1	392	44.33	30.24	25.62	58.27	20.96	87.82	44.56	20.64	9.71	6.83	54.69	15.80	3.92	38.22	21.57	15.46	6.08	3.91	1.39
19	600	4	0.1016	0.021	0.0050	1	375	42.61	29.14	24.73	55.94	20.27	84.19	42.83	19.96	9.51	6.76	52.52	15.33	3.98	36.77	20.85	15.01	6.04	3.96	1.56
20	600	4	0.1016	0.021	0.0049	1	358	40.55	27.68	23.47	53.28	19.21	80.26	40.76	18.92	8.94	6.31	50.01	14.50	3.65	34.97	19.77	14.18	5.62	3.64	1.34
21	600	4	0.1016	0.021	0.0045	1	310	35.30	24.17	20.52	46.31	16.83	69.66	35.48	16.58	7.94	5.67	43.49	12.75	3.37	30.47	17.32	12.48	5.07	3.36	1.37
22	600	4	0.1016	0.021	0.0035	1	189	21.87	15.10	12.88	28.57	10.64	42.78	21.98	10.48	5.23	3.84	26.85	8.16	2.45	18.93	10.93	7.99	3.48	2.44	1.23
23	600	4	0.1016	0.021	0.0030	1	132	15.94	11.24	9.69	20.59	8.14	30.46	16.02	8.03	4.38	3.42	19.40	6.41	2.45	13.90	8.34	6.30	3.17	2.44	1.60
24	600	4	0.1016	0.021	0.0027	1	113	14.11	10.10	8.79	18.07	7.46	26.48	14.17	7.37	4.26	3.44	17.06	5.99	2.61	12.37	7.63	5.89	3.23	2.61	1.89

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	600	4	0.1016	0.021	0.0026	0	102	13.06	9.47	8.28	16.64	7.10	23.91	13.15	7.01	4.24	3.50	15.74	5.80	2.76	11.51	7.29	5.72	3.32	2.76	2.11
26	600	4	0.1016	0.021	0.0025	0	98	12.15	8.69	7.54	15.61	6.40	22.63	12.24	6.32	3.64	2.93	14.74	5.15	2.21	10.66	6.58	5.06	2.75	2.21	1.59
27	600	4	0.1016	0.021	0.0025	0	95	12.19	8.85	7.75	15.53	6.64	22.30	12.28	6.56	3.98	3.29	14.69	5.44	2.60	10.75	6.82	5.35	3.12	2.60	2.00
28	600	4	0.1016	0.021	0.0025	0	98	12.15	8.69	7.54	15.61	6.40	22.63	12.24	6.32	3.64	2.93	14.74	5.15	2.21	10.66	6.58	5.06	2.75	2.21	1.59
29	600	4	0.1016	0.021	0.0026	0	105	12.91	9.20	7.97	16.62	6.74	24.15	13.01	6.65	3.78	3.02	15.69	5.40	2.25	11.31	6.93	5.31	2.82	2.25	1.58
30	600	4	0.1016	0.021	0.0030	0	132	16.34	11.68	10.13	21.00	8.59	30.46	16.46	8.48	4.88	3.92	19.83	6.91	2.95	14.33	8.83	6.79	3.67	2.95	2.11
31	600	4	0.1016	0.021	0.0036	0	199	23.80	16.74	14.40	30.86	12.06	45.18	23.98	11.89	6.44	4.98	29.08	9.51	3.52	20.75	12.43	9.34	4.61	3.51	2.24
32	600	4	0.1016	0.021	0.0045	0	310	36.25	25.21	21.56	47.28	17.90	69.66	36.54	17.65	9.12	6.84	44.50	13.92	4.56	31.49	18.48	13.65	6.26	4.55	2.57
33	600	4	0.1016	0.021	0.0059	0	523	60.36	41.71	35.53	79.00	29.35	116.83	60.85	28.92	14.52	10.66	74.30	22.63	6.81	52.32	30.33	22.17	9.69	6.79	3.44
34	600	4	0.1016	0.021	0.0065	0	628	72.11	49.70	42.28	94.51	34.85	139.96	72.70	34.34	17.03	12.40	88.87	26.78	7.77	62.45	36.03	26.23	11.23	7.75	3.72
35	600	4	0.1016	0.021	0.0067	0	673	77.41	53.41	45.45	101.42	37.50	150.12	78.04	36.95	18.40	13.44	95.37	28.85	8.48	67.07	38.76	28.26	12.18	8.46	4.14
36	600	4	0.1016	0.021	0.0068	0	696	80.05	55.23	47.00	104.88	38.77	155.24	80.70	38.20	19.03	13.89	98.62	29.82	8.76	69.35	40.08	29.22	12.59	8.74	4.27
37	600	4	0.1016	0.021	0.0068	0	691	79.15	54.49	46.32	103.81	38.15	153.84	79.80	37.58	18.53	13.43	97.60	29.26	8.34	68.52	39.45	28.65	12.14	8.32	3.88
38	600	4	0.1016	0.021	0.0065	0	633	73.20	50.64	43.16	95.76	35.68	141.53	73.79	35.16	17.74	13.07	90.08	27.55	8.41	63.47	36.87	27.00	11.89	8.39	4.33
39	600	4	0.1016	0.021	0.0061	0	564	65.08	44.98	38.31	85.19	31.65	125.98	65.61	31.18	15.65	11.49	80.13	24.40	7.34	56.42	32.71	23.90	10.44	7.32	3.70
40	600	4	0.1016	0.021	0.0057	0	484	56.26	39.02	33.31	73.50	27.59	108.47	56.71	27.20	13.88	10.32	69.16	21.38	6.75	48.83	28.50	20.95	9.41	6.74	3.63
41	600	4	0.1016	0.021	0.0053	0	428	50.05	34.82	29.77	65.28	24.72	96.18	50.45	24.37	12.60	9.45	61.44	19.23	6.30	43.48	25.52	18.85	8.65	6.29	3.55
42	600	4	0.1016	0.021	0.0051	0	392	45.53	31.57	26.94	59.49	22.31	87.82	45.90	21.99	11.20	8.32	55.98	17.28	5.43	39.51	23.05	16.93	7.58	5.42	2.90
43	600	4	0.1016	0.021	0.0050	0	375	43.76	30.41	25.98	57.11	21.56	84.19	44.11	21.25	10.94	8.18	53.74	16.75	5.42	38.00	22.26	16.42	7.48	5.41	3.00
44	600	4	0.1016	0.021	0.0049	0	358	41.64	28.89	24.67	54.39	20.44	80.26	41.98	20.15	10.30	7.66	51.18	15.84	5.03	36.15	21.11	15.53	7.00	5.02	2.72
45	600	4	0.1016	0.021	0.0045	0	310	36.25	25.21	21.56	47.28	17.90	69.66	36.54	17.65	9.12	6.84	44.50	13.92	4.56	31.49	18.48	13.65	6.26	4.55	2.57
46	600	4	0.1016	0.021	0.0035	0	189	22.45	15.74	13.51	29.16	11.29	42.78	22.62	11.13	5.95	4.56	27.47	8.87	3.17	19.55	11.64	8.70	4.21	3.17	1.96
47	600	4	0.1016	0.021	0.0030	0	132	16.34	11.68	10.13	21.00	8.59	30.46	16.46	8.48	4.88	3.92	19.83	6.91	2.95	14.33	8.83	6.79	3.67	2.95	2.11
48	600	4	0.1016	0.021	0.0027	0	113	14.45	10.48	9.16	18.42	7.84	26.48	14.55	7.75	4.68	3.86	17.42	6.41	3.04	12.74	8.05	6.31	3.66	3.04	2.32

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	600	4	0.1016	0.021	0.0052	1	403	46.00	31.53	26.79	60.31	22.00	90.66	46.24	21.67	10.45	7.49	56.64	16.70	4.50	39.72	22.63	16.35	6.72	4.49	1.90
2	600	4	0.1016	0.021	0.0051	1	389	44.41	30.45	25.87	58.23	21.25	87.52	44.65	20.94	10.10	7.25	54.69	16.14	4.36	38.36	21.86	15.80	6.50	4.35	1.85
3	600	4	0.1016	0.021	0.0050	1	375	42.61	29.14	24.73	55.94	20.27	84.19	42.83	19.96	9.51	6.76	52.52	15.33	3.98	36.77	20.85	15.01	6.04	3.96	1.56
4	600	4	0.1016	0.021	0.0051	1	389	44.41	30.45	25.87	58.23	21.25	87.52	44.65	20.94	10.10	7.25	54.69	16.14	4.36	38.36	21.86	15.80	6.50	4.35	1.85
5	600	4	0.1016	0.021	0.0053	1	417	47.36	32.38	27.47	62.19	22.51	93.60	47.61	22.18	10.55	7.49	58.38	17.03	4.40	40.86	23.17	16.66	6.69	4.38	1.71
6	600	4	0.1016	0.021	0.0059	1	523	58.75	39.94	33.78	77.37	27.55	116.83	59.07	27.12	12.53	8.68	72.59	20.66	4.79	50.59	28.37	20.20	7.67	4.78	1.41
7	600	4	0.1016	0.021	0.0073	1	792	88.76	60.27	50.93	116.97	41.49	176.74	89.24	40.85	18.74	12.91	109.73	31.05	7.02	76.40	42.73	30.36	11.39	7.00	1.90
8	600	4	0.1016	0.021	0.0091	1	1236	137.19	92.67	78.07	181.26	63.33	274.65	137.93	62.33	27.78	18.67	169.95	47.02	9.47	117.88	65.27	45.94	16.29	9.43	1.48
9	600	4	0.1016	0.021	0.0118	1	2088	231.01	155.77	131.10	305.49	106.19	463.32	232.26	104.50	46.11	30.72	286.37	78.62	15.17	198.37	109.47	76.79	26.70	15.10	1.66
10	600	4	0.1016	0.021	0.0130	1	2508	276.72	186.32	156.69	366.22	126.75	555.86	278.23	124.72	54.56	36.06	343.25	93.63	17.38	237.51	130.69	91.43	31.23	17.30	1.15
11	600	4	0.1016	0.021	0.0134	1	2687	296.40	199.53	167.79	392.28	135.72	595.46	298.01	133.53	58.37	38.55	367.67	100.22	18.53	254.38	139.94	97.87	33.38	18.45	1.14
12	600	4	0.1016	0.021	0.0136	1	2779	306.67	206.50	173.67	405.83	140.50	615.96	308.34	138.24	60.50	40.01	380.38	103.79	19.31	263.22	144.86	101.36	34.66	19.22	1.32
13	600	4	0.1016	0.021	0.0136	1	2761	305.13	205.62	173.01	403.63	140.06	612.36	306.79	137.82	60.60	40.24	378.34	103.60	19.68	261.96	144.40	101.18	34.93	19.59	1.81
14	600	4	0.1016	0.021	0.0130	1	2526	279.04	188.00	158.16	369.16	128.01	560.13	280.56	125.96	55.31	36.69	346.03	94.65	17.87	239.55	131.98	92.44	31.82	17.79	1.52
15	600	4	0.1016	0.021	0.0123	1	2251	248.41	167.27	140.68	328.73	113.81	498.94	249.77	111.99	49.02	32.42	308.12	84.08	15.65	213.22	117.35	82.11	28.09	15.58	1.08
16	600	4	0.1016	0.021	0.0114	1	1930	213.10	143.54	120.74	281.97	97.71	427.89	214.27	96.14	42.16	27.93	264.29	72.22	13.55	182.93	100.74	70.52	24.21	13.49	1.06
17	600	4	0.1016	0.021	0.0107	1	1706	188.95	127.48	107.34	249.80	86.99	378.73	189.98	85.60	37.90	25.33	234.18	64.46	12.62	162.29	89.66	62.97	22.04	12.57	1.59
18	600	4	0.1016	0.021	0.0102	1	1564	173.31	116.97	98.50	229.09	79.84	347.29	174.26	78.57	34.85	23.32	214.78	59.20	11.68	148.87	82.30	57.83	20.31	11.62	1.56
19	600	4	0.1016	0.021	0.0100	1	1495	165.44	111.57	93.91	218.76	76.07	331.77	166.34	74.86	33.05	22.03	205.08	56.33	10.90	142.07	78.42	55.02	19.16	10.85	1.23
20	600	4	0.1016	0.021	0.0098	1	1428	158.18	106.73	89.87	209.11	72.84	317.04	159.04	71.68	31.75	21.23	196.04	53.98	10.59	135.87	75.08	52.73	18.48	10.55	1.35
21	600	4	0.1016	0.021	0.0091	1	1236	137.19	92.67	78.07	181.26	63.33	274.65	137.93	62.33	27.78	18.67	169.95	47.02	9.47	117.88	65.27	45.94	16.29	9.43	1.48
22	600	4	0.1016	0.021	0.0071	1	753	84.48	57.40	48.52	111.30	39.55	168.11	84.93	38.94	17.92	12.38	104.41	29.62	6.78	72.73	40.73	28.97	10.93	6.76	1.92
23	600	4	0.1016	0.021	0.0059	1	523	58.75	39.94	33.78	77.37	27.55	116.83	59.07	27.12	12.53	8.68	72.59	20.66	4.79	50.59	28.37	20.20	7.67	4.78	1.41
24	600	4	0.1016	0.021	0.0055	1	446	50.43	34.40	29.15	66.29	23.84	99.91	50.70	23.48	11.04	7.76	62.22	17.97	4.45	43.48	24.54	17.58	6.91	4.44	1.57

Anexo 2. Valores de carga en nodo [m]   {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	600	4	0.1016	0.021	0.0052	0	403	47.23	32.89	28.14	61.57	23.39	90.66	47.61	23.06	11.98	9.02	57.96	18.22	6.05	41.05	24.14	17.86	8.26	6.04	3.46
26	600	4	0.1016	0.021	0.0051	0	389	45.60	31.76	27.18	59.44	22.59	87.52	45.97	22.27	11.58	8.72	55.96	17.60	5.86	39.64	23.32	17.26	7.99	5.85	3.35
27	600	4	0.1016	0.021	0.0050	0	375	43.76	30.41	25.98	57.11	21.56	84.19	44.11	21.25	10.94	8.18	53.74	16.75	5.42	38.00	22.26	16.42	7.48	5.41	3.00
28	600	4	0.1016	0.021	0.0051	0	389	45.60	31.76	27.18	59.44	22.59	87.52	45.97	22.27	11.58	8.72	55.96	17.60	5.86	39.64	23.32	17.26	7.99	5.85	3.35
29	600	4	0.1016	0.021	0.0053	0	417	48.64	33.79	28.87	63.48	23.95	93.60	49.03	23.61	12.14	9.07	59.74	18.60	6.00	42.24	24.73	18.23	8.29	5.99	3.32
30	600	4	0.1016	0.021	0.0059	0	523	60.36	41.71	35.53	79.00	29.35	116.83	60.85	28.92	14.52	10.66	74.30	22.63	6.81	52.32	30.33	22.17	9.69	6.79	3.44
31	600	4	0.1016	0.021	0.0073	0	792	91.19	62.94	53.58	119.44	44.22	176.74	91.93	43.57	21.75	15.92	112.32	34.04	10.08	79.01	45.71	33.35	14.44	10.05	4.97
32	600	4	0.1016	0.021	0.0091	0	1236	140.98	96.85	82.22	185.12	67.60	274.65	142.14	66.58	32.49	23.37	174.00	51.69	14.25	121.96	69.92	50.60	21.06	14.21	6.26
33	600	4	0.1016	0.021	0.0118	0	2088	237.42	162.84	138.12	312.01	113.40	463.32	239.38	111.69	54.07	38.65	293.22	86.51	23.24	205.27	117.33	84.68	34.74	23.17	9.74
34	600	4	0.1016	0.021	0.0130	0	2508	284.43	194.82	165.11	374.05	135.41	555.86	286.78	133.35	64.12	45.60	351.47	103.11	27.08	245.80	140.13	100.91	40.90	27.00	10.86
35	600	4	0.1016	0.021	0.0134	0	2687	304.66	208.64	176.81	400.68	144.99	595.46	307.18	142.79	68.61	48.77	376.48	110.38	28.92	263.27	150.05	108.02	43.74	28.83	11.55
36	600	4	0.1016	0.021	0.0136	0	2779	315.22	215.91	183.00	414.52	150.09	615.96	317.82	147.81	71.10	50.58	389.50	114.30	30.06	272.41	155.32	111.86	45.38	29.96	12.09
37	600	4	0.1016	0.021	0.0136	0	2761	313.61	214.97	182.28	412.25	149.59	612.36	316.20	147.32	71.13	50.74	387.40	114.03	30.35	271.09	154.78	111.61	45.57	30.26	12.50
38	600	4	0.1016	0.021	0.0130	0	2526	286.80	196.55	166.64	377.05	136.73	560.13	289.17	134.66	64.94	46.29	354.31	104.20	27.64	247.90	141.49	101.98	41.56	27.55	11.31
39	600	4	0.1016	0.021	0.0123	0	2251	255.33	174.90	148.24	335.77	121.58	498.94	257.44	119.74	57.60	40.98	315.50	92.59	24.35	220.66	125.82	90.62	36.76	24.28	9.80
40	600	4	0.1016	0.021	0.0114	0	1930	219.04	150.08	127.22	288.00	104.37	427.89	220.85	102.79	49.52	35.26	270.62	79.51	21.01	189.31	108.00	77.82	31.65	20.95	8.53
41	600	4	0.1016	0.021	0.0107	0	1706	194.19	133.26	113.07	255.13	92.87	378.73	195.79	91.47	44.40	31.81	239.77	70.91	19.22	167.93	96.08	69.41	28.62	19.16	8.19
42	600	4	0.1016	0.021	0.0102	0	1564	178.12	122.26	103.75	233.98	85.24	347.29	179.59	83.96	40.81	29.26	219.90	65.10	17.72	154.04	88.18	63.73	26.34	17.67	7.61
43	600	4	0.1016	0.021	0.0100	0	1495	170.03	116.63	98.93	223.43	81.23	331.77	171.43	80.01	38.75	27.72	209.98	61.98	16.68	147.01	84.04	60.67	24.92	16.63	7.02
44	600	4	0.1016	0.021	0.0098	0	1428	162.57	111.57	94.67	213.58	77.76	317.04	163.91	76.59	37.19	26.65	200.72	59.38	16.11	140.59	80.45	58.13	23.98	16.06	6.88
45	600	4	0.1016	0.021	0.0091	0	1236	140.98	96.85	82.22	185.12	67.60	274.65	142.14	66.58	32.49	23.37	174.00	51.69	14.25	121.96	69.92	50.60	21.06	14.21	6.26
46	600	4	0.1016	0.021	0.0071	0	753	86.79	59.94	51.04	113.64	42.14	168.11	87.50	41.53	20.78	15.24	106.88	32.46	9.69	75.22	43.56	31.81	13.83	9.66	4.83
47	600	4	0.1016	0.021	0.0059	0	523	60.36	41.71	35.53	79.00	29.35	116.83	60.85	28.92	14.52	10.66	74.30	22.63	6.81	52.32	30.33	22.17	9.69	6.79	3.44
48	600	4	0.1016	0.021	0.0055	0	446	51.79	35.91	30.64	67.68	25.37	99.91	52.21	25.01	12.74	9.45	63.68	19.65	6.17	44.95	26.21	19.26	8.62	6.15	3.29

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	600	4	0.1016	0.021	0.0078	1	904	100.74	68.19	57.53	132.96	46.75	201.23	101.28	46.02	20.76	14.10	124.69	34.83	7.38	86.62	48.17	34.03	12.36	7.35	1.53
2	600	4	0.1016	0.021	0.0076	1	873	97.68	66.26	55.97	128.77	45.57	194.67	98.20	44.86	20.48	14.05	120.79	34.06	7.56	84.05	46.93	33.29	12.38	7.53	1.92
3	600	4	0.1016	0.021	0.0075	1	842	94.12	63.82	53.89	124.12	43.85	187.68	94.63	43.17	19.66	13.46	116.42	32.75	7.19	80.98	45.17	32.01	11.84	7.17	1.75
4	600	4	0.1016	0.021	0.0076	1	873	97.68	66.26	55.97	128.77	45.57	194.67	98.20	44.86	20.48	14.05	120.79	34.06	7.56	84.05	46.93	33.29	12.38	7.53	1.92
5	600	4	0.1016	0.021	0.0079	1	936	104.31	70.61	59.57	137.67	48.41	208.35	104.87	47.65	21.50	14.60	129.10	36.06	7.64	89.69	49.88	35.24	12.80	7.61	1.59
6	600	4	0.1016	0.021	0.0089	1	1175	130.44	88.12	74.25	172.34	60.23	261.12	131.15	59.28	26.44	17.78	161.58	44.73	9.03	112.08	62.08	43.70	15.52	8.99	1.43
7	600	4	0.1016	0.021	0.0109	1	1779	196.71	132.60	111.59	260.17	90.36	394.65	197.78	88.92	39.16	26.05	243.88	66.87	12.80	168.90	93.15	65.31	22.62	12.74	1.29
8	600	4	0.1016	0.021	0.0136	1	2779	306.67	206.50	173.67	405.83	140.50	615.96	308.34	138.24	60.50	40.01	380.38	103.79	19.31	263.22	144.86	101.36	34.66	19.22	1.32
9	600	4	0.1016	0.021	0.0177	1	4696	517.76	348.47	292.99	685.35	236.93	1040.46	520.59	233.12	101.74	67.11	642.33	174.90	32.13	444.33	244.31	170.78	58.07	31.98	1.72
10	600	4	0.1016	0.021	0.0194	1	5642	621.63	418.21	351.54	822.99	284.19	1249.68	625.03	279.61	121.75	80.14	771.30	209.66	38.11	533.39	293.06	204.71	69.28	37.93	1.58
11	600	4	0.1016	0.021	0.0201	1	6045	666.14	448.20	376.77	881.88	304.61	1339.04	669.78	299.70	130.57	85.99	826.50	224.75	40.95	571.60	314.11	219.45	74.35	40.76	1.81
12	600	4	0.1016	0.021	0.0205	1	6251	688.26	462.87	389.00	911.37	314.37	1384.16	692.03	309.30	134.38	88.28	854.10	231.79	41.70	590.49	324.19	226.30	76.24	41.50	1.22
13	600	4	0.1016	0.021	0.0204	1	6210	684.28	460.39	387.01	905.91	312.88	1375.55	688.02	307.84	134.09	88.29	849.02	230.85	42.03	587.17	322.64	225.40	76.33	41.83	1.82
14	600	4	0.1016	0.021	0.0195	1	5682	626.33	421.49	354.35	829.11	286.53	1258.80	629.76	281.92	122.95	81.04	777.06	211.47	38.71	537.48	295.45	206.49	70.10	38.53	1.93
15	600	4	0.1016	0.021	0.0184	1	5064	558.18	375.62	315.78	738.90	255.33	1121.86	561.23	251.22	109.54	72.19	692.51	188.44	34.47	478.99	263.29	183.99	62.44	34.30	1.68
16	600	4	0.1016	0.021	0.0170	1	4342	478.99	322.47	271.17	633.93	219.34	962.25	481.60	215.82	94.35	62.33	594.16	161.99	29.99	411.09	226.16	158.18	53.97	29.85	1.88
17	600	4	0.1016	0.021	0.0160	1	3836	422.64	284.34	239.01	559.55	193.22	849.65	424.95	190.11	82.78	54.48	524.40	142.54	25.90	362.65	199.25	139.18	47.10	25.78	1.07
18	600	4	0.1016	0.021	0.0153	1	3517	387.96	261.18	219.62	513.46	177.65	779.40	390.08	174.79	76.40	50.47	481.25	131.19	24.27	332.96	183.17	128.11	43.70	24.16	1.50
19	600	4	0.1016	0.021	0.0150	1	3362	370.48	249.27	209.55	490.47	169.41	744.72	372.51	166.68	72.62	47.82	459.67	125.00	22.78	317.91	174.69	122.05	41.35	22.67	1.01
20	600	4	0.1016	0.021	0.0147	1	3211	353.91	238.15	200.21	468.51	161.88	711.34	355.85	159.28	69.44	45.76	439.09	119.46	21.83	303.70	166.93	116.65	39.57	21.73	1.05
21	600	4	0.1016	0.021	0.0136	1	2779	306.67	206.50	173.67	405.83	140.50	615.96	308.34	138.24	60.50	40.01	380.38	103.79	19.31	263.22	144.86	101.36	34.66	19.22	1.32
22	600	4	0.1016	0.021	0.0106	1	1691	186.83	125.89	105.91	247.16	85.74	375.01	187.85	84.36	37.07	24.60	231.68	63.40	12.01	160.40	88.39	61.92	21.34	11.95	1.06
23	600	4	0.1016	0.021	0.0089	1	1175	130.44	88.12	74.25	172.34	60.23	261.12	131.15	59.28	26.44	17.78	161.58	44.73	9.03	112.08	62.08	43.70	15.52	8.99	1.43
24	600	4	0.1016	0.021	0.0082	1	1001	110.96	74.90	63.08	146.66	51.14	222.31	111.56	50.33	22.34	14.96	137.50	37.93	7.51	95.32	52.71	37.05	13.04	7.48	1.04

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	600	4	0.1016	0.021	0.0078	0	904	103.52	71.25	60.56	135.78	49.87	201.23	104.36	49.13	24.20	17.54	127.65	38.24	10.87	89.61	51.57	37.45	15.85	10.84	5.03
26	600	4	0.1016	0.021	0.0076	0	873	100.36	69.22	58.90	131.50	48.57	194.67	101.17	47.86	23.80	17.37	123.65	37.35	10.93	86.93	50.21	36.58	15.74	10.90	5.30
27	600	4	0.1016	0.021	0.0075	0	842	96.71	66.67	56.71	126.74	46.75	187.68	97.49	46.07	22.86	16.65	119.18	35.93	10.44	83.76	48.34	35.19	15.08	10.42	5.01
28	600	4	0.1016	0.021	0.0076	0	873	100.36	69.22	58.90	131.50	48.57	194.67	101.17	47.86	23.80	17.37	123.65	37.35	10.93	86.93	50.21	36.58	15.74	10.90	5.30
29	600	4	0.1016	0.021	0.0079	0	936	107.18	73.78	62.71	140.59	51.63	208.35	108.06	50.87	25.06	18.16	132.17	39.59	11.26	92.78	53.39	38.77	16.41	11.22	5.21
30	600	4	0.1016	0.021	0.0089	0	1175	134.05	92.10	78.19	176.01	64.29	261.12	135.15	63.32	30.91	22.24	165.43	49.16	13.57	115.97	66.50	48.13	20.04	13.53	5.98
31	600	4	0.1016	0.021	0.0109	0	1779	202.18	138.63	117.56	265.73	96.50	394.65	203.84	95.04	45.95	32.81	249.72	73.59	19.68	174.78	99.85	72.03	29.48	19.62	8.18
32	600	4	0.1016	0.021	0.0136	0	2779	315.22	215.91	183.00	414.52	150.09	615.96	317.82	147.81	71.10	50.58	389.50	114.30	30.06	272.41	155.32	111.86	45.38	29.96	12.09
33	600	4	0.1016	0.021	0.0177	0	4696	532.21	364.39	308.76	700.02	253.14	1040.46	536.61	249.29	119.65	84.97	657.74	192.65	50.28	459.86	261.99	188.53	76.17	50.13	19.92
34	600	4	0.1016	0.021	0.0194	0	5642	638.98	437.33	370.50	840.62	303.67	1249.68	644.27	299.04	143.28	101.60	789.81	230.99	59.92	552.05	314.30	226.04	91.03	59.74	23.44
35	600	4	0.1016	0.021	0.0201	0	6045	684.73	468.69	397.08	900.77	325.48	1339.04	690.39	320.52	153.63	108.98	846.34	247.61	64.33	591.60	336.86	242.30	97.66	64.13	25.24
36	600	4	0.1016	0.021	0.0205	0	6251	707.49	484.06	410.00	930.91	335.95	1384.16	713.34	330.83	158.23	112.05	874.62	255.42	65.87	611.17	347.73	249.94	100.34	65.67	25.45
37	600	4	0.1016	0.021	0.0204	0	6210	703.38	481.44	407.88	925.32	334.32	1375.55	709.20	329.23	157.78	111.91	869.40	254.32	66.04	607.71	346.02	248.88	100.28	65.84	25.88
38	600	4	0.1016	0.021	0.0195	0	5682	643.81	440.75	373.44	846.87	306.14	1258.80	649.13	301.48	144.62	102.65	795.70	232.95	60.68	556.27	316.84	227.97	92.01	60.50	23.94
39	600	4	0.1016	0.021	0.0184	0	5064	573.75	392.78	332.79	754.73	272.81	1121.86	578.50	268.66	128.86	91.45	709.13	207.58	54.05	495.74	282.35	203.14	81.97	53.88	21.30
40	600	4	0.1016	0.021	0.0170	0	4342	492.34	337.18	285.75	647.50	234.33	962.25	496.41	230.77	110.91	78.84	608.40	178.40	46.77	425.45	242.50	174.59	70.71	46.63	18.70
41	600	4	0.1016	0.021	0.0160	0	3836	434.44	297.34	251.90	571.54	206.46	849.65	438.03	203.32	97.41	69.07	536.99	157.04	40.74	375.34	213.69	153.68	61.89	40.61	15.93
42	600	4	0.1016	0.021	0.0153	0	3517	398.77	273.10	231.44	524.45	189.78	779.40	402.07	186.90	89.82	63.84	492.78	144.49	37.87	344.60	196.41	141.40	57.26	37.75	15.13
43	600	4	0.1016	0.021	0.0150	0	3362	380.82	260.67	220.84	500.98	181.02	744.72	383.97	178.26	85.44	60.61	470.70	137.71	35.78	329.03	187.35	134.76	54.31	35.67	14.04
44	600	4	0.1016	0.021	0.0147	0	3211	363.79	249.03	211.00	478.54	172.97	711.34	366.80	170.33	81.69	57.97	449.63	131.60	34.25	314.32	179.01	128.79	51.96	34.15	13.49
45	600	4	0.1016	0.021	0.0136	0	2779	315.22	215.91	183.00	414.52	150.09	615.96	317.82	147.81	71.10	50.58	389.50	114.30	30.06	272.41	155.32	111.86	45.38	29.96	12.09
46	600	4	0.1016	0.021	0.0106	0	1691	192.03	131.62	111.59	252.45	91.57	375.01	193.62	90.19	43.52	31.03	237.23	69.79	18.54	165.99	94.75	68.31	27.86	18.49	7.61
47	600	4	0.1016	0.021	0.0089	0	1175	134.05	92.10	78.19	176.01	64.29	261.12	135.15	63.32	30.91	22.24	165.43	49.16	13.57	115.97	66.50	48.13	20.04	13.53	5.98
48	600	4	0.1016	0.021	0.0082	0	1001	114.04	78.29	66.44	149.79	54.59	222.31	114.98	53.77	26.16	18.77	140.78	41.71	11.38	98.63	56.48	40.83	16.90	11.35	4.91

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	600	6	0.1524	0.019	0.0026	1	13	2.34	1.91	1.77	2.77	1.62	3.70	2.35	1.61	1.28	1.19	2.66	1.46	1.10	2.15	1.64	1.45	1.17	1.10	1.02
2	600	6	0.1524	0.019	0.0025	1	13	2.71	2.29	2.16	3.12	2.02	4.02	2.72	2.01	1.69	1.60	3.02	1.87	1.51	2.53	2.04	1.85	1.58	1.51	1.44
3	600	6	0.1524	0.019	0.0025	1	13	3.08	2.67	2.54	3.47	2.41	4.34	3.08	2.40	2.09	2.00	3.37	2.26	1.92	2.90	2.42	2.25	1.98	1.92	1.85
4	600	6	0.1524	0.019	0.0025	1	13	2.71	2.29	2.16	3.12	2.02	4.02	2.72	2.01	1.69	1.60	3.02	1.87	1.51	2.53	2.04	1.85	1.58	1.51	1.44
5	600	6	0.1524	0.019	0.0026	1	14	2.96	2.52	2.37	3.41	2.22	4.37	2.97	2.21	1.86	1.77	3.29	2.06	1.68	2.77	2.24	2.04	1.75	1.68	1.60
6	600	6	0.1524	0.019	0.0030	1	17	3.14	2.58	2.39	3.69	2.21	4.90	3.15	2.19	1.76	1.64	3.55	2.00	1.52	2.89	2.23	1.98	1.61	1.52	1.42
7	600	6	0.1524	0.019	0.0036	1	25	4.01	3.15	2.87	4.84	2.59	6.67	4.01	2.57	1.91	1.73	4.63	2.28	1.56	3.63	2.62	2.25	1.69	1.56	1.41
8	600	6	0.1524	0.019	0.0045	1	38	5.20	3.86	3.43	6.51	2.99	9.36	5.21	2.96	1.92	1.65	6.17	2.49	1.37	4.62	3.04	2.46	1.58	1.37	1.13
9	600	6	0.1524	0.019	0.0059	1	64	8.56	6.31	5.57	10.78	4.83	15.61	8.58	4.78	3.02	2.57	10.20	3.99	2.10	7.58	4.91	3.94	2.44	2.10	1.70
10	600	6	0.1524	0.019	0.0065	1	76	9.39	6.68	5.80	12.05	4.90	17.85	9.42	4.84	2.73	2.18	11.36	3.90	1.62	8.21	5.00	3.83	2.04	1.62	1.14
11	600	6	0.1524	0.019	0.0067	1	82	10.63	7.73	6.78	13.48	5.82	19.70	10.66	5.76	3.50	2.91	12.74	4.75	2.31	9.37	5.93	4.68	2.76	2.31	1.79
12	600	6	0.1524	0.019	0.0068	1	84	10.19	7.19	6.21	13.14	5.22	19.57	10.22	5.15	2.82	2.21	12.38	4.11	1.59	8.88	5.33	4.04	2.05	1.59	1.05
13	600	6	0.1524	0.019	0.0068	1	84	10.68	7.70	6.73	13.61	5.74	20.00	10.71	5.68	3.36	2.75	12.85	4.64	2.14	9.38	5.86	4.57	2.59	2.13	1.60
14	600	6	0.1524	0.019	0.0065	1	77	9.92	7.19	6.30	12.60	5.40	18.44	9.95	5.34	3.22	2.66	11.90	4.39	2.10	8.73	5.50	4.33	2.52	2.10	1.61
15	600	6	0.1524	0.019	0.0061	1	69	9.21	6.78	5.99	11.60	5.19	16.81	9.24	5.13	3.24	2.75	10.98	4.29	2.25	8.16	5.28	4.23	2.62	2.24	1.81
16	600	6	0.1524	0.019	0.0057	1	59	7.74	5.66	4.98	9.79	4.29	14.26	7.77	4.25	2.62	2.20	9.26	3.52	1.77	6.84	4.37	3.47	2.09	1.77	1.40
17	600	6	0.1524	0.019	0.0053	1	52	6.71	4.87	4.27	8.52	3.66	12.47	6.73	3.62	2.19	1.81	8.05	2.98	1.43	5.91	3.73	2.93	1.71	1.43	1.10
18	600	6	0.1524	0.019	0.0051	1	48	6.48	4.79	4.25	8.14	3.69	11.76	6.50	3.65	2.34	1.99	7.71	3.06	1.64	5.75	3.75	3.02	1.90	1.64	1.34
19	600	6	0.1524	0.019	0.0050	1	46	6.31	4.69	4.17	7.89	3.63	11.35	6.32	3.60	2.34	2.01	7.48	3.04	1.68	5.60	3.69	3.00	1.93	1.68	1.39
20	600	6	0.1524	0.019	0.0049	1	44	6.09	4.55	4.05	7.61	3.54	10.91	6.11	3.50	2.30	1.99	7.21	2.97	1.67	5.42	3.60	2.93	1.91	1.67	1.40
21	600	6	0.1524	0.019	0.0045	1	38	5.20	3.86	3.43	6.51	2.99	9.36	5.21	2.96	1.92	1.65	6.17	2.49	1.37	4.62	3.04	2.46	1.58	1.37	1.13
22	600	6	0.1524	0.019	0.0035	1	24	4.04	3.23	2.97	4.84	2.70	6.58	4.05	2.68	2.05	1.88	4.63	2.40	1.72	3.69	2.73	2.38	1.84	1.72	1.57
23	600	6	0.1524	0.019	0.0030	1	17	3.14	2.58	2.39	3.69	2.21	4.90	3.15	2.19	1.76	1.64	3.55	2.00	1.52	2.89	2.23	1.98	1.61	1.52	1.42
24	600	6	0.1524	0.019	0.0027	1	15	3.19	2.71	2.55	3.66	2.40	4.69	3.20	2.38	2.01	1.91	3.54	2.22	1.81	2.98	2.41	2.21	1.89	1.81	1.73

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	600	6	0.1524	0.019	0.0026	0	13	2.40	1.98	1.83	2.83	1.69	3.70	2.41	1.68	1.35	1.26	2.72	1.54	1.18	2.22	1.72	1.53	1.24	1.18	1.10
26	600	6	0.1524	0.019	0.0025	0	13	2.77	2.36	2.22	3.18	2.09	4.02	2.78	2.08	1.76	1.67	3.08	1.94	1.59	2.59	2.11	1.93	1.65	1.59	1.51
27	600	6	0.1524	0.019	0.0025	0	13	3.13	2.74	2.60	3.53	2.47	4.34	3.14	2.46	2.16	2.07	3.43	2.33	1.99	2.96	2.49	2.32	2.05	1.99	1.92
28	600	6	0.1524	0.019	0.0025	0	13	2.77	2.36	2.22	3.18	2.09	4.02	2.78	2.08	1.76	1.67	3.08	1.94	1.59	2.59	2.11	1.93	1.65	1.59	1.51
29	600	6	0.1524	0.019	0.0026	0	14	3.03	2.59	2.44	3.47	2.29	4.37	3.04	2.28	1.94	1.85	3.36	2.13	1.76	2.84	2.32	2.12	1.83	1.76	1.68
30	600	6	0.1524	0.019	0.0030	0	17	3.22	2.66	2.48	3.77	2.30	4.90	3.23	2.28	1.85	1.74	3.63	2.10	1.62	2.98	2.33	2.08	1.71	1.62	1.52
31	600	6	0.1524	0.019	0.0036	0	25	4.13	3.28	3.01	4.97	2.73	6.67	4.15	2.71	2.06	1.88	4.75	2.42	1.71	3.76	2.77	2.40	1.84	1.71	1.56
32	600	6	0.1524	0.019	0.0045	0	38	5.38	4.07	3.63	6.70	3.20	9.36	5.42	3.17	2.15	1.88	6.37	2.72	1.61	4.82	3.27	2.69	1.81	1.61	1.37
33	600	6	0.1524	0.019	0.0059	0	64	8.88	6.66	5.92	11.10	5.18	15.61	8.94	5.13	3.42	2.96	10.54	4.38	2.50	7.92	5.30	4.33	2.84	2.50	2.10
34	600	6	0.1524	0.019	0.0065	0	76	9.77	7.10	6.21	12.44	5.33	17.85	9.84	5.27	3.21	2.65	11.76	4.37	2.10	8.62	5.47	4.30	2.51	2.10	1.62
35	600	6	0.1524	0.019	0.0067	0	82	11.04	8.18	7.23	13.90	6.28	19.70	11.11	6.22	4.01	3.42	13.18	5.25	2.83	9.81	6.43	5.18	3.27	2.82	2.31
36	600	6	0.1524	0.019	0.0068	0	84	10.61	7.65	6.67	13.57	5.69	19.57	10.69	5.63	3.34	2.73	12.83	4.63	2.12	9.34	5.85	4.56	2.58	2.12	1.58
37	600	6	0.1524	0.019	0.0068	0	84	11.10	8.16	7.19	14.04	6.22	20.00	11.18	6.15	3.88	3.27	13.30	5.16	2.66	9.83	6.37	5.08	3.12	2.66	2.13
38	600	6	0.1524	0.019	0.0065	0	77	10.30	7.61	6.72	12.99	5.83	18.44	10.37	5.77	3.69	3.14	12.31	4.86	2.58	9.14	5.97	4.80	3.00	2.58	2.10
39	600	6	0.1524	0.019	0.0061	0	69	9.56	7.16	6.37	11.95	5.57	16.81	9.62	5.52	3.67	3.17	11.35	4.71	2.68	8.52	5.70	4.65	3.05	2.67	2.24
40	600	6	0.1524	0.019	0.0057	0	59	8.04	5.98	5.30	10.09	4.62	14.26	8.09	4.57	2.99	2.56	9.57	3.88	2.14	7.15	4.73	3.83	2.45	2.14	1.77
41	600	6	0.1524	0.019	0.0053	0	52	6.97	5.15	4.55	8.78	3.95	12.47	7.02	3.91	2.51	2.13	8.33	3.30	1.76	6.19	4.05	3.25	2.04	1.76	1.43
42	600	6	0.1524	0.019	0.0051	0	48	6.72	5.06	4.50	8.38	3.95	11.76	6.76	3.91	2.63	2.29	7.96	3.35	1.94	6.00	4.04	3.31	2.20	1.94	1.64
43	600	6	0.1524	0.019	0.0050	0	46	6.53	4.94	4.42	8.12	3.89	11.35	6.58	3.85	2.62	2.29	7.72	3.32	1.97	5.85	3.97	3.28	2.21	1.96	1.68
44	600	6	0.1524	0.019	0.0049	0	44	6.31	4.79	4.28	7.83	3.78	10.91	6.35	3.75	2.57	2.26	7.44	3.23	1.94	5.65	3.86	3.20	2.18	1.94	1.67
45	600	6	0.1524	0.019	0.0045	0	38	5.38	4.07	3.63	6.70	3.20	9.36	5.42	3.17	2.15	1.88	6.37	2.72	1.61	4.82	3.27	2.69	1.81	1.61	1.37
46	600	6	0.1524	0.019	0.0035	0	24	4.16	3.36	3.09	4.96	2.83	6.58	4.18	2.81	2.19	2.02	4.75	2.54	1.86	3.81	2.87	2.52	1.98	1.86	1.71
47	600	6	0.1524	0.019	0.0030	0	17	3.22	2.66	2.48	3.77	2.30	4.90	3.23	2.28	1.85	1.74	3.63	2.10	1.62	2.98	2.33	2.08	1.71	1.62	1.52
48	600	6	0.1524	0.019	0.0027	0	15	3.26	2.78	2.63	3.73	2.47	4.69	3.27	2.46	2.09	2.00	3.61	2.30	1.90	3.05	2.50	2.29	1.97	1.90	1.81

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	600	6	0.1524	0.019	0.0052	1	49	6.37	4.63	4.07	8.07	3.50	11.79	6.39	3.46	2.11	1.76	7.63	2.86	1.40	5.61	3.56	2.81	1.66	1.40	1.09
2	600	6	0.1524	0.019	0.0051	1	48	6.85	5.18	4.63	8.50	4.08	12.08	6.87	4.04	2.74	2.40	8.07	3.46	2.05	6.12	4.14	3.42	2.31	2.05	1.76
3	600	6	0.1524	0.019	0.0050	1	46	6.31	4.69	4.17	7.89	3.63	11.35	6.32	3.60	2.34	2.01	7.48	3.04	1.68	5.60	3.69	3.00	1.93	1.68	1.39
4	600	6	0.1524	0.019	0.0051	1	48	6.85	5.18	4.63	8.50	4.08	12.08	6.87	4.04	2.74	2.40	8.07	3.46	2.05	6.12	4.14	3.42	2.31	2.05	1.76
5	600	6	0.1524	0.019	0.0053	1	51	6.86	5.06	4.48	8.62	3.89	12.47	6.88	3.85	2.45	2.08	8.17	3.22	1.71	6.08	3.95	3.18	1.99	1.71	1.39
6	600	6	0.1524	0.019	0.0059	1	64	8.56	6.31	5.57	10.78	4.83	15.61	8.58	4.78	3.02	2.57	10.20	3.99	2.10	7.58	4.91	3.94	2.44	2.10	1.70
7	600	6	0.1524	0.019	0.0073	1	96	12.02	8.61	7.50	15.38	6.37	22.69	12.06	6.29	3.63	2.94	14.51	5.10	2.23	10.53	6.50	5.02	2.75	2.23	1.62
8	600	6	0.1524	0.019	0.0091	1	149	17.78	12.45	10.71	23.03	8.95	34.46	17.84	8.83	4.68	3.59	21.67	6.97	2.49	15.46	9.15	6.84	3.30	2.49	1.54
9	600	6	0.1524	0.019	0.0118	1	251	29.24	20.23	17.29	38.11	14.31	57.43	29.34	14.11	7.09	5.26	35.81	10.97	3.40	25.32	14.65	10.75	4.77	3.39	1.79
10	600	6	0.1524	0.019	0.0130	1	301	34.55	23.72	20.19	45.20	16.61	68.41	34.66	16.37	7.93	5.73	42.43	12.59	3.49	29.83	17.01	12.33	5.15	3.48	1.56
11	600	6	0.1524	0.019	0.0134	1	322	36.52	24.92	21.14	47.94	17.30	72.80	36.64	17.04	8.01	5.65	44.97	13.00	3.25	31.47	17.74	12.72	5.02	3.24	1.18
12	600	6	0.1524	0.019	0.0136	1	333	37.76	25.76	21.85	49.57	17.88	75.28	37.89	17.62	8.27	5.83	46.50	13.44	3.35	32.54	18.33	13.15	5.18	3.34	1.21
13	600	6	0.1524	0.019	0.0136	1	331	37.73	25.80	21.92	49.45	17.98	75.00	37.85	17.71	8.43	6.01	46.41	13.56	3.55	32.54	18.43	13.28	5.37	3.54	1.42
14	600	6	0.1524	0.019	0.0130	1	303	34.68	23.77	20.22	45.40	16.61	68.78	34.79	16.36	7.87	5.66	42.62	12.57	3.40	29.92	17.02	12.30	5.07	3.39	1.45
15	600	6	0.1524	0.019	0.0123	1	270	30.86	21.14	17.97	40.42	14.75	61.25	30.96	14.54	6.97	5.00	37.94	11.15	2.99	26.62	15.12	10.92	4.47	2.98	1.25
16	600	6	0.1524	0.019	0.0114	1	232	26.97	18.64	15.93	35.17	13.17	53.03	27.06	12.98	6.49	4.80	33.04	10.08	3.08	23.34	13.48	9.88	4.35	3.07	1.59
17	600	6	0.1524	0.019	0.0107	1	205	23.84	16.47	14.08	31.08	11.64	46.86	23.92	11.48	5.74	4.25	29.20	8.91	2.73	20.63	11.92	8.73	3.85	2.72	1.41
18	600	6	0.1524	0.019	0.0102	1	188	21.93	15.18	12.98	28.57	10.75	43.03	22.00	10.60	5.34	3.97	26.84	8.25	2.57	18.99	11.00	8.08	3.60	2.57	1.37
19	600	6	0.1524	0.019	0.0100	1	180	21.23	14.77	12.67	27.58	10.54	41.41	21.30	10.39	5.37	4.06	25.93	8.15	2.72	18.42	10.78	7.99	3.71	2.72	1.57
20	600	6	0.1524	0.019	0.0098	1	172	20.36	14.20	12.19	26.43	10.15	39.63	20.43	10.01	5.22	3.96	24.85	7.87	2.69	17.68	10.38	7.72	3.63	2.68	1.59
21	600	6	0.1524	0.019	0.0091	1	149	17.78	12.45	10.71	23.03	8.95	34.46	17.84	8.83	4.68	3.59	21.67	6.97	2.49	15.46	9.15	6.84	3.30	2.49	1.54
22	600	6	0.1524	0.019	0.0071	1	91	11.17	7.92	6.87	14.36	5.79	21.31	11.20	5.72	3.19	2.53	13.53	4.59	1.86	9.75	5.91	4.51	2.36	1.86	1.28
23	600	6	0.1524	0.019	0.0059	1	64	8.56	6.31	5.57	10.78	4.83	15.61	8.58	4.78	3.02	2.57	10.20	3.99	2.10	7.58	4.91	3.94	2.44	2.10	1.70
24	600	6	0.1524	0.019	0.0055	1	55	7.76	5.84	5.22	9.65	4.58	13.77	7.78	4.54	3.04	2.65	9.16	3.87	2.26	6.93	4.65	3.82	2.55	2.25	1.91

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	600	6	0.1524	0.019	0.0052	0	49	6.61	4.90	4.34	8.32	3.77	11.79	6.66	3.73	2.41	2.06	7.89	3.15	1.71	5.88	3.86	3.11	1.97	1.70	1.40
26	600	6	0.1524	0.019	0.0051	0	48	7.09	5.44	4.89	8.73	4.34	12.08	7.13	4.31	3.03	2.69	8.32	3.75	2.35	6.37	4.43	3.71	2.60	2.35	2.05
27	600	6	0.1524	0.019	0.0050	0	46	6.53	4.94	4.42	8.12	3.89	11.35	6.58	3.85	2.62	2.29	7.72	3.32	1.97	5.85	3.97	3.28	2.21	1.96	1.68
28	600	6	0.1524	0.019	0.0051	0	48	7.09	5.44	4.89	8.73	4.34	12.08	7.13	4.31	3.03	2.69	8.32	3.75	2.35	6.37	4.43	3.71	2.60	2.35	2.05
29	600	6	0.1524	0.019	0.0053	0	51	7.11	5.34	4.76	8.88	4.17	12.47	7.16	4.13	2.76	2.40	8.43	3.53	2.03	6.35	4.26	3.49	2.30	2.03	1.71
30	600	6	0.1524	0.019	0.0059	0	64	8.88	6.66	5.92	11.10	5.18	15.61	8.94	5.13	3.42	2.96	10.54	4.38	2.50	7.92	5.30	4.33	2.84	2.50	2.10
31	600	6	0.1524	0.019	0.0073	0	96	12.50	9.14	8.02	15.87	6.91	22.69	12.59	6.83	4.23	3.53	15.02	5.69	2.84	11.05	7.08	5.61	3.36	2.83	2.23
32	600	6	0.1524	0.019	0.0091	0	149	18.53	13.28	11.53	23.79	9.79	34.46	18.67	9.67	5.61	4.52	22.47	7.89	3.43	16.27	10.07	7.77	4.24	3.43	2.48
33	600	6	0.1524	0.019	0.0118	0	251	30.51	21.63	18.68	39.40	15.73	57.43	30.75	15.53	8.67	6.83	37.16	12.53	4.99	26.68	16.20	12.31	6.36	4.98	3.38
34	600	6	0.1524	0.019	0.0130	0	301	36.07	25.39	21.86	46.75	18.32	68.41	36.35	18.07	9.82	7.62	44.06	14.47	5.41	31.47	18.88	14.21	7.06	5.40	3.48
35	600	6	0.1524	0.019	0.0134	0	322	38.15	26.71	22.92	49.59	19.13	72.80	38.45	18.87	10.03	7.67	46.71	15.01	5.30	33.22	19.73	14.73	7.07	5.29	3.23
36	600	6	0.1524	0.019	0.0136	0	333	39.45	27.62	23.70	51.28	19.78	75.28	39.76	19.51	10.37	7.92	48.30	15.51	5.48	34.35	20.40	15.22	7.30	5.46	3.33
37	600	6	0.1524	0.019	0.0136	0	331	39.40	27.65	23.76	51.16	19.86	75.00	39.71	19.59	10.51	8.08	48.20	15.63	5.66	34.34	20.48	15.34	7.47	5.64	3.53
38	600	6	0.1524	0.019	0.0130	0	303	36.21	25.46	21.89	46.96	18.33	68.78	36.49	18.08	9.78	7.55	44.25	14.45	5.33	31.57	18.90	14.19	6.99	5.32	3.39
39	600	6	0.1524	0.019	0.0123	0	270	32.23	22.64	19.47	41.81	16.29	61.25	32.48	16.07	8.67	6.69	39.39	12.84	4.71	28.09	16.79	12.60	6.18	4.70	2.97
40	600	6	0.1524	0.019	0.0114	0	232	28.15	19.93	17.21	36.36	14.48	53.03	28.36	14.30	7.95	6.25	34.29	11.52	4.55	24.60	14.92	11.32	5.82	4.54	3.07
41	600	6	0.1524	0.019	0.0107	0	205	24.88	17.62	15.21	32.13	12.80	46.86	25.07	12.64	7.03	5.53	30.31	10.19	4.03	21.75	13.19	10.01	5.15	4.02	2.71
42	600	6	0.1524	0.019	0.0102	0	188	22.88	16.22	14.02	29.53	11.81	43.03	23.05	11.66	6.52	5.14	27.86	9.41	3.77	20.01	12.16	9.25	4.79	3.76	2.56
43	600	6	0.1524	0.019	0.0100	0	180	22.14	15.77	13.66	28.50	11.56	41.41	22.30	11.41	6.49	5.18	26.90	9.26	3.86	19.39	11.89	9.11	4.85	3.86	2.71
44	600	6	0.1524	0.019	0.0098	0	172	21.23	15.15	13.14	27.31	11.13	39.63	21.39	10.99	6.29	5.04	25.78	8.93	3.78	18.61	11.45	8.79	4.72	3.77	2.68
45	600	6	0.1524	0.019	0.0091	0	149	18.53	13.28	11.53	23.79	9.79	34.46	18.67	9.67	5.61	4.52	22.47	7.89	3.43	16.27	10.07	7.77	4.24	3.43	2.48
46	600	6	0.1524	0.019	0.0071	0	91	11.62	8.43	7.36	14.82	6.30	21.31	11.71	6.23	3.76	3.10	14.02	5.15	2.44	10.25	6.47	5.07	2.93	2.43	1.86
47	600	6	0.1524	0.019	0.0059	0	64	8.88	6.66	5.92	11.10	5.18	15.61	8.94	5.13	3.42	2.96	10.54	4.38	2.50	7.92	5.30	4.33	2.84	2.50	2.10
48	600	6	0.1524	0.019	0.0055	0	55	8.03	6.14	5.51	9.93	4.88	13.77	8.08	4.84	3.38	2.99	9.45	4.20	2.60	7.22	4.98	4.16	2.89	2.59	2.25

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	600	6	0.1524	0.019	0.0078	1	109	13.08	9.18	7.91	16.91	6.62	25.27	13.12	6.53	3.50	2.70	15.92	5.17	1.90	11.38	6.77	5.08	2.49	1.89	1.20
2	600	6	0.1524	0.019	0.0076	1	106	13.41	9.65	8.42	17.12	7.18	25.18	13.45	7.10	4.17	3.40	16.15	5.79	2.62	11.77	7.32	5.69	3.20	2.62	1.95
3	600	6	0.1524	0.019	0.0075	1	102	12.69	9.06	7.88	16.26	6.68	24.04	12.73	6.60	3.77	3.03	15.33	5.33	2.28	11.11	6.81	5.24	2.84	2.28	1.63
4	600	6	0.1524	0.019	0.0076	1	106	13.41	9.65	8.42	17.12	7.18	25.18	13.45	7.10	4.17	3.40	16.15	5.79	2.62	11.77	7.32	5.69	3.20	2.62	1.95
5	600	6	0.1524	0.019	0.0079	1	113	13.68	9.64	8.33	17.65	6.99	26.30	13.72	6.90	3.76	2.94	16.62	5.50	2.11	11.92	7.15	5.40	2.72	2.10	1.39
6	600	6	0.1524	0.019	0.0089	1	142	17.26	12.19	10.54	22.25	8.86	33.11	17.32	8.75	4.80	3.77	20.95	6.98	2.72	15.05	9.05	6.86	3.50	2.72	1.82
7	600	6	0.1524	0.019	0.0109	1	214	25.05	17.37	14.87	32.60	12.32	49.06	25.13	12.15	6.17	4.61	30.64	9.48	3.03	21.70	12.61	9.29	4.20	3.02	1.65
8	600	6	0.1524	0.019	0.0136	1	333	37.76	25.76	21.85	49.57	17.88	75.28	37.89	17.62	8.27	5.83	46.50	13.44	3.35	32.54	18.33	13.15	5.18	3.34	1.21
9	600	6	0.1524	0.019	0.0177	1	562	63.05	42.76	36.16	83.00	29.45	126.46	63.26	29.00	13.21	9.09	77.82	21.94	4.90	54.21	30.22	21.45	7.99	4.88	1.27
10	600	6	0.1524	0.019	0.0194	1	675	75.48	51.11	43.18	99.45	35.11	151.67	75.74	34.57	15.60	10.65	93.23	26.09	5.61	64.87	36.03	25.50	9.33	5.59	1.26
11	600	6	0.1524	0.019	0.0201	1	723	80.67	54.56	46.06	106.36	37.42	162.31	80.95	36.84	16.51	11.21	99.68	27.75	5.81	69.30	38.41	27.12	9.80	5.79	1.15
12	600	6	0.1524	0.019	0.0205	1	748	83.72	56.71	47.92	110.28	38.99	168.14	84.00	38.38	17.36	11.88	103.38	28.98	6.29	71.95	40.00	28.33	10.41	6.27	1.47
13	600	6	0.1524	0.019	0.0204	1	743	83.14	56.31	47.58	109.52	38.70	167.00	83.42	38.11	17.23	11.77	102.67	28.77	6.23	71.45	39.71	28.12	10.32	6.21	1.44
14	600	6	0.1524	0.019	0.0195	1	680	76.27	51.72	43.74	100.41	35.62	153.00	76.53	35.07	15.96	10.98	94.14	26.53	5.91	65.58	36.54	25.93	9.65	5.88	1.52
15	600	6	0.1524	0.019	0.0184	1	606	67.93	46.05	38.94	89.44	31.70	136.31	68.16	31.21	14.18	9.74	83.85	23.60	5.22	58.40	32.52	23.07	8.56	5.20	1.31
16	600	6	0.1524	0.019	0.0170	1	520	58.69	39.94	33.83	77.14	27.63	117.32	58.89	27.21	12.61	8.80	72.34	20.68	4.93	50.52	28.33	20.23	7.79	4.91	1.58
17	600	6	0.1524	0.019	0.0160	1	460	52.39	35.82	30.42	68.68	24.94	104.19	52.56	24.57	11.67	8.31	64.45	18.80	4.88	45.17	25.56	18.40	7.41	4.87	1.92
18	600	6	0.1524	0.019	0.0153	1	421	47.34	32.15	27.21	62.28	22.18	94.83	47.50	21.84	10.02	6.93	58.40	16.55	3.79	40.72	22.75	16.19	6.11	3.78	1.08
19	600	6	0.1524	0.019	0.0150	1	403	45.76	31.24	26.51	60.05	21.71	91.16	45.92	21.38	10.08	7.13	56.34	16.33	4.13	39.44	22.25	15.98	6.34	4.11	1.53
20	600	6	0.1524	0.019	0.0147	1	385	43.82	29.95	25.43	57.46	20.84	87.18	43.96	20.53	9.74	6.92	53.91	15.71	4.05	37.78	21.36	15.37	6.17	4.04	1.57
21	600	6	0.1524	0.019	0.0136	1	333	37.76	25.76	21.85	49.57	17.88	75.28	37.89	17.62	8.27	5.83	46.50	13.44	3.35	32.54	18.33	13.15	5.18	3.34	1.21
22	600	6	0.1524	0.019	0.0106	1	203	23.38	16.07	13.70	30.56	11.28	46.21	23.45	11.12	5.44	3.95	28.69	8.58	2.44	20.20	11.56	8.40	3.56	2.44	1.14
23	600	6	0.1524	0.019	0.0089	1	142	17.26	12.19	10.54	22.25	8.86	33.11	17.32	8.75	4.80	3.77	20.95	6.98	2.72	15.05	9.05	6.86	3.50	2.72	1.82
24	600	6	0.1524	0.019	0.0082	1	121	14.71	10.39	8.99	18.96	7.56	28.22	14.76	7.46	4.10	3.22	17.86	5.96	2.33	12.83	7.72	5.85	2.99	2.32	1.55

Anexo 2. Valores de carga en nodo [m]   {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	600	6	0.1524	0.019	0.0078	0	109	13.63	9.78	8.51	17.47	7.23	25.27	13.73	7.15	4.18	3.38	16.50	5.85	2.59	11.97	7.44	5.75	3.18	2.58	1.89
26	600	6	0.1524	0.019	0.0076	0	106	13.94	10.23	9.00	17.65	7.77	25.18	14.04	7.69	4.82	4.06	16.72	6.44	3.29	12.34	7.97	6.34	3.86	3.28	2.62
27	600	6	0.1524	0.019	0.0075	0	102	13.20	9.62	8.44	16.78	7.25	24.04	13.30	7.17	4.40	3.66	15.88	5.96	2.92	11.66	7.44	5.87	3.48	2.92	2.28
28	600	6	0.1524	0.019	0.0076	0	106	13.94	10.23	9.00	17.65	7.77	25.18	14.04	7.69	4.82	4.06	16.72	6.44	3.29	12.34	7.97	6.34	3.86	3.28	2.62
29	600	6	0.1524	0.019	0.0079	0	113	14.25	10.27	8.95	18.23	7.63	26.30	14.35	7.54	4.47	3.64	17.23	6.20	2.82	12.53	7.84	6.10	3.43	2.82	2.10
30	600	6	0.1524	0.019	0.0089	0	142	17.98	12.98	11.32	22.97	9.66	33.11	18.11	9.55	5.69	4.65	21.71	7.86	3.62	15.82	9.93	7.74	4.39	3.62	2.72
31	600	6	0.1524	0.019	0.0109	0	214	26.13	18.56	16.05	33.70	13.54	49.06	26.33	13.36	7.51	5.95	31.79	10.81	4.38	22.86	13.94	10.62	5.55	4.38	3.01
32	600	6	0.1524	0.019	0.0136	0	333	39.45	27.62	23.70	51.28	19.78	75.28	39.76	19.51	10.37	7.92	48.30	15.51	5.48	34.35	20.40	15.22	7.30	5.46	3.33
33	600	6	0.1524	0.019	0.0177	0	562	65.90	45.91	39.28	85.90	32.65	126.46	66.43	32.19	16.75	12.62	80.86	25.45	8.48	57.28	33.71	24.96	11.57	8.46	4.87
34	600	6	0.1524	0.019	0.0194	0	675	78.91	54.89	46.92	102.94	38.96	151.67	79.54	38.41	19.85	14.89	96.88	30.30	9.92	68.56	40.23	29.71	13.63	9.90	5.57
35	600	6	0.1524	0.019	0.0201	0	723	84.35	58.61	50.08	110.09	41.54	162.31	85.02	40.95	21.07	15.75	103.60	32.27	10.43	73.25	42.90	31.63	14.40	10.41	5.77
36	600	6	0.1524	0.019	0.0205	0	748	87.51	60.89	52.07	114.14	43.25	168.14	88.21	42.64	22.07	16.57	107.43	33.65	11.07	76.04	44.65	33.00	15.18	11.05	6.25
37	600	6	0.1524	0.019	0.0204	0	743	86.91	60.47	51.70	113.35	42.94	167.00	87.60	42.33	21.90	16.44	106.69	33.41	10.97	75.51	44.33	32.76	15.05	10.95	6.19
38	600	6	0.1524	0.019	0.0195	0	680	79.72	55.53	47.51	103.92	39.49	153.00	80.36	38.94	20.25	15.25	97.82	30.77	10.24	69.29	40.77	30.18	13.98	10.22	5.87
39	600	6	0.1524	0.019	0.0184	0	606	71.01	49.44	42.30	92.57	35.15	136.31	71.57	34.66	18.00	13.54	87.14	27.38	9.09	61.71	36.29	26.85	12.41	9.07	5.18
40	600	6	0.1524	0.019	0.0170	0	520	61.33	42.84	36.72	79.82	30.59	117.32	61.81	30.16	15.88	12.06	75.16	23.93	8.24	53.36	31.56	23.47	11.09	8.23	4.90
41	600	6	0.1524	0.019	0.0160	0	460	54.72	38.38	32.97	71.05	27.56	104.19	55.15	27.18	14.56	11.19	66.94	21.67	7.81	47.68	28.42	21.27	10.33	7.80	4.86
42	600	6	0.1524	0.019	0.0153	0	421	49.48	34.50	29.54	64.45	24.58	94.83	49.87	24.23	12.67	9.57	60.68	19.18	6.48	43.02	25.37	18.81	8.79	6.46	3.77
43	600	6	0.1524	0.019	0.0150	0	403	47.81	33.49	28.74	62.12	24.00	91.16	48.18	23.67	12.61	9.65	58.51	18.84	6.70	41.63	24.75	18.49	8.90	6.68	4.10
44	600	6	0.1524	0.019	0.0147	0	385	45.77	32.09	27.56	59.44	23.03	87.18	46.13	22.72	12.16	9.33	55.99	18.10	6.50	39.87	23.75	17.77	8.61	6.49	4.03
45	600	6	0.1524	0.019	0.0136	0	333	39.45	27.62	23.70	51.28	19.78	75.28	39.76	19.51	10.37	7.92	48.30	15.51	5.48	34.35	20.40	15.22	7.30	5.46	3.33
46	600	6	0.1524	0.019	0.0106	0	203	24.40	17.21	14.82	31.60	12.44	46.21	24.59	12.27	6.71	5.22	29.79	9.84	3.73	21.30	12.81	9.66	4.84	3.73	2.43
47	600	6	0.1524	0.019	0.0089	0	142	17.98	12.98	11.32	22.97	9.66	33.11	18.11	9.55	5.69	4.65	21.71	7.86	3.62	15.82	9.93	7.74	4.39	3.62	2.72
48	600	6	0.1524	0.019	0.0082	0	121	15.32	11.06	9.65	19.58	8.24	28.22	15.43	8.14	4.85	3.97	18.51	6.70	3.09	13.49	8.46	6.60	3.75	3.09	2.32

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	600	8	0.2032	0.0165	0.0026	1	4	1.80	1.71	1.68	1.88	1.65	2.08	1.80	1.65	1.58	1.56	1.86	1.61	1.54	1.76	1.65	1.61	1.55	1.54	1.52
2	600	8	0.2032	0.0165	0.0025	1	4	1.87	1.79	1.76	1.96	1.73	2.15	1.87	1.73	1.66	1.64	1.94	1.70	1.62	1.84	1.73	1.70	1.64	1.62	1.61
3	600	8	0.2032	0.0165	0.0025	1	4	1.95	1.86	1.84	2.03	1.81	2.21	1.95	1.81	1.74	1.73	2.01	1.78	1.71	1.91	1.81	1.78	1.72	1.71	1.69
4	600	8	0.2032	0.0165	0.0025	1	4	1.87	1.79	1.76	1.96	1.73	2.15	1.87	1.73	1.66	1.64	1.94	1.70	1.62	1.84	1.73	1.70	1.64	1.62	1.61
5	600	8	0.2032	0.0165	0.0026	1	4	1.72	1.63	1.60	1.81	1.56	2.01	1.72	1.56	1.49	1.47	1.79	1.53	1.45	1.68	1.57	1.53	1.47	1.45	1.44
6	600	8	0.2032	0.0165	0.0030	1	5	2.14	2.02	1.98	2.25	1.94	2.51	2.14	1.94	1.85	1.82	2.22	1.90	1.80	2.08	1.95	1.89	1.82	1.80	1.78
7	600	8	0.2032	0.0165	0.0036	1	6	1.66	1.48	1.43	1.83	1.37	2.22	1.66	1.36	1.22	1.19	1.79	1.30	1.15	1.58	1.37	1.30	1.18	1.15	1.12
8	600	8	0.2032	0.0165	0.0045	1	9	2.22	1.94	1.85	2.49	1.76	3.10	2.22	1.76	1.54	1.48	2.42	1.66	1.43	2.10	1.77	1.65	1.47	1.43	1.38
9	600	8	0.2032	0.0165	0.0059	1	14	2.54	2.07	1.92	3.00	1.77	4.03	2.54	1.76	1.39	1.30	2.88	1.59	1.20	2.34	1.78	1.58	1.27	1.20	1.12
10	600	8	0.2032	0.0165	0.0065	1	17	3.23	2.67	2.49	3.78	2.30	5.02	3.23	2.29	1.85	1.74	3.63	2.09	1.62	2.98	2.32	2.08	1.70	1.62	1.52
11	600	8	0.2032	0.0165	0.0067	1	18	3.25	2.64	2.45	3.83	2.25	5.16	3.25	2.24	1.77	1.65	3.68	2.03	1.52	2.98	2.27	2.01	1.61	1.52	1.41
12	600	8	0.2032	0.0165	0.0068	1	19	3.74	3.12	2.92	4.35	2.71	5.72	3.74	2.70	2.21	2.09	4.19	2.48	1.96	3.47	2.73	2.46	2.05	1.96	1.85
13	600	8	0.2032	0.0165	0.0068	1	19	3.84	3.23	3.03	4.45	2.82	5.81	3.85	2.81	2.32	2.20	4.29	2.59	2.07	3.57	2.84	2.57	2.17	2.07	1.96
14	600	8	0.2032	0.0165	0.0065	1	17	3.13	2.57	2.38	3.69	2.20	4.93	3.13	2.19	1.74	1.63	3.54	1.98	1.51	2.89	2.21	1.97	1.60	1.51	1.41
15	600	8	0.2032	0.0165	0.0061	1	15	2.64	2.14	1.97	3.13	1.81	4.25	2.64	1.80	1.40	1.30	3.00	1.62	1.20	2.42	1.82	1.61	1.27	1.20	1.11
16	600	8	0.2032	0.0165	0.0057	1	13	2.40	1.97	1.83	2.83	1.69	3.78	2.41	1.68	1.34	1.25	2.72	1.53	1.17	2.22	1.70	1.52	1.23	1.16	1.09
17	600	8	0.2032	0.0165	0.0053	1	12	2.64	2.26	2.13	3.01	2.01	3.85	2.64	2.00	1.70	1.62	2.91	1.86	1.54	2.47	2.02	1.85	1.60	1.54	1.47
18	600	8	0.2032	0.0165	0.0051	1	11	2.42	2.07	1.95	2.76	1.84	3.53	2.42	1.83	1.56	1.49	2.67	1.71	1.41	2.26	1.85	1.70	1.47	1.41	1.35
19	600	8	0.2032	0.0165	0.0050	1	11	2.80	2.46	2.35	3.12	2.24	3.86	2.80	2.23	1.97	1.90	3.04	2.12	1.84	2.65	2.25	2.11	1.89	1.83	1.78
20	600	8	0.2032	0.0165	0.0049	1	10	2.16	1.84	1.74	2.48	1.63	3.18	2.16	1.63	1.38	1.31	2.39	1.51	1.25	2.02	1.64	1.51	1.30	1.25	1.19
21	600	8	0.2032	0.0165	0.0045	1	9	2.22	1.94	1.85	2.49	1.76	3.10	2.22	1.76	1.54	1.48	2.42	1.66	1.43	2.10	1.77	1.65	1.47	1.43	1.38
22	600	8	0.2032	0.0165	0.0035	1	6	1.87	1.71	1.65	2.04	1.60	2.41	1.87	1.59	1.46	1.43	2.00	1.53	1.39	1.80	1.60	1.53	1.42	1.39	1.36
23	600	8	0.2032	0.0165	0.0030	1	5	2.14	2.02	1.98	2.25	1.94	2.51	2.14	1.94	1.85	1.82	2.22	1.90	1.80	2.08	1.95	1.89	1.82	1.80	1.78
24	600	8	0.2032	0.0165	0.0027	1	4	1.56	1.46	1.43	1.66	1.39	1.88	1.56	1.39	1.31	1.29	1.63	1.36	1.27	1.52	1.40	1.35	1.29	1.27	1.26

Anexo 2. Valores de carga en nodo [m]   {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	600	8	0.2032	0.0165	0.0026	0	4	1.82	1.73	1.70	1.90	1.67	2.08	1.82	1.67	1.60	1.58	1.88	1.64	1.56	1.78	1.67	1.64	1.58	1.56	1.55
26	600	8	0.2032	0.0165	0.0025	0	4	1.89	1.81	1.78	1.98	1.75	2.15	1.89	1.75	1.68	1.67	1.96	1.72	1.65	1.86	1.76	1.72	1.66	1.65	1.63
27	600	8	0.2032	0.0165	0.0025	0	4	1.97	1.88	1.86	2.05	1.83	2.21	1.97	1.83	1.77	1.75	2.03	1.80	1.73	1.93	1.83	1.80	1.74	1.73	1.72
28	600	8	0.2032	0.0165	0.0025	0	4	1.89	1.81	1.78	1.98	1.75	2.15	1.89	1.75	1.68	1.67	1.96	1.72	1.65	1.86	1.76	1.72	1.66	1.65	1.63
29	600	8	0.2032	0.0165	0.0026	0	4	1.74	1.65	1.62	1.83	1.59	2.01	1.74	1.59	1.51	1.50	1.81	1.55	1.48	1.70	1.59	1.55	1.49	1.48	1.46
30	600	8	0.2032	0.0165	0.0030	0	5	2.16	2.05	2.01	2.27	1.97	2.51	2.16	1.97	1.88	1.86	2.25	1.93	1.83	2.11	1.98	1.93	1.85	1.83	1.81
31	600	8	0.2032	0.0165	0.0036	0	6	1.70	1.52	1.47	1.87	1.41	2.22	1.70	1.41	1.27	1.24	1.83	1.35	1.20	1.62	1.42	1.34	1.23	1.20	1.17
32	600	8	0.2032	0.0165	0.0045	0	9	2.28	2.01	1.92	2.55	1.83	3.10	2.29	1.82	1.61	1.56	2.48	1.73	1.50	2.16	1.84	1.72	1.54	1.50	1.45
33	600	8	0.2032	0.0165	0.0059	0	14	2.64	2.18	2.03	3.10	1.88	4.03	2.65	1.87	1.51	1.42	2.98	1.71	1.33	2.44	1.90	1.70	1.40	1.33	1.24
34	600	8	0.2032	0.0165	0.0065	0	17	3.35	2.80	2.62	3.90	2.44	5.02	3.37	2.42	2.00	1.88	3.76	2.24	1.77	3.11	2.47	2.22	1.86	1.77	1.67
35	600	8	0.2032	0.0165	0.0067	0	18	3.38	2.79	2.59	3.97	2.40	5.16	3.39	2.38	1.93	1.81	3.82	2.18	1.68	3.12	2.43	2.17	1.77	1.68	1.58
36	600	8	0.2032	0.0165	0.0068	0	19	3.88	3.27	3.06	4.49	2.86	5.72	3.89	2.85	2.38	2.25	4.33	2.64	2.13	3.61	2.89	2.63	2.22	2.13	2.02
37	600	8	0.2032	0.0165	0.0068	0	19	3.98	3.37	3.17	4.58	2.97	5.81	3.99	2.96	2.49	2.36	4.43	2.75	2.24	3.72	3.00	2.74	2.33	2.24	2.13
38	600	8	0.2032	0.0165	0.0065	0	17	3.25	2.70	2.52	3.81	2.33	4.93	3.27	2.32	1.89	1.78	3.67	2.13	1.66	3.02	2.36	2.12	1.75	1.66	1.56
39	600	8	0.2032	0.0165	0.0061	0	15	2.75	2.26	2.09	3.24	1.93	4.25	2.76	1.92	1.54	1.43	3.12	1.75	1.33	2.54	1.95	1.74	1.41	1.33	1.24
40	600	8	0.2032	0.0165	0.0057	0	13	2.50	2.07	1.93	2.92	1.79	3.78	2.51	1.78	1.46	1.37	2.81	1.64	1.28	2.31	1.82	1.63	1.35	1.28	1.21
41	600	8	0.2032	0.0165	0.0053	0	12	2.72	2.35	2.22	3.09	2.10	3.85	2.73	2.09	1.80	1.72	3.00	1.96	1.65	2.56	2.12	1.95	1.70	1.65	1.58
42	600	8	0.2032	0.0165	0.0051	0	11	2.49	2.15	2.04	2.84	1.92	3.53	2.50	1.91	1.65	1.58	2.75	1.80	1.51	2.35	1.94	1.79	1.56	1.51	1.45
43	600	8	0.2032	0.0165	0.0050	0	11	2.87	2.54	2.43	3.19	2.32	3.86	2.88	2.31	2.06	1.99	3.11	2.20	1.93	2.73	2.34	2.20	1.98	1.93	1.87
44	600	8	0.2032	0.0165	0.0049	0	10	2.23	1.92	1.82	2.55	1.71	3.18	2.24	1.70	1.46	1.40	2.47	1.60	1.33	2.10	1.73	1.59	1.38	1.33	1.28
45	600	8	0.2032	0.0165	0.0045	0	9	2.28	2.01	1.92	2.55	1.83	3.10	2.29	1.82	1.61	1.56	2.48	1.73	1.50	2.16	1.84	1.72	1.54	1.50	1.45
46	600	8	0.2032	0.0165	0.0035	0	6	1.91	1.75	1.69	2.08	1.64	2.41	1.91	1.63	1.51	1.47	2.03	1.58	1.44	1.84	1.65	1.57	1.46	1.44	1.41
47	600	8	0.2032	0.0165	0.0030	0	5	2.16	2.05	2.01	2.27	1.97	2.51	2.16	1.97	1.88	1.86	2.25	1.93	1.83	2.11	1.98	1.93	1.85	1.83	1.81
48	600	8	0.2032	0.0165	0.0027	0	4	1.58	1.48	1.45	1.68	1.42	1.88	1.58	1.42	1.34	1.32	1.65	1.38	1.30	1.54	1.42	1.38	1.32	1.30	1.28

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	600	8	0.2032	0.0165	0.0052	1	11	2.19	1.83	1.71	2.54	1.59	3.33	2.19	1.58	1.30	1.23	2.45	1.46	1.16	2.03	1.60	1.45	1.21	1.16	1.09
2	600	8	0.2032	0.0165	0.0051	1	11	2.49	2.15	2.03	2.83	1.92	3.60	2.49	1.91	1.64	1.57	2.74	1.79	1.50	2.34	1.93	1.78	1.55	1.50	1.44
3	600	8	0.2032	0.0165	0.0050	1	11	2.80	2.46	2.35	3.12	2.24	3.86	2.80	2.23	1.97	1.90	3.04	2.12	1.84	2.65	2.25	2.11	1.89	1.83	1.78
4	600	8	0.2032	0.0165	0.0051	1	11	2.49	2.15	2.03	2.83	1.92	3.60	2.49	1.91	1.64	1.57	2.74	1.79	1.50	2.34	1.93	1.78	1.55	1.50	1.44
5	600	8	0.2032	0.0165	0.0053	1	12	2.88	2.50	2.38	3.24	2.26	4.06	2.88	2.25	1.96	1.89	3.14	2.12	1.81	2.71	2.27	2.11	1.86	1.81	1.74
6	600	8	0.2032	0.0165	0.0059	1	14	2.54	2.07	1.92	3.00	1.77	4.03	2.54	1.76	1.39	1.30	2.88	1.59	1.20	2.34	1.78	1.58	1.27	1.20	1.12
7	600	8	0.2032	0.0165	0.0073	1	21	3.64	2.93	2.70	4.33	2.47	5.89	3.64	2.45	1.90	1.76	4.15	2.20	1.61	3.33	2.49	2.19	1.72	1.61	1.48
8	600	8	0.2032	0.0165	0.0091	1	32	4.88	3.77	3.41	5.96	3.05	8.40	4.88	3.02	2.16	1.93	5.67	2.63	1.70	4.39	3.08	2.60	1.87	1.70	1.51
9	600	8	0.2032	0.0165	0.0118	1	53	7.16	5.29	4.69	8.99	4.07	13.11	7.16	4.03	2.56	2.19	8.50	3.36	1.80	6.34	4.12	3.32	2.08	1.80	1.47
10	600	8	0.2032	0.0165	0.0130	1	63	7.92	5.67	4.95	10.11	4.20	15.07	7.93	4.15	2.40	1.94	9.54	3.36	1.48	6.94	4.27	3.30	1.82	1.48	1.08
11	600	8	0.2032	0.0165	0.0134	1	68	8.99	6.58	5.80	11.34	5.00	16.65	8.99	4.95	3.07	2.58	10.72	4.10	2.09	7.93	5.08	4.04	2.45	2.08	1.66
12	600	8	0.2032	0.0165	0.0136	1	70	8.97	6.48	5.68	11.40	4.85	16.89	8.98	4.80	2.85	2.35	10.76	3.92	1.83	7.88	4.93	3.86	2.21	1.83	1.39
13	600	8	0.2032	0.0165	0.0136	1	70	9.38	6.90	6.10	11.79	5.29	17.24	9.38	5.23	3.30	2.80	11.15	4.36	2.29	8.29	5.36	4.30	2.66	2.28	1.85
14	600	8	0.2032	0.0165	0.0130	1	64	8.53	6.27	5.54	10.74	4.79	15.73	8.54	4.74	2.97	2.51	10.16	3.94	2.05	7.54	4.86	3.89	2.39	2.04	1.64
15	600	8	0.2032	0.0165	0.0123	1	57	7.57	5.55	4.90	9.53	4.23	13.98	7.57	4.19	2.61	2.20	9.02	3.47	1.78	6.68	4.29	3.42	2.09	1.78	1.43
16	600	8	0.2032	0.0165	0.0114	1	49	6.62	4.89	4.33	8.31	3.76	12.12	6.62	3.72	2.37	2.02	7.86	3.11	1.66	5.86	3.81	3.07	1.92	1.66	1.35
17	600	8	0.2032	0.0165	0.0107	1	44	6.55	5.02	4.53	8.04	4.02	11.41	6.56	3.99	2.80	2.49	7.65	3.45	2.17	5.88	4.07	3.41	2.40	2.17	1.90
18	600	8	0.2032	0.0165	0.0102	1	40	5.67	4.27	3.82	7.04	3.35	10.13	5.67	3.32	2.23	1.95	6.68	2.83	1.66	5.06	3.40	2.79	1.87	1.65	1.41
19	600	8	0.2032	0.0165	0.0100	1	38	5.18	3.84	3.41	6.49	2.96	9.44	5.18	2.94	1.89	1.62	6.14	2.46	1.34	4.59	3.00	2.43	1.54	1.34	1.10
20	600	8	0.2032	0.0165	0.0098	1	37	5.65	4.37	3.96	6.90	3.54	9.72	5.66	3.51	2.51	2.25	6.57	3.06	1.99	5.09	3.58	3.03	2.18	1.99	1.76
21	600	8	0.2032	0.0165	0.0091	1	32	4.88	3.77	3.41	5.96	3.05	8.40	4.88	3.02	2.16	1.93	5.67	2.63	1.70	4.39	3.08	2.60	1.87	1.70	1.51
22	600	8	0.2032	0.0165	0.0071	1	20	3.50	2.82	2.61	4.15	2.38	5.64	3.50	2.37	1.84	1.71	3.98	2.13	1.57	3.20	2.40	2.11	1.67	1.57	1.45
23	600	8	0.2032	0.0165	0.0059	1	14	2.54	2.07	1.92	3.00	1.77	4.03	2.54	1.76	1.39	1.30	2.88	1.59	1.20	2.34	1.78	1.58	1.27	1.20	1.12
24	600	8	0.2032	0.0165	0.0055	1	12	2.24	1.84	1.71	2.62	1.58	3.50	2.24	1.57	1.26	1.18	2.52	1.43	1.09	2.06	1.59	1.42	1.15	1.09	1.02

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	600	8	0.2032	0.0165	0.0052	0	11	2.26	1.91	1.80	2.62	1.68	3.33	2.27	1.67	1.40	1.33	2.53	1.55	1.25	2.11	1.70	1.54	1.31	1.25	1.19
26	600	8	0.2032	0.0165	0.0051	0	11	2.57	2.23	2.12	2.91	2.00	3.60	2.58	2.00	1.73	1.66	2.82	1.88	1.59	2.42	2.02	1.87	1.64	1.59	1.53
27	600	8	0.2032	0.0165	0.0050	0	11	2.87	2.54	2.43	3.19	2.32	3.86	2.88	2.31	2.06	1.99	3.11	2.20	1.93	2.73	2.34	2.20	1.98	1.93	1.87
28	600	8	0.2032	0.0165	0.0051	0	11	2.57	2.23	2.12	2.91	2.00	3.60	2.58	2.00	1.73	1.66	2.82	1.88	1.59	2.42	2.02	1.87	1.64	1.59	1.53
29	600	8	0.2032	0.0165	0.0053	0	12	2.96	2.59	2.47	3.32	2.35	4.06	2.96	2.34	2.06	1.98	3.23	2.22	1.91	2.80	2.37	2.21	1.96	1.91	1.84
30	600	8	0.2032	0.0165	0.0059	0	14	2.64	2.18	2.03	3.10	1.88	4.03	2.65	1.87	1.51	1.42	2.98	1.71	1.33	2.44	1.90	1.70	1.40	1.33	1.24
31	600	8	0.2032	0.0165	0.0073	0	21	3.79	3.10	2.87	4.49	2.64	5.89	3.81	2.62	2.09	1.94	4.31	2.39	1.80	3.49	2.68	2.37	1.91	1.80	1.68
32	600	8	0.2032	0.0165	0.0091	0	32	5.11	4.03	3.67	6.20	3.31	8.40	5.14	3.29	2.45	2.23	5.92	2.92	2.00	4.65	3.37	2.89	2.17	2.00	1.81
33	600	8	0.2032	0.0165	0.0118	0	53	7.56	5.73	5.12	9.39	4.52	13.11	7.61	4.47	3.06	2.68	8.93	3.86	2.30	6.77	4.61	3.81	2.59	2.30	1.97
34	600	8	0.2032	0.0165	0.0130	0	63	8.40	6.20	5.47	10.60	4.74	15.07	8.46	4.69	2.99	2.54	10.05	3.95	2.08	7.45	4.86	3.90	2.42	2.08	1.69
35	600	8	0.2032	0.0165	0.0134	0	68	9.50	7.15	6.37	11.86	5.58	16.65	9.57	5.53	3.71	3.22	11.27	4.73	2.73	8.49	5.71	4.68	3.10	2.73	2.31
36	600	8	0.2032	0.0165	0.0136	0	70	9.51	7.07	6.26	11.94	5.45	16.89	9.57	5.39	3.51	3.01	11.33	4.57	2.50	8.45	5.58	4.51	2.88	2.50	2.06
37	600	8	0.2032	0.0165	0.0136	0	70	9.91	7.49	6.68	12.33	5.88	17.24	9.97	5.82	3.95	3.45	11.72	5.01	2.95	8.86	6.01	4.95	3.33	2.95	2.51
38	600	8	0.2032	0.0165	0.0130	0	64	9.02	6.80	6.07	11.24	5.33	15.73	9.08	5.28	3.57	3.11	10.68	4.54	2.66	8.06	5.45	4.48	3.00	2.65	2.26
39	600	8	0.2032	0.0165	0.0123	0	57	8.00	6.02	5.37	9.97	4.72	13.98	8.05	4.67	3.14	2.74	9.48	4.00	2.33	7.15	4.82	3.95	2.63	2.33	1.97
40	600	8	0.2032	0.0165	0.0114	0	49	6.99	5.30	4.74	8.68	4.17	12.12	7.03	4.14	2.83	2.48	8.26	3.56	2.13	6.26	4.26	3.52	2.39	2.13	1.82
41	600	8	0.2032	0.0165	0.0107	0	44	6.88	5.38	4.89	8.38	4.39	11.41	6.92	4.36	3.20	2.89	8.00	3.85	2.58	6.23	4.47	3.82	2.81	2.58	2.31
42	600	8	0.2032	0.0165	0.0102	0	40	5.97	4.60	4.15	7.34	3.69	10.13	6.01	3.66	2.60	2.32	7.00	3.20	2.03	5.38	3.76	3.16	2.24	2.03	1.79
43	600	8	0.2032	0.0165	0.0100	0	38	5.47	4.16	3.72	6.78	3.29	9.44	5.50	3.26	2.24	1.97	6.45	2.81	1.70	4.90	3.36	2.78	1.90	1.70	1.46
44	600	8	0.2032	0.0165	0.0098	0	37	5.93	4.68	4.26	7.18	3.85	9.72	5.96	3.82	2.85	2.59	6.87	3.40	2.33	5.39	3.91	3.36	2.53	2.33	2.11
45	600	8	0.2032	0.0165	0.0091	0	32	5.11	4.03	3.67	6.20	3.31	8.40	5.14	3.29	2.45	2.23	5.92	2.92	2.00	4.65	3.37	2.89	2.17	2.00	1.81
46	600	8	0.2032	0.0165	0.0071	0	20	3.64	2.98	2.76	4.30	2.55	5.64	3.66	2.53	2.02	1.89	4.14	2.31	1.75	3.36	2.58	2.29	1.85	1.75	1.63
47	600	8	0.2032	0.0165	0.0059	0	14	2.64	2.18	2.03	3.10	1.88	4.03	2.65	1.87	1.51	1.42	2.98	1.71	1.33	2.44	1.90	1.70	1.40	1.33	1.24
48	600	8	0.2032	0.0165	0.0055	0	12	2.32	1.93	1.80	2.71	1.67	3.50	2.33	1.66	1.36	1.28	2.61	1.53	1.20	2.15	1.69	1.52	1.26	1.20	1.13

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	600	8	0.2032	0.0165	0.0078	1	24	4.17	3.36	3.10	4.96	2.83	6.74	4.17	2.82	2.18	2.02	4.75	2.53	1.85	3.82	2.86	2.51	1.98	1.85	1.71
2	600	8	0.2032	0.0165	0.0076	1	23	3.86	3.08	2.83	4.62	2.57	6.34	3.86	2.55	1.94	1.78	4.42	2.28	1.62	3.52	2.59	2.26	1.74	1.62	1.48
3	600	8	0.2032	0.0165	0.0075	1	22	3.54	2.78	2.54	4.27	2.29	5.93	3.54	2.28	1.69	1.54	4.08	2.01	1.38	3.21	2.32	1.99	1.49	1.38	1.25
4	600	8	0.2032	0.0165	0.0076	1	23	3.86	3.08	2.83	4.62	2.57	6.34	3.86	2.55	1.94	1.78	4.42	2.28	1.62	3.52	2.59	2.26	1.74	1.62	1.48
5	600	8	0.2032	0.0165	0.0079	1	25	4.47	3.63	3.36	5.29	3.08	7.13	4.47	3.07	2.41	2.24	5.07	2.77	2.07	4.10	3.11	2.75	2.20	2.07	1.92
6	600	8	0.2032	0.0165	0.0089	1	30	4.22	3.16	2.82	5.24	2.47	7.56	4.22	2.45	1.63	1.42	4.97	2.08	1.20	3.75	2.51	2.05	1.36	1.20	1.01
7	600	8	0.2032	0.0165	0.0109	1	45	5.94	4.35	3.83	7.50	3.30	11.01	5.95	3.27	2.02	1.70	7.09	2.71	1.37	5.24	3.35	2.67	1.61	1.37	1.09
8	600	8	0.2032	0.0165	0.0136	1	70	8.97	6.48	5.68	11.40	4.85	16.89	8.98	4.80	2.85	2.35	10.76	3.92	1.83	7.88	4.93	3.86	2.21	1.83	1.39
9	600	8	0.2032	0.0165	0.0177	1	117	13.86	9.65	8.29	17.97	6.90	27.24	13.87	6.81	3.51	2.67	16.88	5.32	1.80	12.02	7.02	5.22	2.44	1.79	1.05
10	600	8	0.2032	0.0165	0.0194	1	141	17.07	12.01	10.38	22.01	8.71	33.15	17.09	8.60	4.64	3.62	20.70	6.81	2.58	14.86	8.86	6.69	3.34	2.57	1.68
11	600	8	0.2032	0.0165	0.0201	1	151	18.22	12.80	11.05	23.51	9.26	35.45	18.24	9.14	4.90	3.81	22.11	7.23	2.69	15.85	9.42	7.09	3.51	2.69	1.73
12	600	8	0.2032	0.0165	0.0205	1	156	18.69	13.08	11.27	24.15	9.42	36.50	18.70	9.29	4.91	3.78	22.71	7.31	2.62	16.23	9.58	7.18	3.47	2.62	1.63
13	600	8	0.2032	0.0165	0.0204	1	155	18.60	13.03	11.23	24.03	9.39	36.30	18.61	9.27	4.92	3.79	22.60	7.30	2.64	16.16	9.56	7.17	3.49	2.64	1.65
14	600	8	0.2032	0.0165	0.0195	1	142	17.20	12.11	10.46	22.17	8.78	33.39	17.21	8.67	4.68	3.66	20.86	6.86	2.60	14.97	8.93	6.74	3.38	2.60	1.70
15	600	8	0.2032	0.0165	0.0184	1	127	15.77	11.23	9.77	20.20	8.27	30.21	15.79	8.17	4.62	3.70	19.03	6.56	2.76	13.79	8.40	6.45	3.45	2.76	1.96
16	600	8	0.2032	0.0165	0.0170	1	109	13.64	9.75	8.49	17.44	7.21	26.02	13.65	7.12	4.08	3.29	16.44	5.74	2.49	11.94	7.32	5.65	3.08	2.48	1.80
17	600	8	0.2032	0.0165	0.0160	1	96	11.74	8.30	7.19	15.10	6.05	22.67	11.75	5.98	3.29	2.60	14.21	4.76	1.89	10.24	6.16	4.68	2.41	1.88	1.27
18	600	8	0.2032	0.0165	0.0153	1	88	10.76	7.61	6.59	13.84	5.55	20.78	10.77	5.48	3.01	2.38	13.02	4.36	1.73	9.38	5.64	4.29	2.20	1.72	1.16
19	600	8	0.2032	0.0165	0.0150	1	85	11.16	8.14	7.17	14.09	6.17	20.74	11.16	6.10	3.75	3.14	13.32	5.04	2.52	9.83	6.26	4.97	2.97	2.51	1.98
20	600	8	0.2032	0.0165	0.0147	1	81	10.47	7.59	6.66	13.28	5.71	19.62	10.48	5.65	3.40	2.82	12.54	4.63	2.22	9.21	5.80	4.56	2.66	2.22	1.71
21	600	8	0.2032	0.0165	0.0136	1	70	8.97	6.48	5.68	11.40	4.85	16.89	8.98	4.80	2.85	2.35	10.76	3.92	1.83	7.88	4.93	3.86	2.21	1.83	1.39
22	600	8	0.2032	0.0165	0.0106	1	43	5.87	4.35	3.86	7.35	3.36	10.69	5.87	3.33	2.15	1.84	6.96	2.79	1.53	5.21	3.41	2.76	1.76	1.53	1.26
23	600	8	0.2032	0.0165	0.0089	1	30	4.22	3.16	2.82	5.24	2.47	7.56	4.22	2.45	1.63	1.42	4.97	2.08	1.20	3.75	2.51	2.05	1.36	1.20	1.01
24	600	8	0.2032	0.0165	0.0082	1	26	4.03	3.13	2.84	4.90	2.55	6.88	4.03	2.53	1.83	1.64	4.67	2.21	1.46	3.64	2.57	2.19	1.60	1.46	1.30

Anexo 2. Valores de carga en nodo [m] {M S-F}

Caso	L	d	d	f fricción	q	perd loc	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[m]	[adim]	[m3/s]		[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
25	600	8	0.2032	0.0165	0.0078	0	24	4.35	3.55	3.29	5.14	3.03	6.74	4.37	3.01	2.40	2.23	4.94	2.74	2.07	4.00	3.07	2.72	2.19	2.07	1.93
26	600	8	0.2032	0.0165	0.0076	0	23	4.03	3.26	3.01	4.79	2.76	6.34	4.05	2.74	2.15	1.99	4.60	2.48	1.83	3.70	2.80	2.46	1.95	1.83	1.69
27	600	8	0.2032	0.0165	0.0075	0	22	3.70	2.96	2.72	4.44	2.47	5.93	3.72	2.46	1.89	1.73	4.25	2.21	1.58	3.38	2.51	2.19	1.70	1.58	1.45
28	600	8	0.2032	0.0165	0.0076	0	23	4.03	3.26	3.01	4.79	2.76	6.34	4.05	2.74	2.15	1.99	4.60	2.48	1.83	3.70	2.80	2.46	1.95	1.83	1.69
29	600	8	0.2032	0.0165	0.0079	0	25	4.65	3.83	3.56	5.47	3.29	7.13	4.67	3.27	2.63	2.46	5.26	2.99	2.29	4.30	3.33	2.97	2.42	2.29	2.15
30	600	8	0.2032	0.0165	0.0089	0	30	4.44	3.41	3.07	5.47	2.73	7.56	4.47	2.70	1.91	1.70	5.21	2.36	1.48	4.00	2.78	2.33	1.64	1.48	1.30
31	600	8	0.2032	0.0165	0.0109	0	45	6.28	4.72	4.21	7.84	3.69	11.01	6.32	3.65	2.45	2.12	7.45	3.13	1.80	5.61	3.77	3.09	2.04	1.80	1.52
32	600	8	0.2032	0.0165	0.0136	0	70	9.51	7.07	6.26	11.94	5.45	16.89	9.57	5.39	3.51	3.01	11.33	4.57	2.50	8.45	5.58	4.51	2.88	2.50	2.06
33	600	8	0.2032	0.0165	0.0177	0	117	14.76	10.64	9.28	18.88	7.91	27.24	14.87	7.82	4.63	3.78	17.85	6.43	2.93	12.99	8.13	6.33	3.57	2.93	2.19
34	600	8	0.2032	0.0165	0.0194	0	141	18.16	13.21	11.57	23.11	9.92	33.15	18.29	9.81	5.99	4.96	21.86	8.14	3.94	16.02	10.19	8.02	4.70	3.94	3.04
35	600	8	0.2032	0.0165	0.0201	0	151	19.39	14.08	12.32	24.69	10.57	35.45	19.53	10.44	6.35	5.25	23.35	8.65	4.15	17.10	10.84	8.52	4.97	4.15	3.19
36	600	8	0.2032	0.0165	0.0205	0	156	19.89	14.40	12.58	25.37	10.76	36.50	20.03	10.64	6.40	5.27	23.99	8.79	4.13	17.52	11.05	8.65	4.98	4.13	3.14
37	600	8	0.2032	0.0165	0.0204	0	155	19.79	14.34	12.54	25.24	10.73	36.30	19.94	10.61	6.40	5.27	23.87	8.77	4.14	17.44	11.02	8.63	4.98	4.14	3.16
38	600	8	0.2032	0.0165	0.0195	0	142	18.29	13.31	11.66	23.28	10.00	33.39	18.43	9.89	6.04	5.01	22.02	8.21	3.98	16.15	10.27	8.08	4.75	3.97	3.07
39	600	8	0.2032	0.0165	0.0184	0	127	16.75	12.30	10.83	21.19	9.36	30.21	16.86	9.26	5.82	4.91	20.07	7.76	3.99	14.83	9.59	7.65	4.67	3.98	3.18
40	600	8	0.2032	0.0165	0.0170	0	109	14.48	10.67	9.40	18.29	8.14	26.02	14.58	8.05	5.11	4.32	17.33	6.77	3.54	12.83	8.34	6.68	4.12	3.53	2.85
41	600	8	0.2032	0.0165	0.0160	0	96	12.48	9.11	8.00	15.85	6.88	22.67	12.57	6.80	4.20	3.51	15.00	5.67	2.81	11.03	7.06	5.59	3.33	2.81	2.20
42	600	8	0.2032	0.0165	0.0153	0	88	11.44	8.35	7.33	14.52	6.30	20.78	11.52	6.23	3.85	3.21	13.74	5.19	2.57	10.11	6.47	5.12	3.05	2.57	2.02
43	600	8	0.2032	0.0165	0.0150	0	85	11.80	8.85	7.87	14.75	6.90	20.74	11.88	6.83	4.55	3.94	14.01	5.83	3.33	10.53	7.05	5.76	3.78	3.33	2.80
44	600	8	0.2032	0.0165	0.0147	0	81	11.09	8.27	7.34	13.91	6.41	19.62	11.16	6.34	4.16	3.58	13.20	5.39	3.00	9.88	6.55	5.32	3.43	3.00	2.49
45	600	8	0.2032	0.0165	0.0136	0	70	9.51	7.07	6.26	11.94	5.45	16.89	9.57	5.39	3.51	3.01	11.33	4.57	2.50	8.45	5.58	4.51	2.88	2.50	2.06
46	600	8	0.2032	0.0165	0.0106	0	43	6.20	4.71	4.22	7.68	3.73	10.69	6.23	3.69	2.55	2.24	7.30	3.19	1.94	5.56	3.81	3.16	2.16	1.93	1.67
47	600	8	0.2032	0.0165	0.0089	0	30	4.44	3.41	3.07	5.47	2.73	7.56	4.47	2.70	1.91	1.70	5.21	2.36	1.48	4.00	2.78	2.33	1.64	1.48	1.30
48	600	8	0.2032	0.0165	0.0082	0	26	4.22	3.34	3.05	5.10	2.76	6.88	4.24	2.74	2.06	1.88	4.88	2.45	1.70	3.84	2.81	2.42	1.84	1.70	1.54

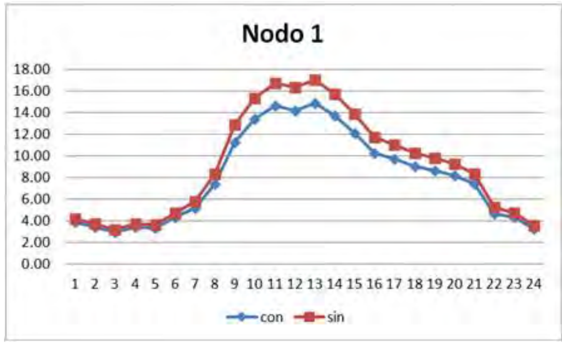
ANEXO 3. GRAFICAS, CARGA EN NODOS,

CON Y SIN PÉRDIDAS LOCALES [m]

Método Sánchez- Fuentes

Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=100m, d=4”, q=2.5 l/s



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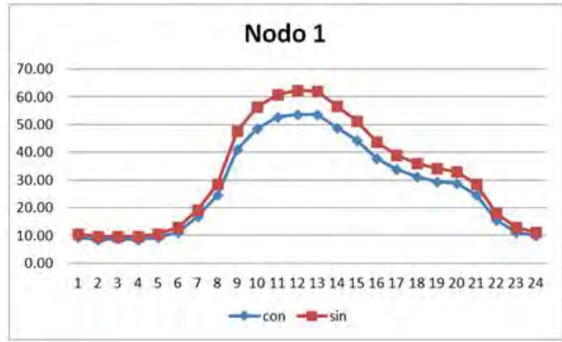

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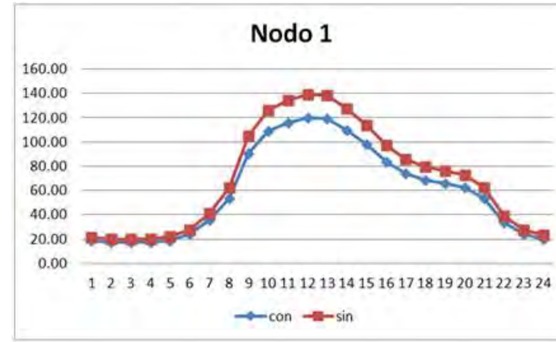
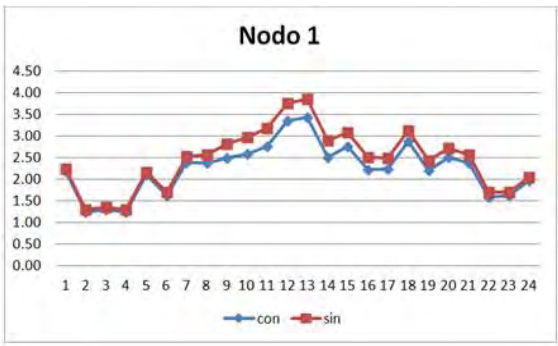
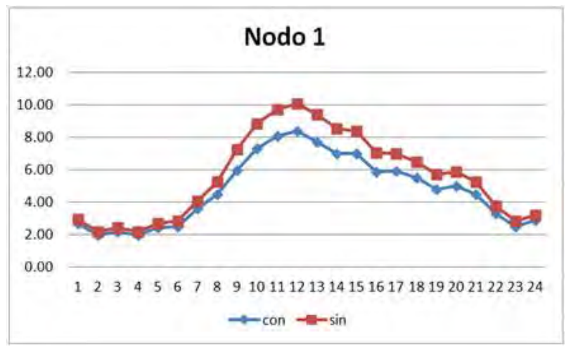


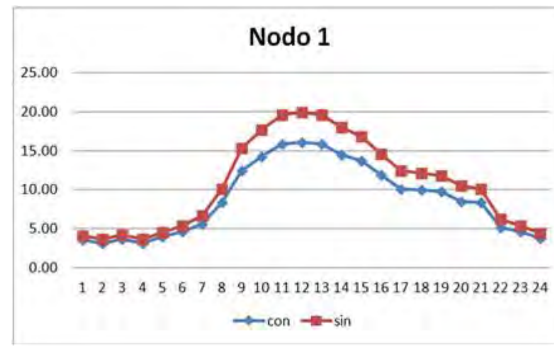
L=100m, d=6”, q=2.5 l/s



L=100m, d=6”, q=5 l/s



L=100m, d=6”, q=7.5 l/s



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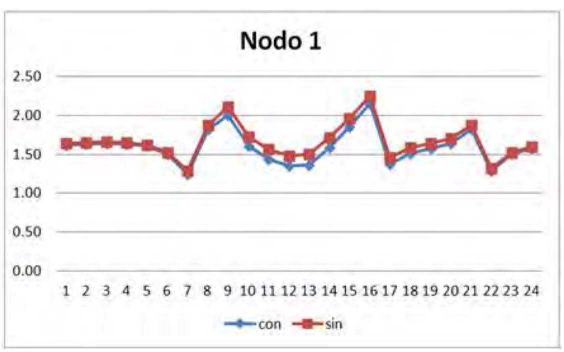
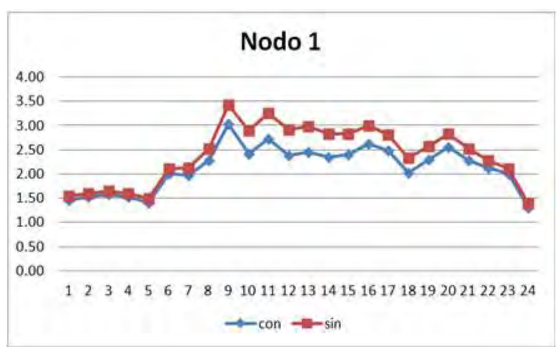
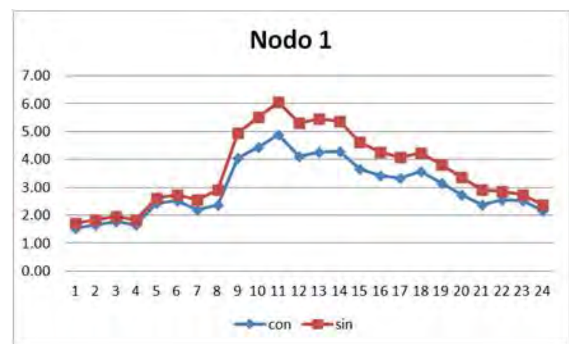


L=100m, d=8”, q=5 l/s

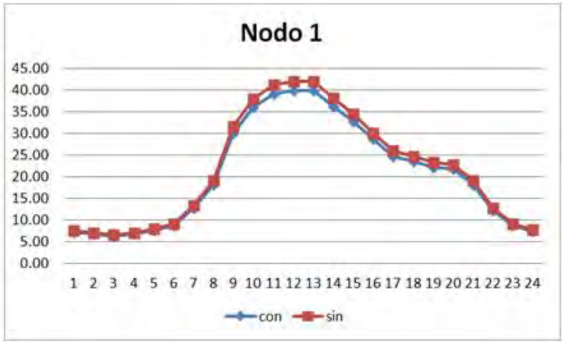


L=100m, d=8”, q=7.5 l/s



Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=300m, d=4", q=2.5 l/s



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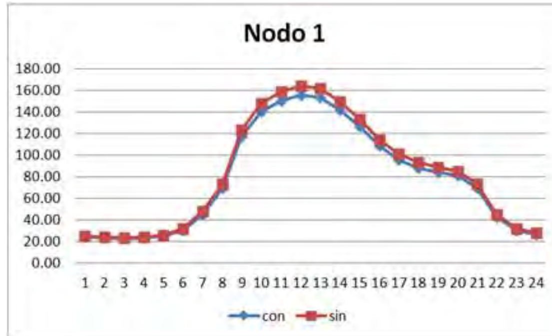

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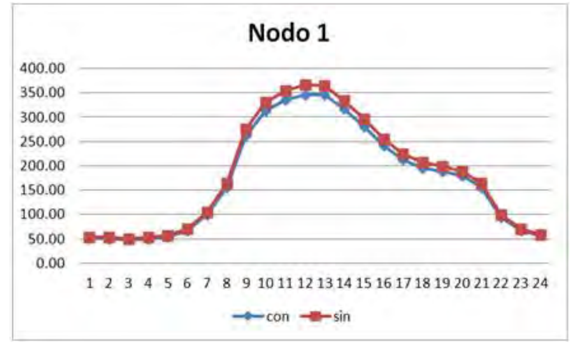

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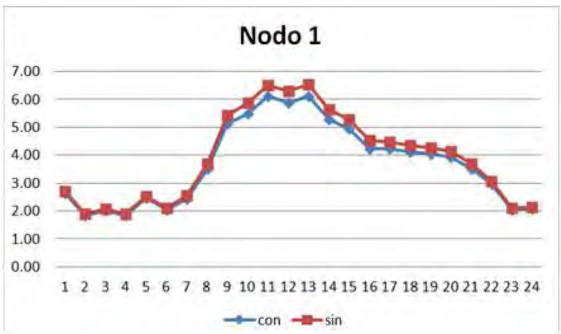
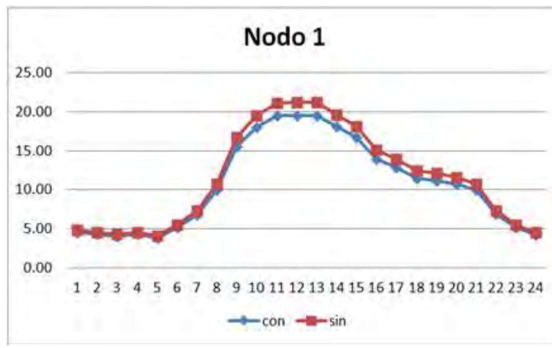
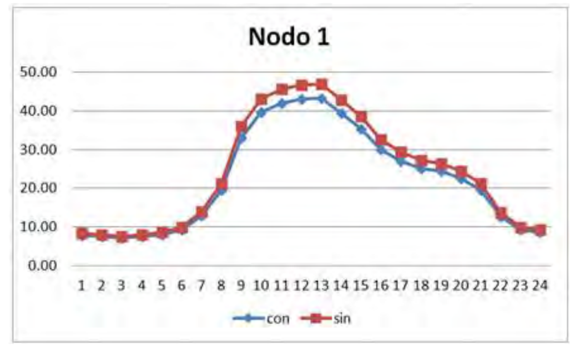


L=300m, d=6", q=5 l/s



L=300m, d=6", q=7.5 l/s



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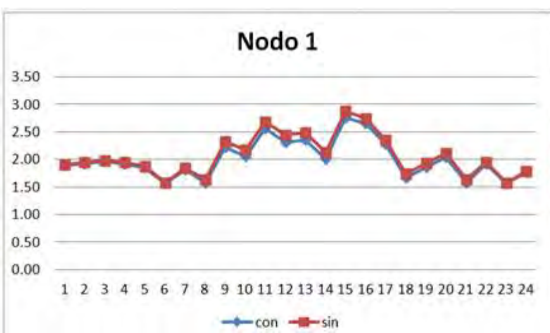
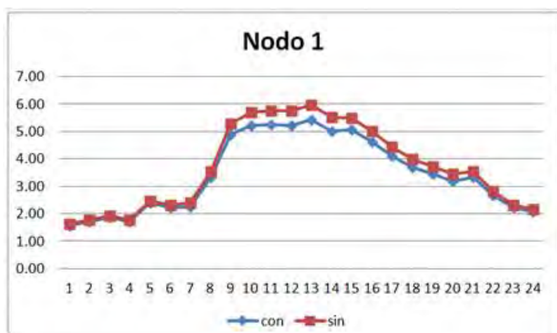
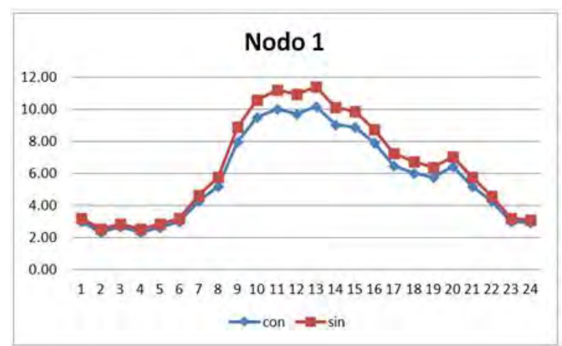


L=300m, d=8", q=5 l/s



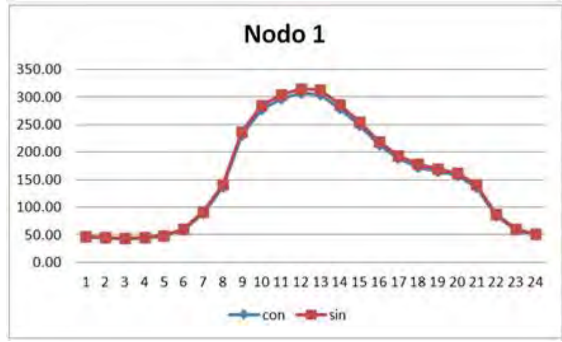
L=300m, d=8", q=7.5 l/s



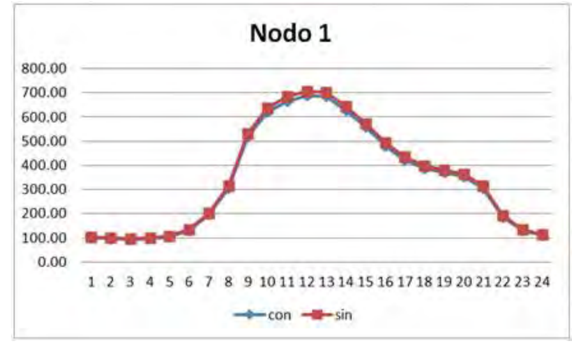
Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=600m, d=4”, q=2.5 l/s

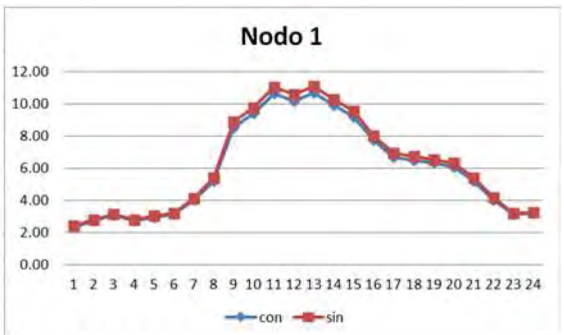
L=600m, d=4”, q=5 l/s



L=600m, d=4”, q=7.5 l/s



L=600m, d=6”, q=2.5 l/s



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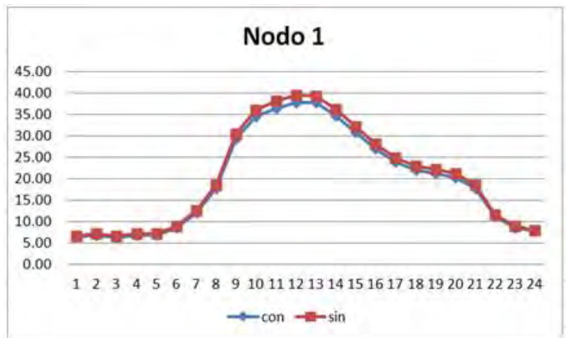

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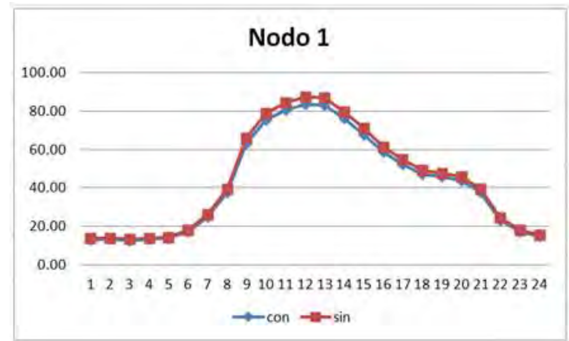
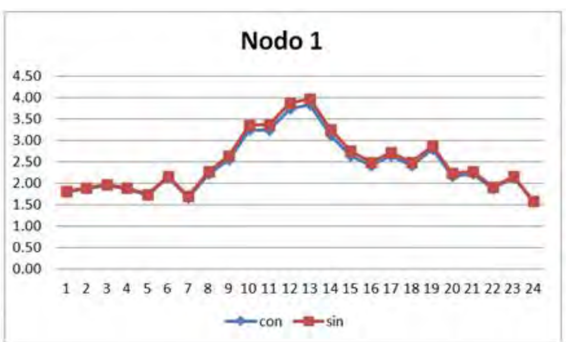
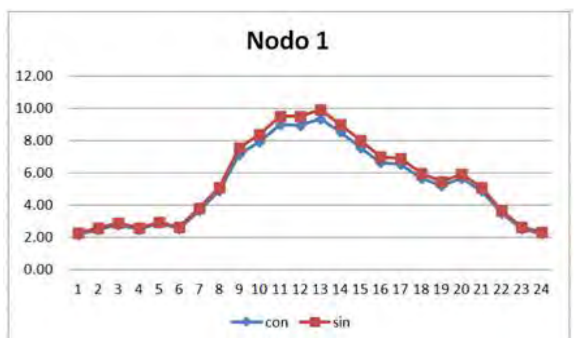


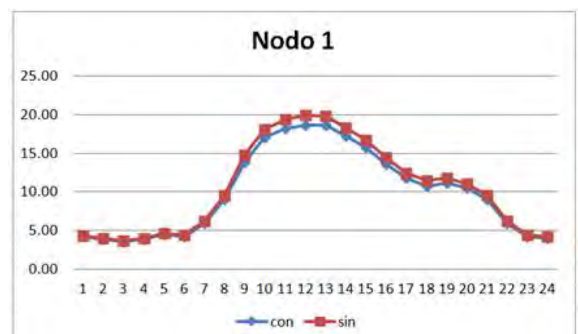
L=600m, d=8”, q=2.5 l/s



L=600m, d=8”, q=5 l/s

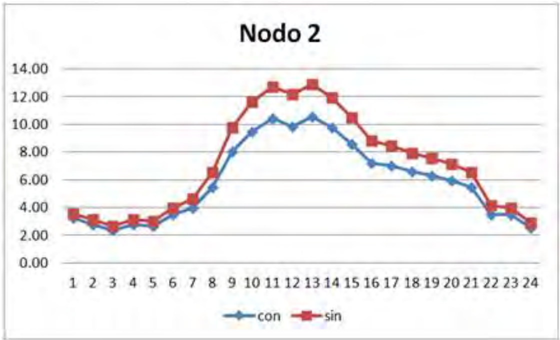


L=600m, d=8”, q=7.5 l/s



Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=100m, d=4", q=2.5 l/s



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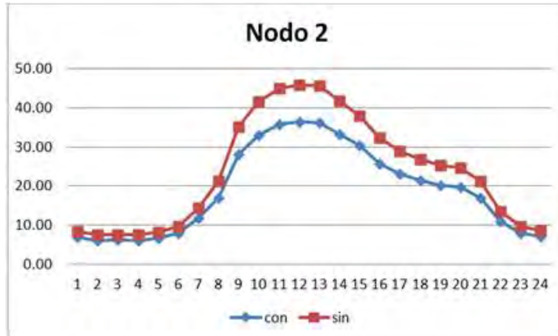
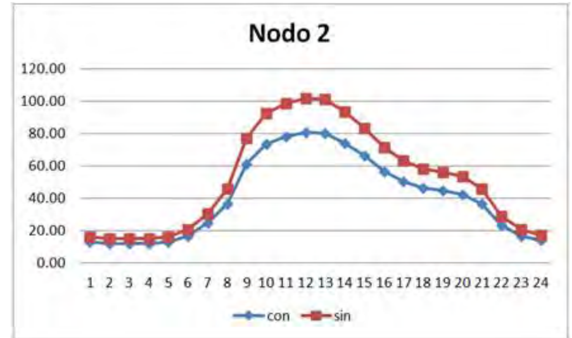
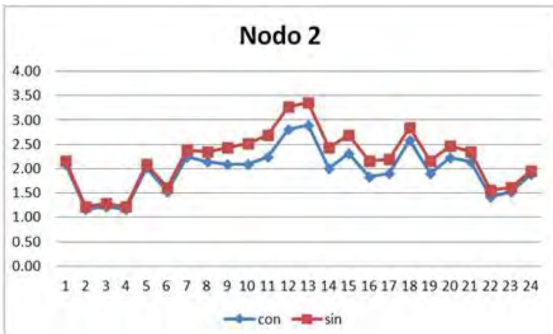


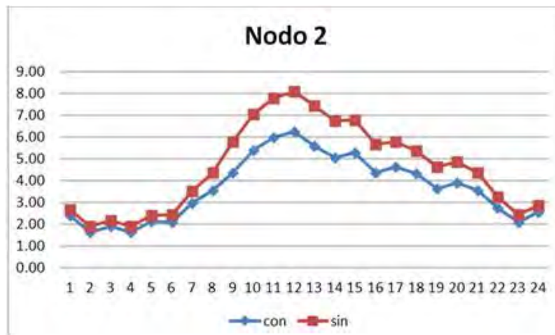
L=100m, d=4", q=7.5 l/s



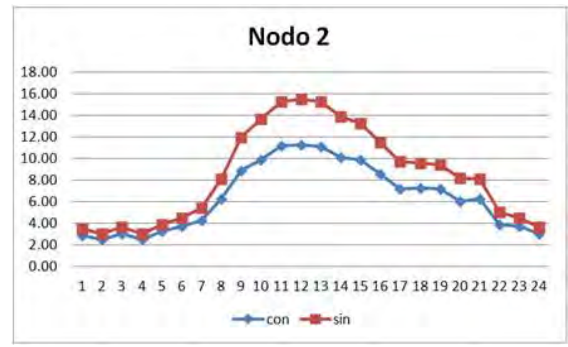
L=100m, d=6", q=2.5 l/s



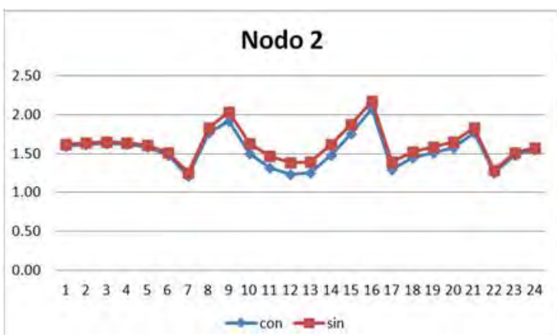
L=100m, d=6", q=5 l/s



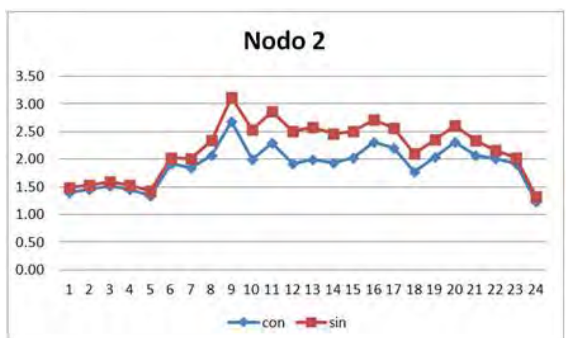
L=100m, d=6", q=7.5 l/s



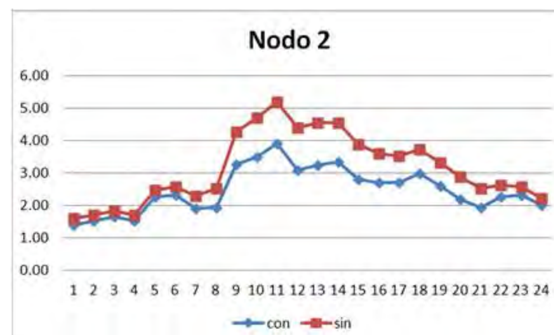
L=100m, d=8", q=2.5 l/s



L=100m, d=8", q=5 l/s

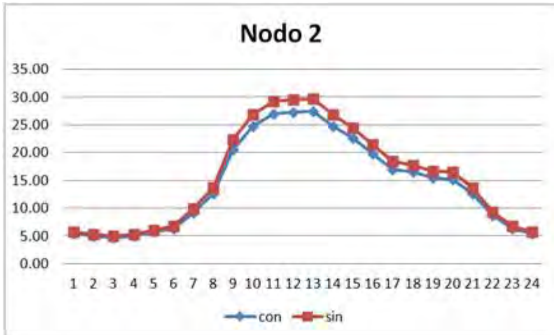


L=100m, d=8", q=7.5 l/s

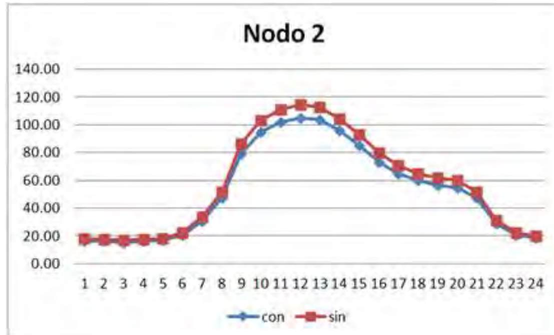


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

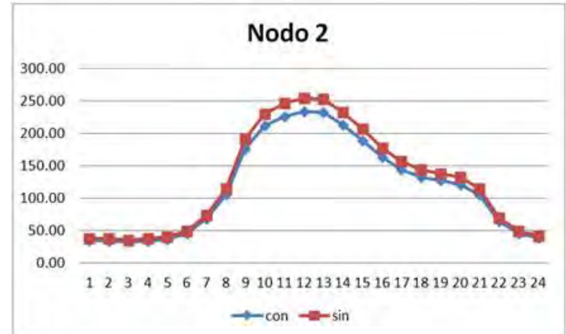
L=300m, d=4”, q=2.5 l/s



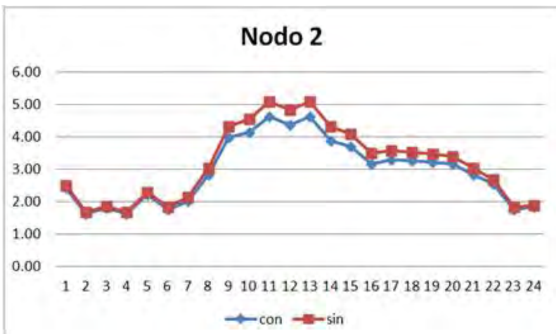
L=300m, d=4”, q=5 l/s



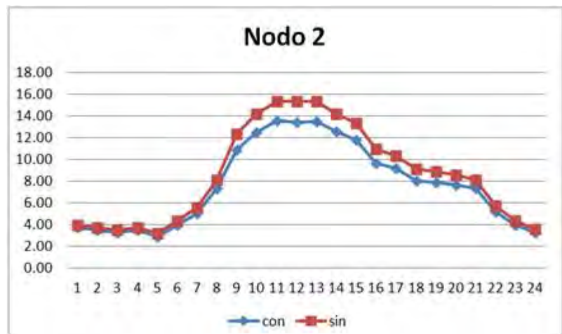
L=300m, d=4”, q=7.5 l/s



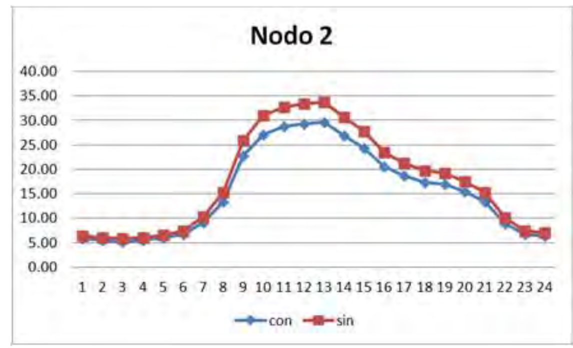
L=300m, d=6”, q=2.5 l/s



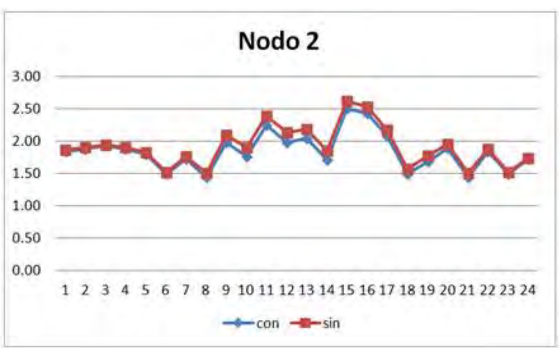
L=300m, d=6”, q=5 l/s



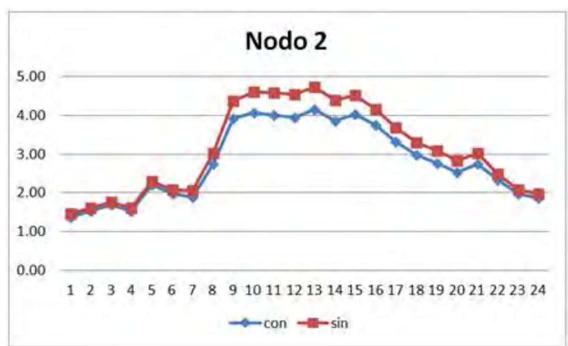
L=300m, d=6”, q=7.5 l/s



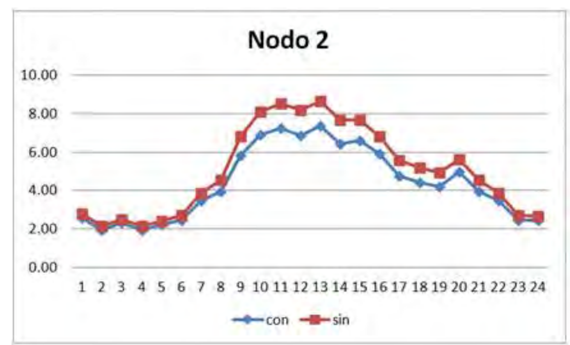
L=300m, d=8”, q=2.5 l/s



L=300m, d=8”, q=5 l/s



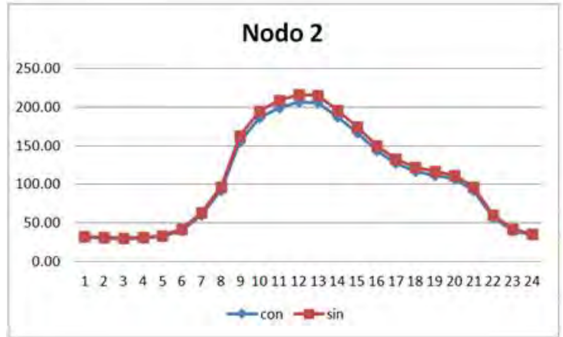
L=300m, d=8”, q=7.5 l/s



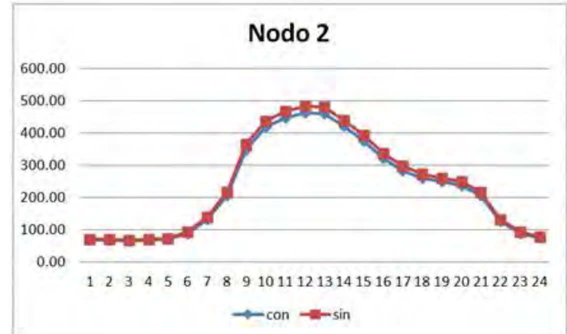
Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=600m, d=4", q=2.5 l/s

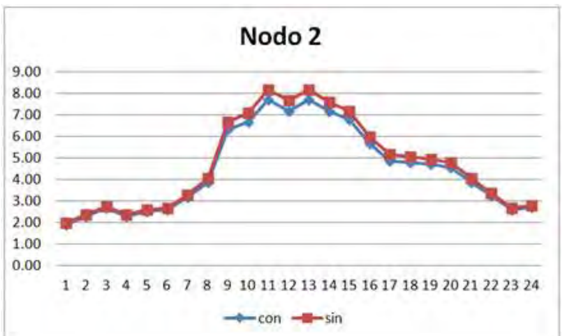
L=600m, d=4", q=5 l/s



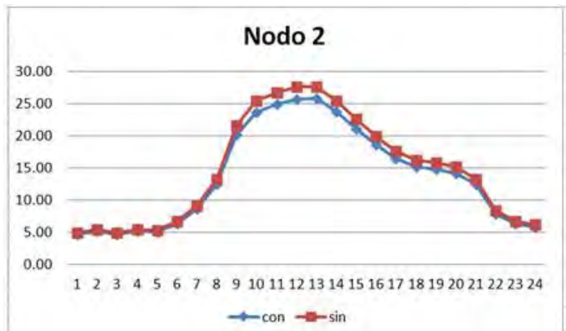
L=600m, d=4", q=7.5 l/s



L=600m, d=6", q=2.5 l/s



L=600m, d=6", q=5 l/s



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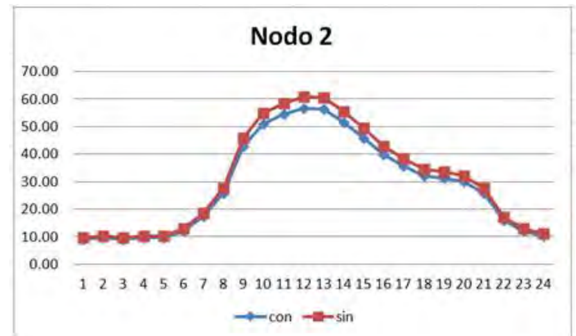
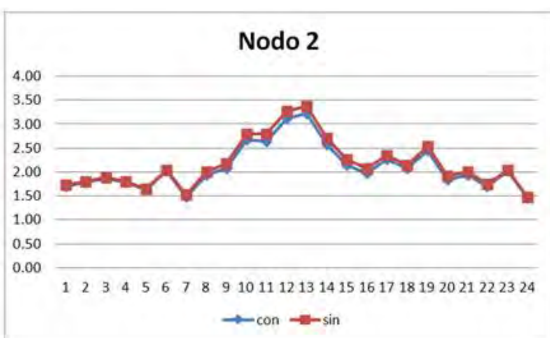
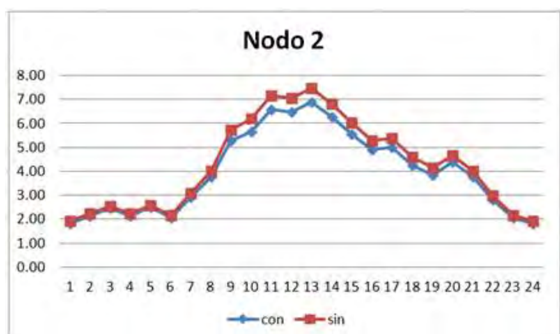


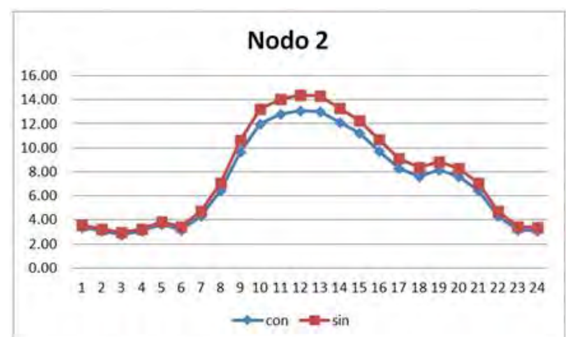
L=600m, d=8", q=2.5 l/s



L=600m, d=8", q=5 l/s

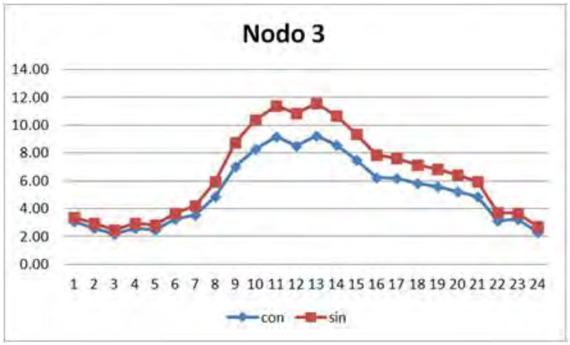


L=600m, d=8", q=7.5 l/s

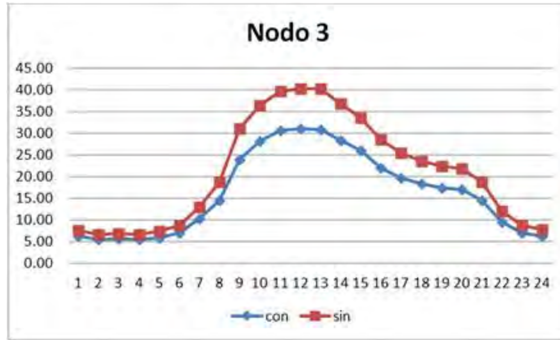


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=100m, d=4", q=2.5 l/s



L=100m, d=4", q=5 l/s



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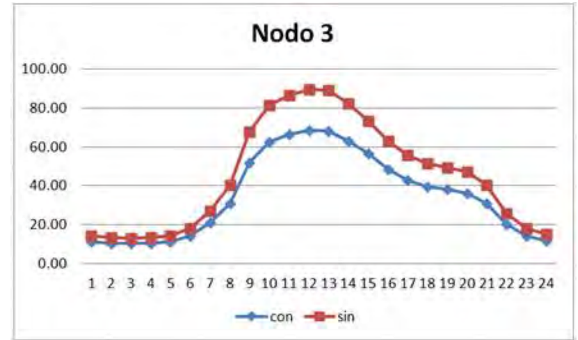
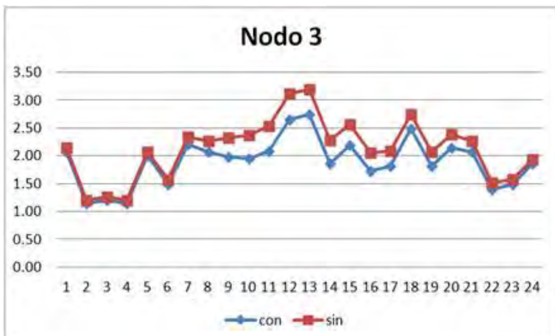
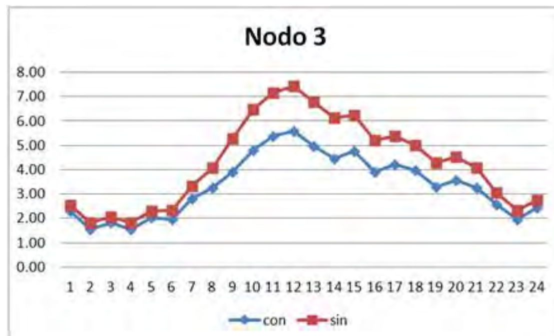


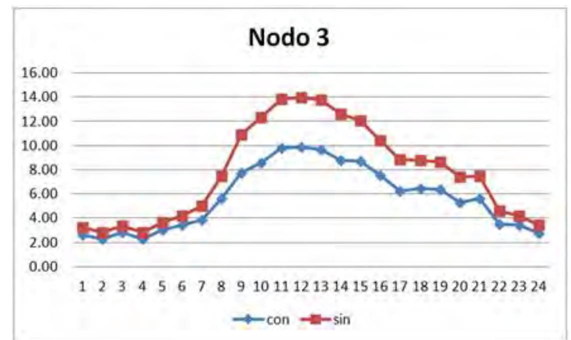
L=100m, d=6", q=2.5 l/s



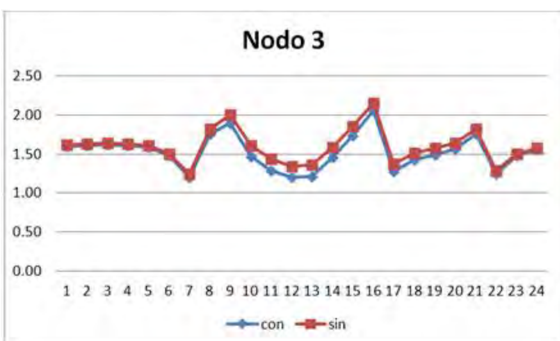
L=100m, d=6", q=5 l/s



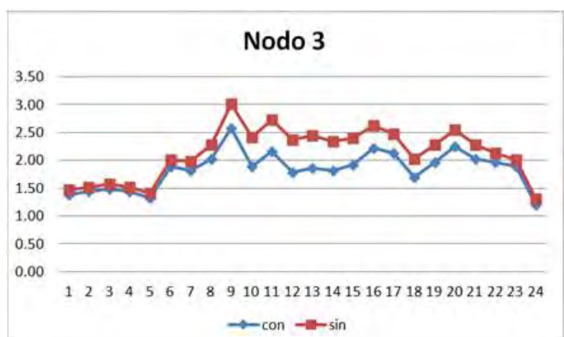
L=100m, d=6", q=7.5 l/s



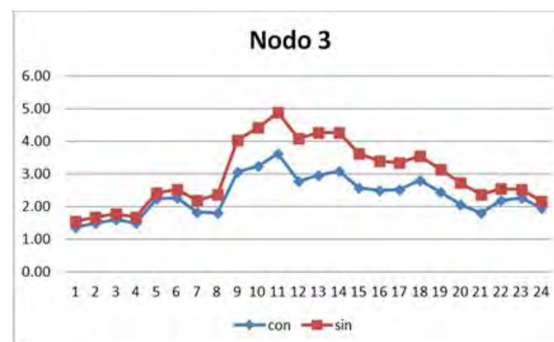
L=100m, d=8", q=2.5 l/s



L=100m, d=8", q=5 l/s

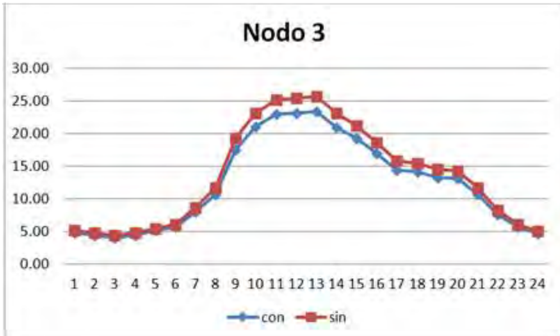


L=100m, d=8", q=7.5 l/s

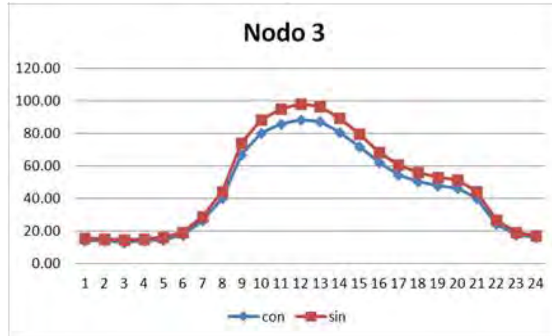


Anexo3. Carga en nodos {M S-F}   ejeX: horas y eje Y:metros

L=300m, d=4", q=2.5 l/s



L=300m, d=4", q=5 l/s



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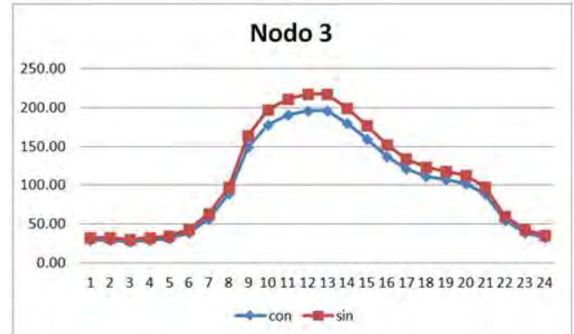
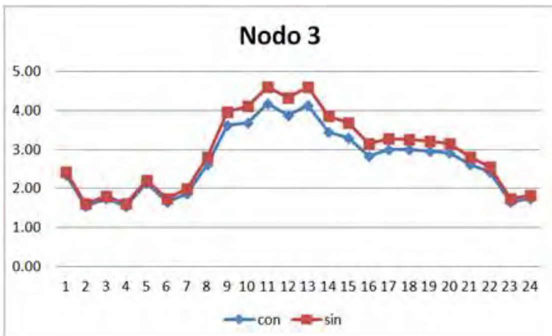
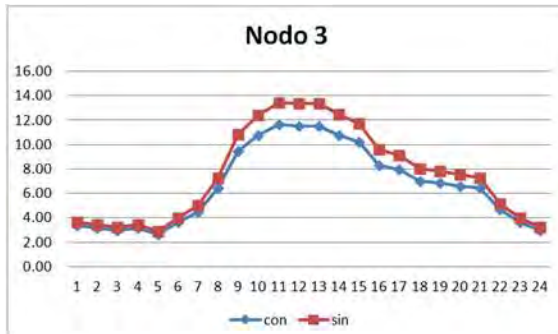


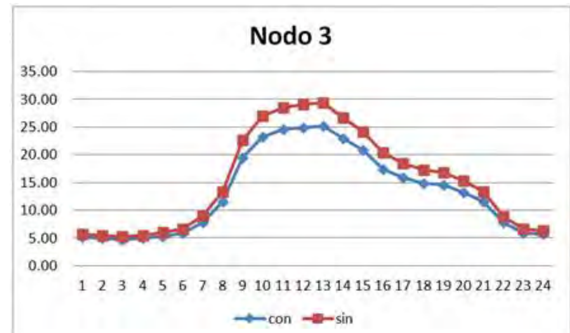
L=300m, d=6", q=2.5 l/s



L=300m, d=6", q=5 l/s



L=300m, d=6", q=7.5 l/s



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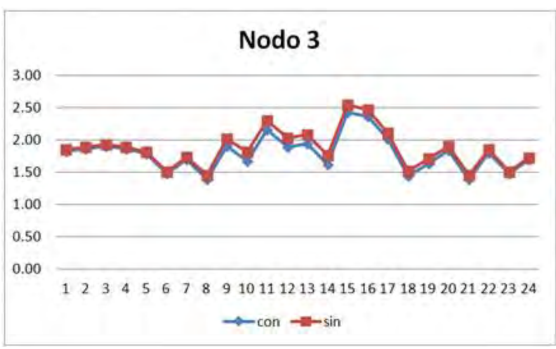
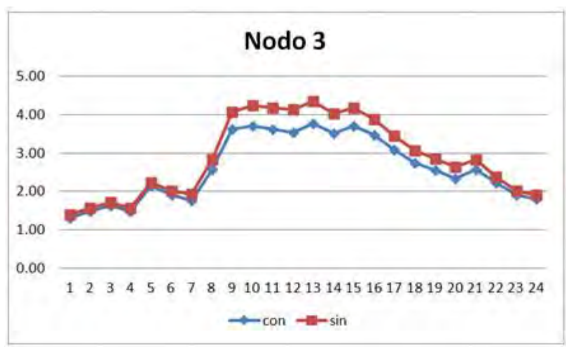
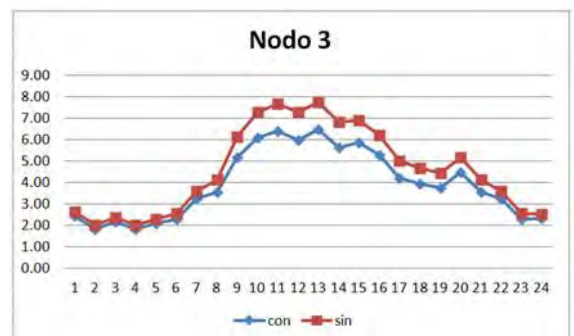


L=300m, d=8", q=5 l/s



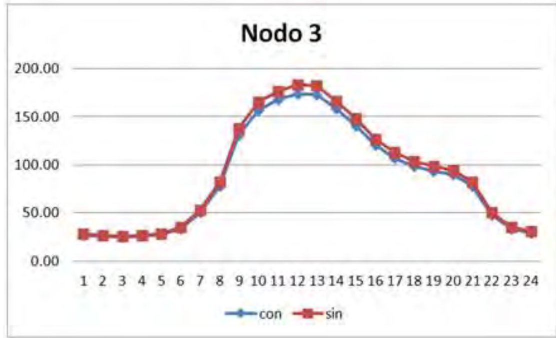
L=300m, d=8", q=7.5 l/s



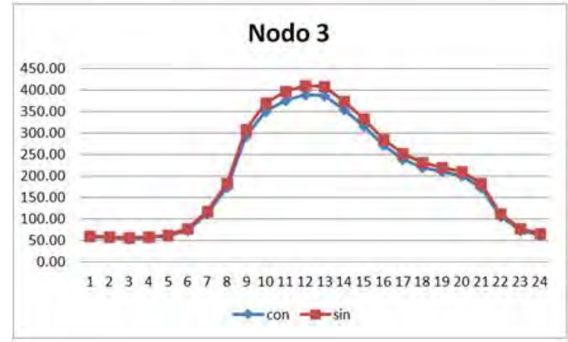
Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=600m, d=4", q=2.5 l/s

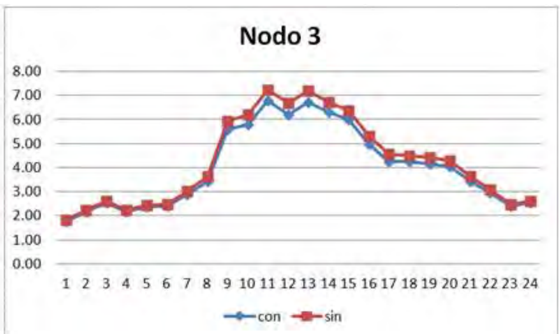
L=600m, d=4", q=5 l/s



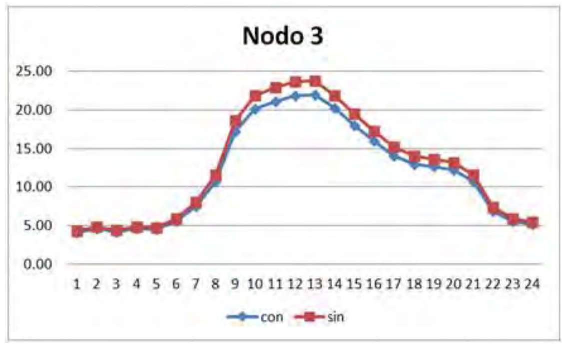
L=600m, d=4", q=7.5 l/s



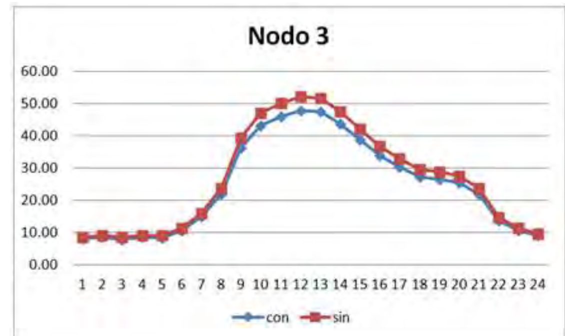
L=600m, d=6", q=2.5 l/s



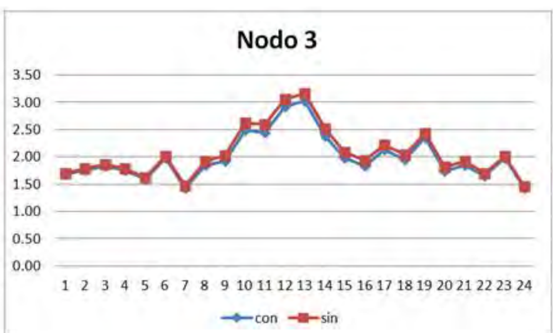
L=600m, d=6", q=5 l/s



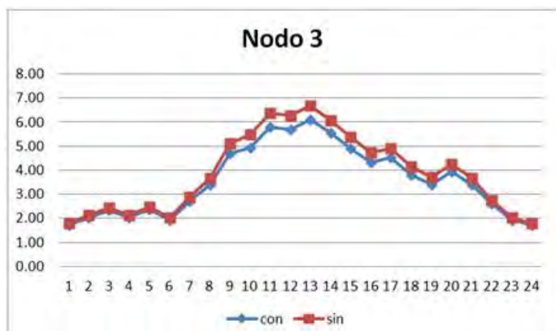
L=600m, d=6", q=7.5 l/s



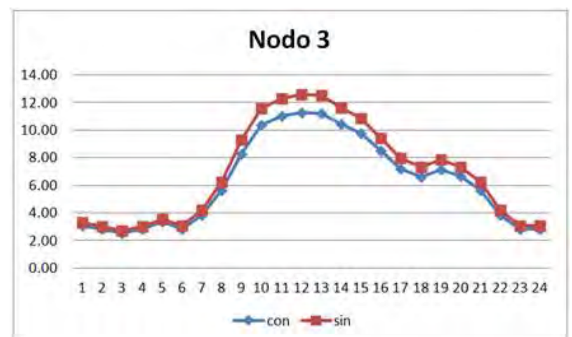
L=600m, d=8", q=2.5 l/s



L=600m, d=8", q=5 l/s

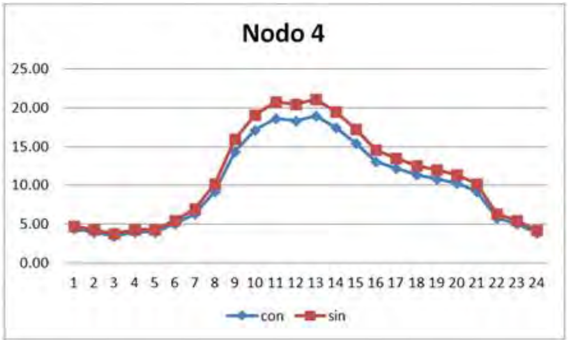


L=600m, d=8", q=7.5 l/s

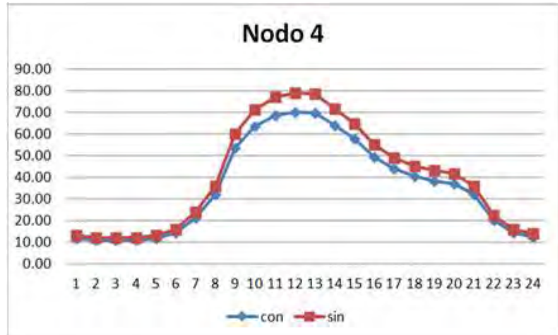


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

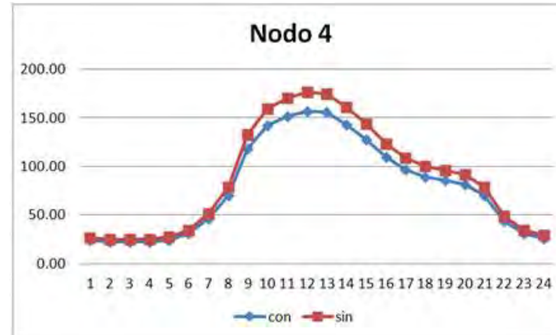
L=100m, d=4”, q=2.5 l/s



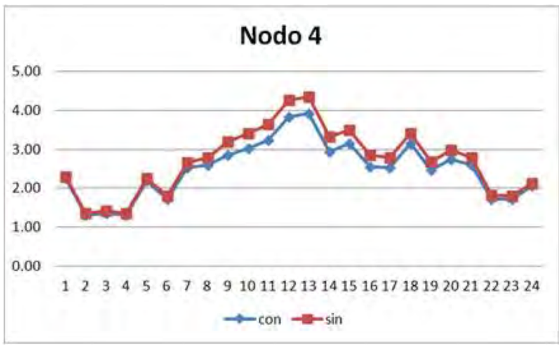
L=100m, d=4”, q=5 l/s



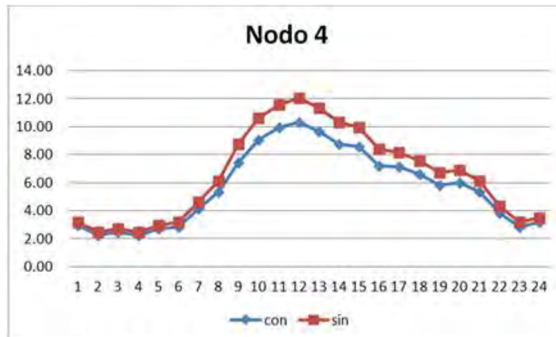
L=100m, d=4”, q=7.5 l/s



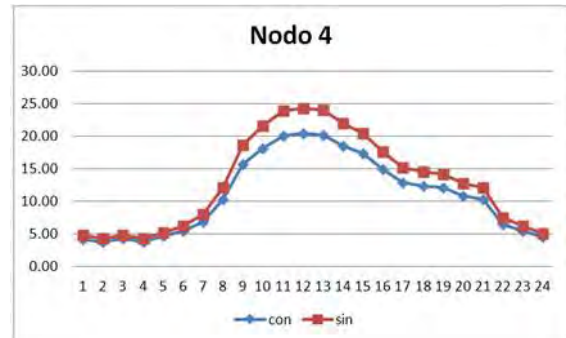
L=100m, d=6”, q=2.5 l/s



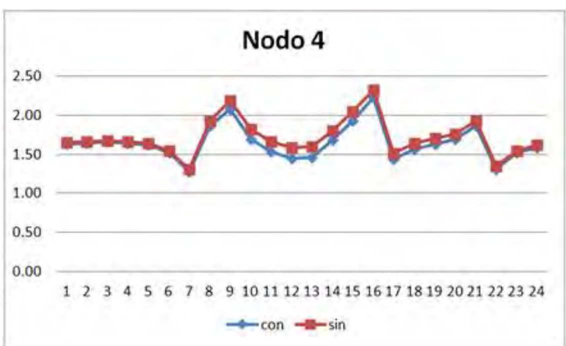
L=100m, d=6”, q=5 l/s



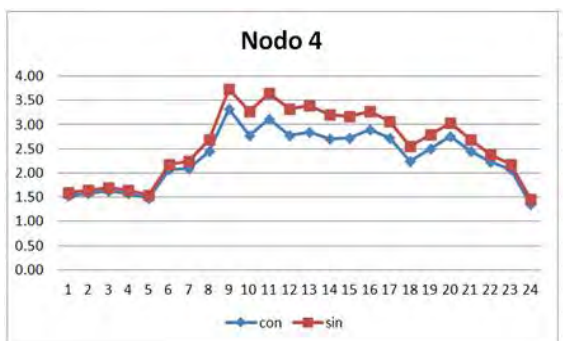
L=100m, d=6”, q=7.5 l/s



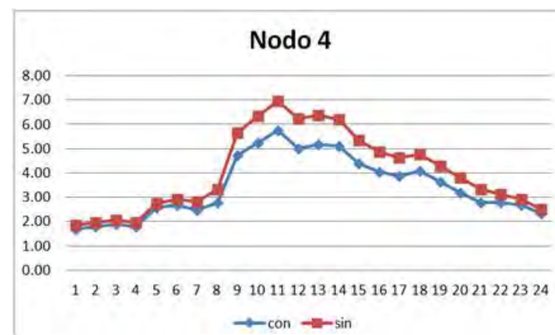
L=100m, d=8”, q=2.5 l/s



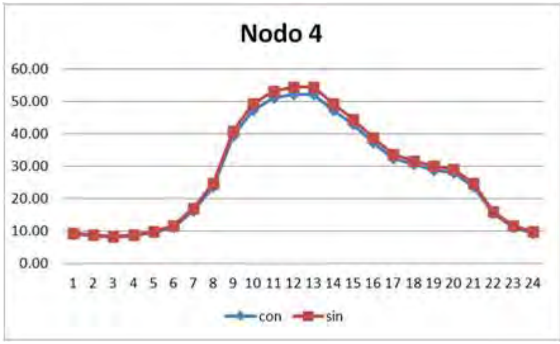
L=100m, d=8”, q=5 l/s



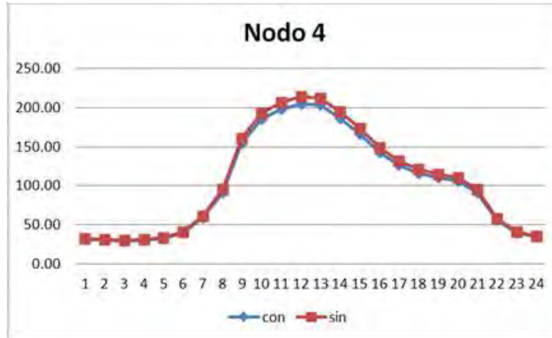
L=100m, d=8”, q=7.5 l/s



L=300m, d=4", q=2.5 l/s



L=300m, d=4", q=5 l/s



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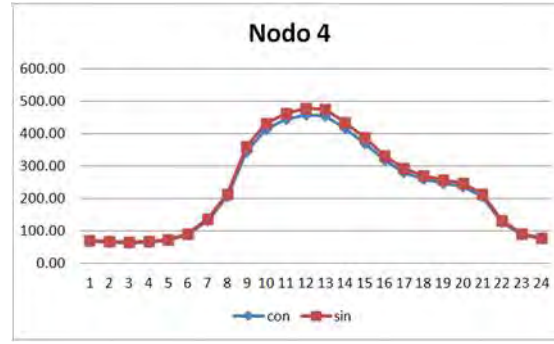
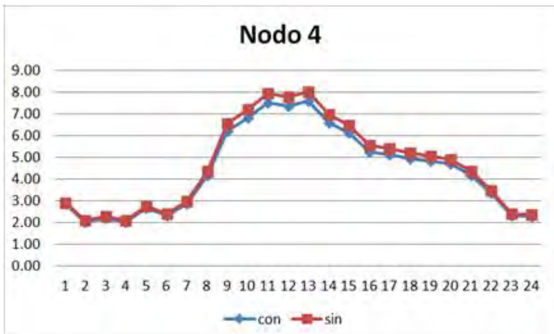
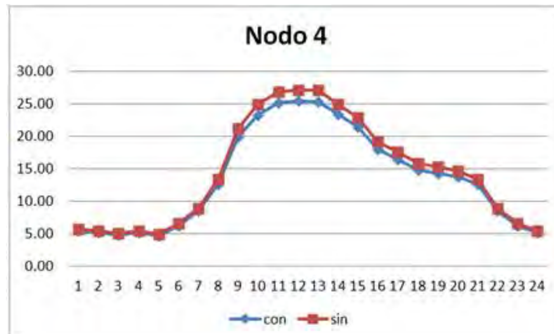


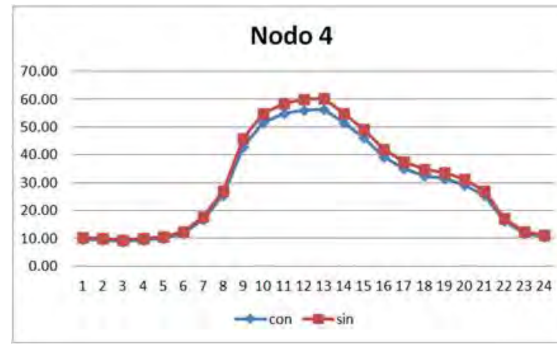
L=300m, d=6", q=2.5 l/s



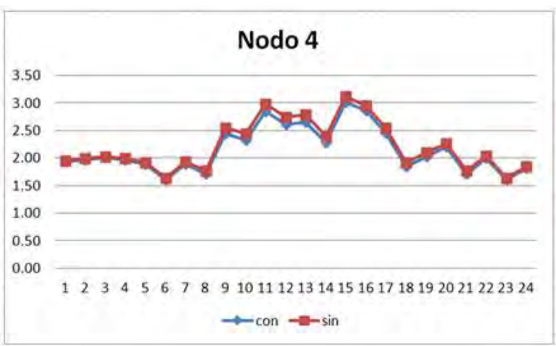
L=300m, d=6", q=5 l/s



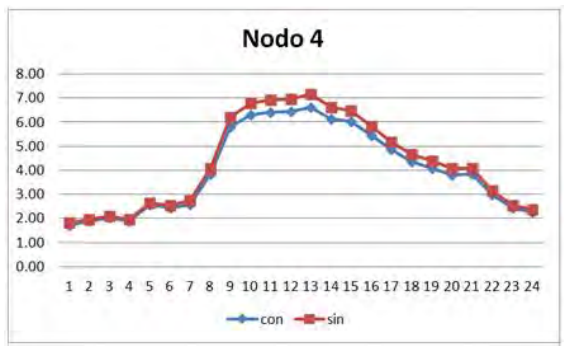
L=300m, d=6", q=7.5 l/s



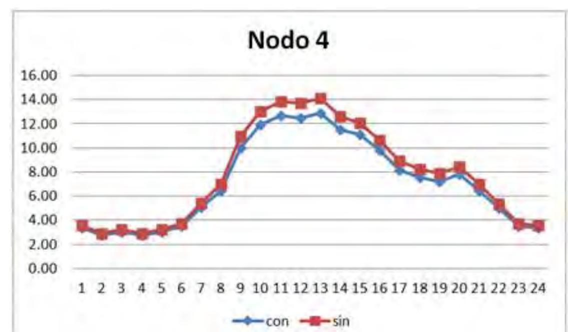
L=300m, d=8", q=2.5 l/s



L=300m, d=8", q=5 l/s

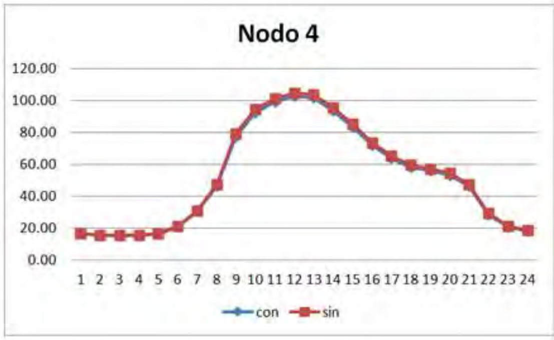


L=300m, d=8", q=7.5 l/s

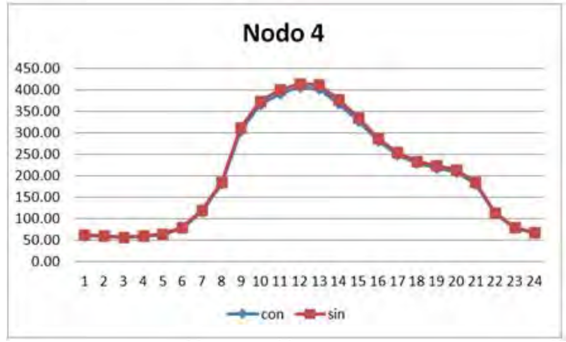


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

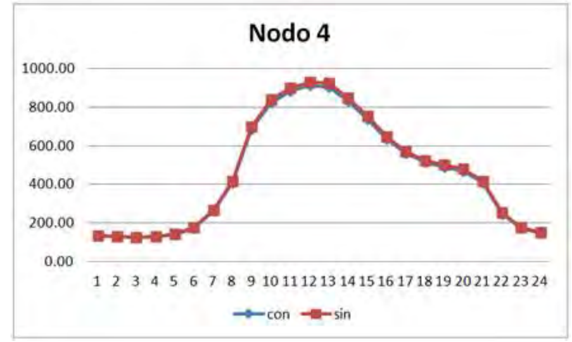
L=600m, d=4”, q=2.5 l/s



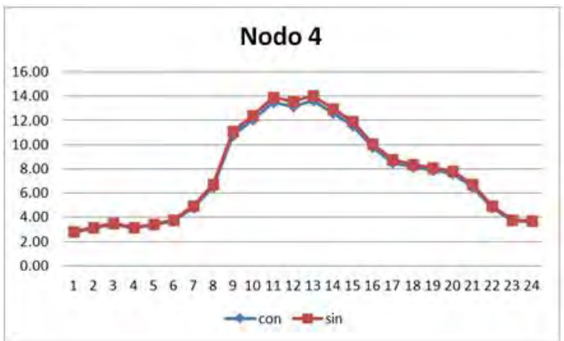
L=600m, d=4”, q=5 l/s



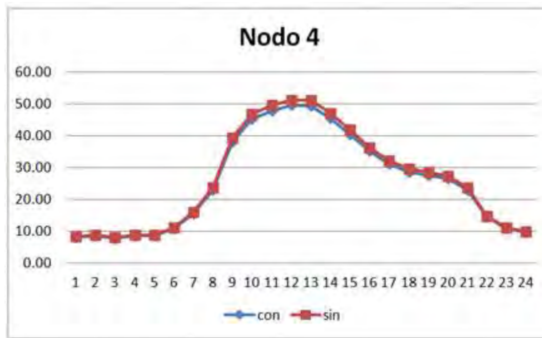
L=600m, d=4”, q=7.5 l/s



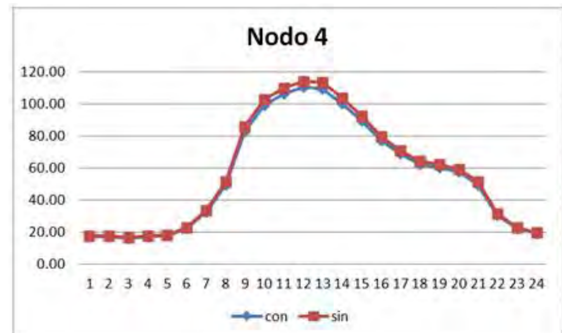
L=600m, d=6”, q=2.5 l/s



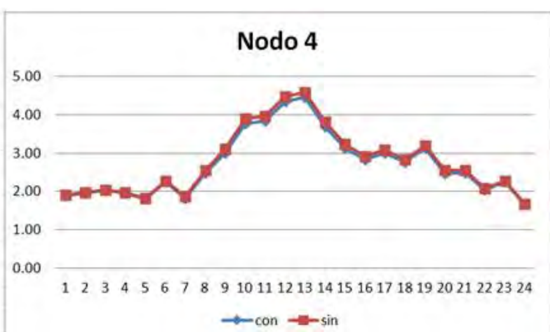
L=600m, d=6”, q=5 l/s



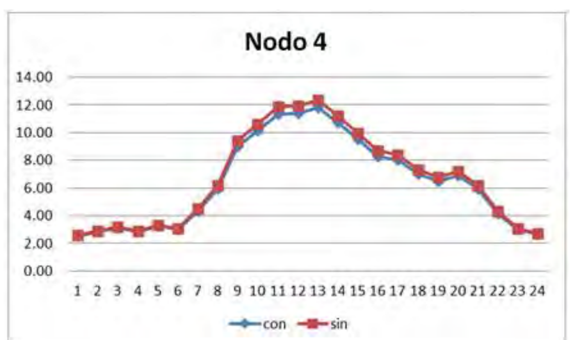
L=600m, d=6”, q=7.5 l/s



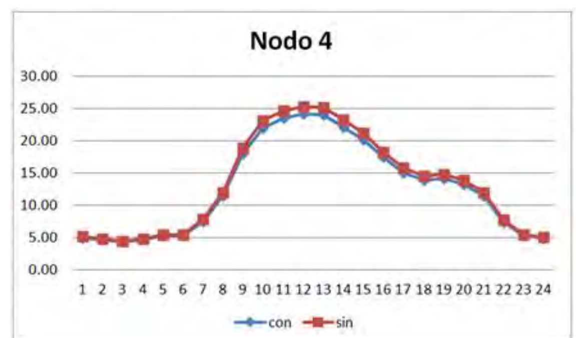
L=600m, d=8”, q=2.5 l/s



L=600m, d=8”, q=5 l/s

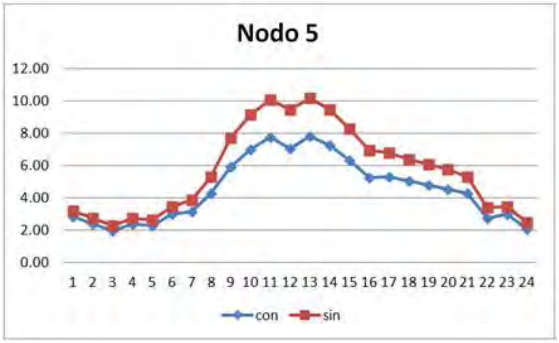


L=600m, d=8”, q=7.5 l/s

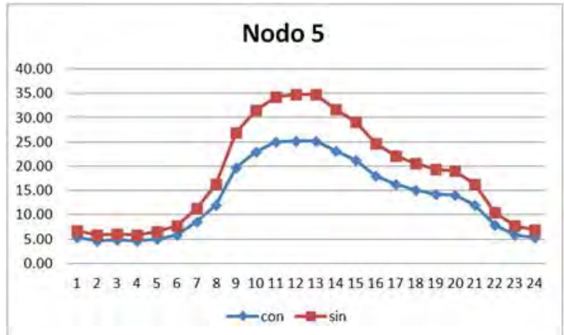


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

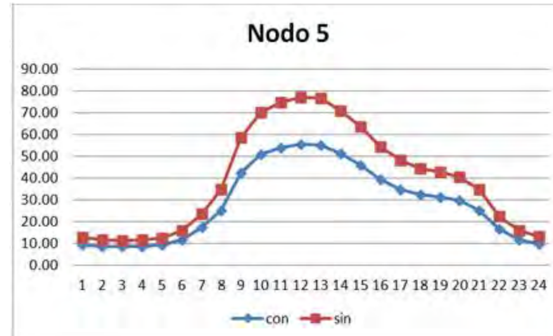
L=100m, d=4", q=2.5 l/s



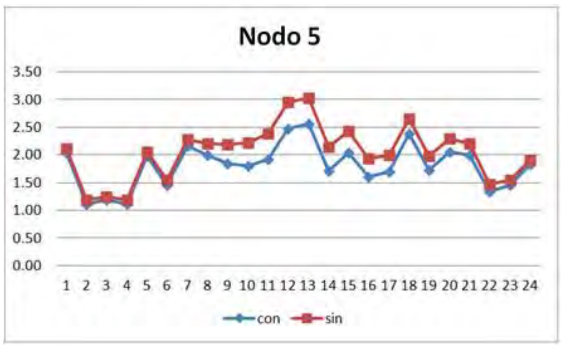
L=100m, d=4", q=5 l/s



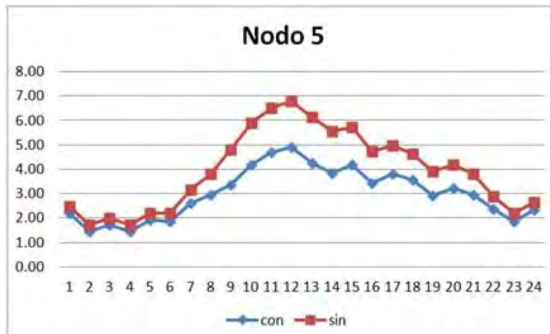
L=100m, d=4", q=7.5 l/s



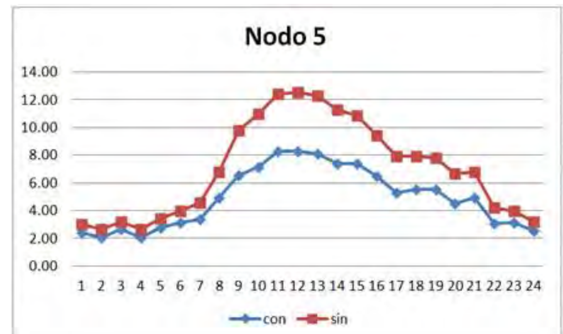
L=100m, d=6", q=2.5 l/s



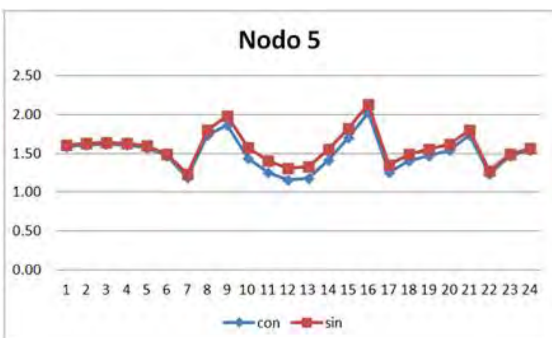
L=100m, d=6", q=5 l/s



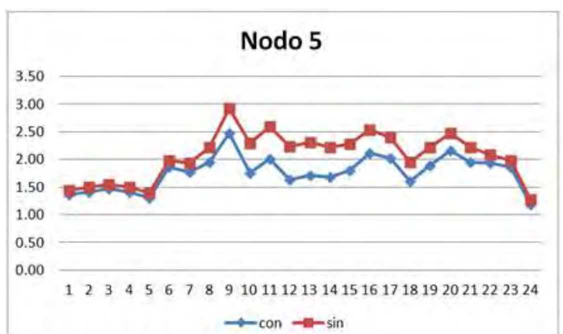
L=100m, d=6", q=7.5 l/s



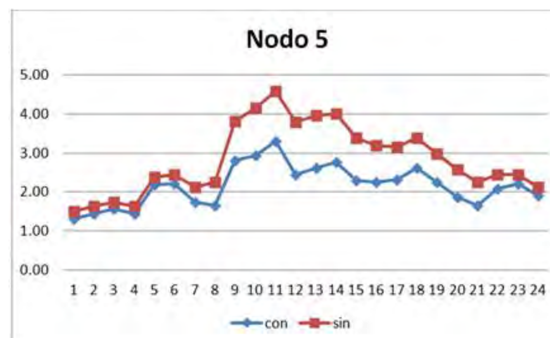
L=100m, d=8", q=2.5 l/s



L=100m, d=8", q=5 l/s

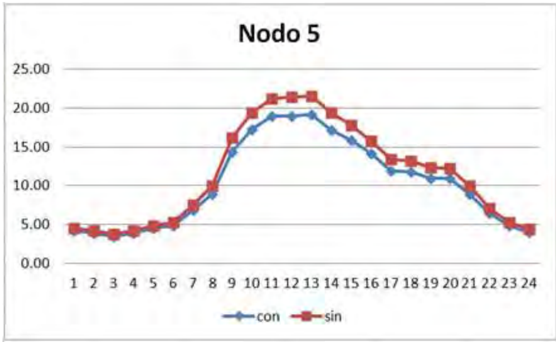


L=100m, d=8", q=7.5 l/s

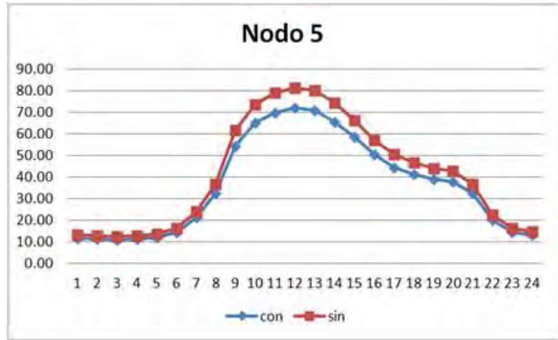


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

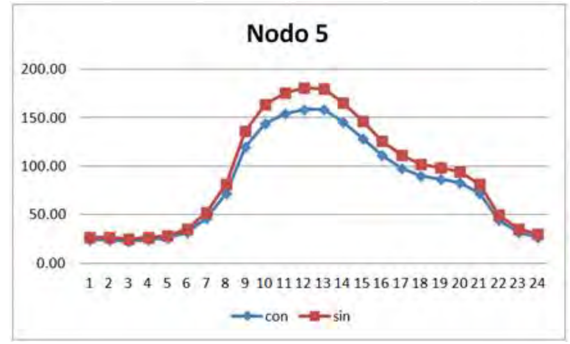
L=300m, d=4”, q=2.5 l/s



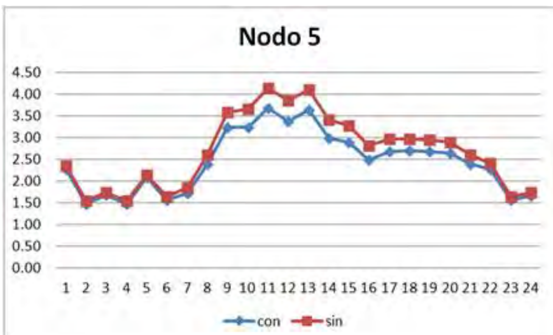
L=300m, d=4”, q=5 l/s



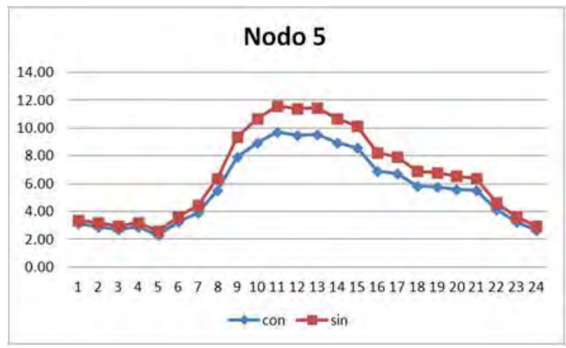
L=300m, d=4”, q=7.5 l/s



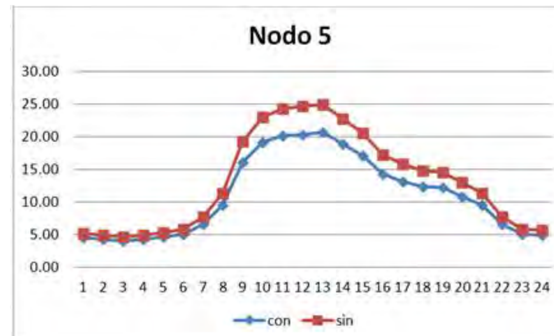
L=300m, d=6”, q=2.5 l/s



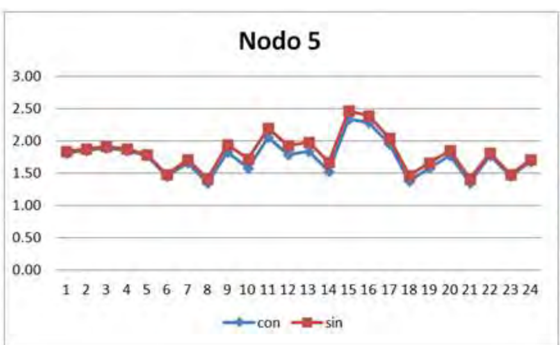
L=300m, d=6”, q=5 l/s



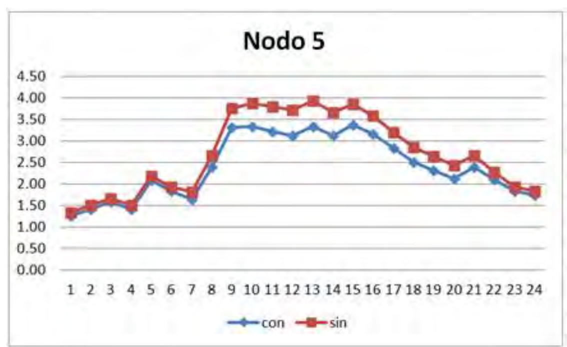
L=300m, d=6”, q=7.5 l/s



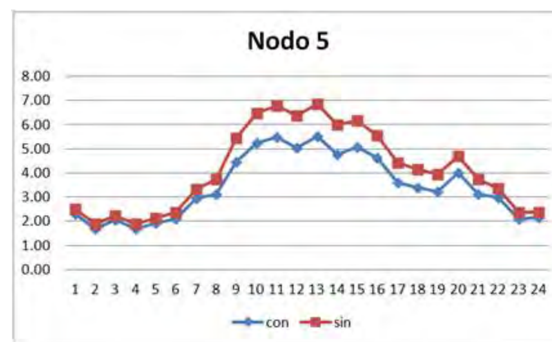
L=300m, d=8”, q=2.5 l/s



L=300m, d=8”, q=5 l/s

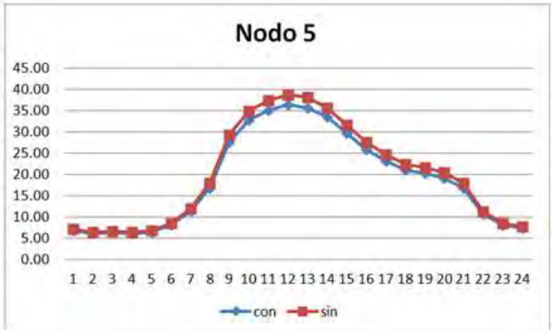


L=300m, d=8”, q=7.5 l/s

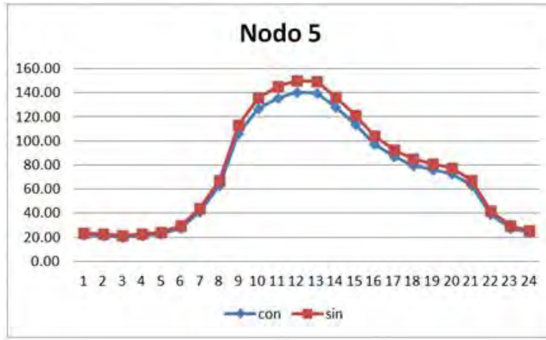


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

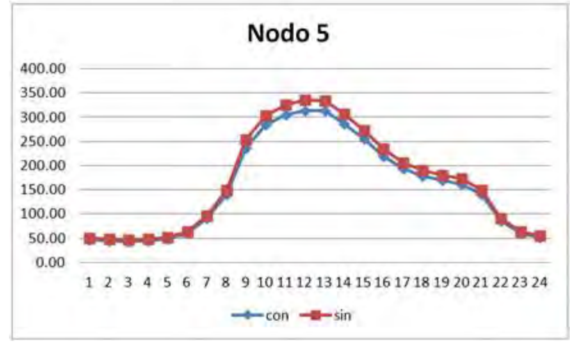
L=600m, d=4", q=2.5 l/s



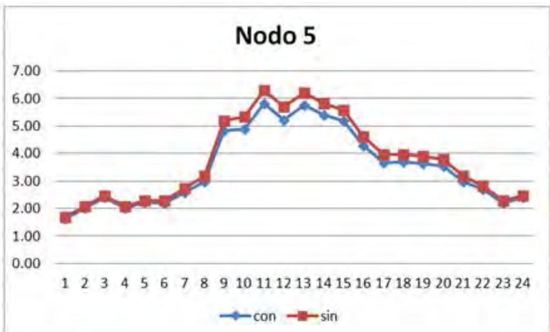
L=600m, d=4", q=5 l/s



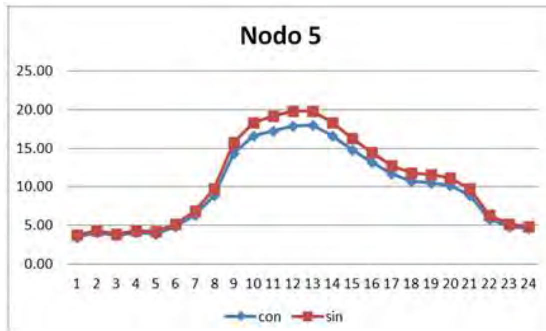
L=600m, d=4", q=7.5 l/s



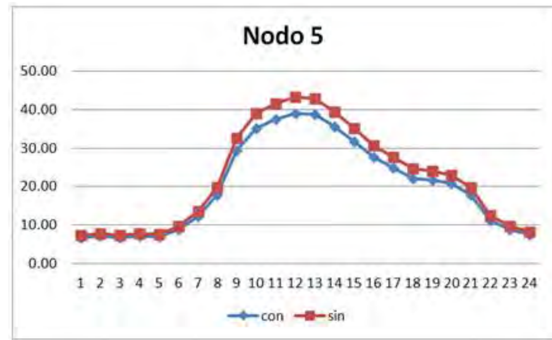
L=600m, d=6", q=2.5 l/s



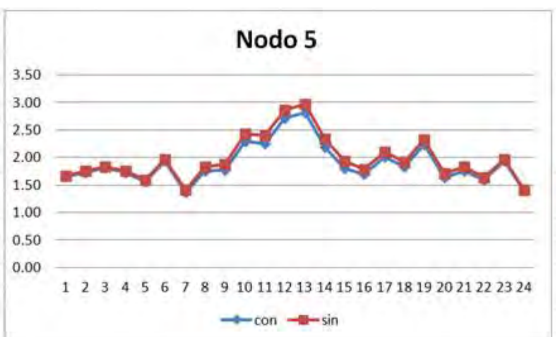
L=600m, d=6", q=5 l/s



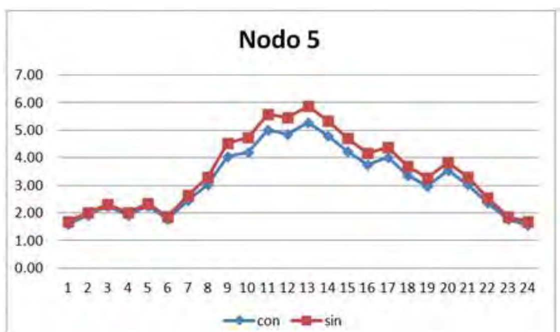
L=600m, d=6", q=7.5 l/s



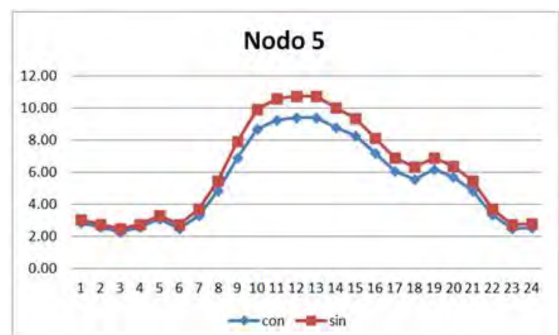
L=600m, d=8", q=2.5 l/s



L=600m, d=8", q=5 l/s

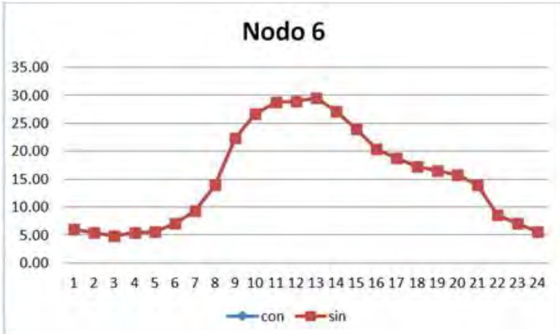


L=600m, d=8", q=7.5 l/s

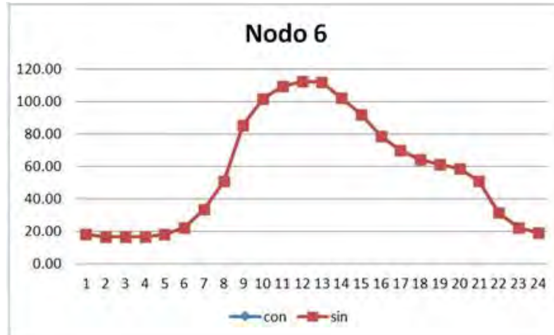


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

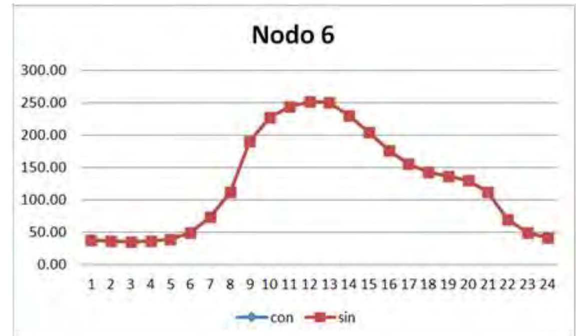
L=100m, d=4”, q=2.5 l/s



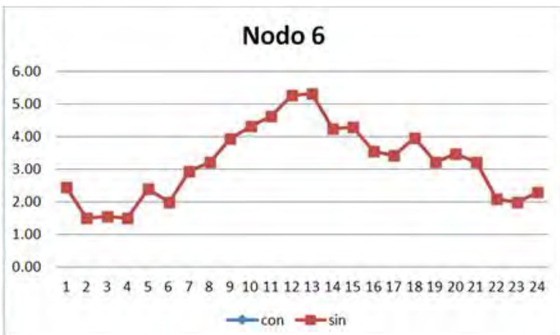
L=100m, d=4”, q=5 l/s



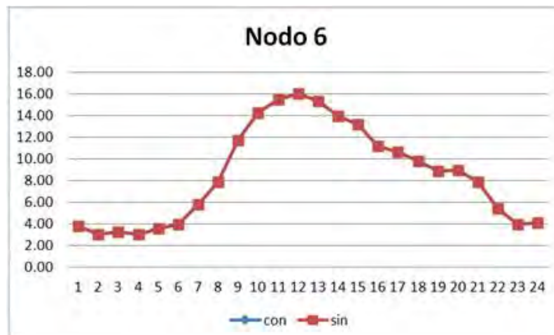
L=100m, d=4”, q=7.5 l/s



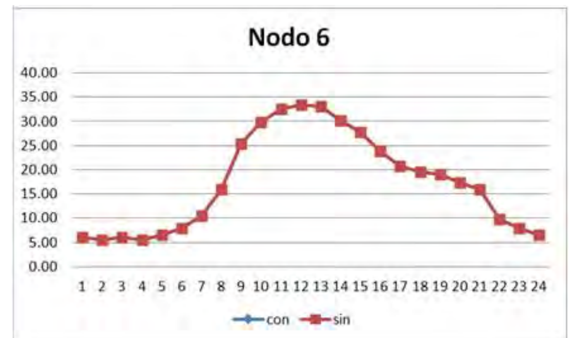
L=100m, d=6”, q=2.5 l/s



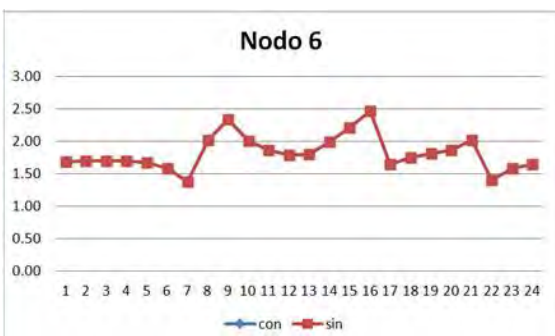
L=100m, d=6”, q=5 l/s



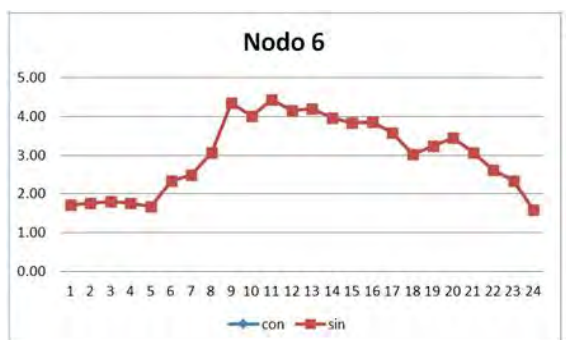
L=100m, d=6”, q=7.5 l/s



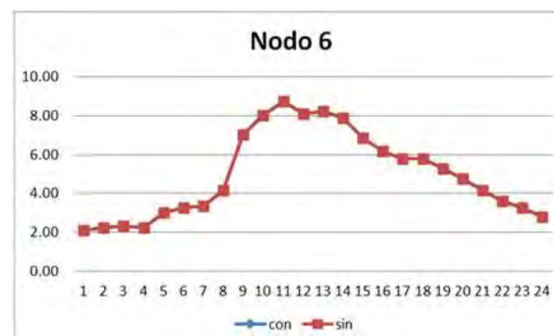
L=100m, d=8”, q=2.5 l/s



L=100m, d=8”, q=5 l/s



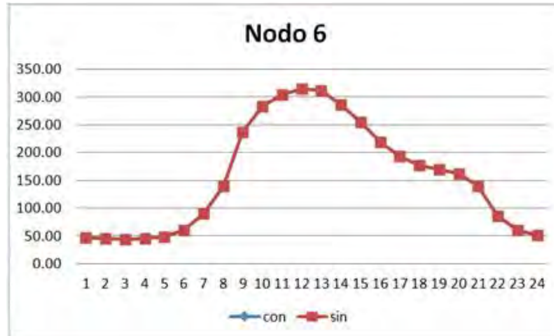
L=100m, d=8”, q=7.5 l/s



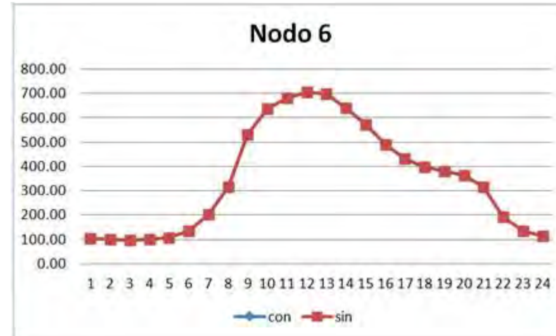
Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=300m, d=4", q=2.5 l/s

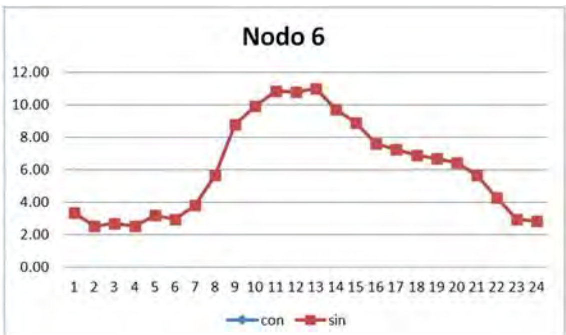
L=300m, d=4", q=5 l/s



L=300m, d=4", q=7.5 l/s

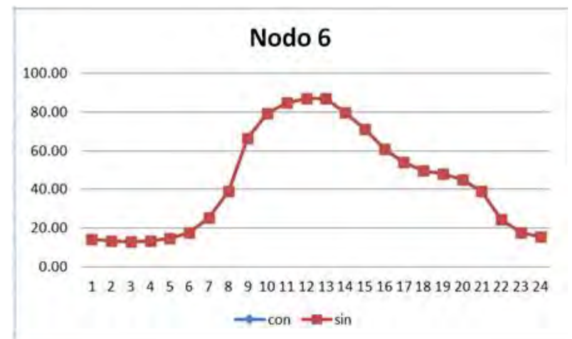


L=300m, d=6", q=2.5 l/s



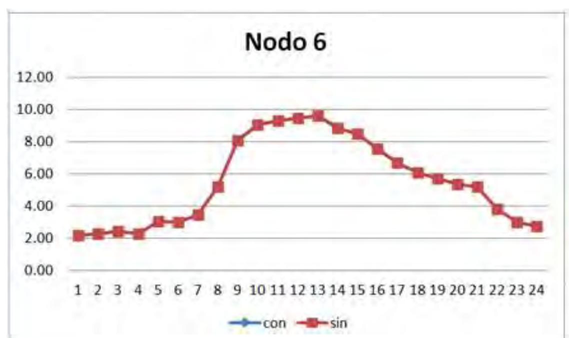
L=300m, d=6", q=5 l/s

L=300m, d=6", q=7.5 l/s



L=300m, d=8", q=2.5 l/s

L=300m, d=8", q=5 l/s



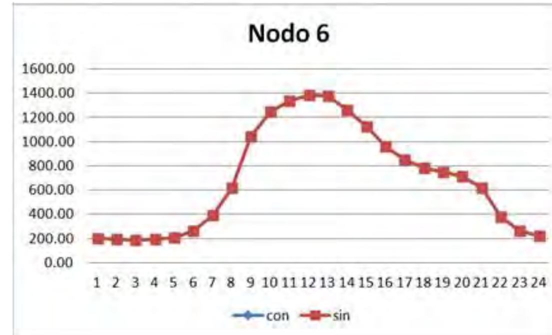
L=300m, d=8", q=7.5 l/s

Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

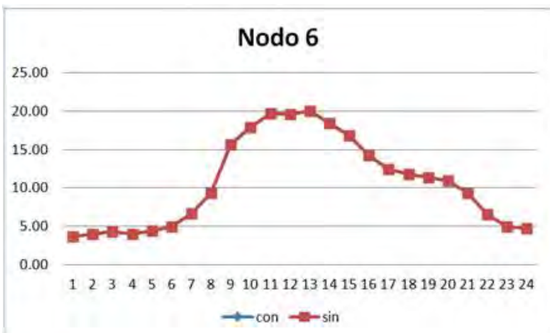
L=600m, d=4”, q=2.5 l/s

L=600m, d=4”, q=5 l/s

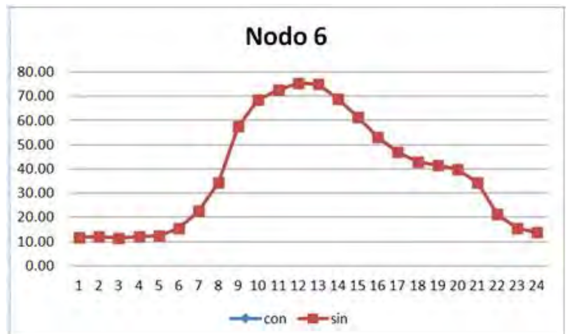
L=600m, d=4”, q=7.5 l/s



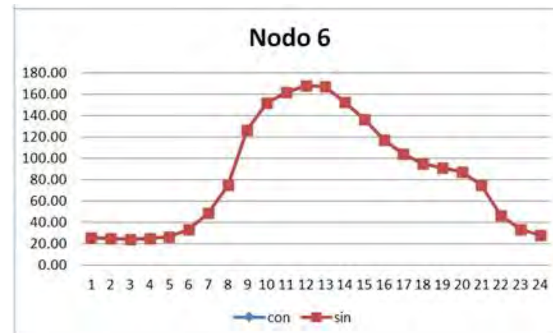
L=600m, d=6”, q=2.5 l/s



L=600m, d=6”, q=5 l/s

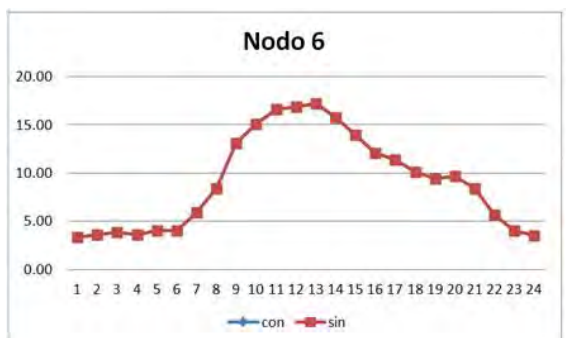


L=600m, d=6”, q=7.5 l/s



L=600m, d=8”, q=2.5 l/s

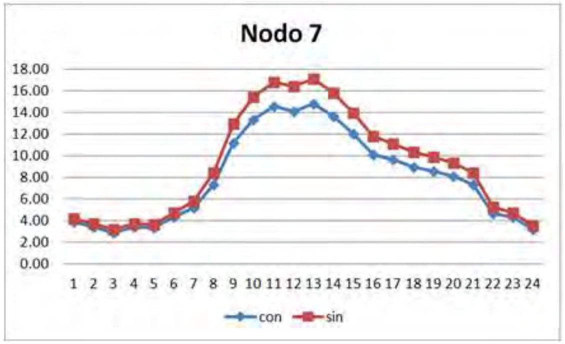
L=600m, d=8”, q=5 l/s



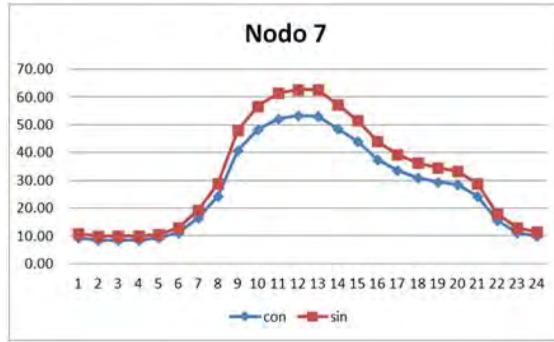
L=600m, d=8”, q=7.5 l/s

Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

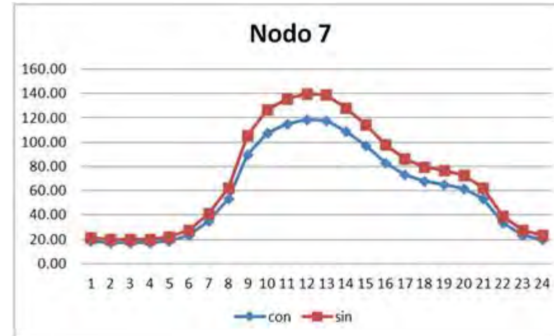
L=100m, d=4”, q=2.5 l/s



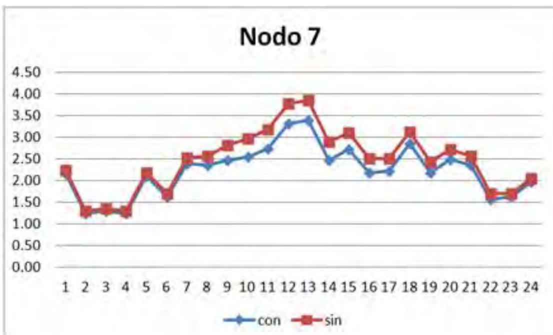
L=100m, d=4”, q=5 l/s



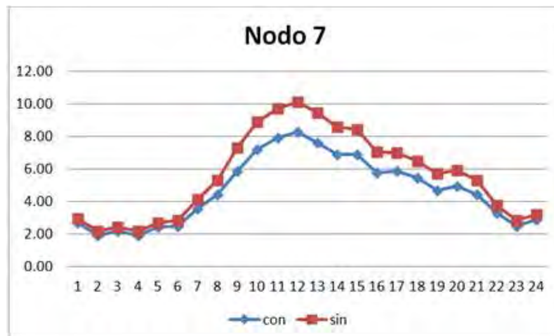
L=100m, d=4”, q=7.5 l/s



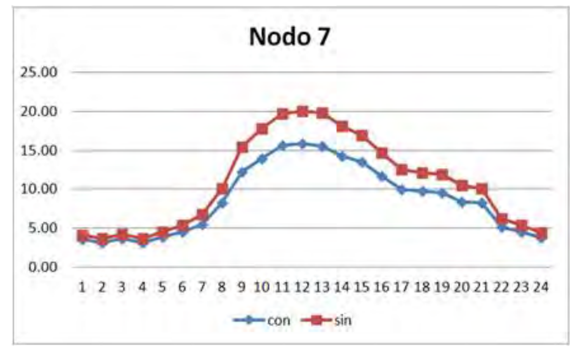
L=100m, d=6”, q=2.5 l/s



L=100m, d=6”, q=5 l/s



L=100m, d=6”, q=7.5 l/s



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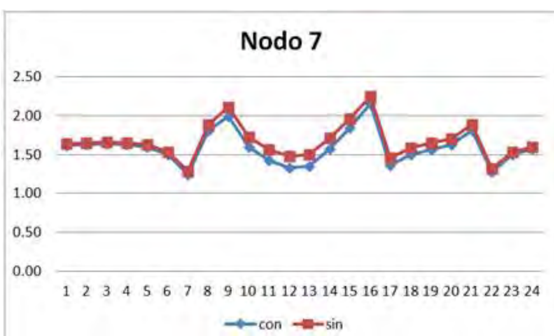
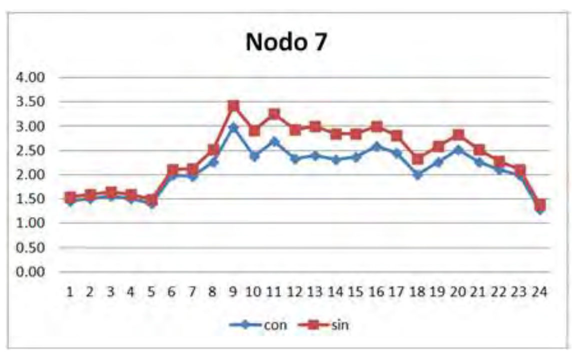
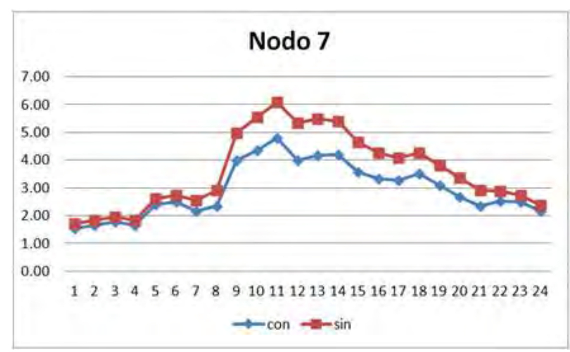


L=100m, d=8”, q=5 l/s

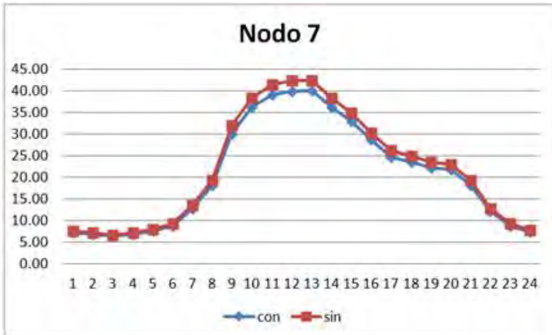


L=100m, d=8”, q=7.5 l/s

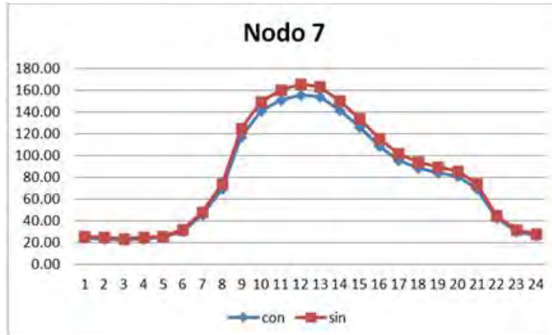


Anexo3. Carga en nodos {M S-F}   ejeX: horas y eje Y:metros

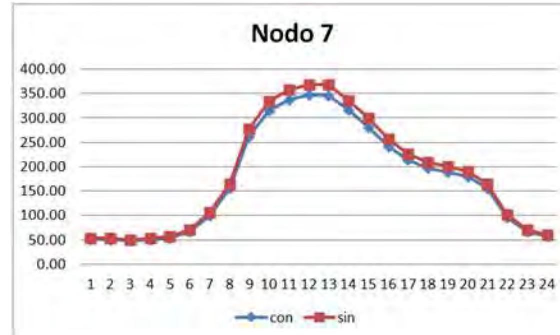
L=300m, d=4", q=2.5 l/s



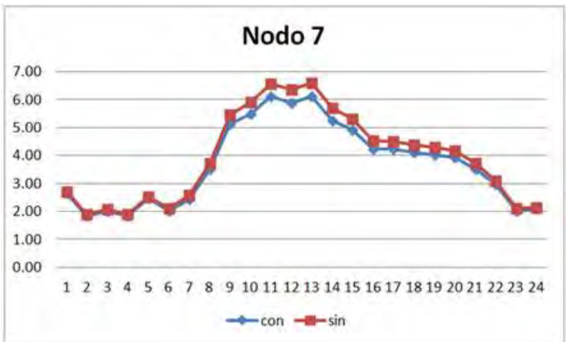
L=300m, d=4", q=5 l/s



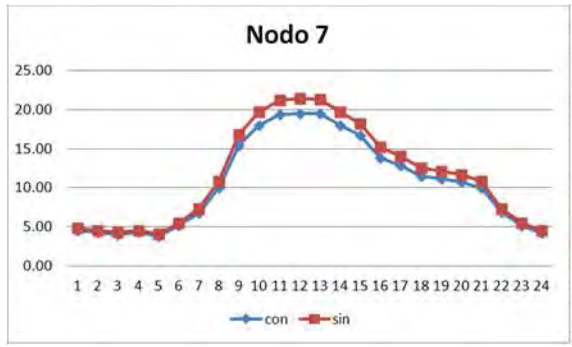
L=300m, d=4", q=7.5 l/s



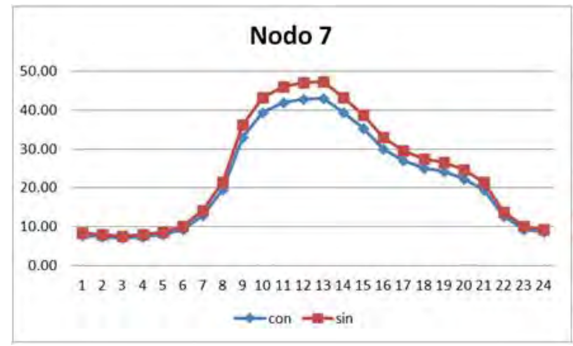
L=300m, d=6", q=2.5 l/s



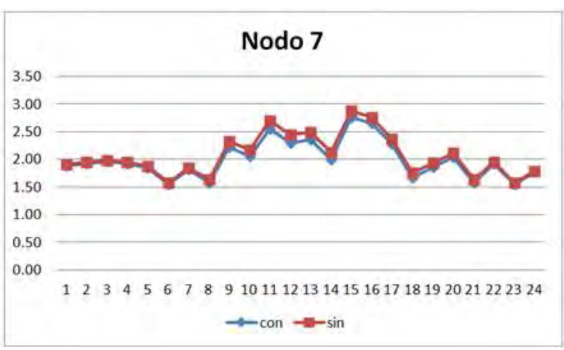
L=300m, d=6", q=5 l/s



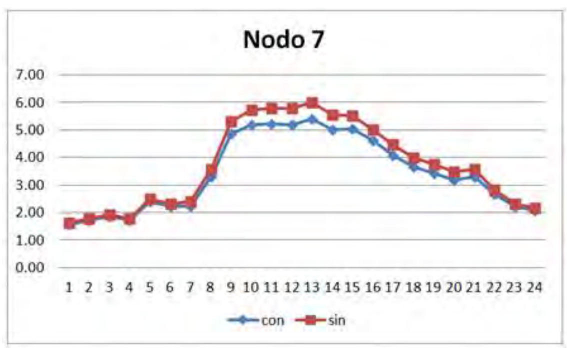
L=300m, d=6", q=7.5 l/s



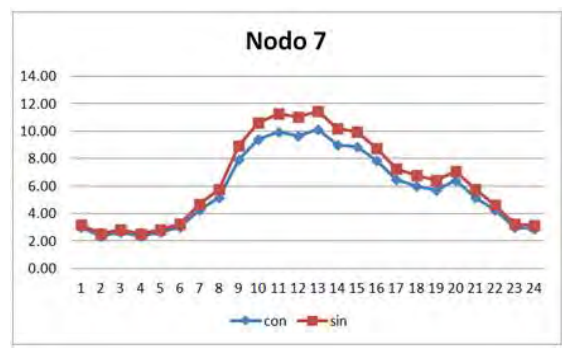
L=300m, d=8", q=2.5 l/s



L=300m, d=8", q=5 l/s



L=300m, d=8", q=7.5 l/s

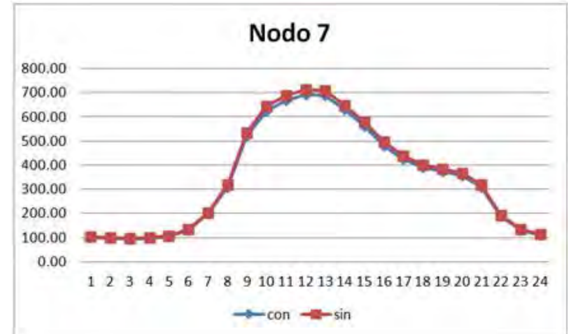


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

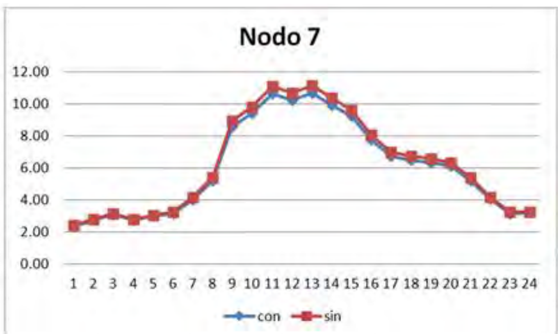
L=600m, d=4”, q=2.5 l/s

L=600m, d=4”, q=5 l/s

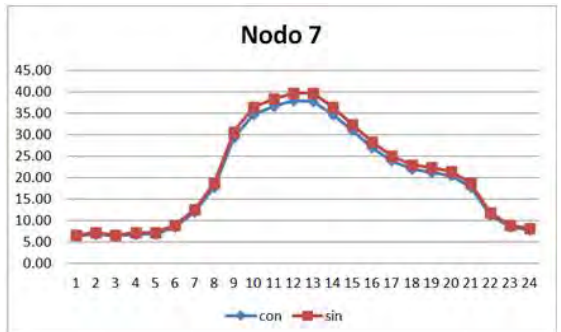
L=600m, d=4”, q=7.5 l/s



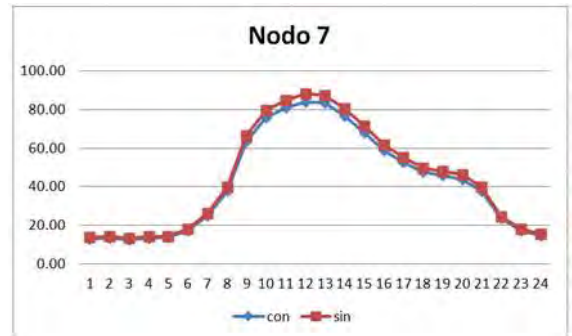
L=600m, d=6”, q=2.5 l/s



L=600m, d=6”, q=5 l/s



L=600m, d=6”, q=7.5 l/s



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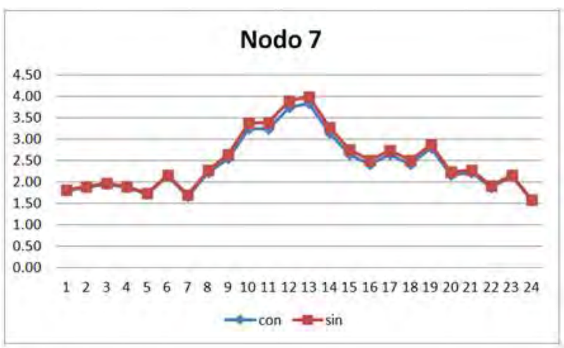
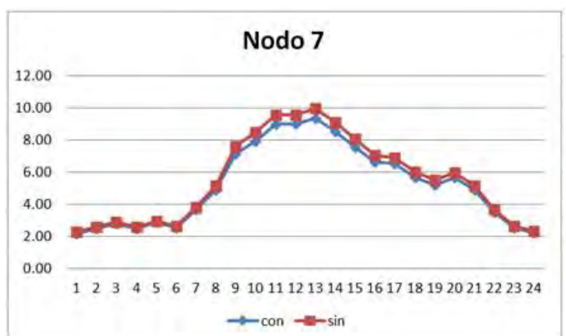
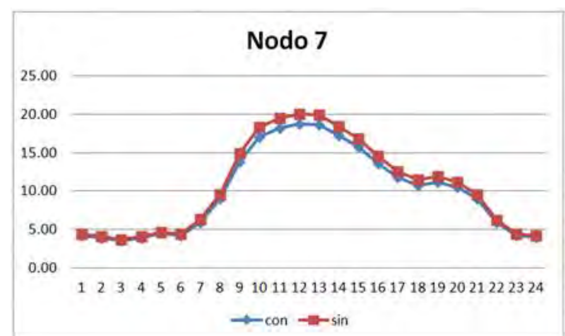


L=600m, d=8”, q=5 l/s

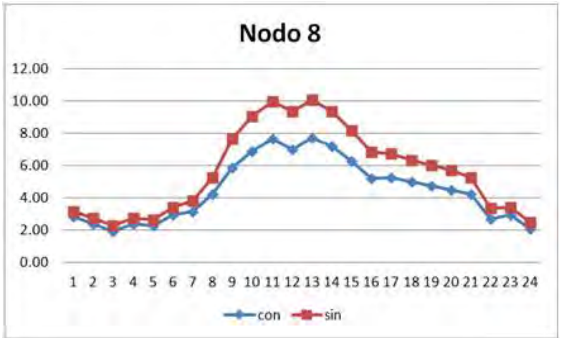


L=600m, d=8”, q=7.5 l/s

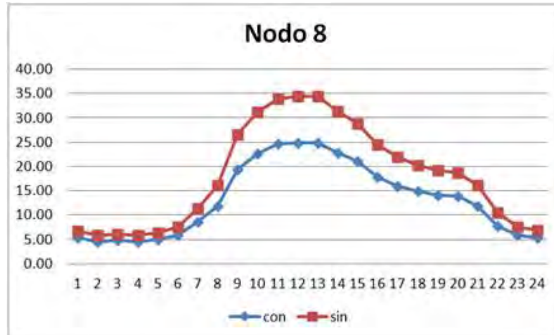


Anexo3. Carga en nodos {M S-F}   ejeX: horas y eje Y:metros

L=100m, d=4", q=2.5 l/s



L=100m, d=4", q=5 l/s



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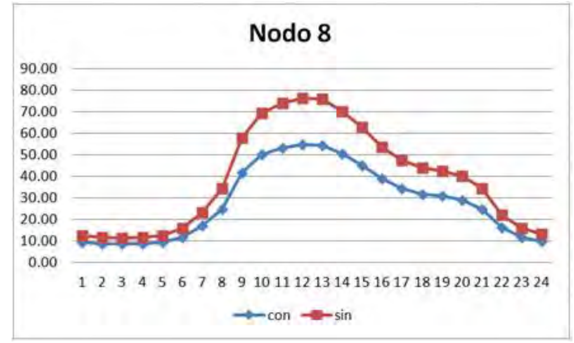
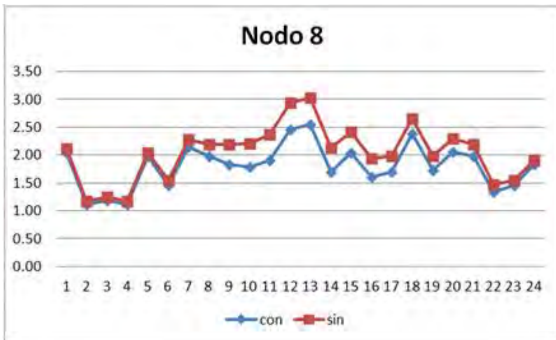
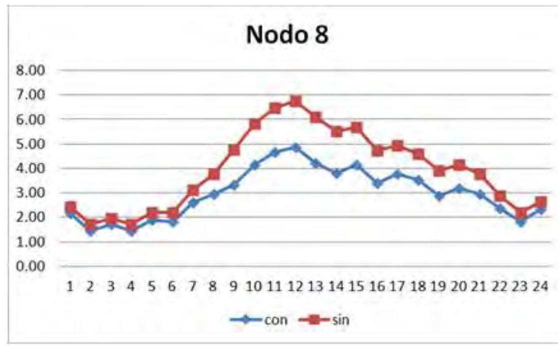


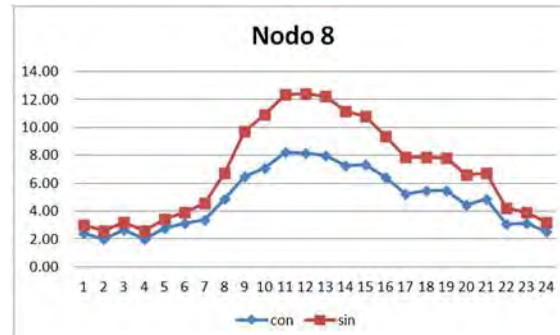
L=100m, d=6", q=2.5 l/s



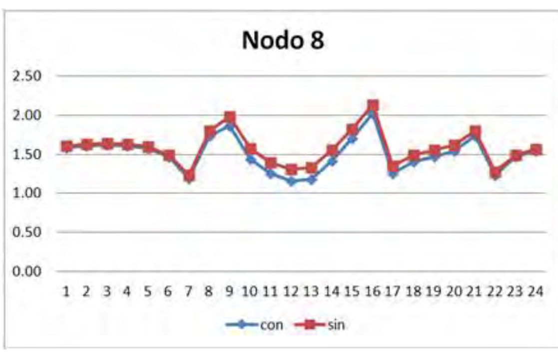
L=100m, d=6", q=5 l/s



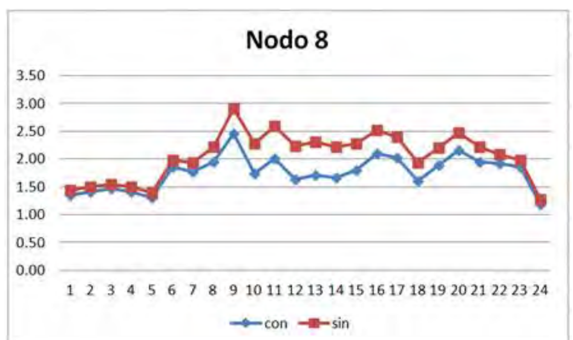
L=100m, d=6", q=7.5 l/s



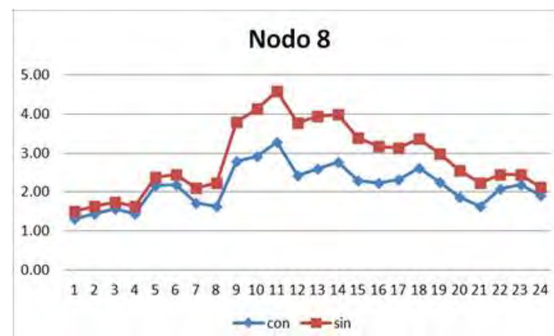
L=100m, d=8", q=2.5 l/s



L=100m, d=8", q=5 l/s

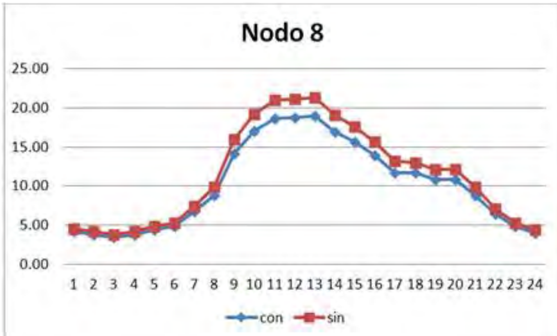


L=100m, d=8", q=7.5 l/s

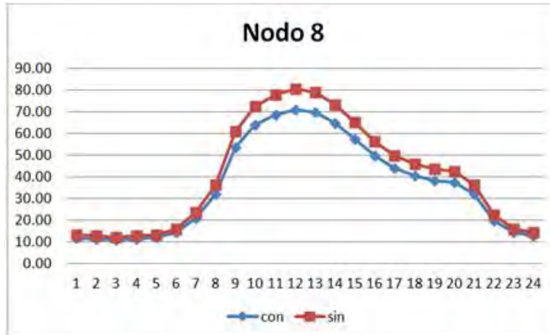


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=300m, d=4”, q=2.5 l/s



L=300m, d=4”, q=5 l/s



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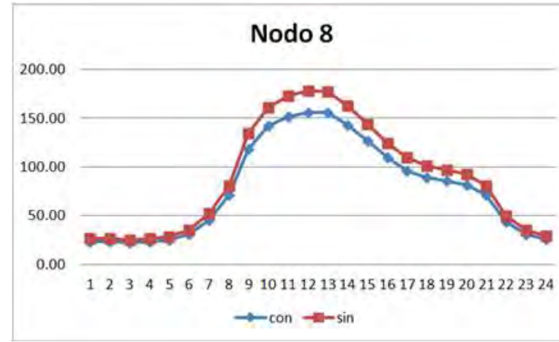

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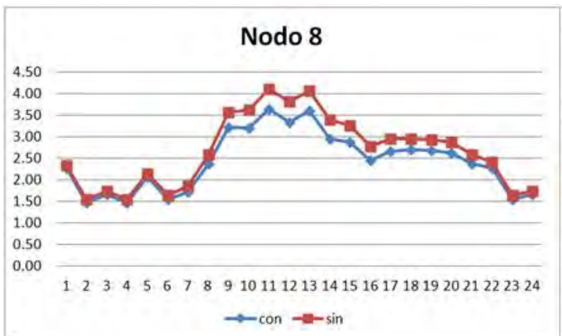
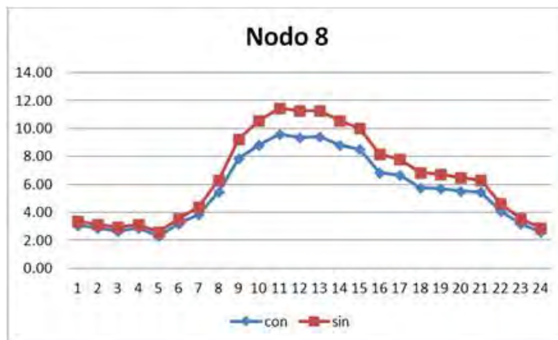
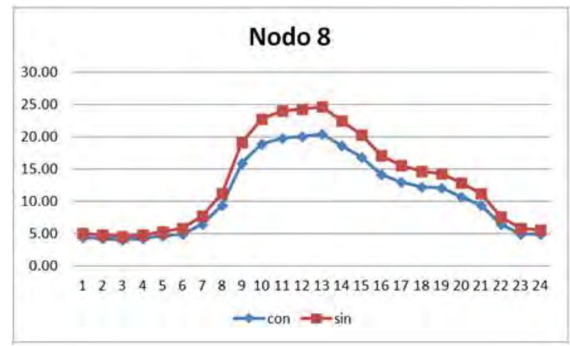


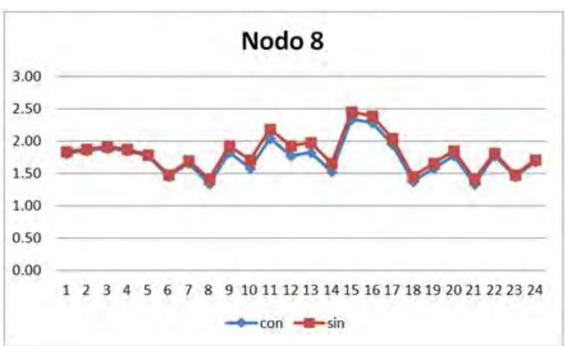
L=300m, d=6”, q=5 l/s



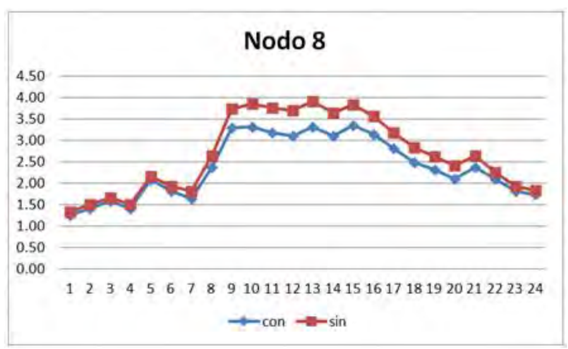
L=300m, d=6”, q=7.5 l/s



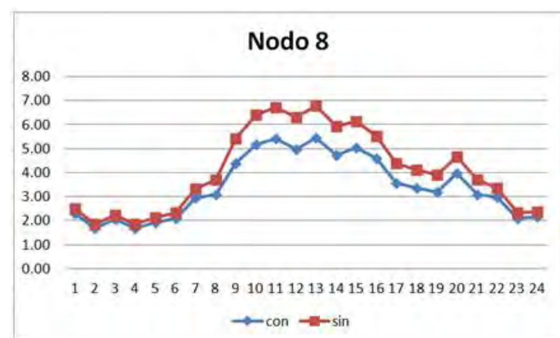
L=300m, d=8”, q=2.5 l/s



L=300m, d=8”, q=5 l/s

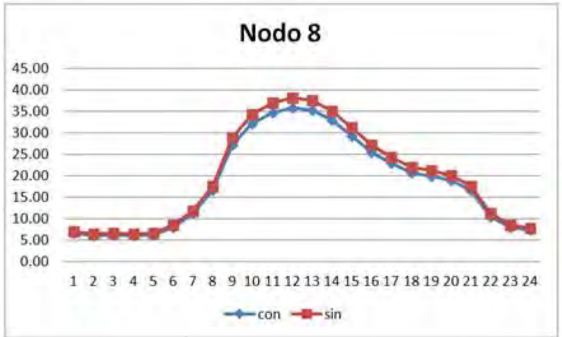


L=300m, d=8”, q=7.5 l/s

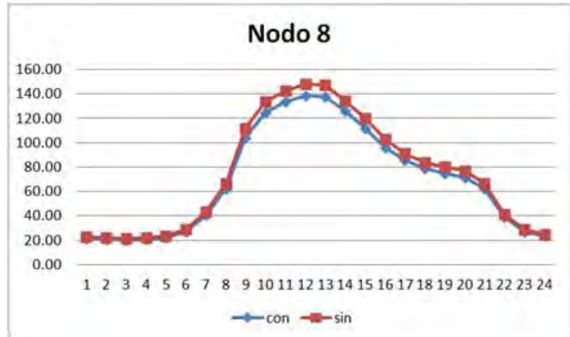


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

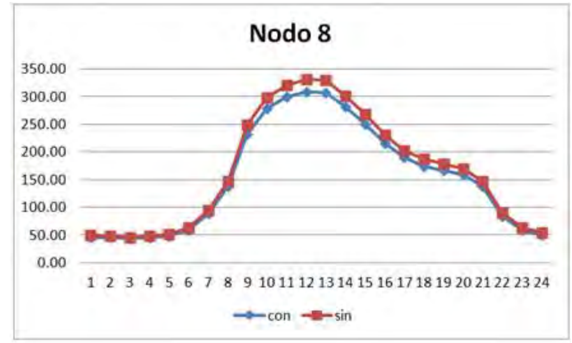
L=600m, d=4”, q=2.5 l/s



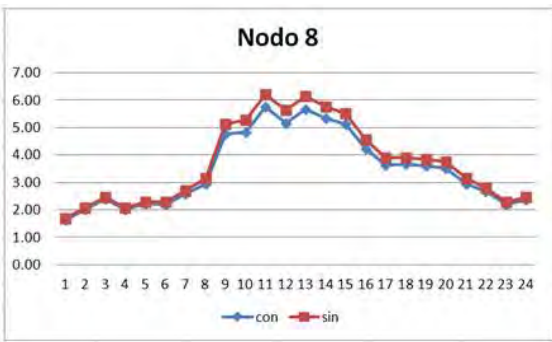
L=600m, d=4”, q=5 l/s



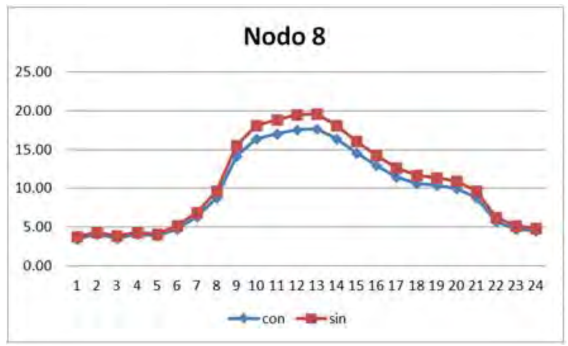
L=600m, d=4”, q=7.5 l/s



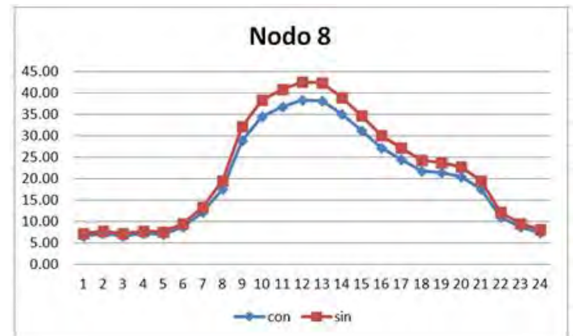
L=600m, d=6”, q=2.5 l/s



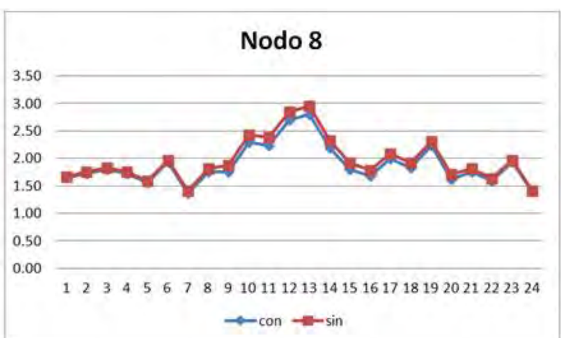
L=600m, d=6”, q=5 l/s



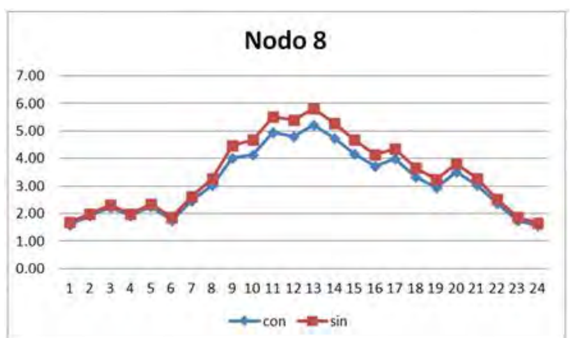
L=600m, d=6”, q=7.5 l/s



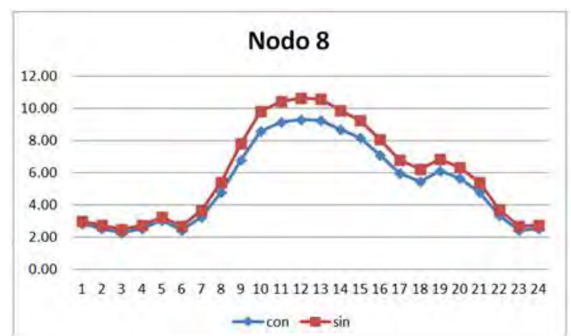
L=600m, d=8”, q=2.5 l/s



L=600m, d=8”, q=5 l/s

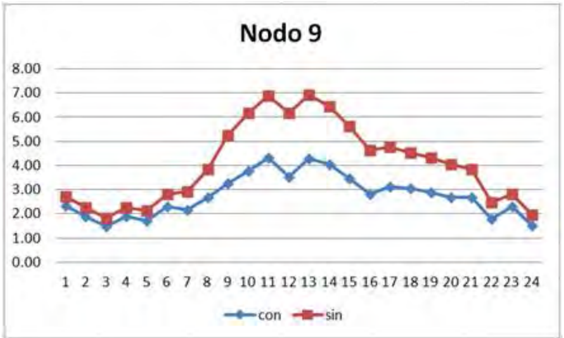


L=600m, d=8”, q=7.5 l/s

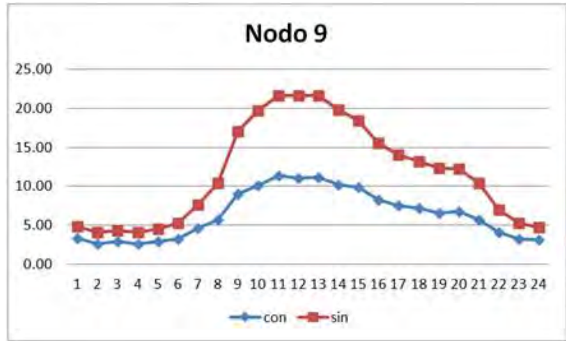


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

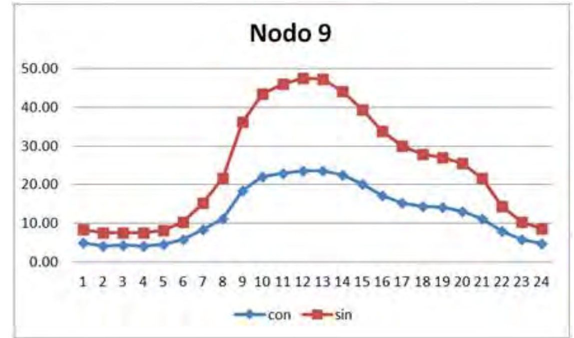
L=100m, d=4”, q=2.5 l/s



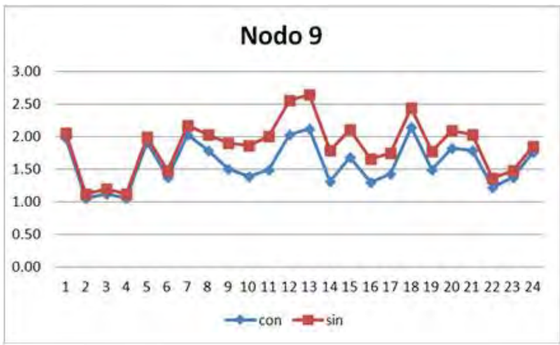
L=100m, d=4”, q=5 l/s



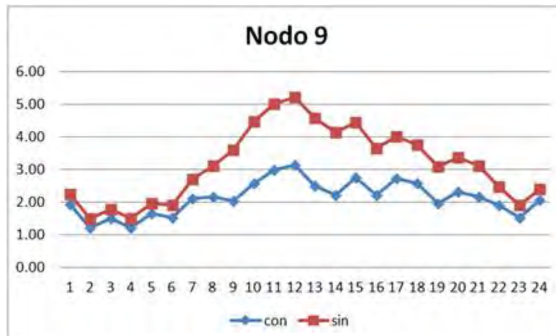
L=100m, d=4”, q=7.5 l/s



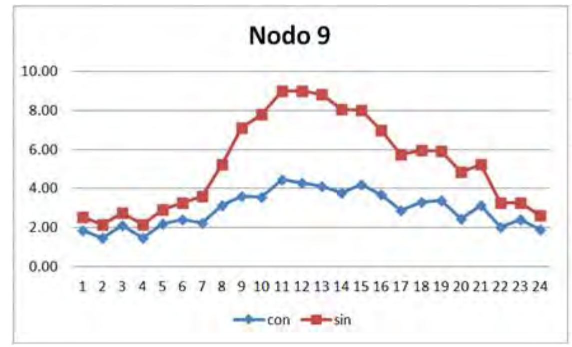
L=100m, d=6”, q=2.5 l/s



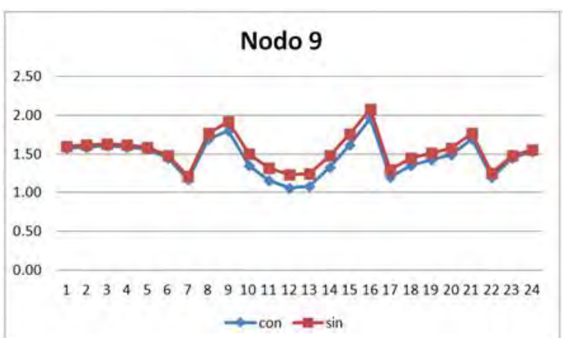
L=100m, d=6”, q=5 l/s



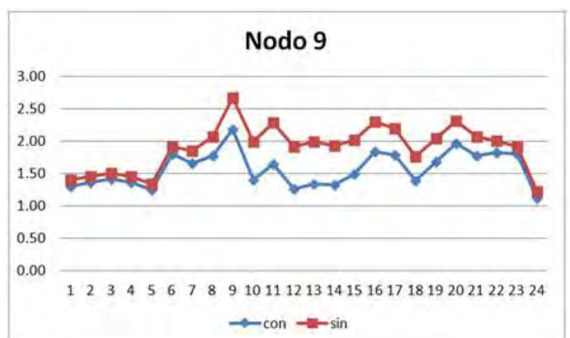
L=100m, d=6”, q=7.5 l/s



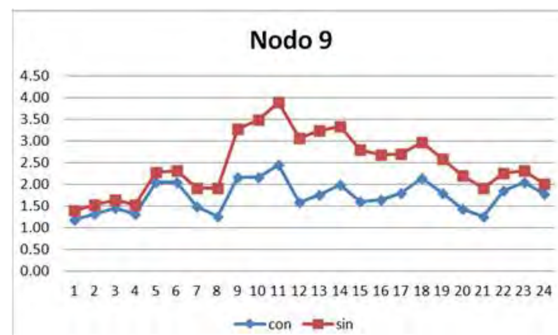
L=100m, d=8”, q=2.5 l/s



L=100m, d=8”, q=5 l/s

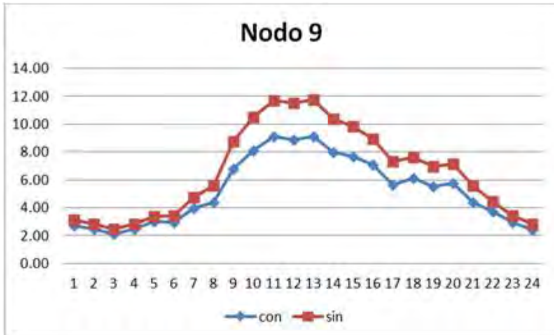


L=100m, d=8”, q=7.5 l/s

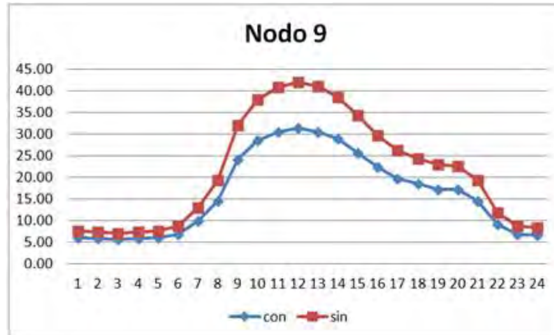


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

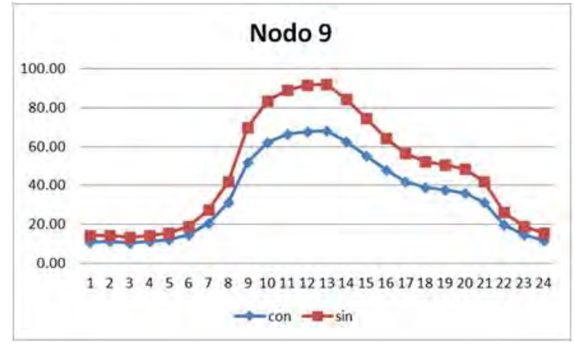
L=300m, d=4”, q=2.5 l/s



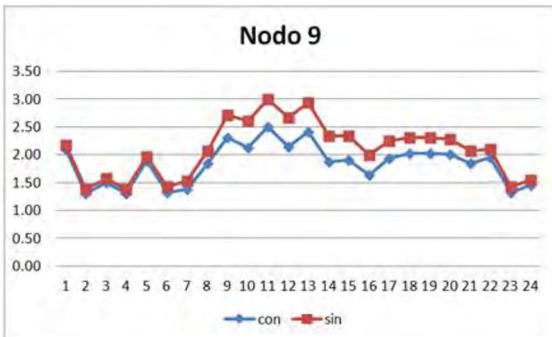
L=300m, d=4”, q=5 l/s



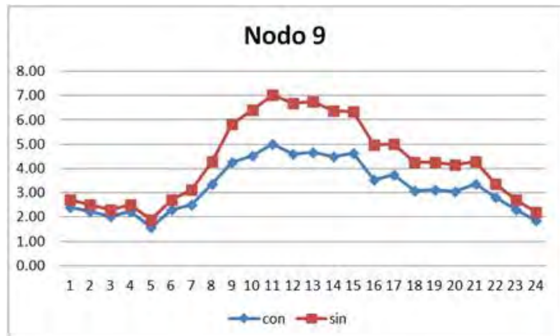
L=300m, d=4”, q=7.5 l/s



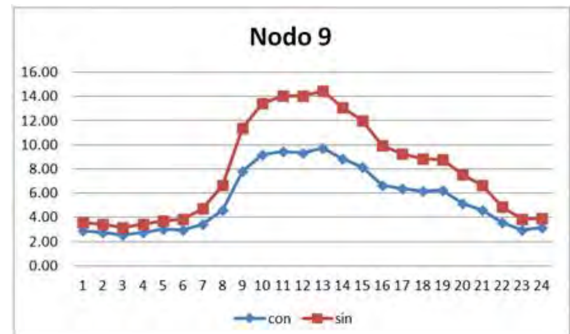
L=300m, d=6”, q=2.5 l/s



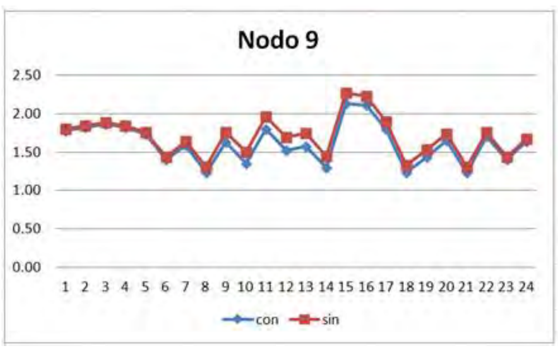
L=300m, d=6”, q=5 l/s



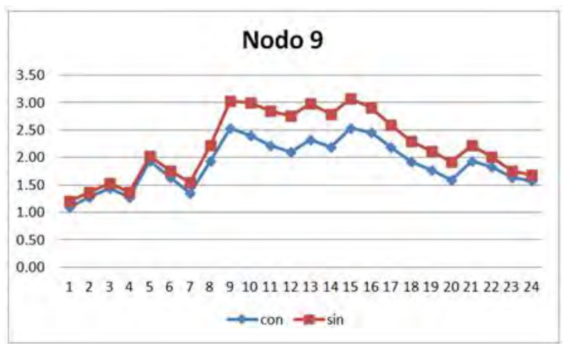
L=300m, d=6”, q=7.5 l/s



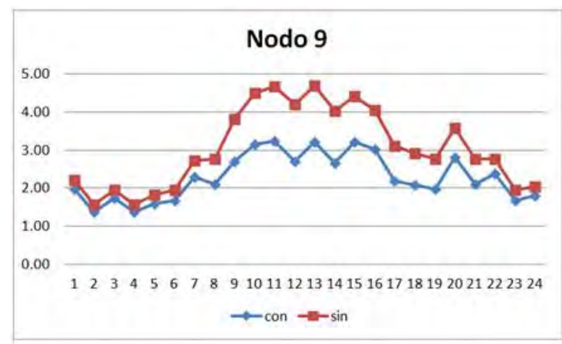
L=300m, d=8”, q=2.5 l/s



L=300m, d=8”, q=5 l/s

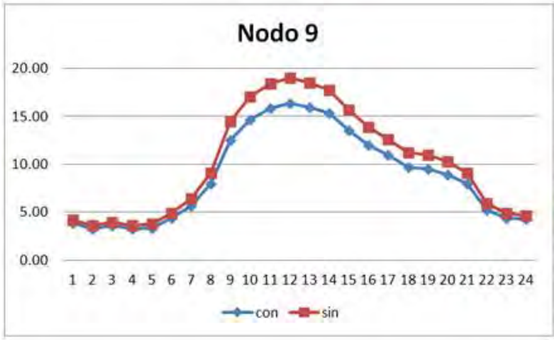


L=300m, d=8”, q=7.5 l/s

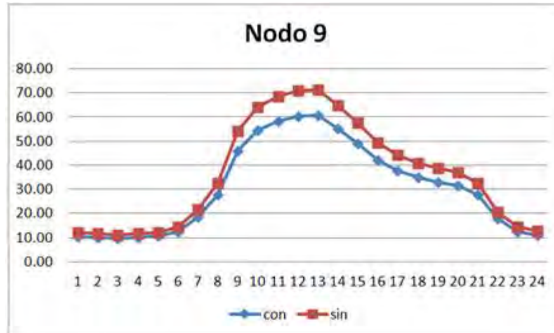


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

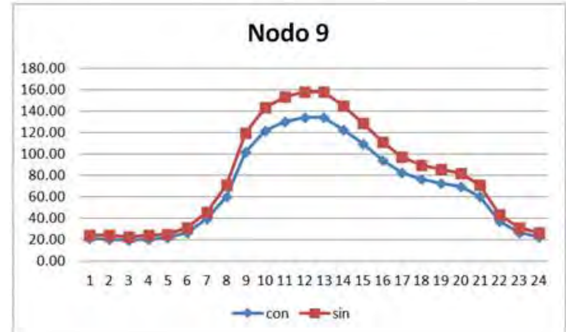
L=600m, d=4”, q=2.5 l/s



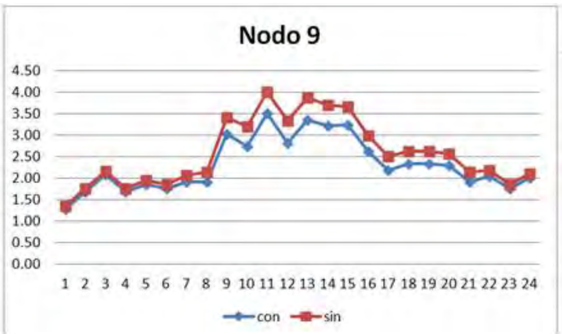
L=600m, d=4”, q=5 l/s



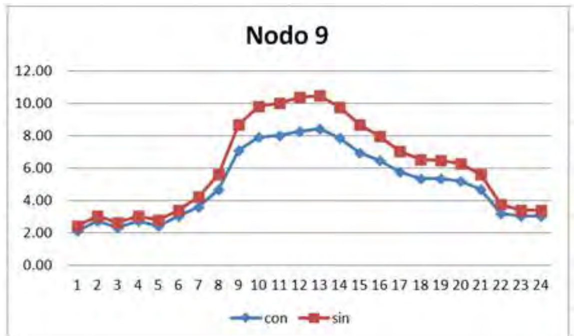
L=600m, d=4”, q=7.5 l/s



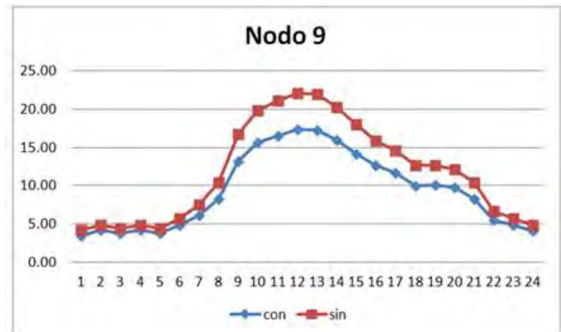
L=600m, d=6”, q=2.5 l/s



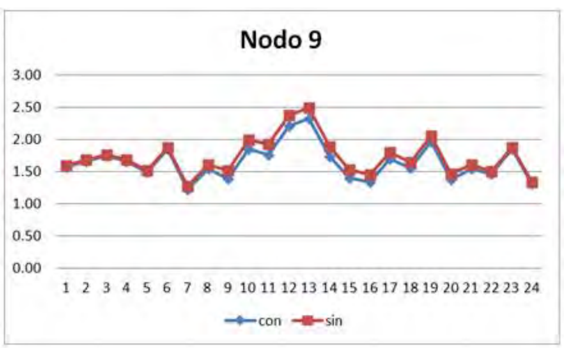
L=600m, d=6”, q=5 l/s



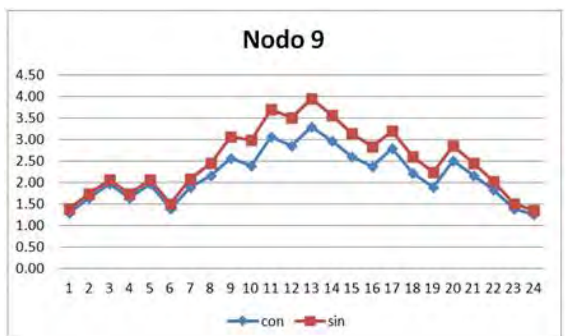
L=600m, d=6”, q=7.5 l/s



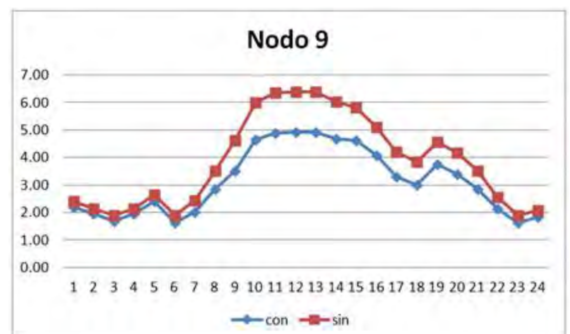
L=600m, d=8”, q=2.5 l/s



L=600m, d=8”, q=5 l/s

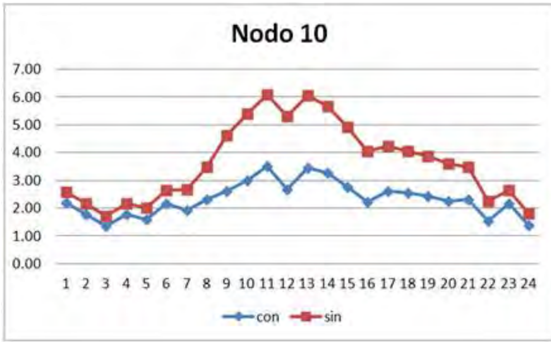


L=600m, d=8”, q=7.5 l/s

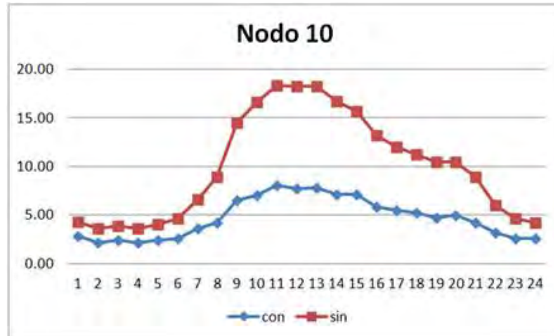


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=100m, d=4", q=2.5 l/s



L=100m, d=4", q=5 l/s



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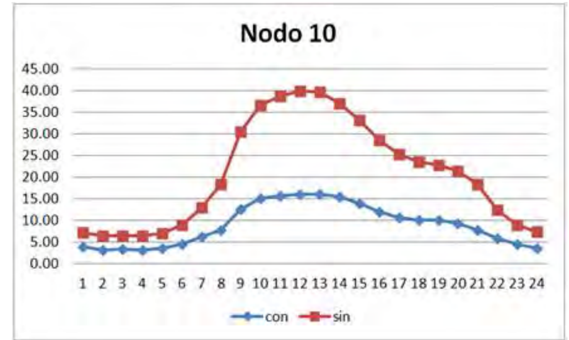
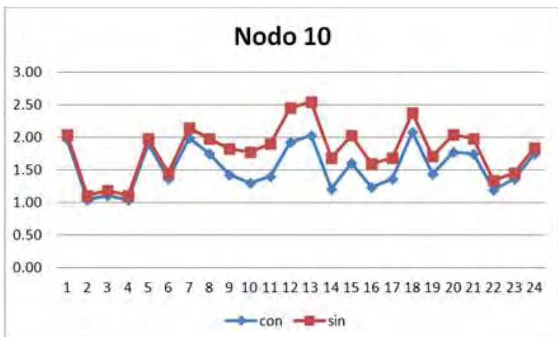
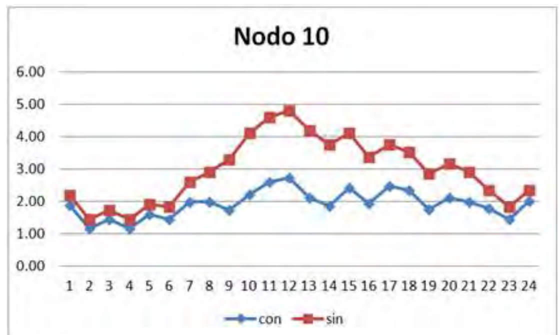


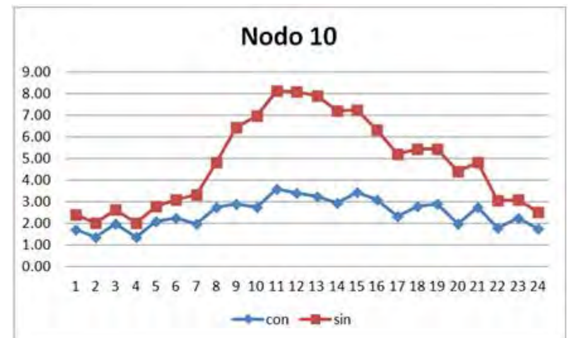
L=100m, d=6", q=2.5 l/s



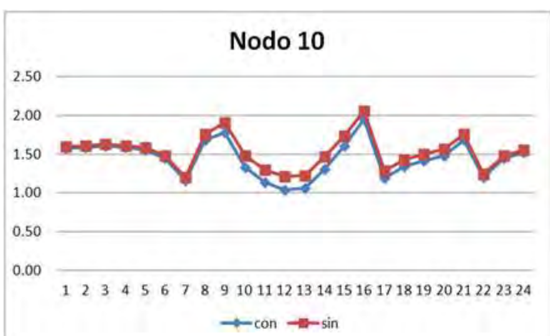
L=100m, d=6", q=5 l/s



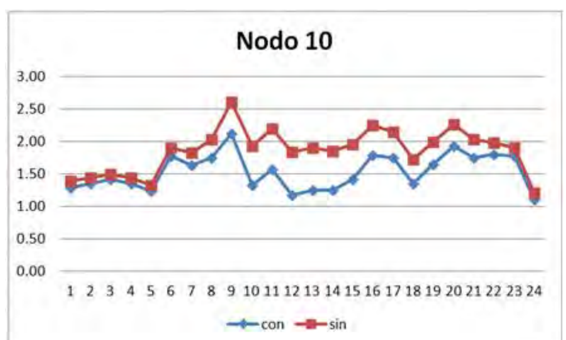
L=100m, d=6", q=7.5 l/s



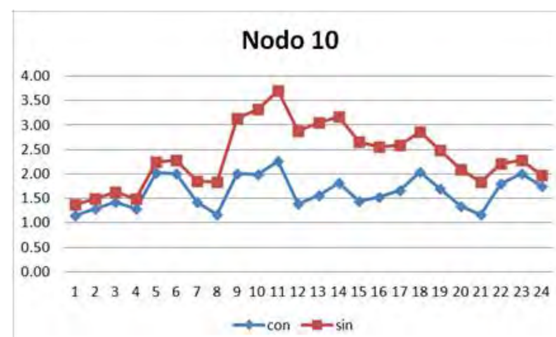
L=100m, d=8", q=2.5 l/s



L=100m, d=8", q=5 l/s

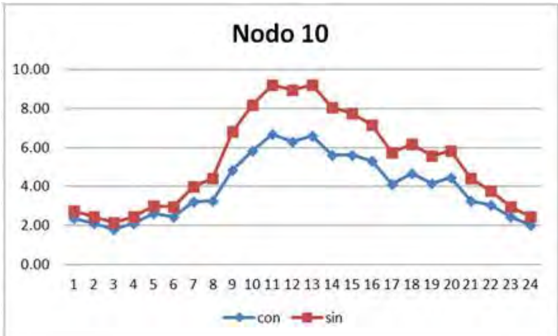


L=100m, d=8", q=7.5 l/s

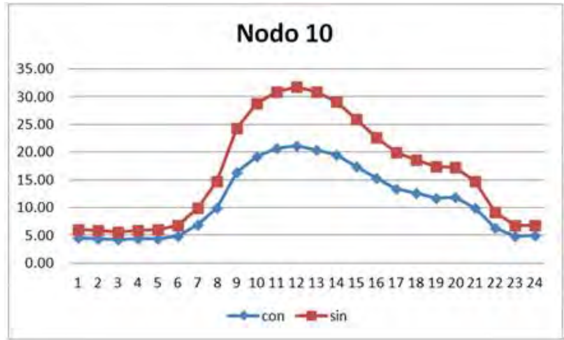


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=300m, d=4", q=2.5 l/s



L=300m, d=4", q=5 l/s



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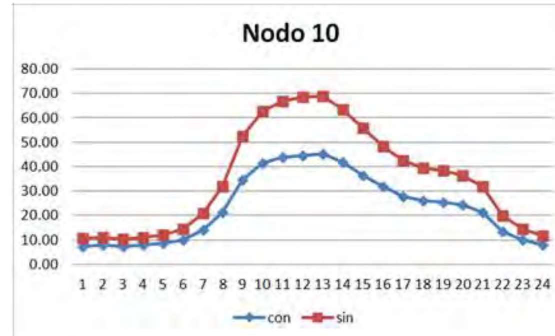
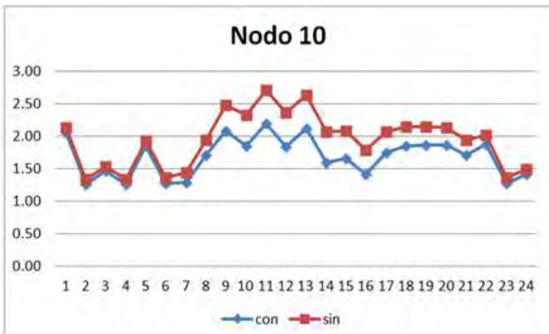
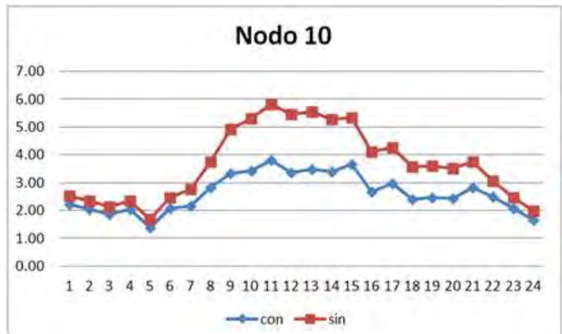


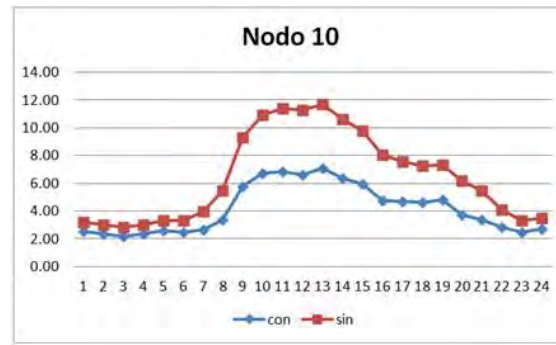
L=300m, d=6", q=2.5 l/s



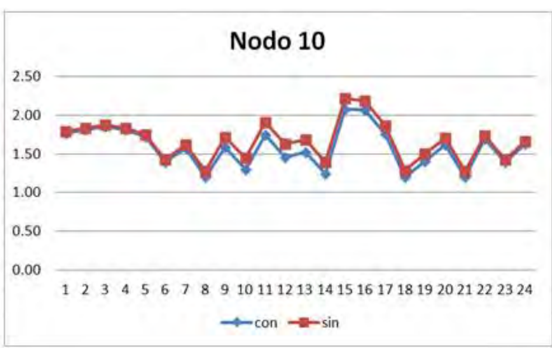
L=300m, d=6", q=5 l/s



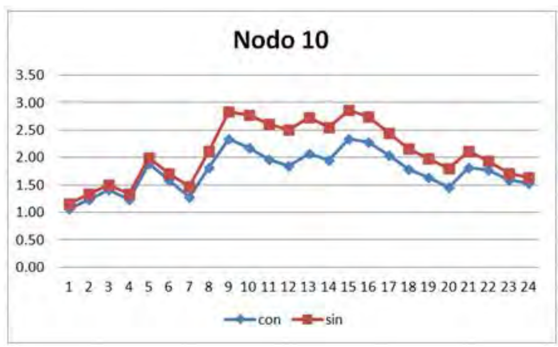
L=300m, d=6", q=7.5 l/s



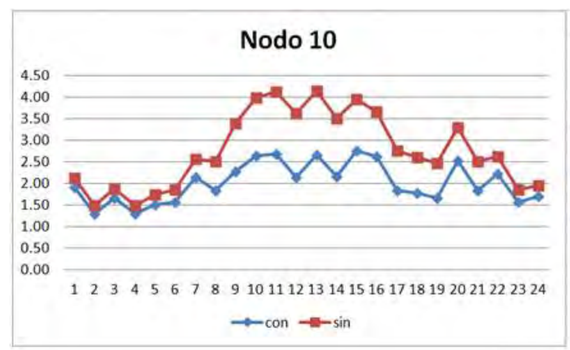
L=300m, d=8", q=2.5 l/s



L=300m, d=8", q=5 l/s

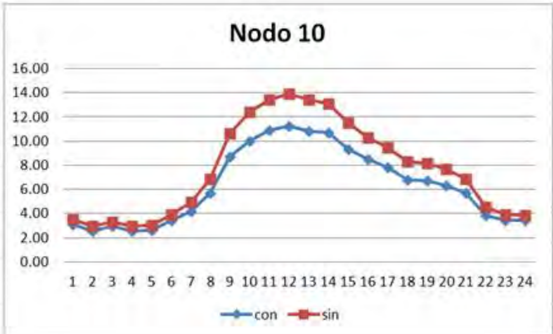


L=300m, d=8", q=7.5 l/s



Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=600m, d=4", q=2.5 l/s



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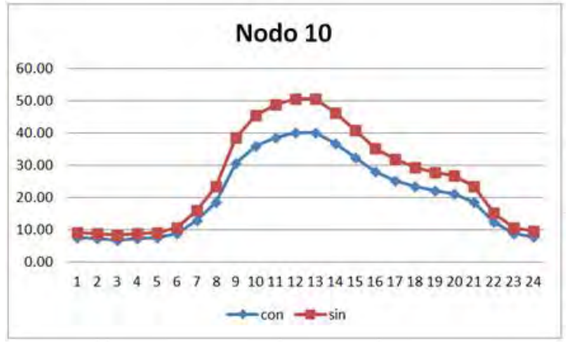

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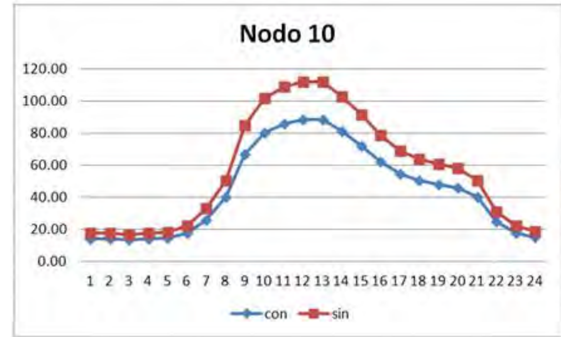
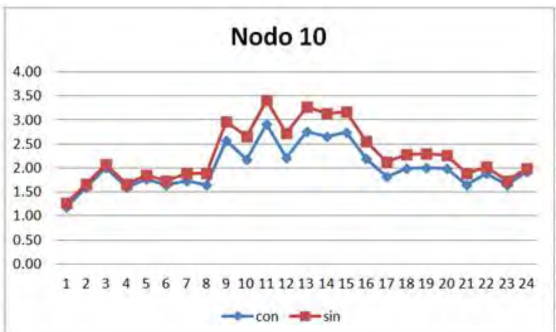
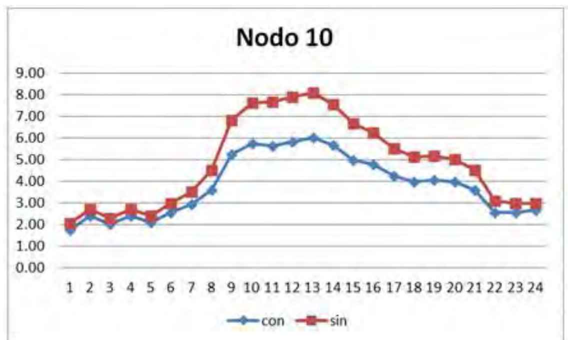


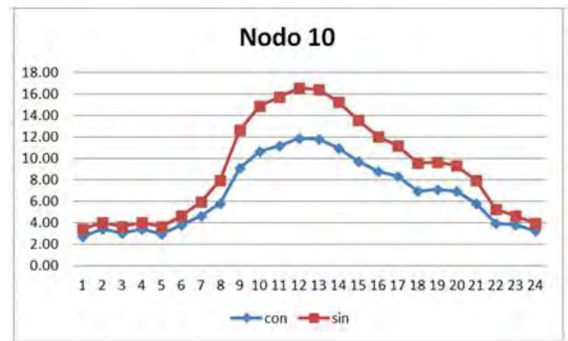
L=600m, d=6", q=2.5 l/s



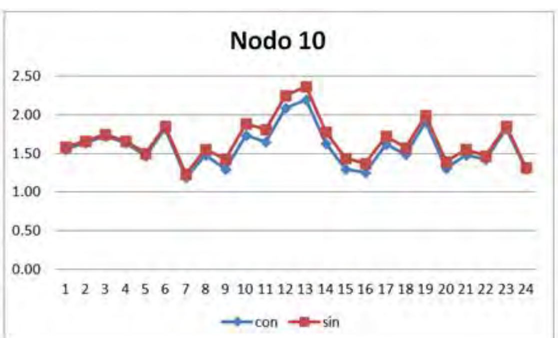
L=600m, d=6", q=5 l/s



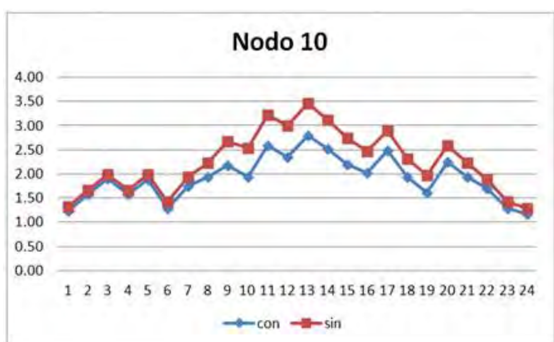
L=600m, d=6", q=7.5 l/s



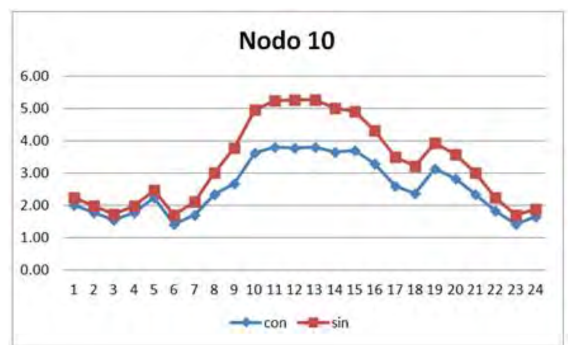
L=600m, d=8", q=2.5 l/s



L=600m, d=8", q=5 l/s

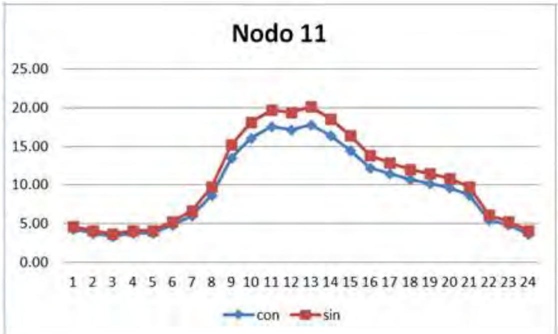


L=600m, d=8", q=7.5 l/s

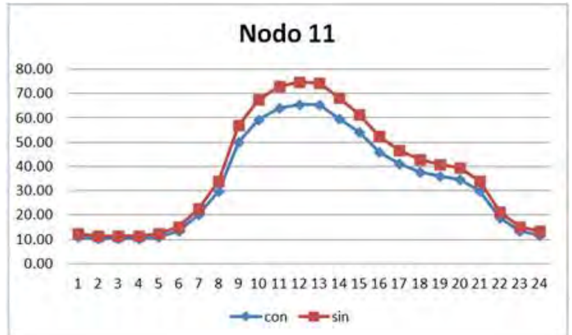


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=100m, d=4”, q=2.5 l/s



L=100m, d=4”, q=5 l/s



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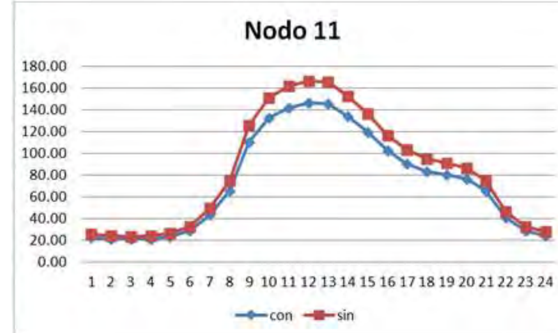
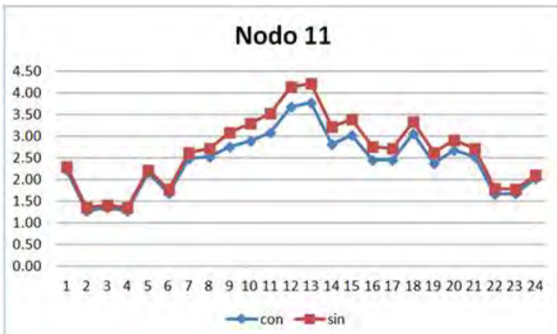
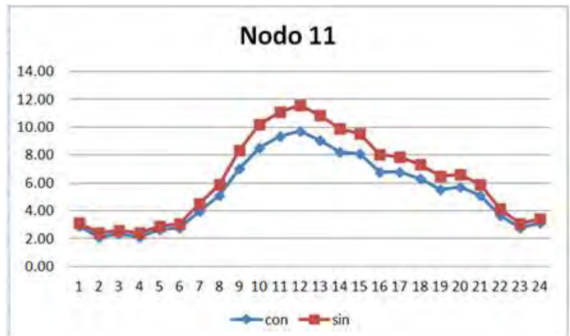


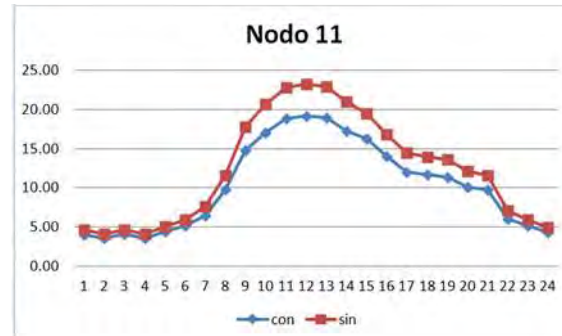
L=100m, d=6”, q=2.5 l/s



L=100m, d=6”, q=5 l/s



L=100m, d=6”, q=7.5 l/s



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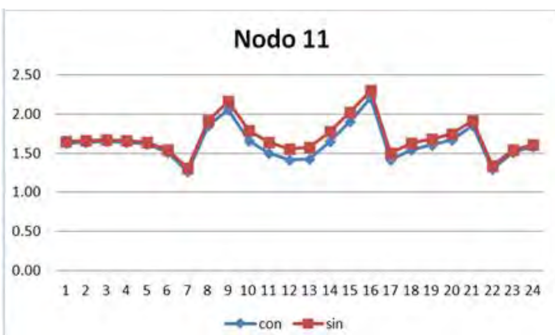
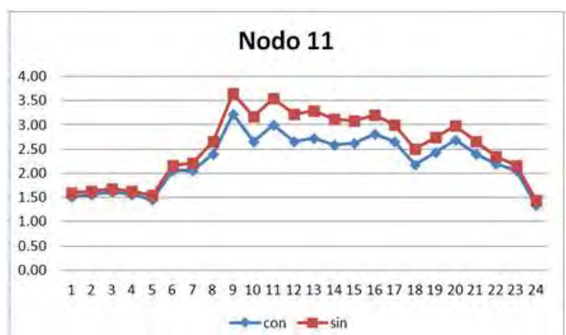
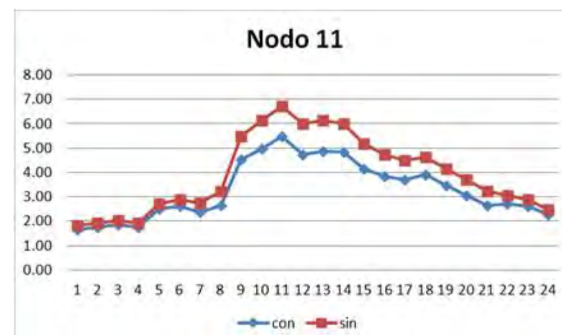


L=100m, d=8”, q=5 l/s

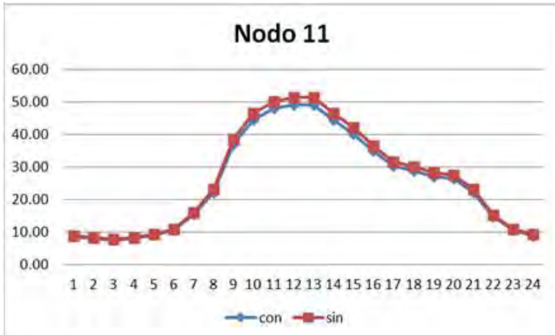


L=100m, d=8”, q=7.5 l/s

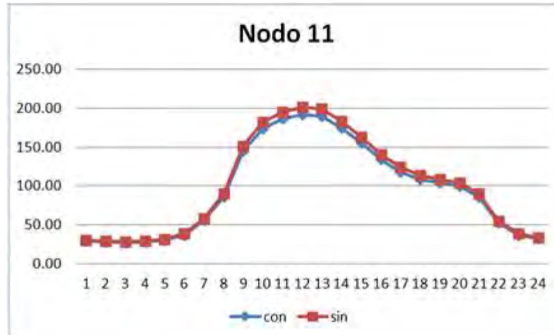


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

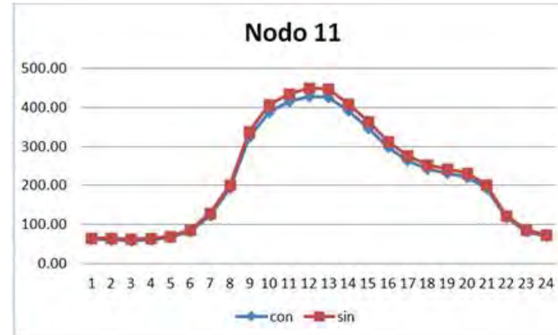
L=300m, d=4”, q=2.5 l/s



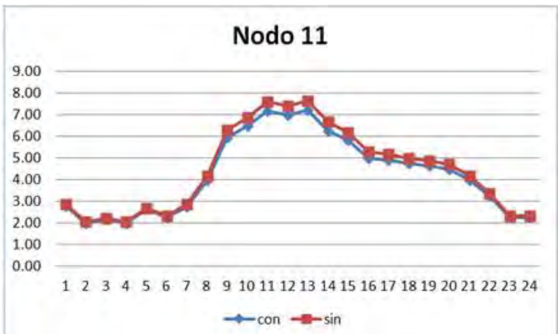
L=300m, d=4”, q=5 l/s



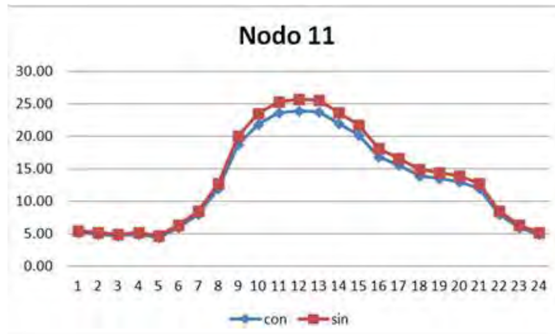
L=300m, d=4”, q=7.5 l/s



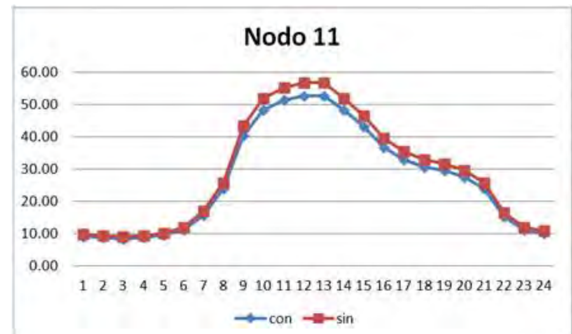
L=300m, d=6”, q=2.5 l/s



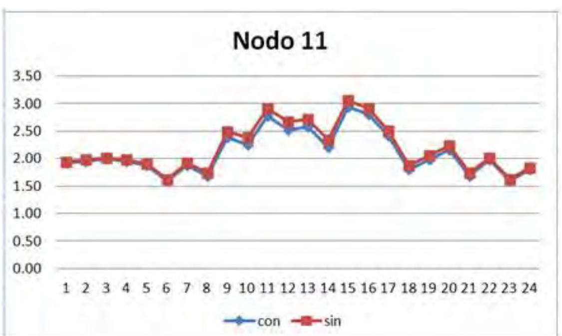
L=300m, d=6”, q=5 l/s



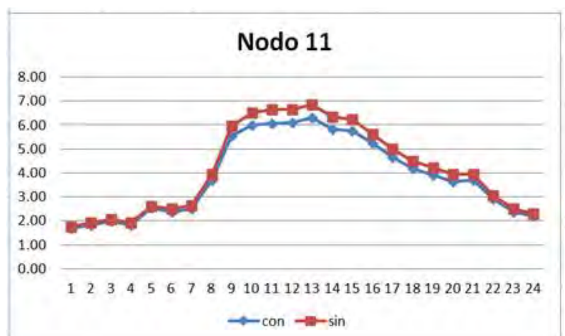
L=300m, d=6”, q=7.5 l/s



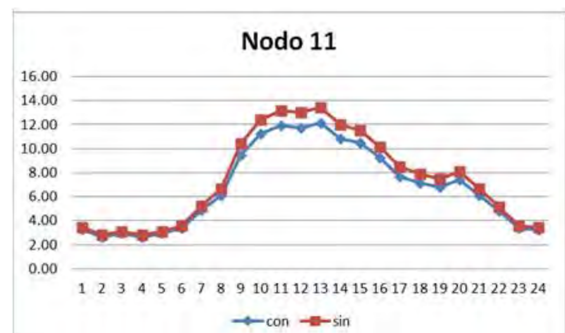
L=300m, d=8”, q=2.5 l/s



L=300m, d=8”, q=5 l/s



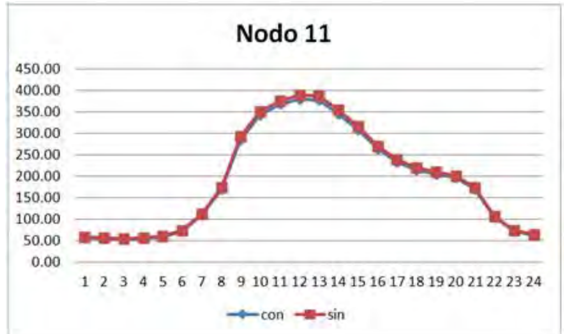
L=300m, d=8”, q=7.5 l/s



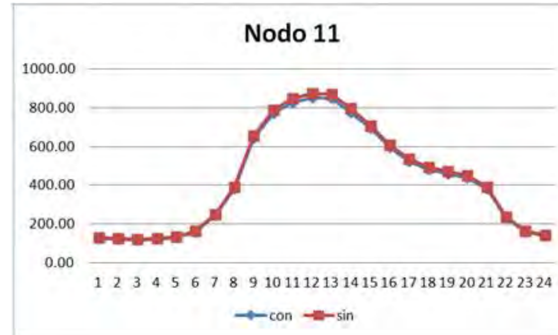
Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=600m, d=4", q=2.5 l/s

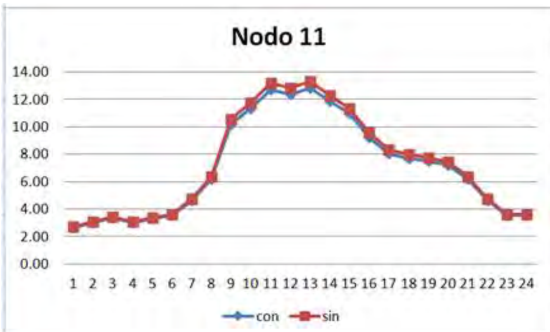
L=600m, d=4", q=5 l/s



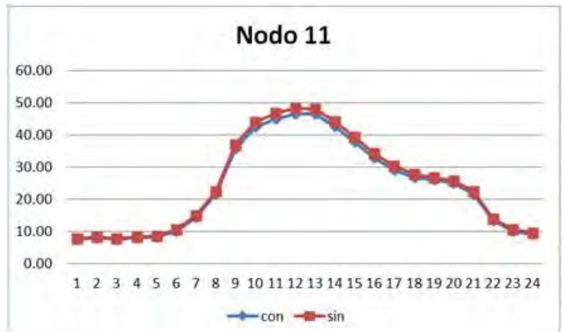
L=600m, d=4", q=7.5 l/s



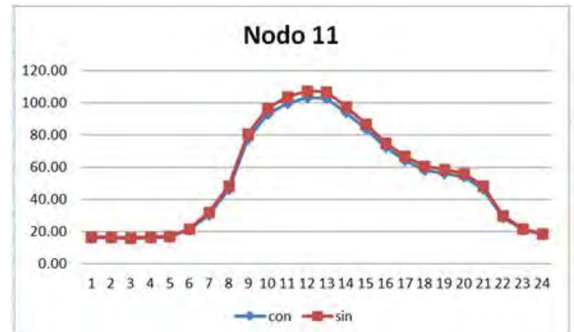
L=600m, d=6", q=2.5 l/s



L=600m, d=6", q=5 l/s



L=600m, d=6", q=7.5 l/s



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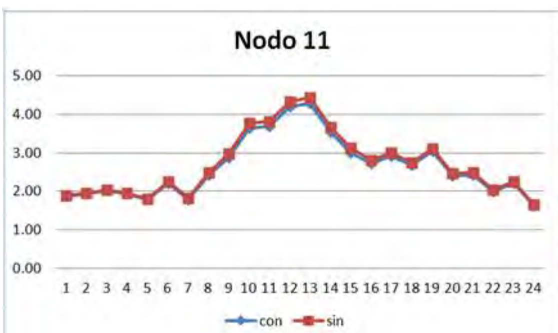
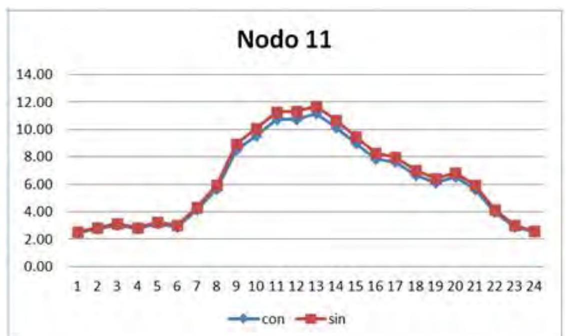
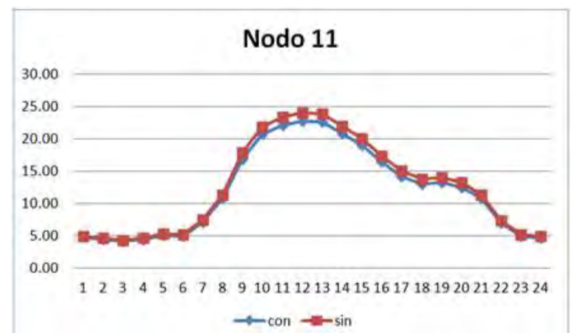


L=600m, d=8", q=5 l/s

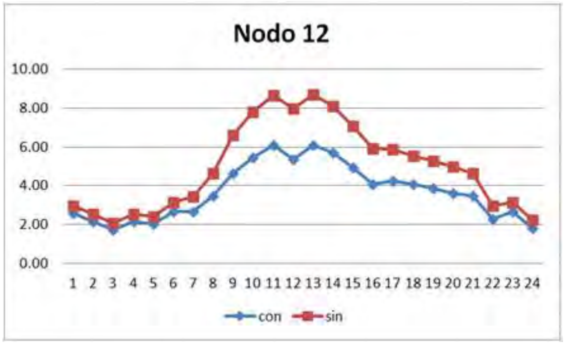


L=600m, d=8", q=7.5 l/s

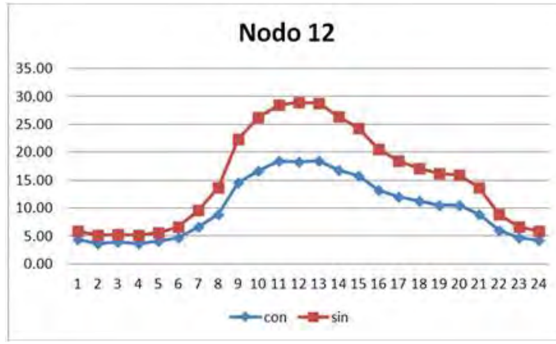


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

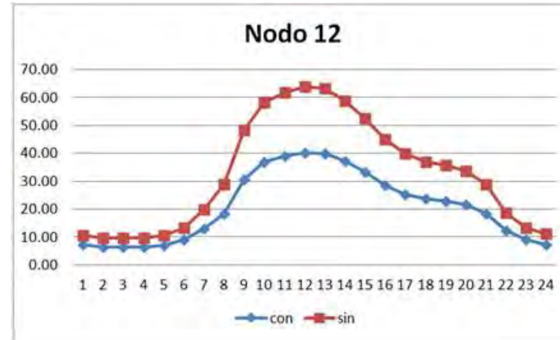
L=100m, d=4", q=2.5 l/s



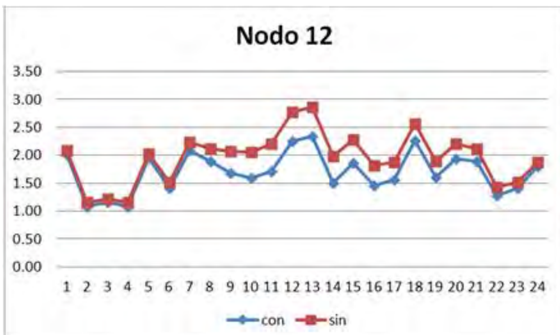
L=100m, d=4", q=5 l/s



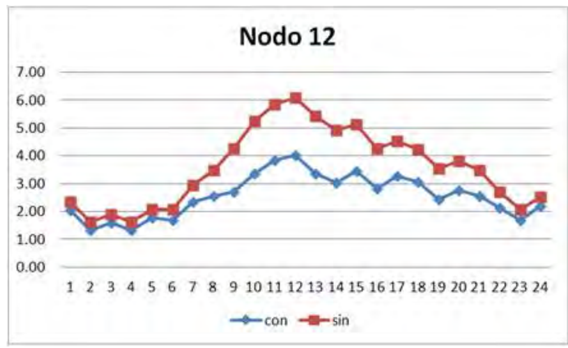
L=100m, d=4", q=7.5 l/s



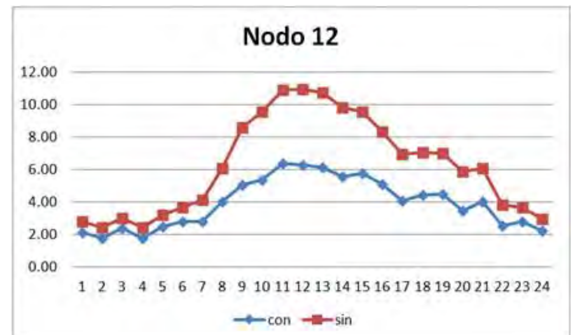
L=100m, d=6", q=2.5 l/s



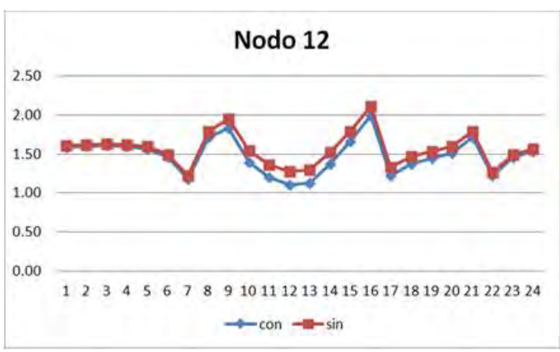
L=100m, d=6", q=5 l/s



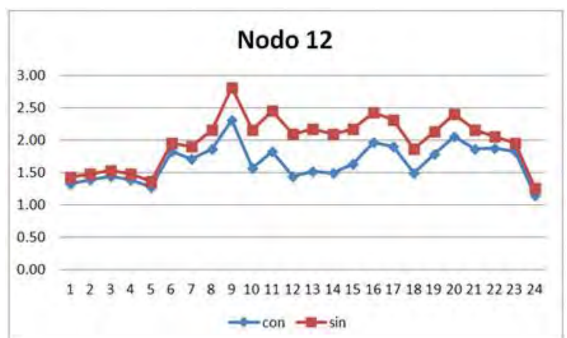
L=100m, d=6", q=7.5 l/s



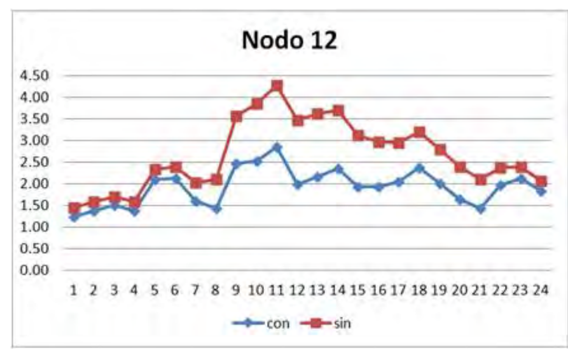
L=100m, d=8", q=2.5 l/s



L=100m, d=8", q=5 l/s

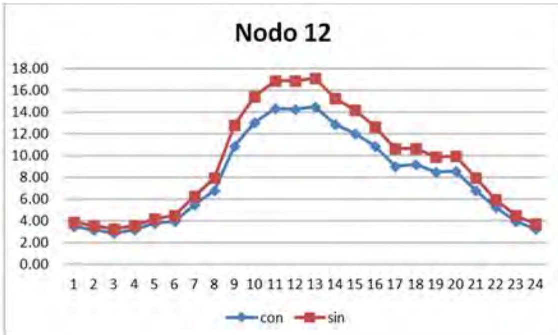


L=100m, d=8", q=7.5 l/s

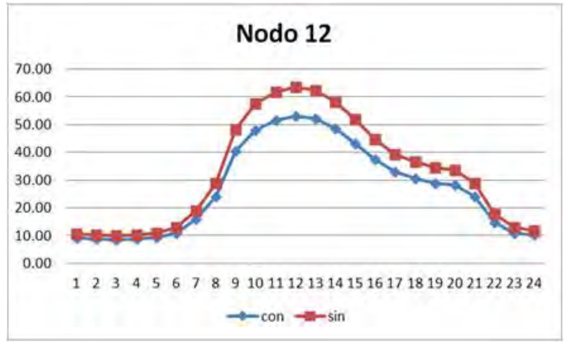


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

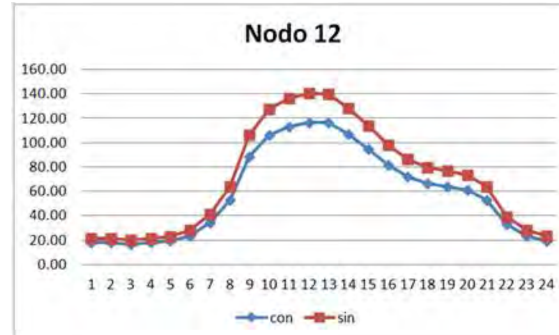
L=300m, d=4", q=2.5 l/s



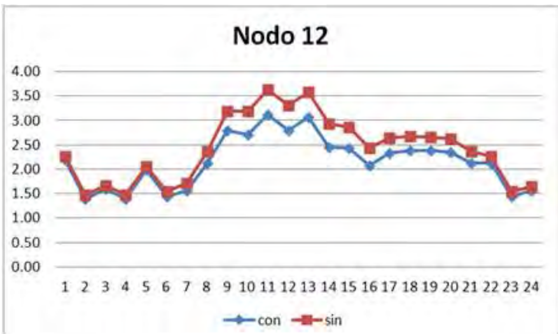
L=300m, d=4", q=5 l/s



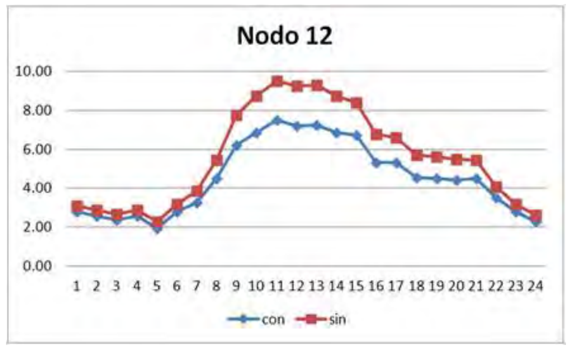
L=300m, d=4", q=7.5 l/s



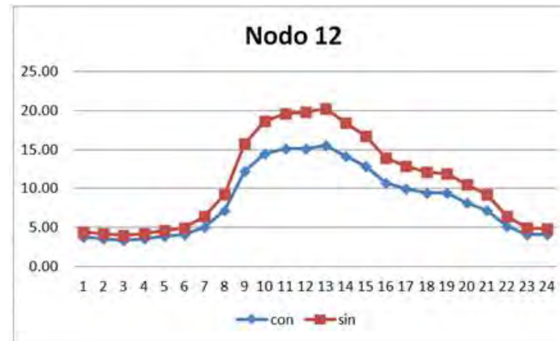
L=300m, d=6", q=2.5 l/s



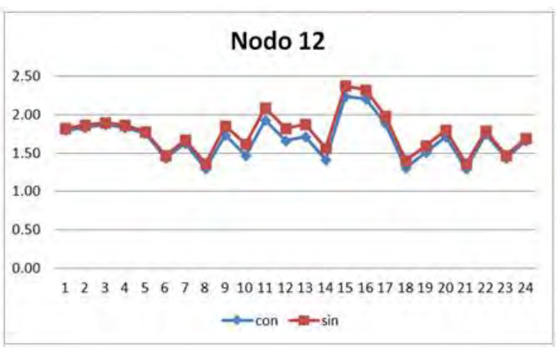
L=300m, d=6", q=5 l/s



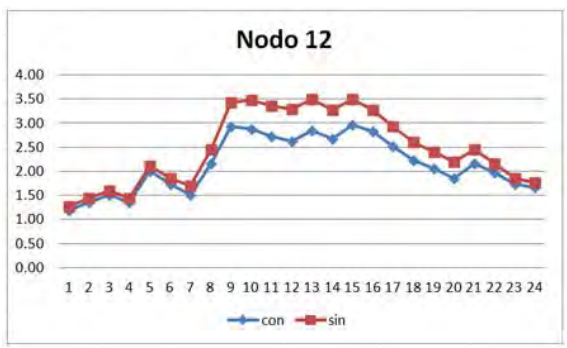
L=300m, d=6", q=7.5 l/s



L=300m, d=8", q=2.5 l/s



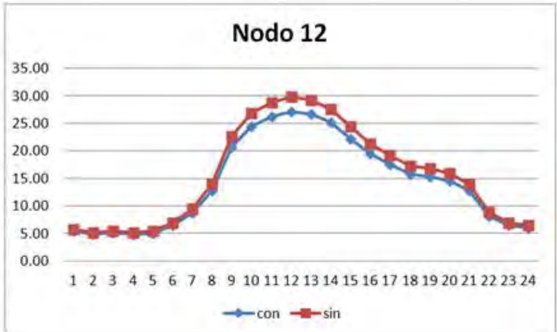
L=300m, d=8", q=5 l/s



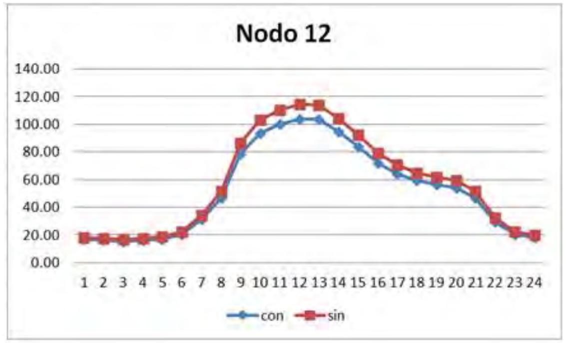
L=300m, d=8", q=7.5 l/s

Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=600m, d=4”, q=2.5 l/s



L=600m, d=4”, q=5 l/s



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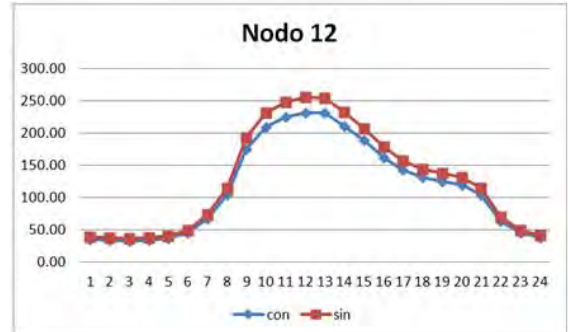

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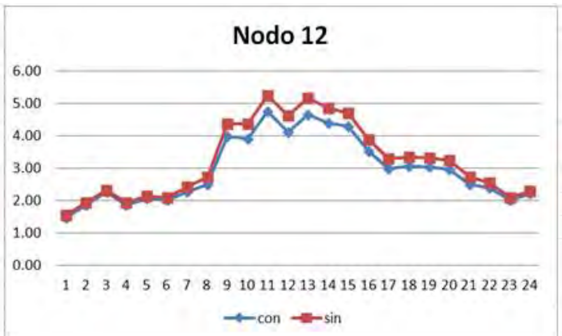
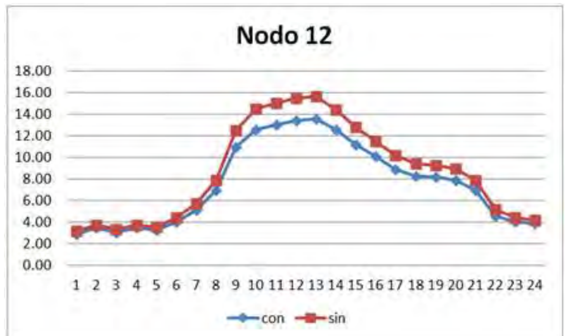


L=600m, d=6”, q=5 l/s



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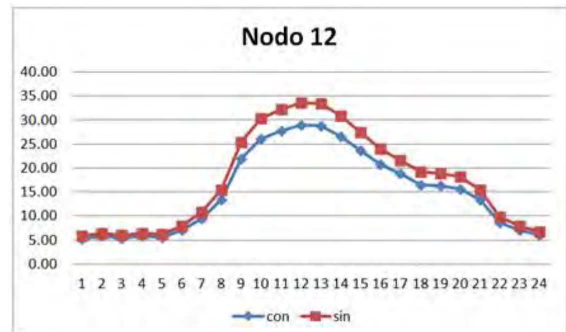
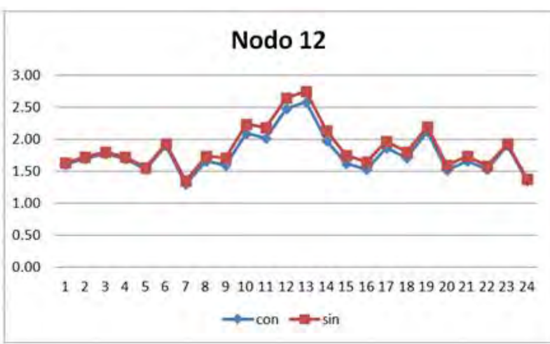


L=600m, d=8”, q=2.5 l/s



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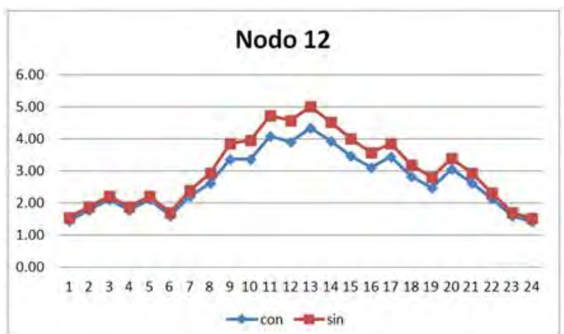
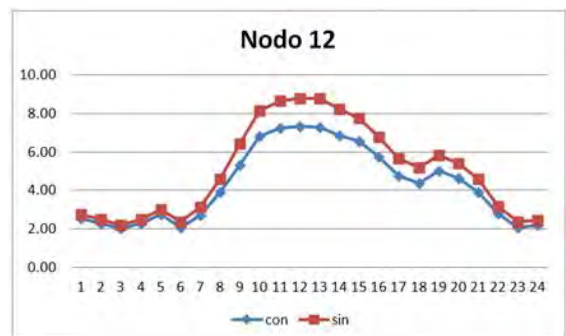
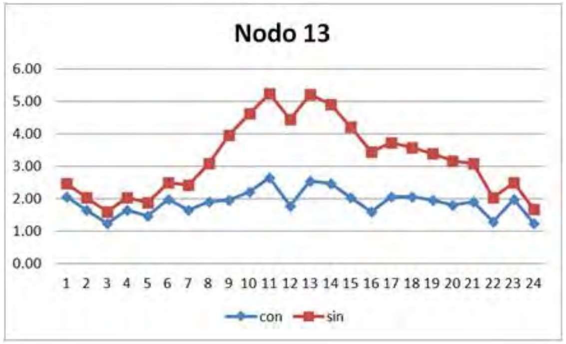


L=600m, d=8”, q=7.5 l/s

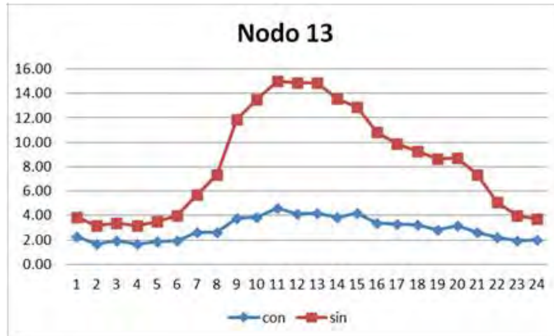


Anexo3. Carga en nodos {M S-F}   ejeX: horas y eje Y:metros

L=100m, d=4", q=2.5 l/s



L=100m, d=4", q=5 l/s



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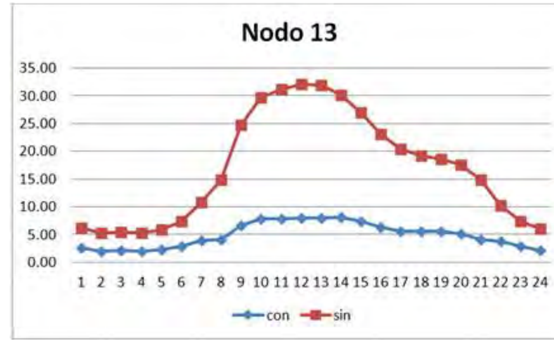
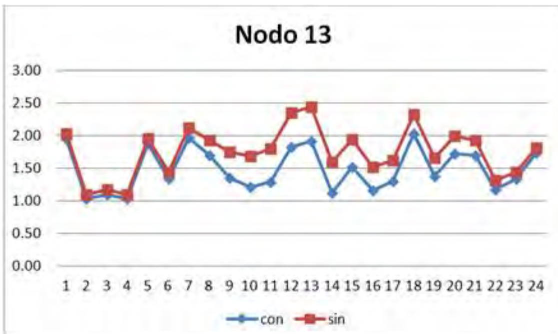
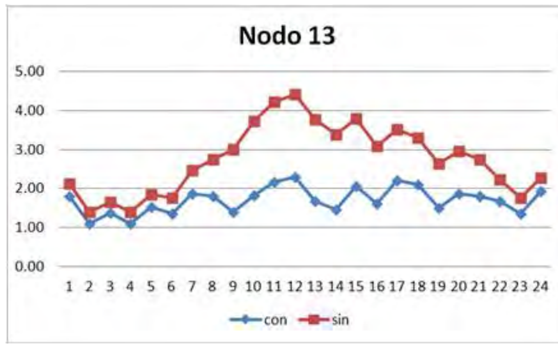


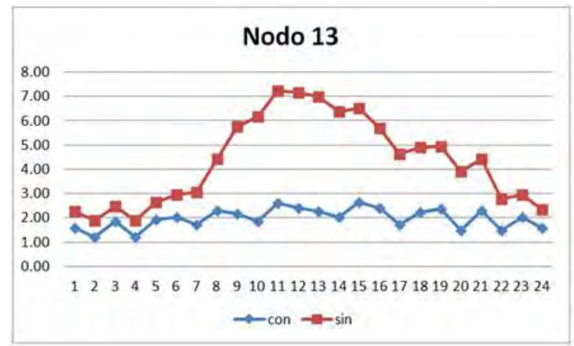
L=100m, d=6", q=2.5 l/s



L=100m, d=6", q=5 l/s



L=100m, d=6", q=7.5 l/s



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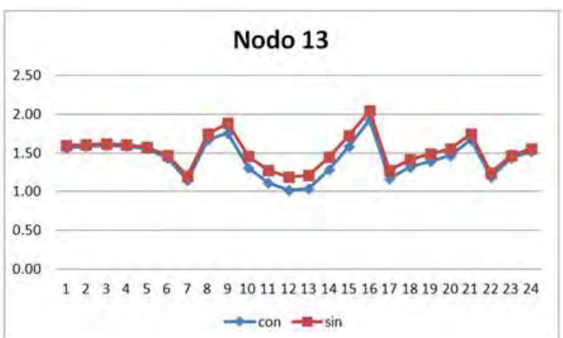
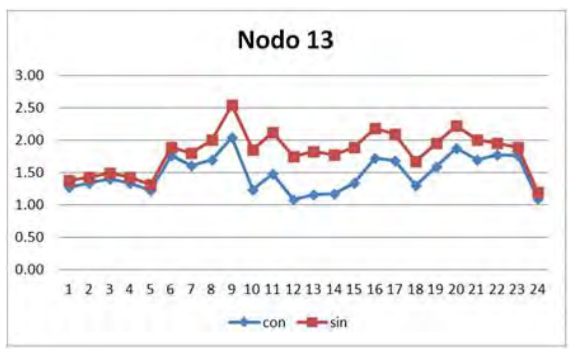
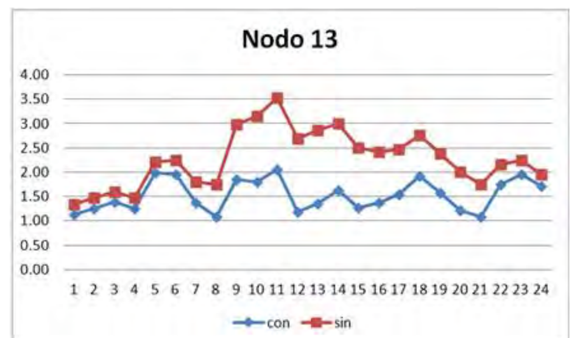


L=100m, d=8", q=5 l/s

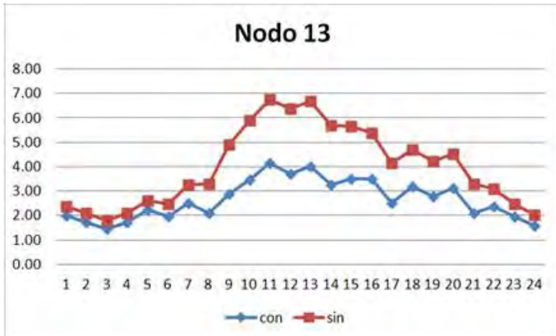


L=100m, d=8", q=7.5 l/s

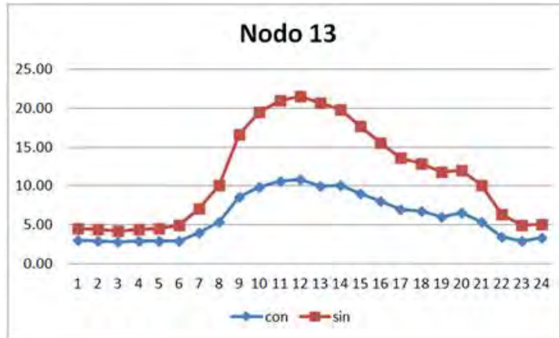


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=300m, d=4", q=2.5 l/s



L=300m, d=4", q=5 l/s



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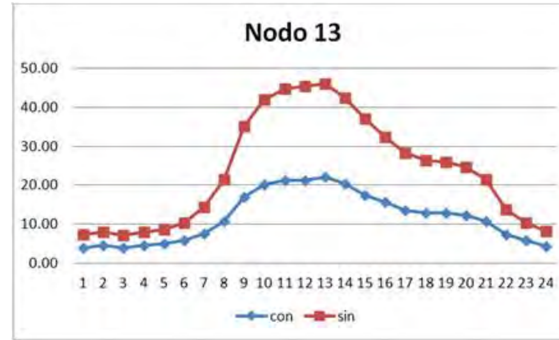
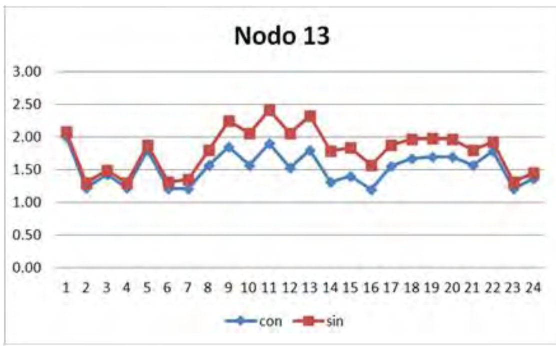
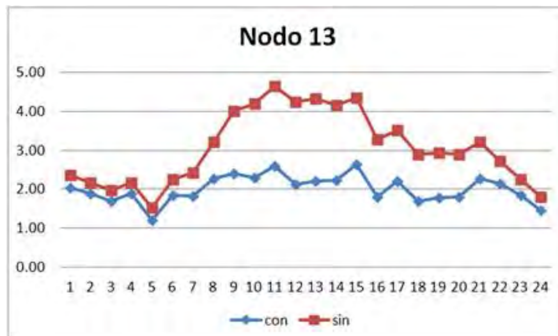


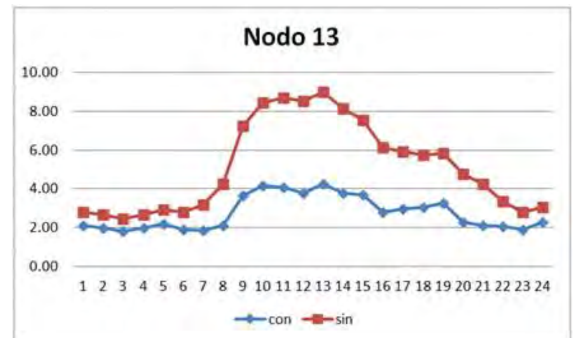
L=300m, d=6", q=2.5 l/s



L=300m, d=6", q=5 l/s



L=300m, d=6", q=7.5 l/s



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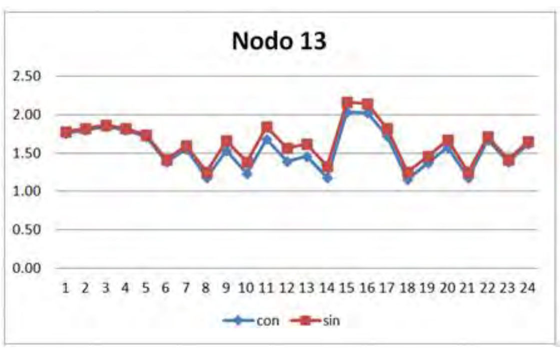
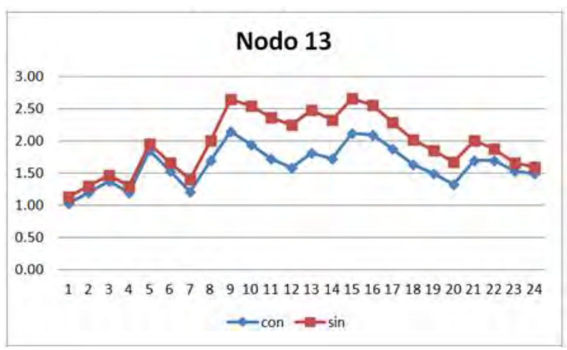


L=300m, d=8", q=5 l/s



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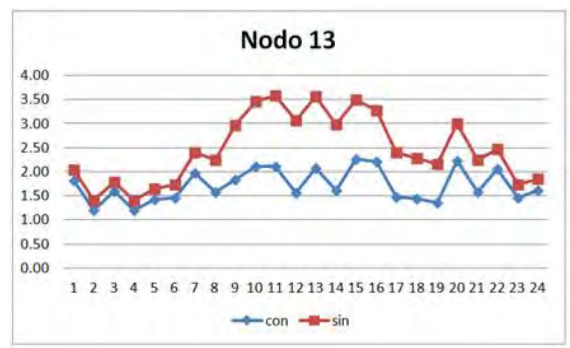
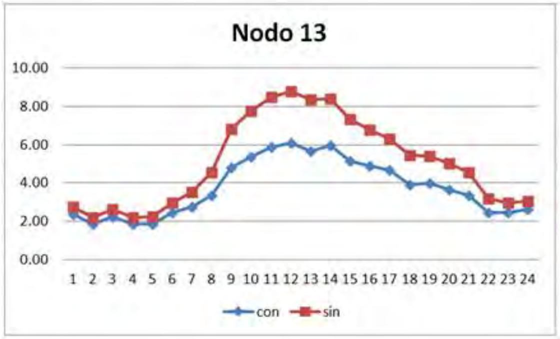
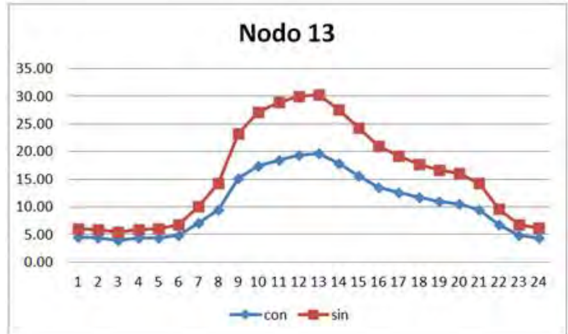


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

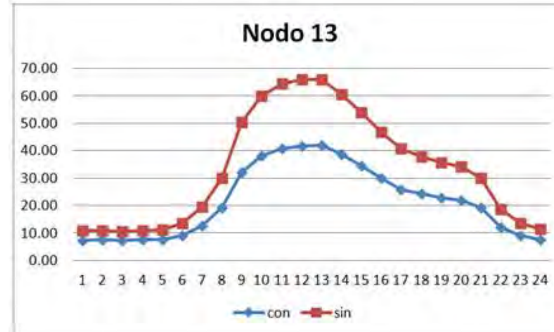
L=600m, d=4", q=2.5 l/s



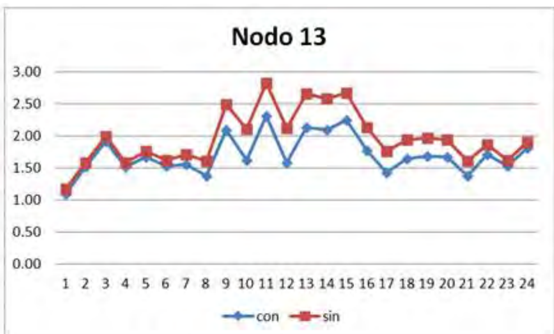
L=600m, d=4", q=5 l/s



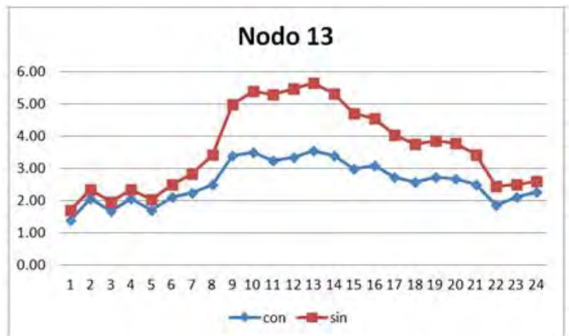
L=600m, d=4", q=7.5 l/s



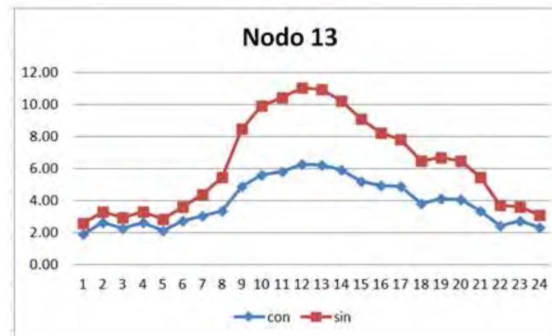
L=600m, d=6", q=2.5 l/s



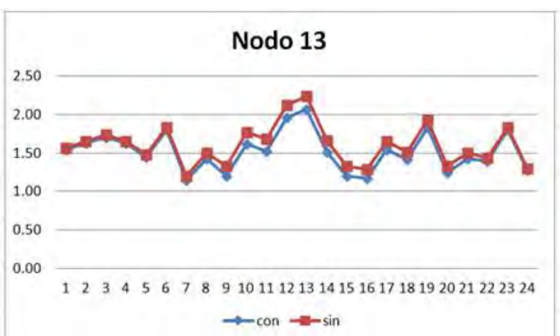
L=600m, d=6", q=5 l/s



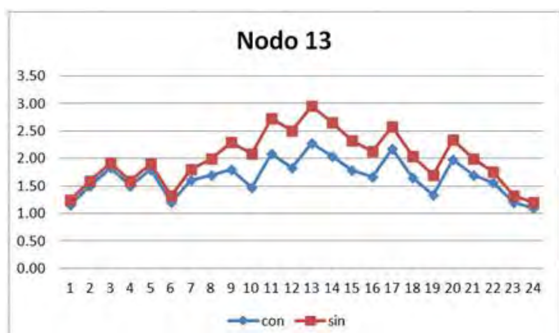
L=600m, d=6", q=7.5 l/s



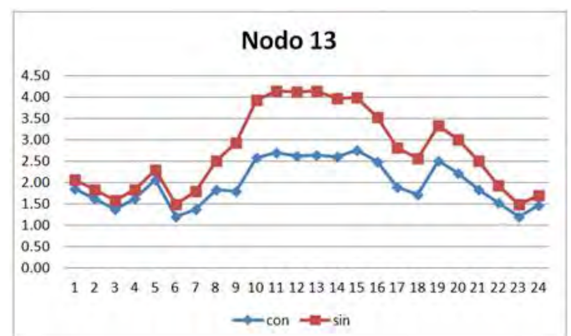
L=600m, d=8", q=2.5 l/s



L=600m, d=8", q=5 l/s



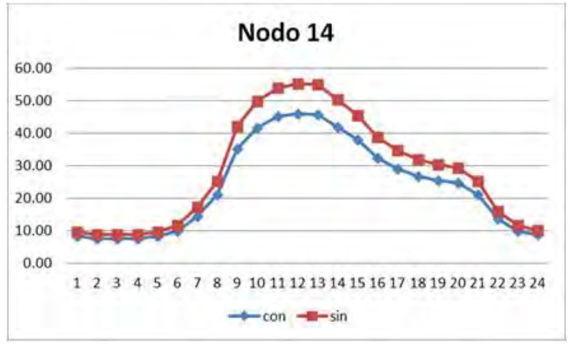
L=600m, d=8", q=7.5 l/s



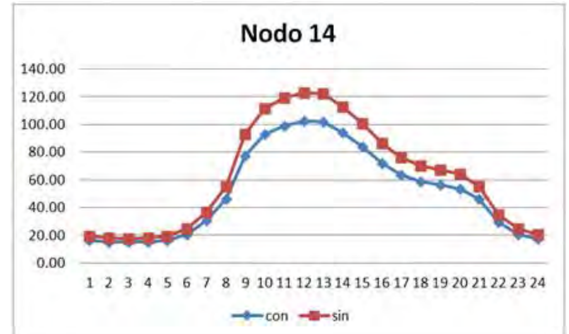
Anexo3. Carga en nodos {M S-F}   ejeX: horas y eje Y:metros

L=100m, d=4”, q=2.5 l/s

L=100m, d=4”, q=5 l/s



L=100m, d=4”, q=7.5 l/s



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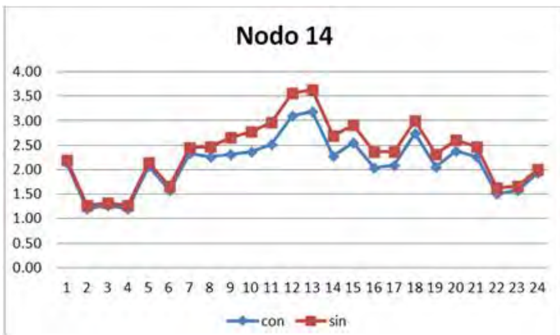

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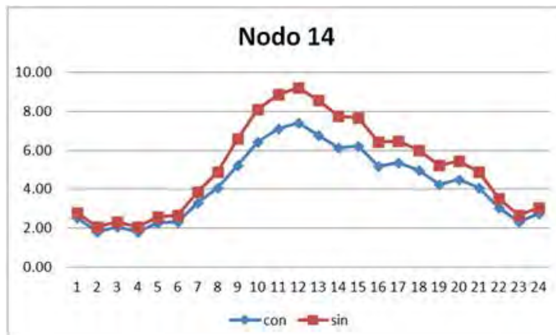

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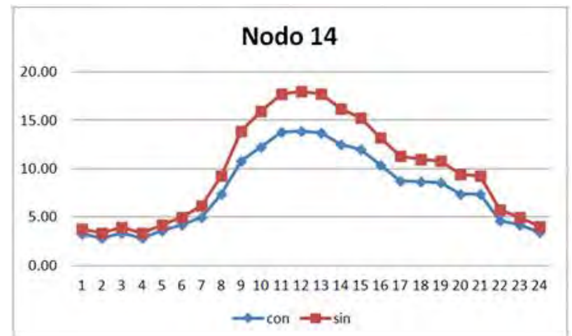

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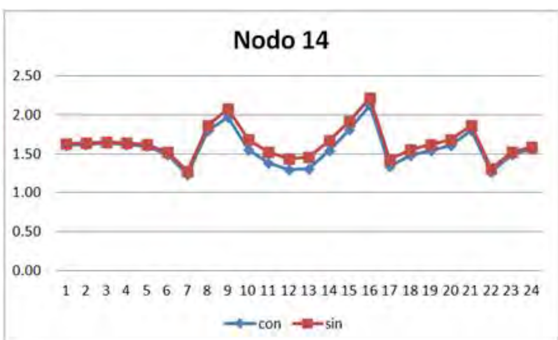
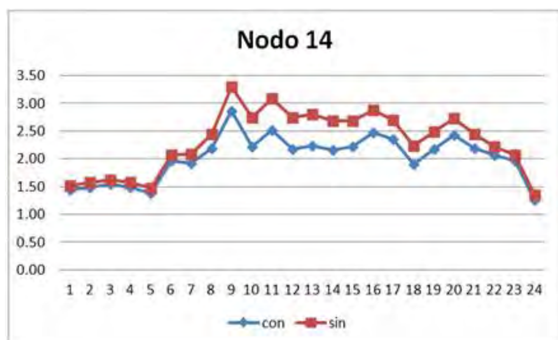
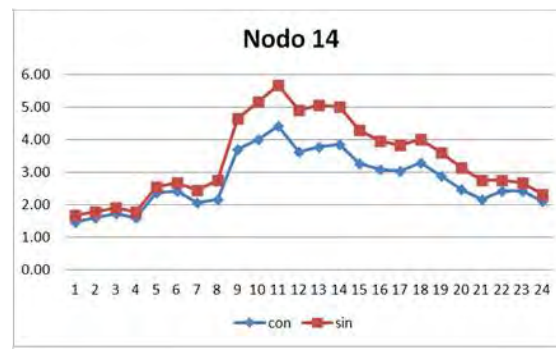


L=100m, d=8”, q=5 l/s

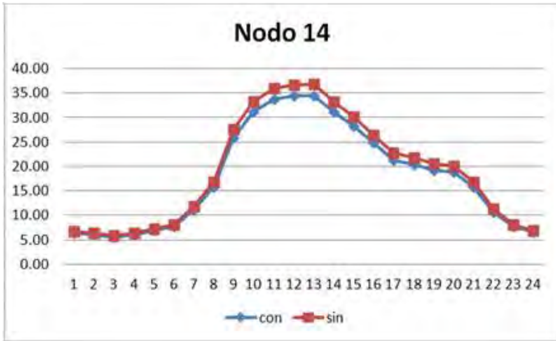


L=100m, d=8”, q=7.5 l/s

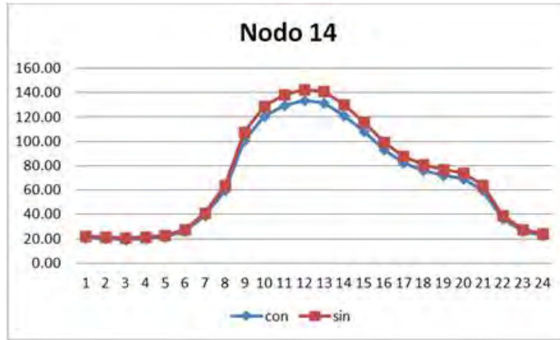


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

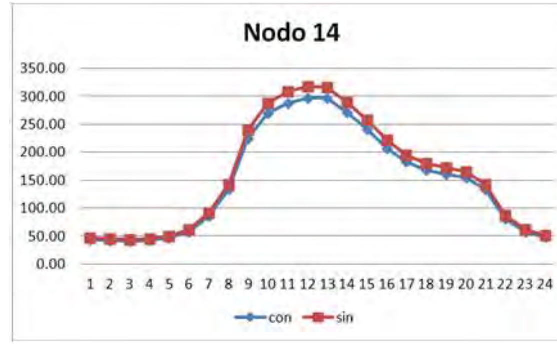
L=300m, d=4”, q=2.5 l/s



L=300m, d=4”, q=5 l/s



L=300m, d=4”, q=7.5 l/s



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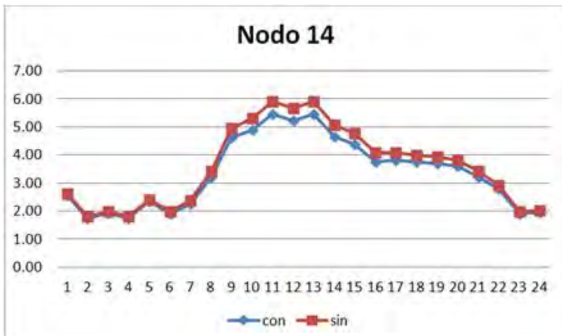
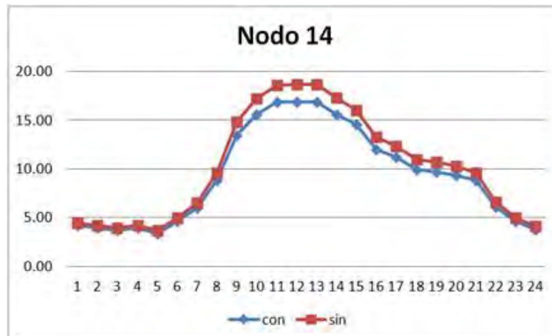


L=300m, d=6”, q=5 l/s



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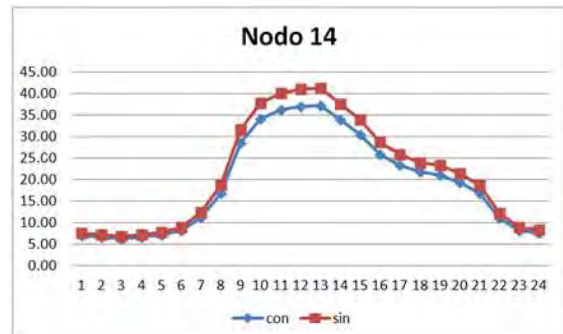

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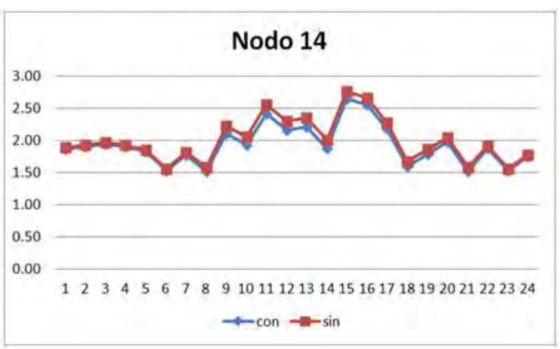
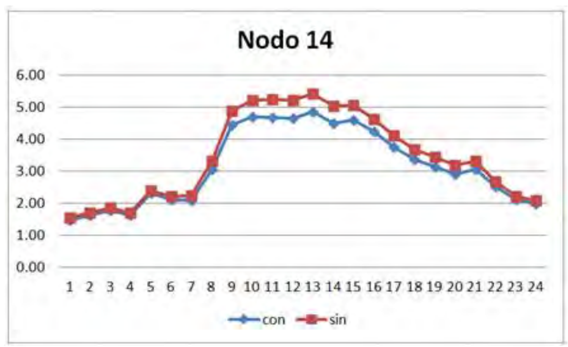
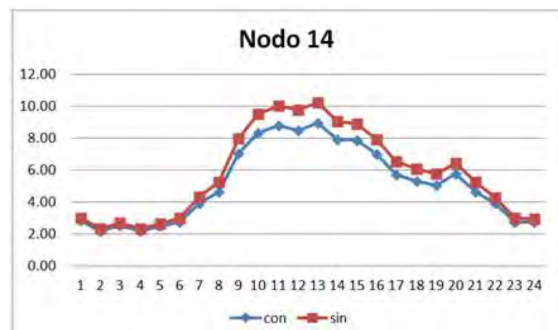


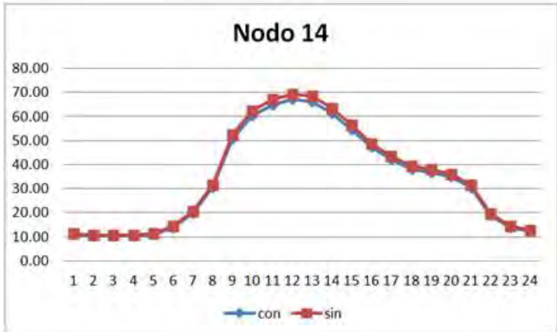
L=300m, d=8”, q=5 l/s



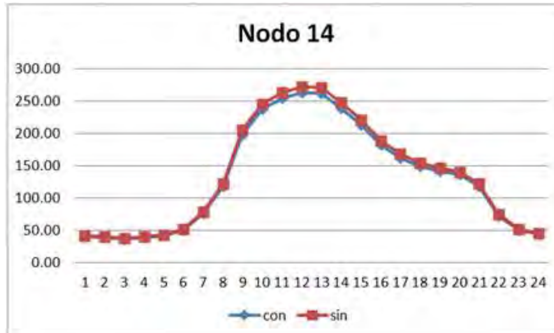
L=300m, d=8”, q=7.5 l/s



L=600m, d=4", q=2.5 l/s

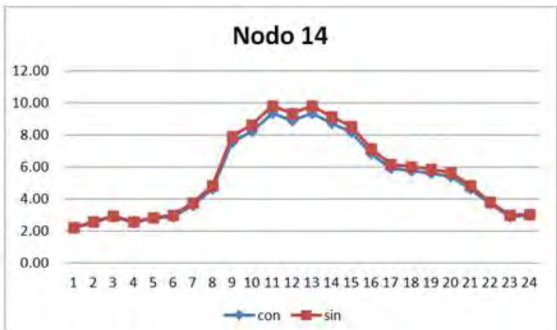


L=600m, d=4", q=5 l/s

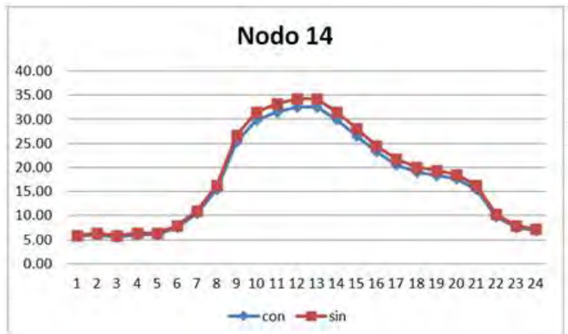


L=600m, d=4", q=7.5 l/s

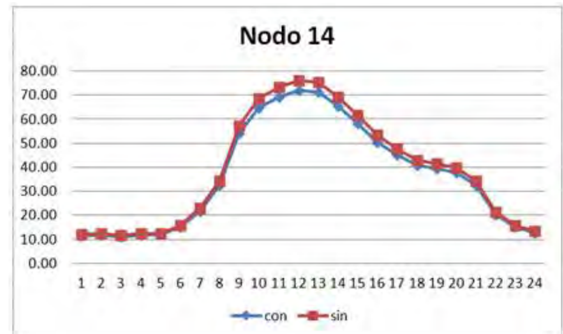
L=600m, d=6", q=2.5 l/s



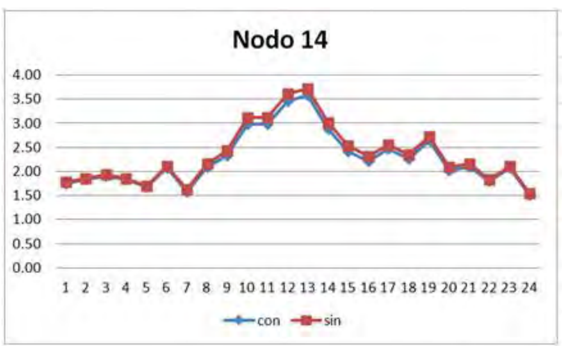
L=600m, d=6", q=5 l/s



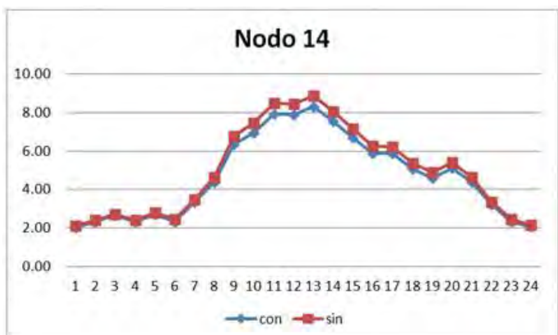
L=600m, d=6", q=7.5 l/s



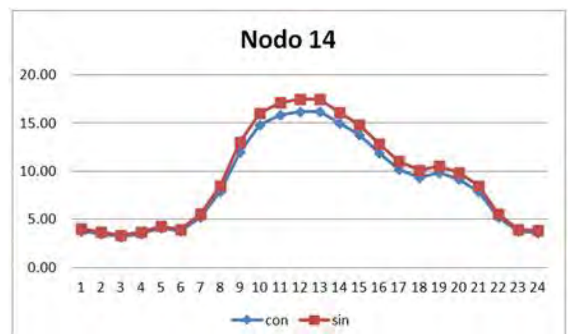
L=600m, d=8", q=2.5 l/s



L=600m, d=8", q=5 l/s

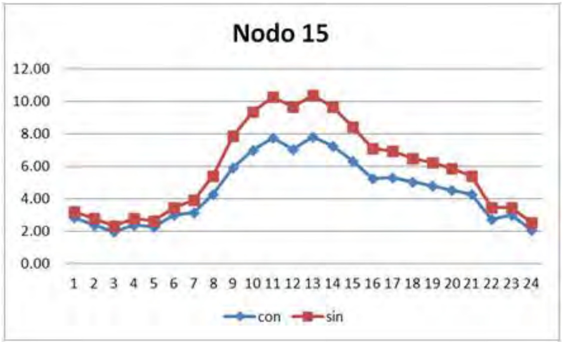


L=600m, d=8", q=7.5 l/s

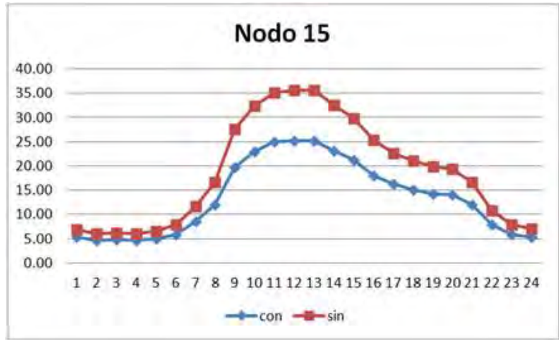


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=100m, d=4", q=2.5 l/s



L=100m, d=4", q=5 l/s



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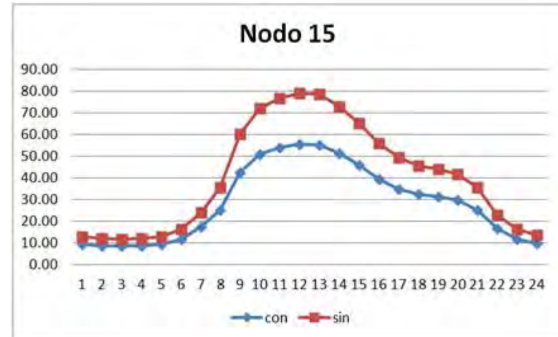

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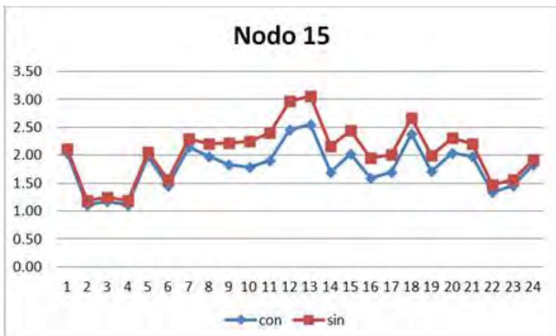
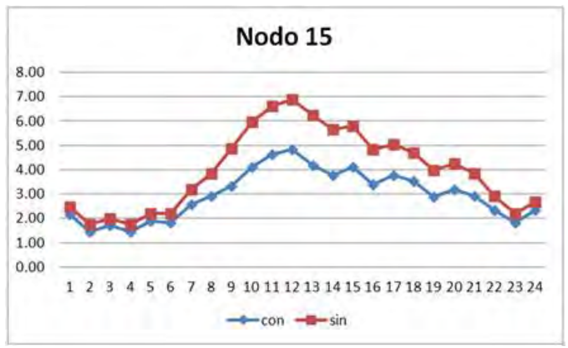


L=100m, d=6", q=5 l/s



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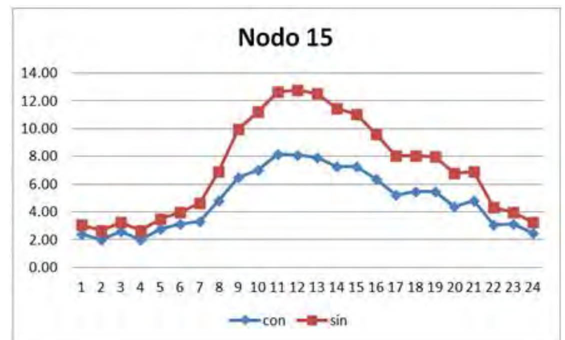
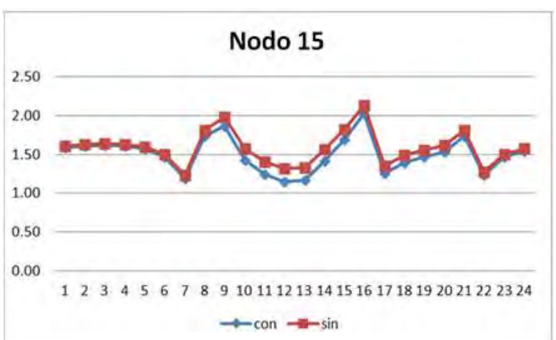
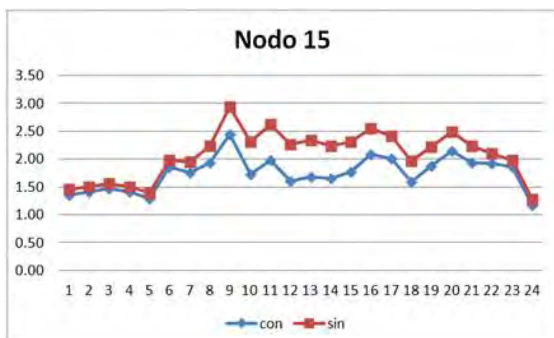


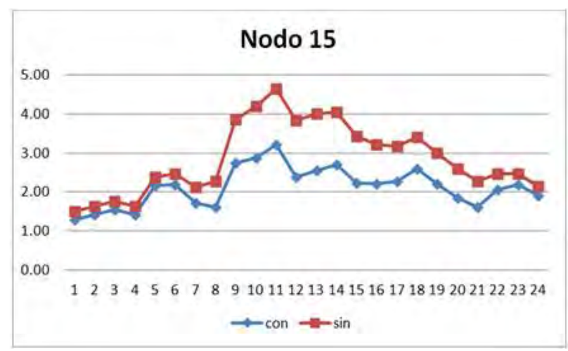
L=100m, d=8", q=2.5 l/s



L=100m, d=8", q=5 l/s

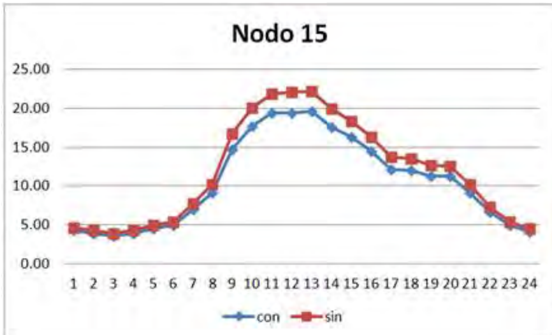


L=100m, d=8", q=7.5 l/s



Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=300m, d=4”, q=2.5 l/s



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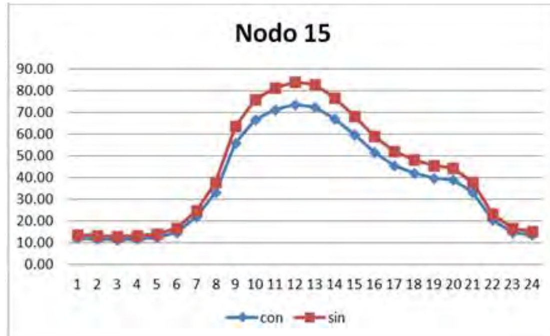

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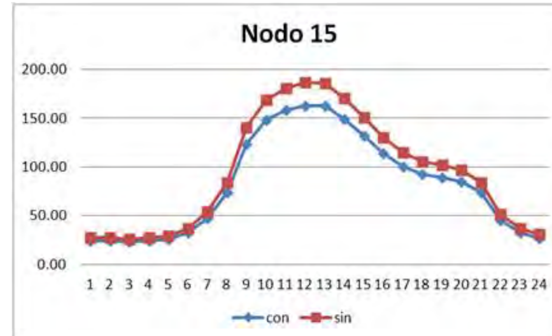
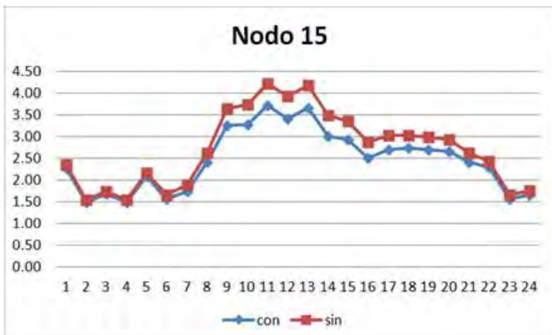
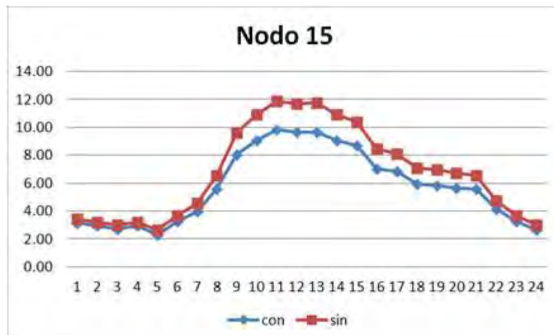


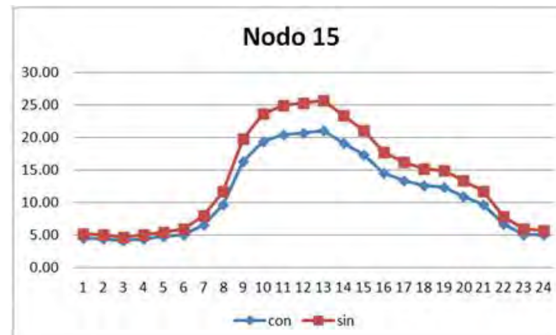
L=300m, d=6”, q=2.5 l/s



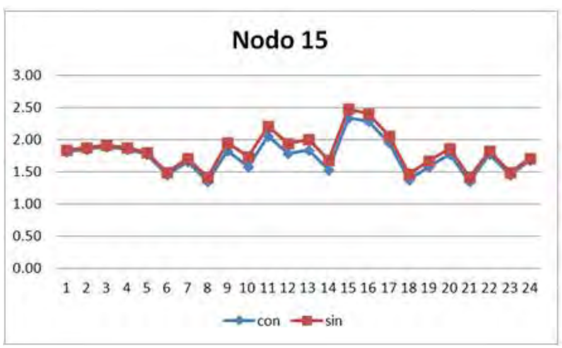
L=300m, d=6”, q=5 l/s



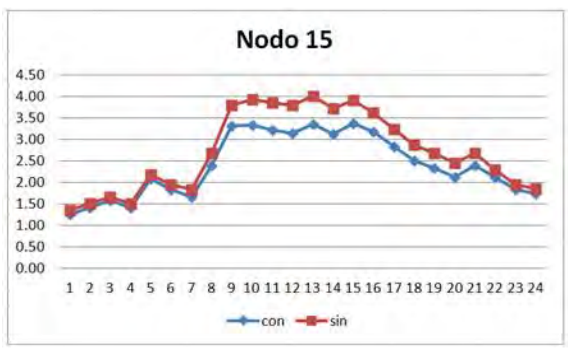
L=300m, d=6”, q=7.5 l/s



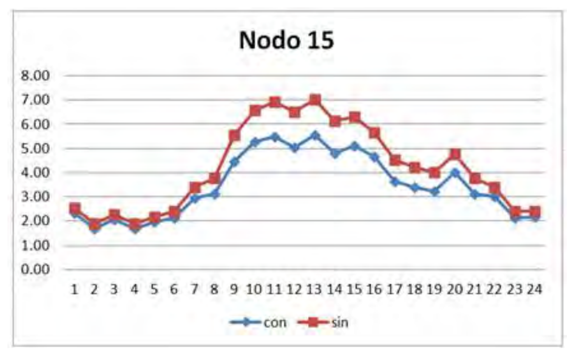
L=300m, d=8”, q=2.5 l/s



L=300m, d=8”, q=5 l/s

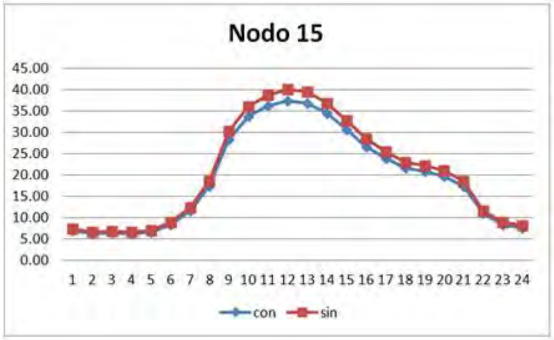


L=300m, d=8”, q=7.5 l/s

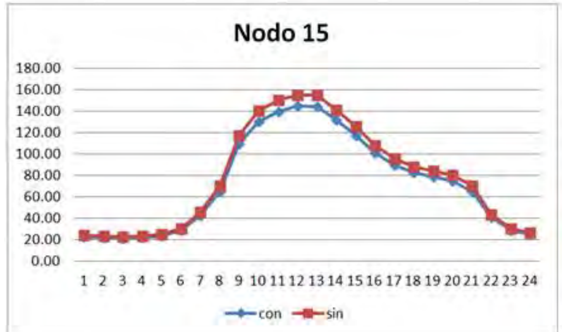


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

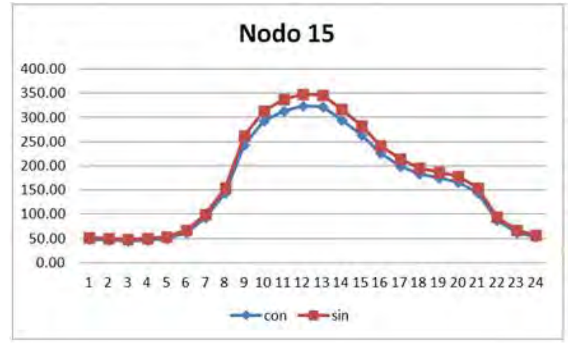
L=600m, d=4", q=2.5 l/s



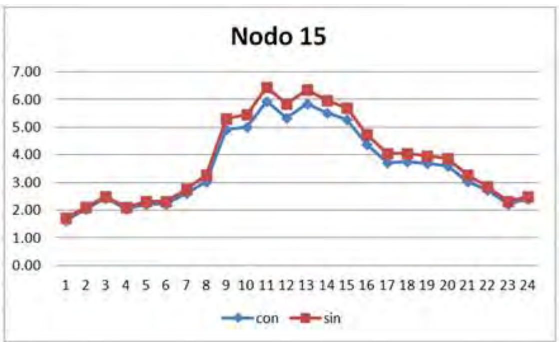
L=600m, d=4", q=5 l/s



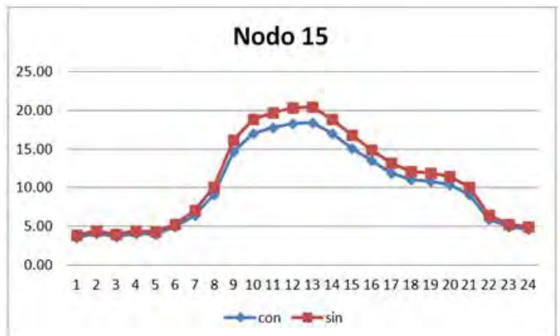
L=600m, d=4", q=7.5 l/s



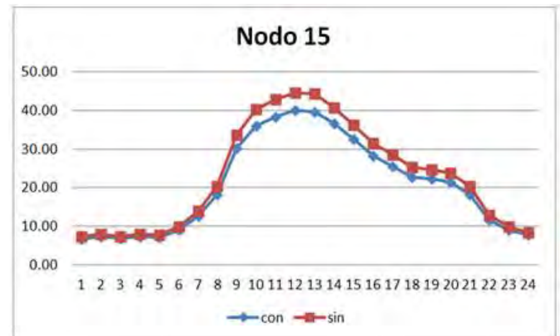
L=600m, d=6", q=2.5 l/s



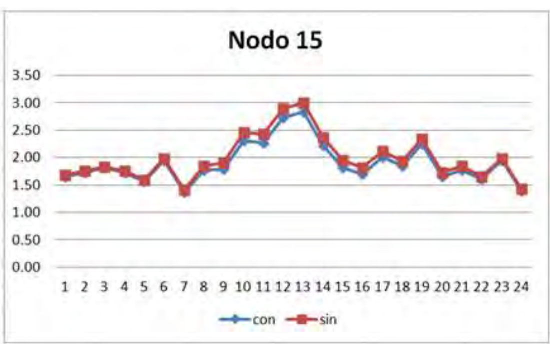
L=600m, d=6", q=5 l/s



L=600m, d=6", q=7.5 l/s

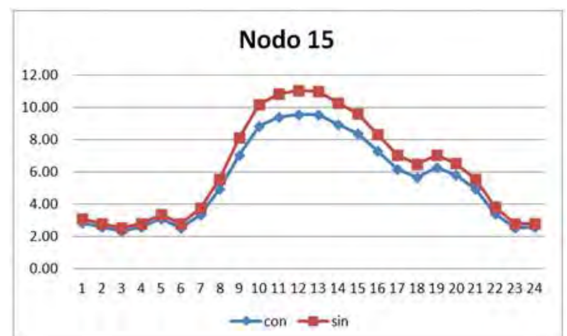


L=600m, d=8", q=2.5 l/s



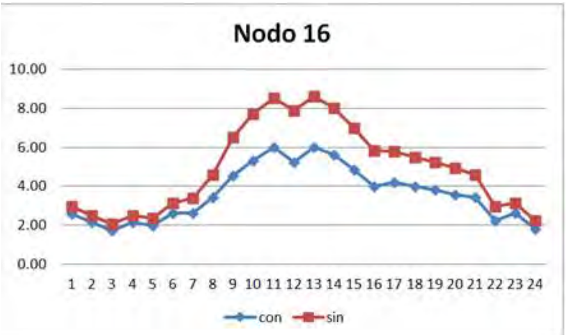
L=600m, d=8", q=5 l/s

L=600m, d=8", q=7.5 l/s

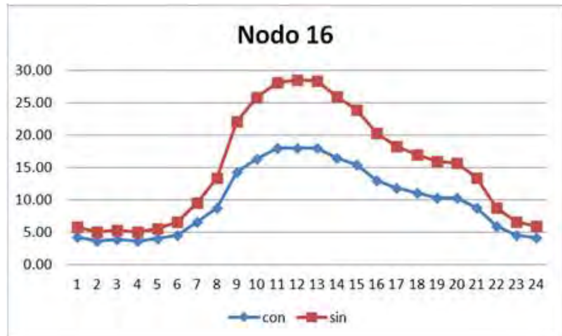


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=100m, d=4", q=2.5 l/s



L=100m, d=4", q=5 l/s



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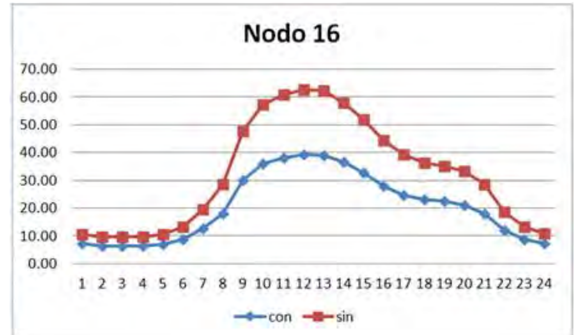
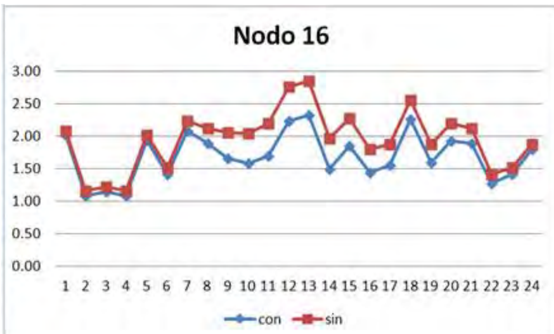
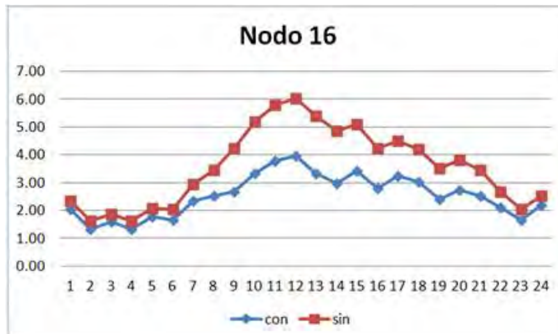


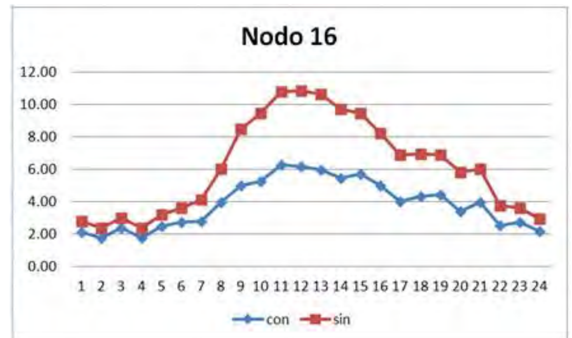
L=100m, d=6", q=2.5 l/s



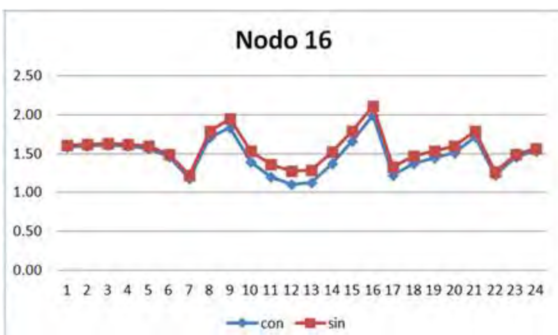
L=100m, d=6", q=5 l/s



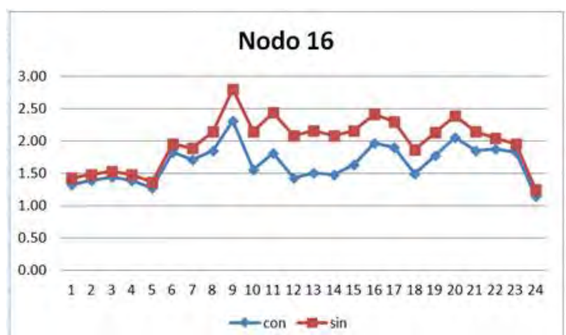
L=100m, d=6", q=7.5 l/s



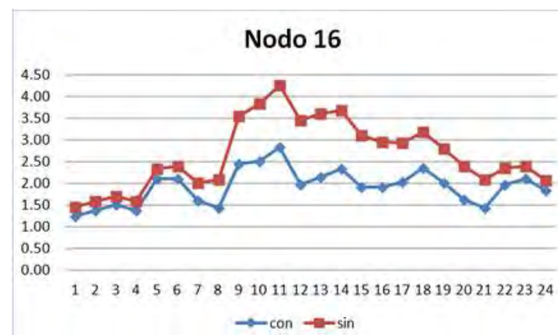
L=100m, d=8", q=2.5 l/s



L=100m, d=8", q=5 l/s

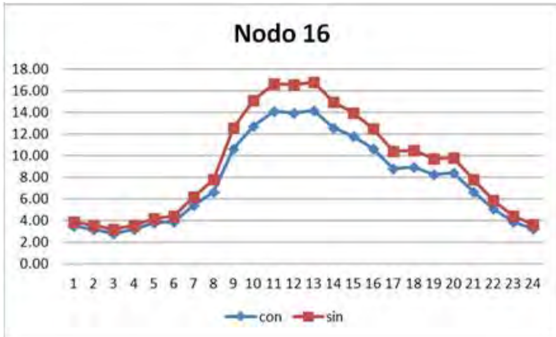


L=100m, d=8", q=7.5 l/s

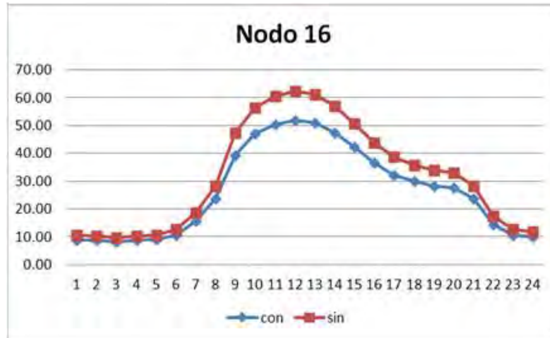


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

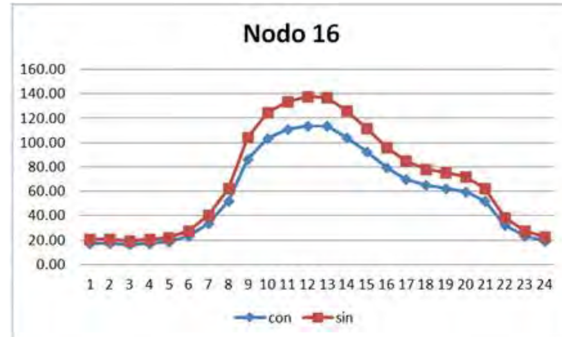
L=300m, d=4”, q=2.5 l/s



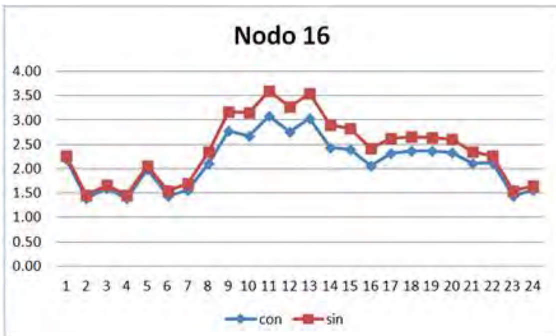
L=300m, d=4”, q=5 l/s



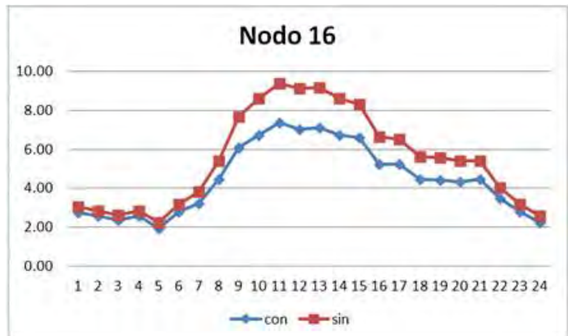
L=300m, d=4”, q=7.5 l/s



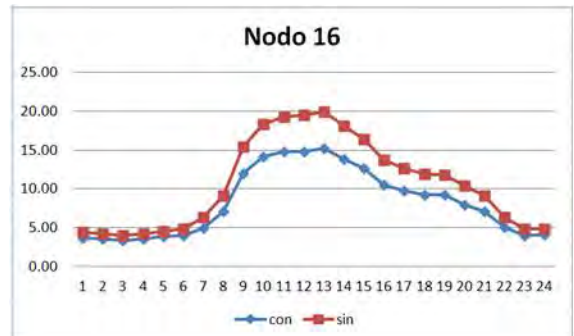
L=300m, d=6”, q=2.5 l/s



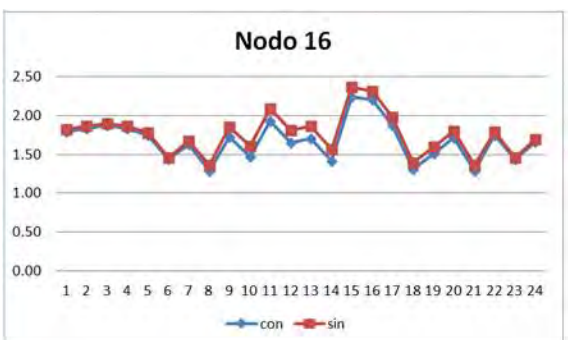
L=300m, d=6”, q=5 l/s



L=300m, d=6”, q=7.5 l/s



L=300m, d=8”, q=2.5 l/s



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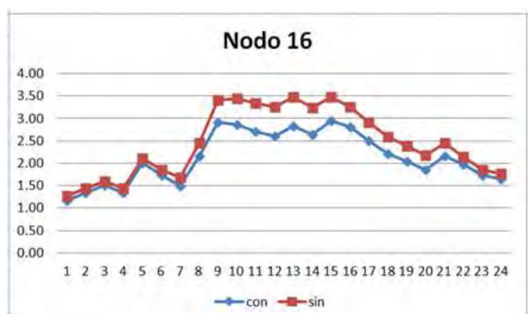
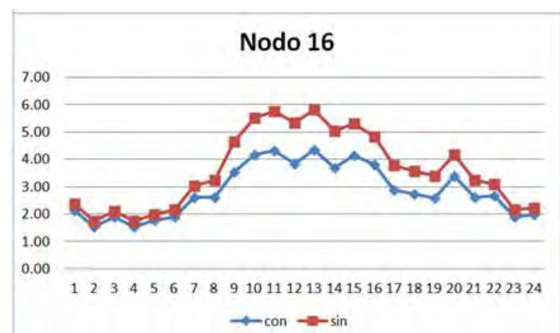
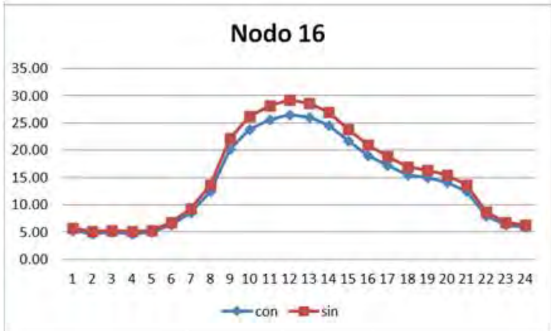


L=300m, d=8”, q=7.5 l/s

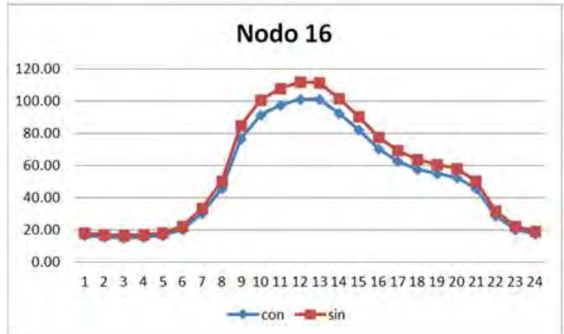


Anexo3. Carga en nodos {M S-F}　　　　　ejeX: horas y eje Y:metros

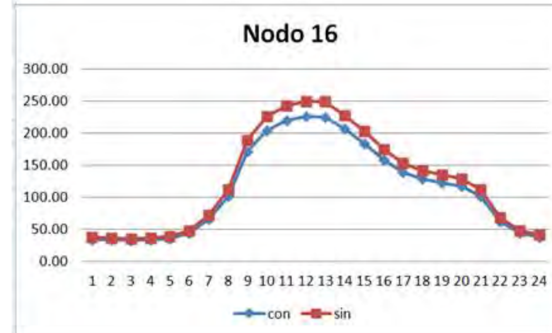
L=600m, d=4”, q=2.5 l/s



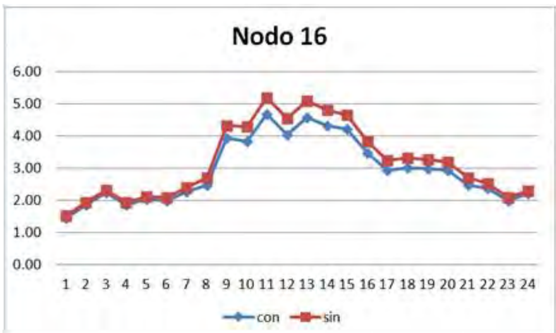
L=600m, d=4”, q=5 l/s



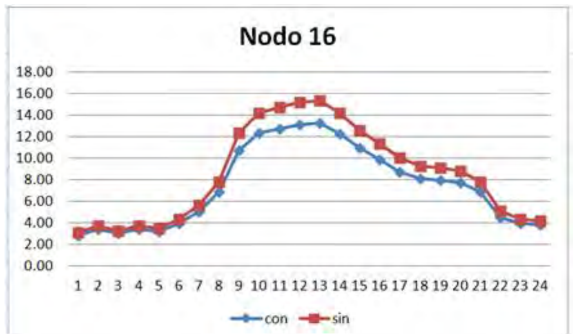
L=600m, d=4”, q=7.5 l/s



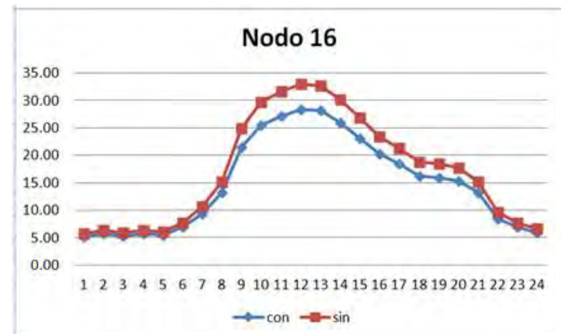
L=600m, d=6”, q=2.5 l/s



L=600m, d=6”, q=5 l/s



L=600m, d=6”, q=7.5 l/s



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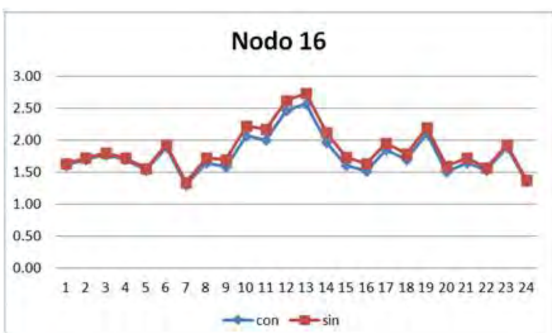
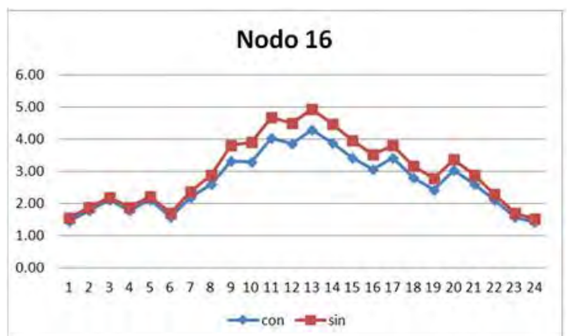
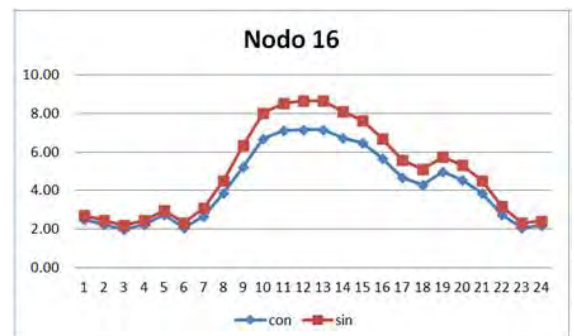


L=600m, d=8”, q=5 l/s

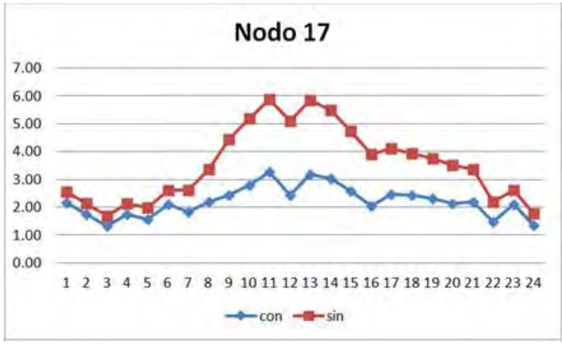


L=600m, d=8”, q=7.5 l/s

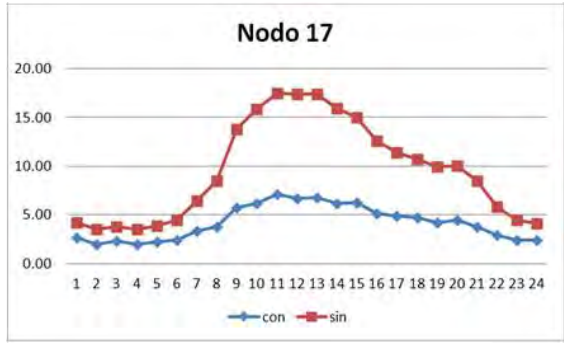


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

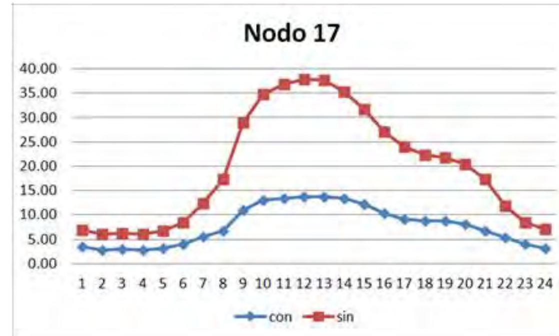
L=100m, d=4", q=2.5 l/s



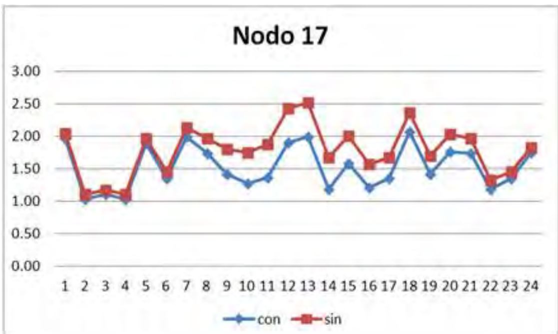
L=100m, d=4", q=5 l/s



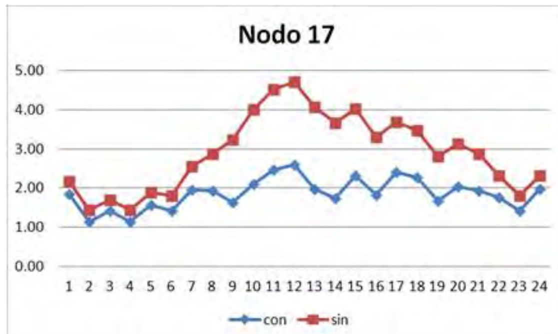
L=100m, d=4", q=7.5 l/s



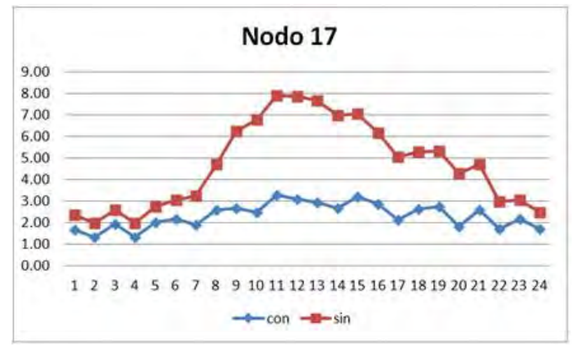
L=100m, d=6", q=2.5 l/s



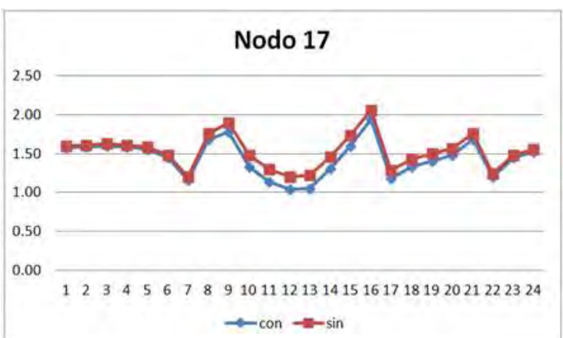
L=100m, d=6", q=5 l/s



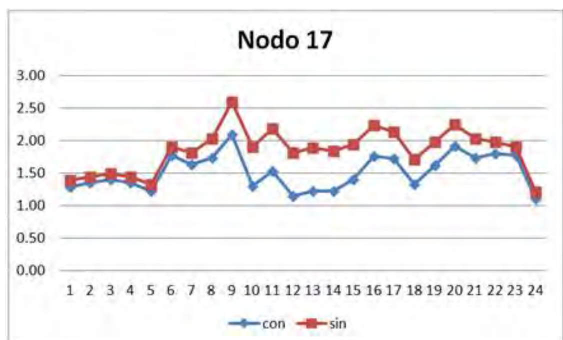
L=100m, d=6", q=7.5 l/s



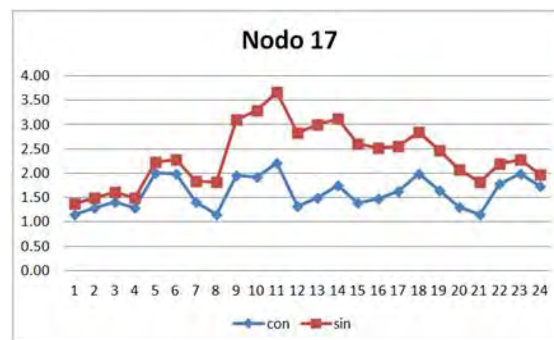
L=100m, d=8", q=2.5 l/s



L=100m, d=8", q=5 l/s

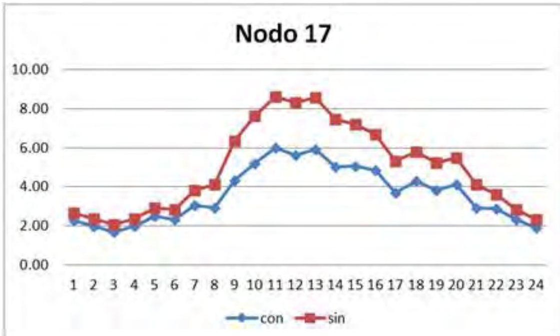


L=100m, d=8", q=7.5 l/s

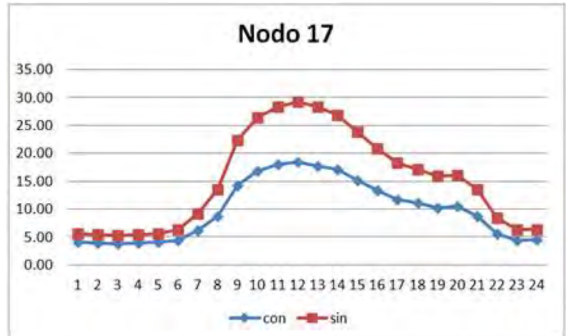


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

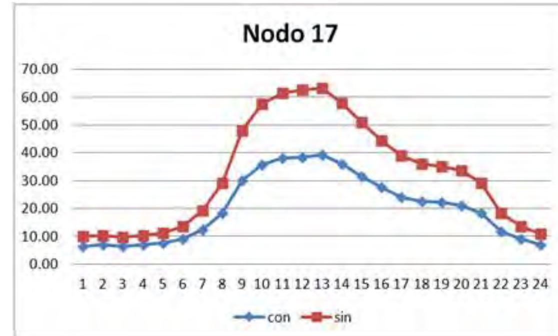
L=300m, d=4”, q=2.5 l/s



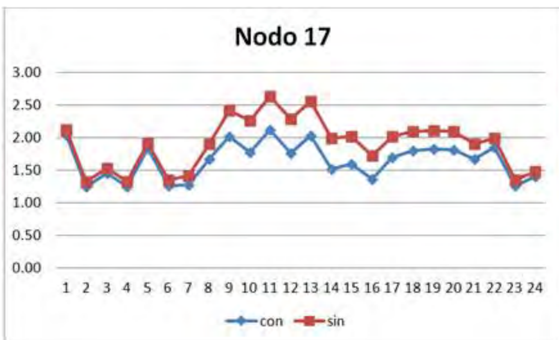
L=300m, d=4”, q=5 l/s



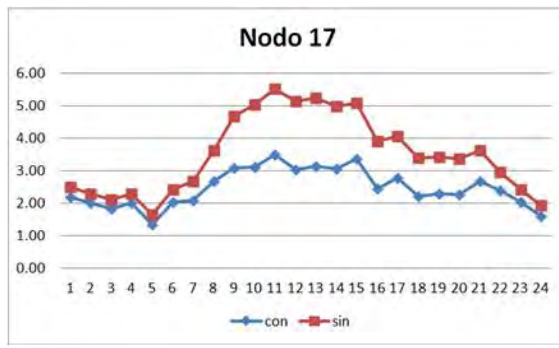
L=300m, d=4”, q=7.5 l/s



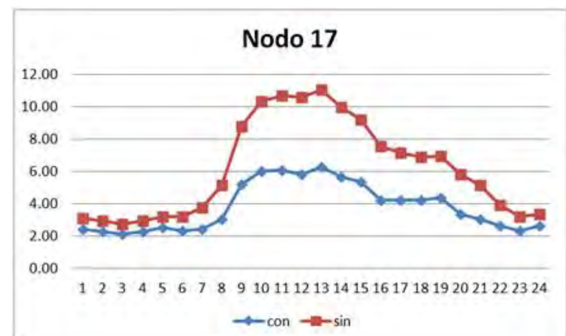
L=300m, d=6”, q=2.5 l/s



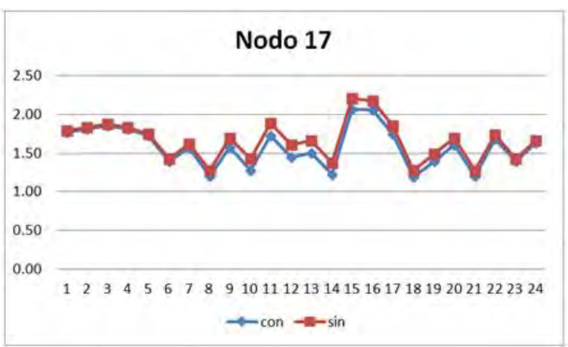
L=300m, d=6”, q=5 l/s



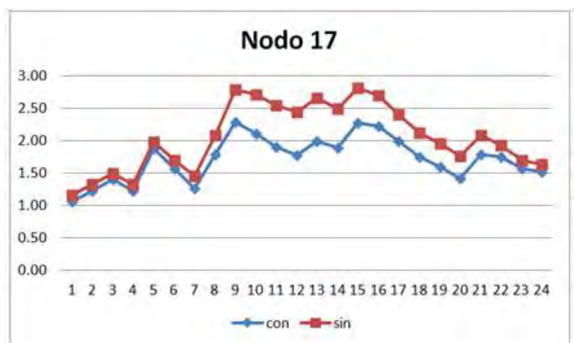
L=300m, d=6”, q=7.5 l/s



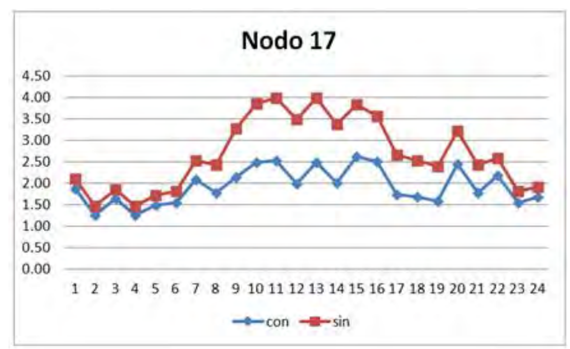
L=300m, d=8”, q=2.5 l/s



L=300m, d=8”, q=5 l/s

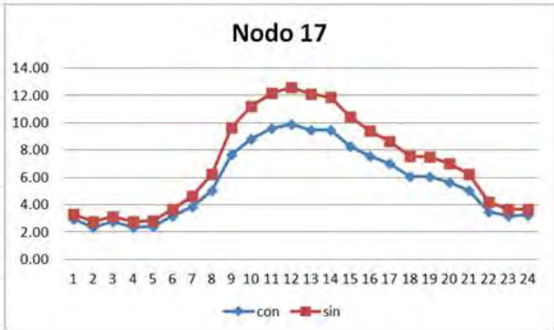


L=300m, d=8”, q=7.5 l/s



Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=600m, d=4”, q=2.5 l/s



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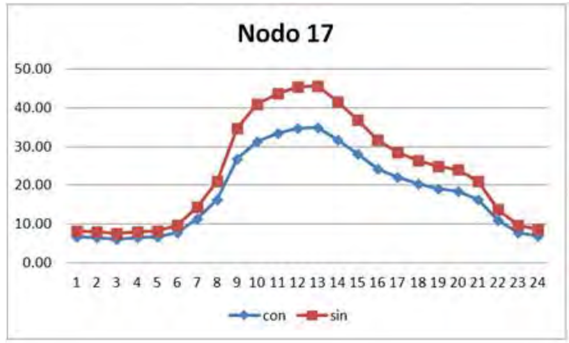

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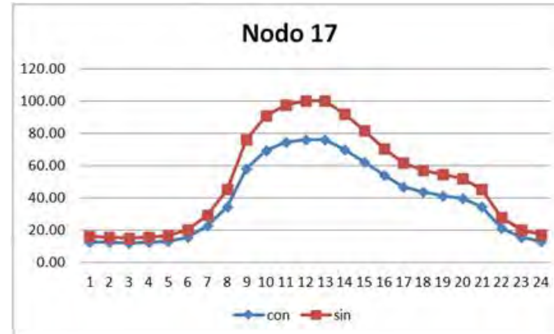
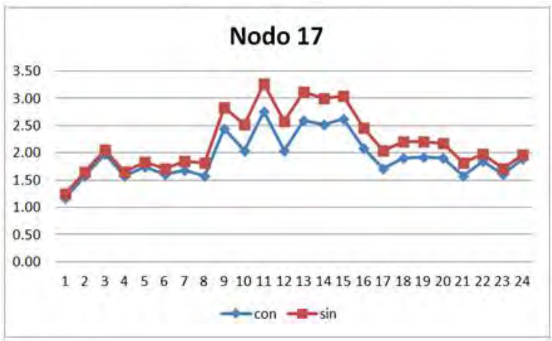
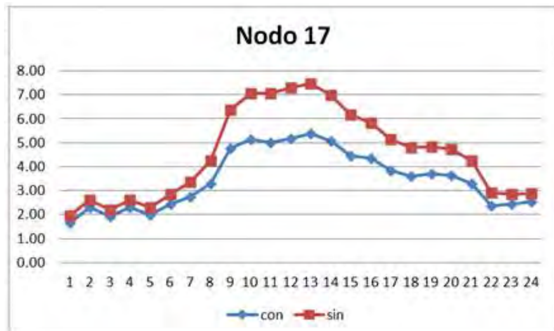


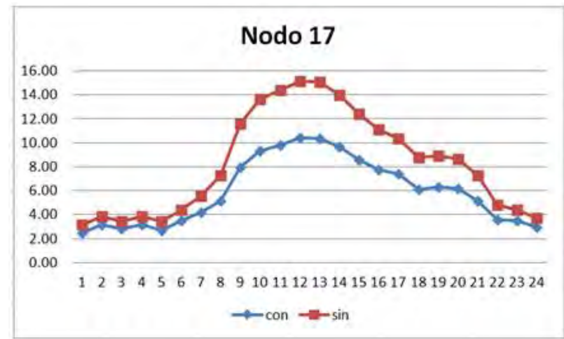
L=600m, d=6”, q=2.5 l/s



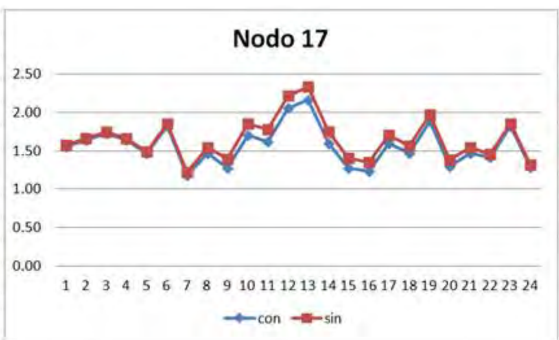
L=600m, d=6”, q=5 l/s



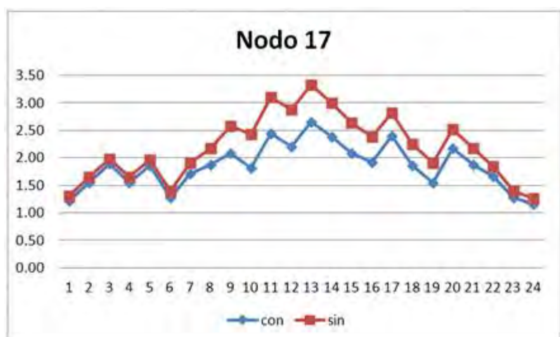
L=600m, d=6”, q=7.5 l/s



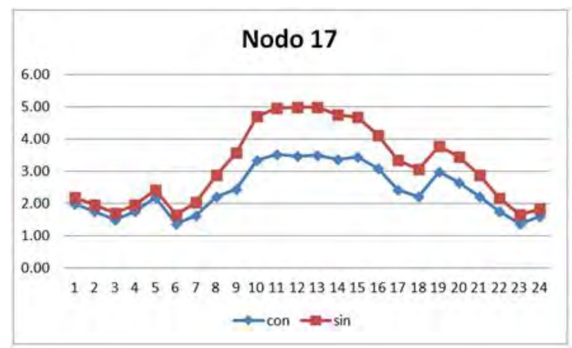
L=600m, d=8”, q=2.5 l/s



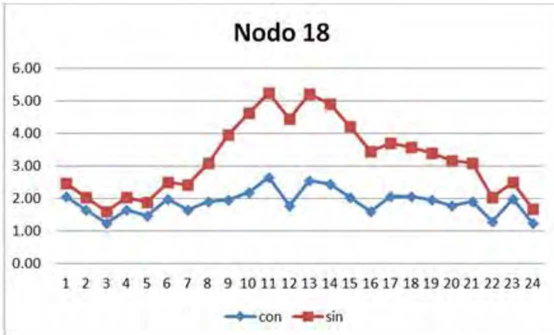
L=600m, d=8”, q=5 l/s



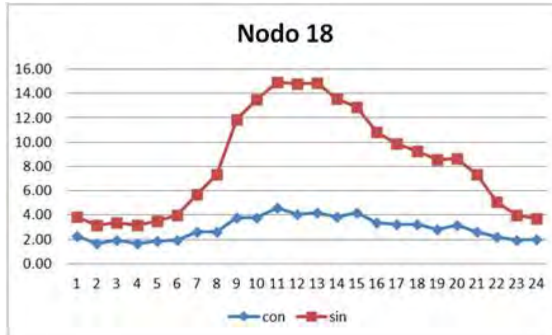
L=600m, d=8”, q=7.5 l/s



L=100m, d=4", q=2.5 l/s



L=100m, d=4", q=5 l/s



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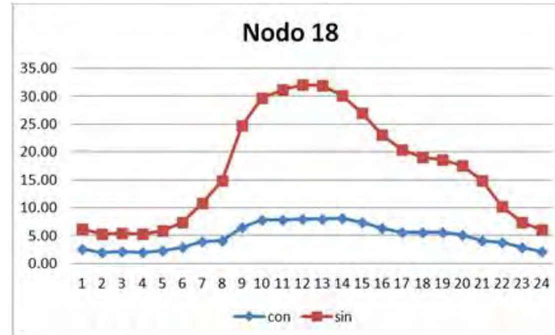
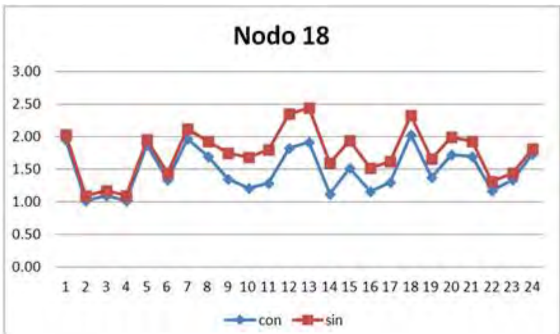
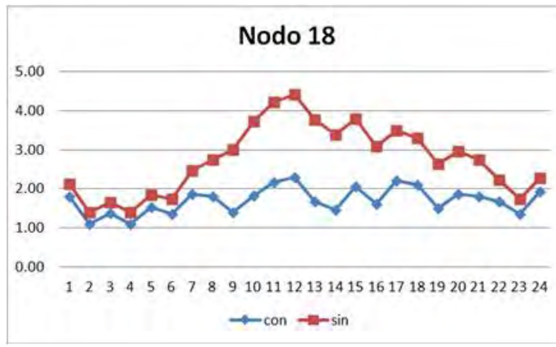


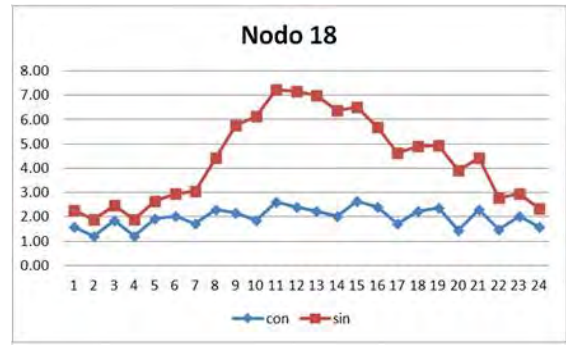
L=100m, d=6", q=2.5 l/s



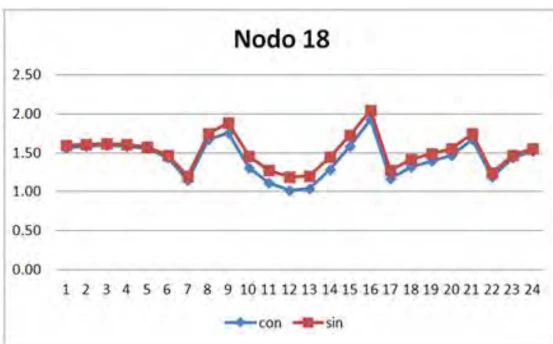
L=100m, d=6", q=5 l/s



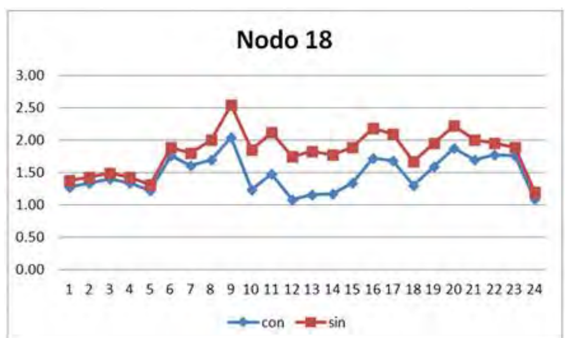
L=100m, d=6", q=7.5 l/s



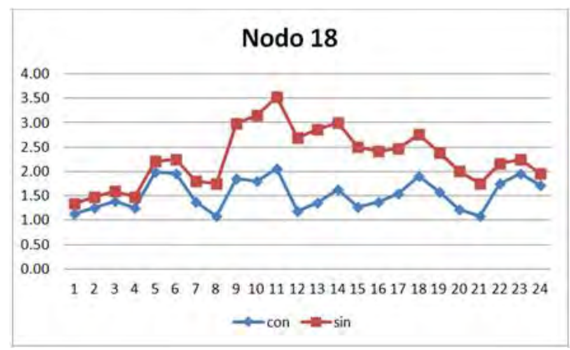
L=100m, d=8", q=2.5 l/s



L=100m, d=8", q=5 l/s

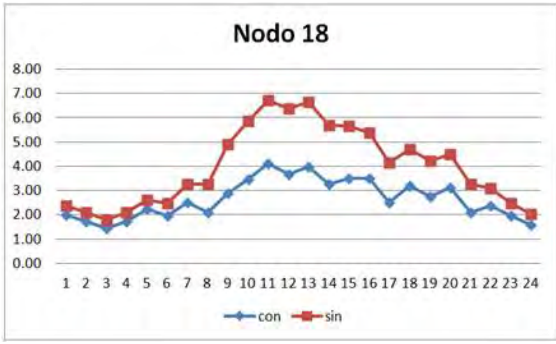


L=100m, d=8", q=7.5 l/s

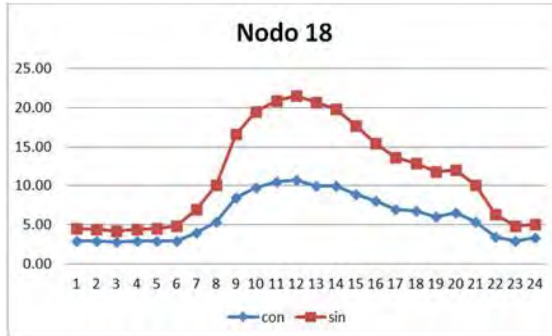


Anexo3. Carga en nodos {M S-F}   ejeX: horas y eje Y:metros

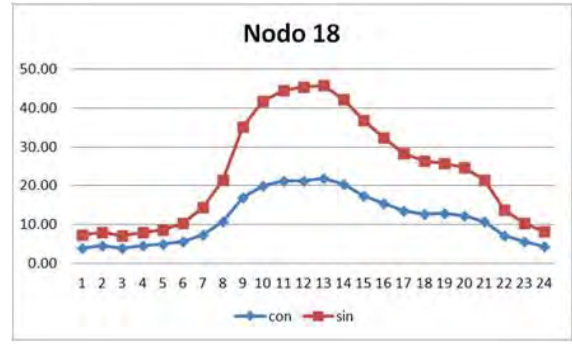
L=300m, d=4", q=2.5 l/s



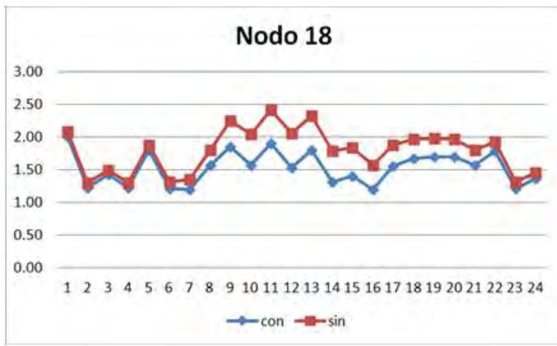
L=300m, d=4", q=5 l/s



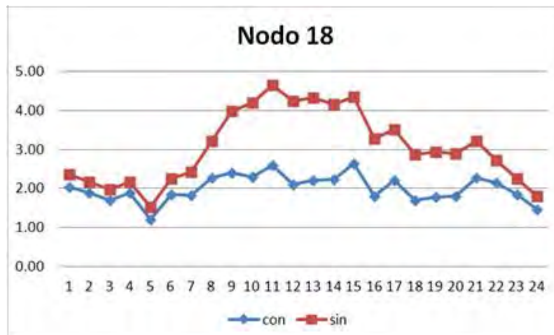
L=300m, d=4", q=7.5 l/s



L=300m, d=6", q=2.5 l/s



L=300m, d=6", q=5 l/s



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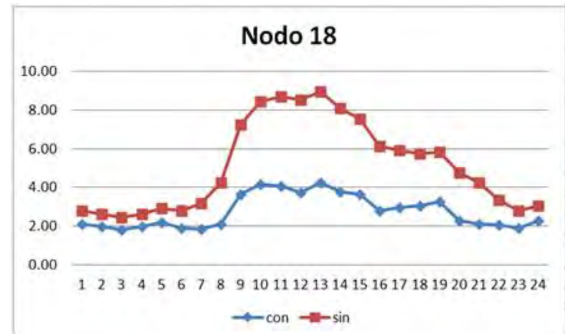

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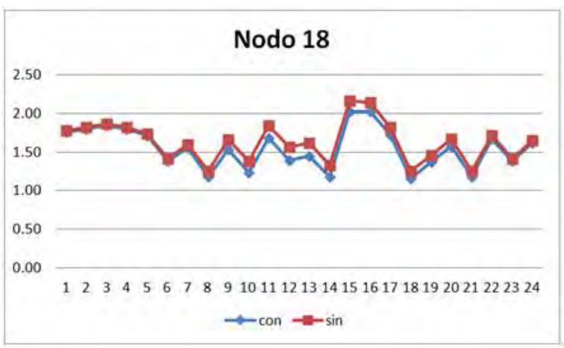
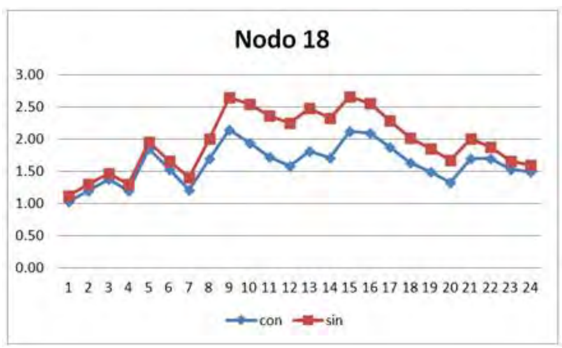
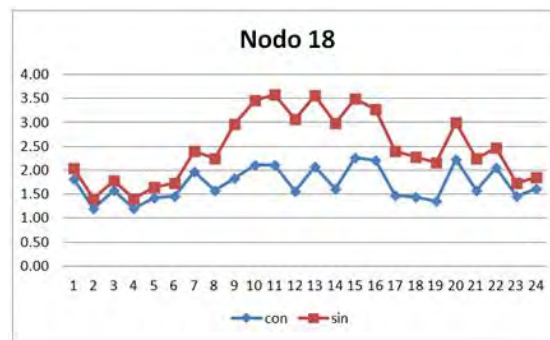


L=300m, d=8", q=5 l/s

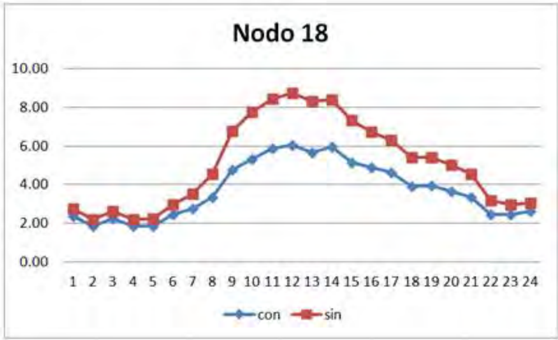


L=300m, d=8", q=7.5 l/s

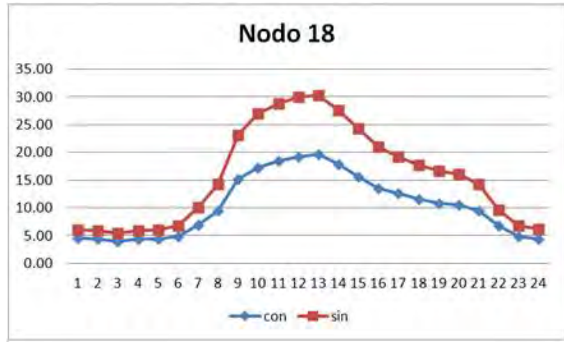


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

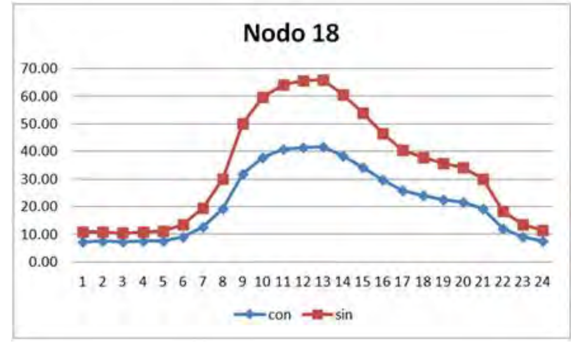
L=600m, d=4”, q=2.5 l/s



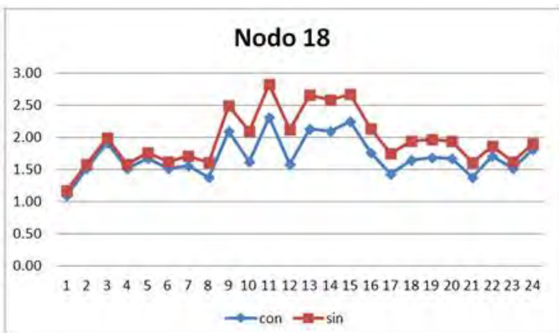
L=600m, d=4”, q=5 l/s



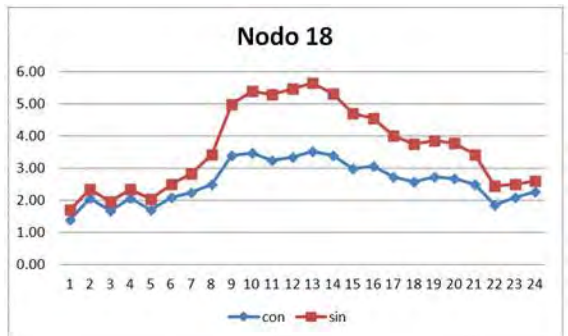
L=600m, d=4”, q=7.5 l/s



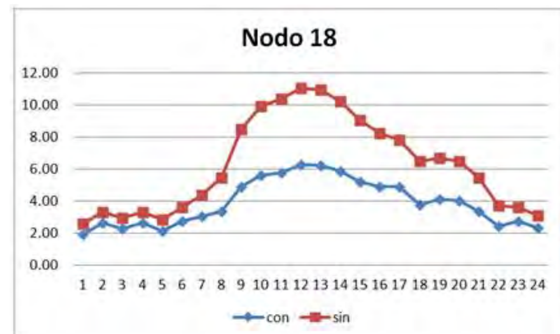
L=600m, d=6”, q=2.5 l/s



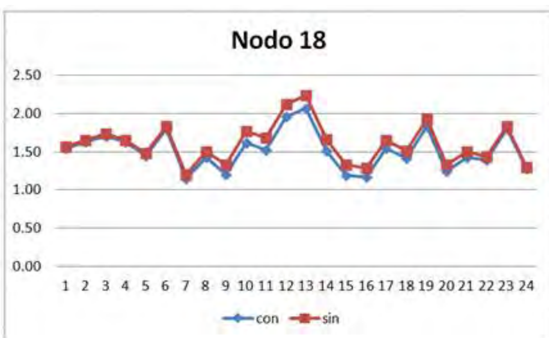
L=600m, d=6”, q=5 l/s



L=600m, d=6”, q=7.5 l/s



L=600m, d=8”, q=2.5 l/s



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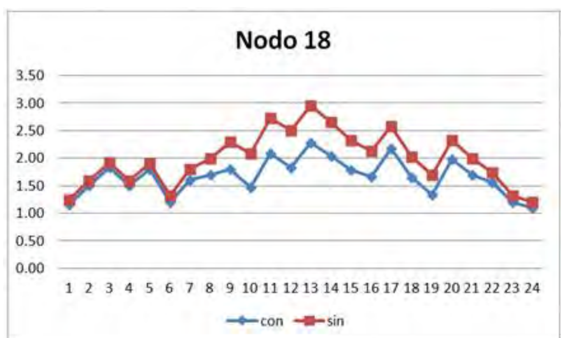
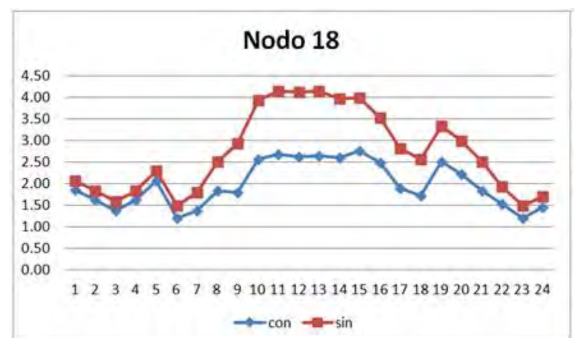


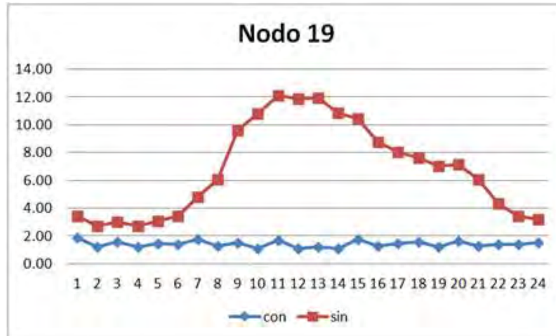
L=600m, d=8”, q=7.5 l/s



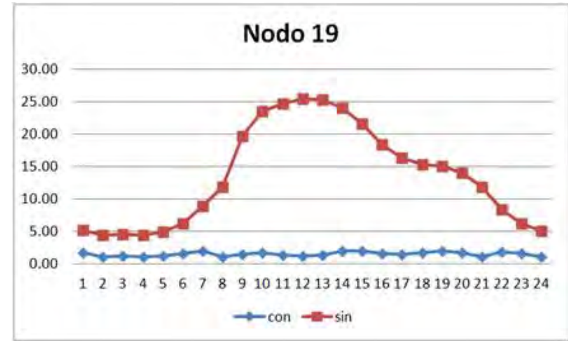
Anexo3. Carga en nodos {M S-F}　　　　ejeX: horas y eje Y:metros

L=100m, d=4”, q=2.5 l/s

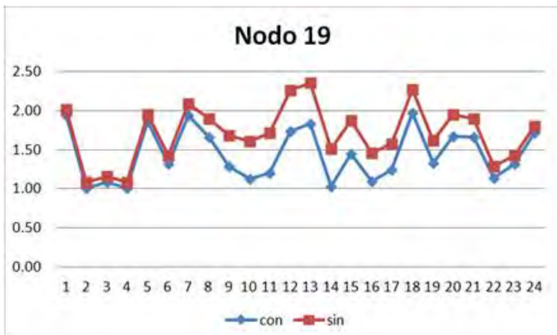
L=100m, d=4”, q=5 l/s



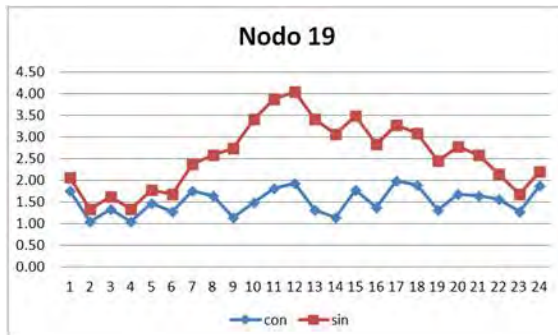
L=100m, d=4”, q=7.5 l/s



L=100m, d=6”, q=2.5 l/s



L=100m, d=6”, q=5 l/s



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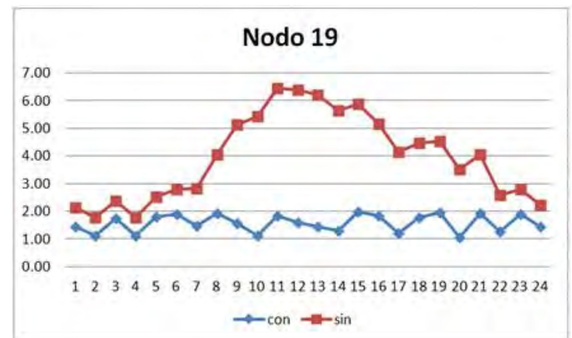
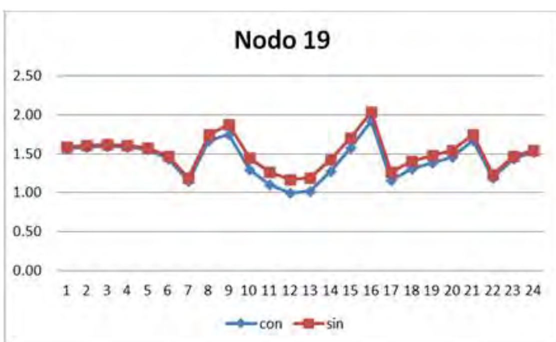
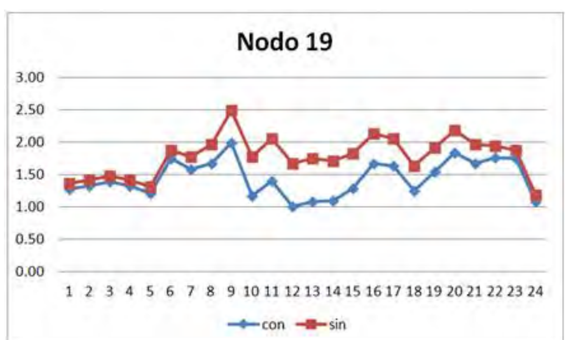


L=100m, d=8”, q=2.5 l/s



L=100m, d=8”, q=5 l/s



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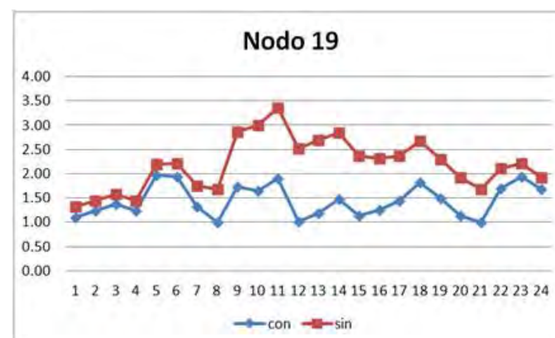
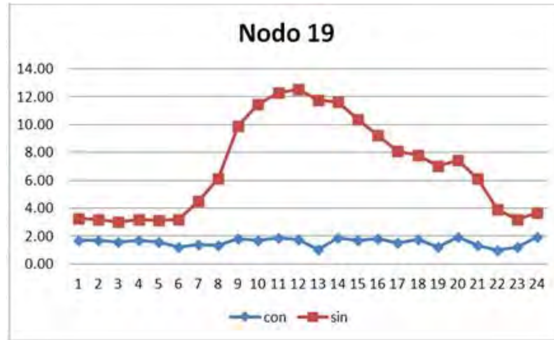


L=300m, d=4", q=2.5 l/s

L=300m, d=4", q=5 l/s



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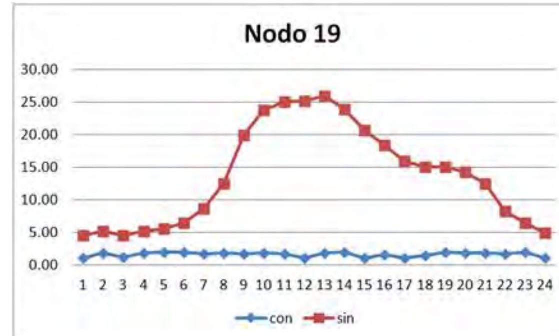
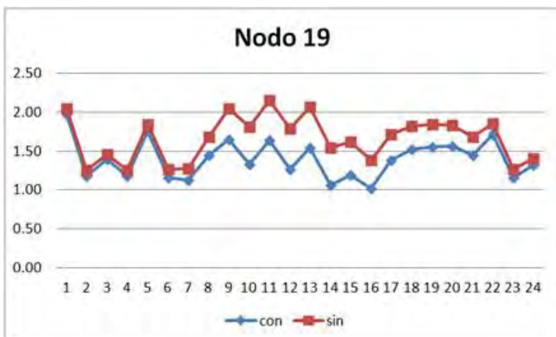
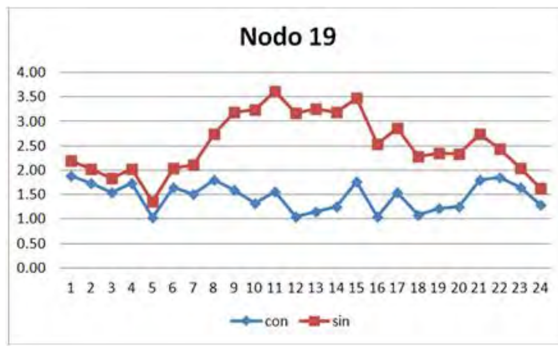


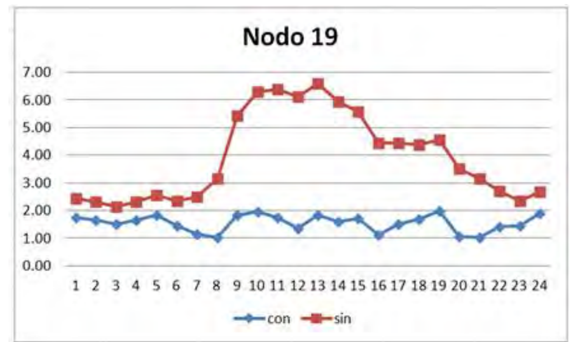
L=300m, d=6", q=2.5 l/s



L=300m, d=6", q=5 l/s



L=300m, d=6", q=7.5 l/s



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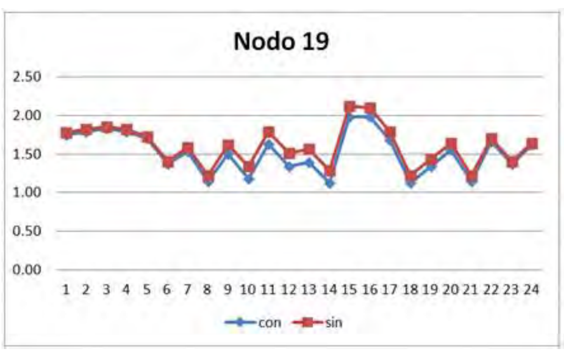
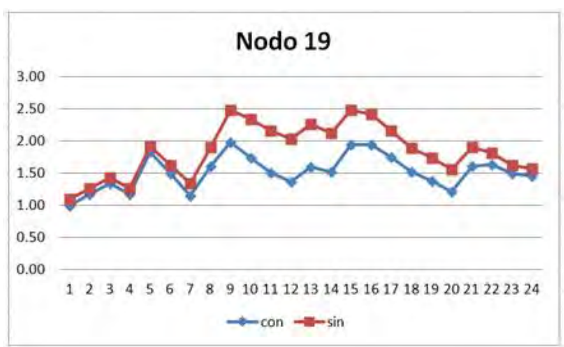
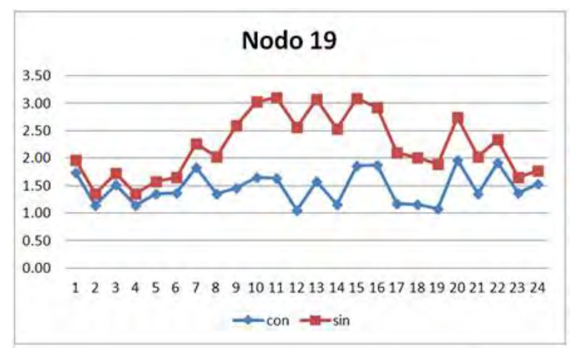


L=300m, d=8", q=5 l/s

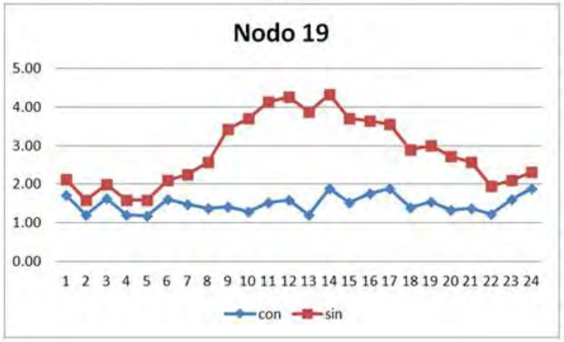


L=300m, d=8", q=7.5 l/s

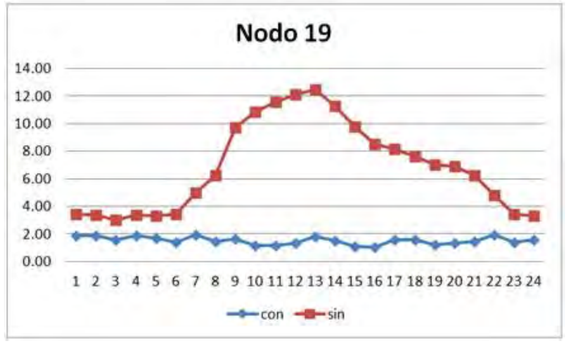


Anexo3. Carga en nodos {M S-F} ejeX: horas y eje Y:metros

L=600m, d=4”, q=2.5 l/s

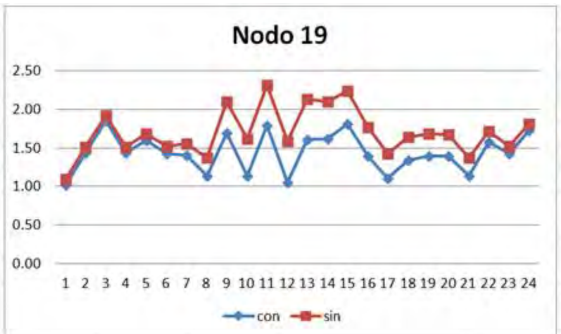


L=600m, d=4”, q=5 l/s

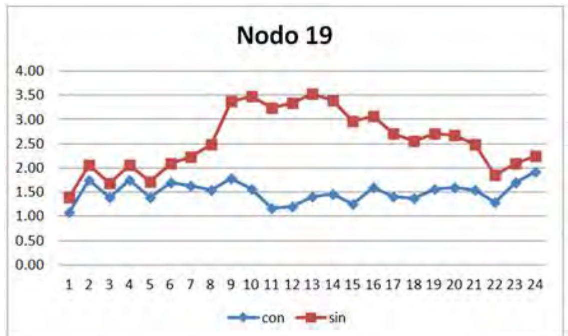


L=600m, d=4”, q=7.5 l/s

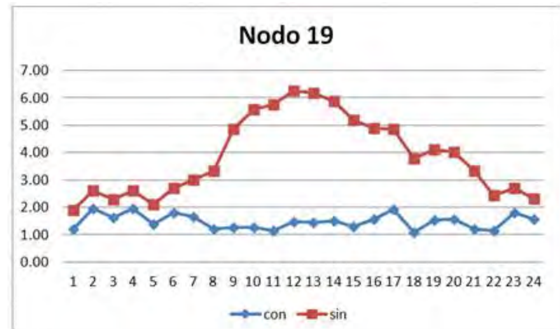
L=600m, d=6”, q=2.5 l/s



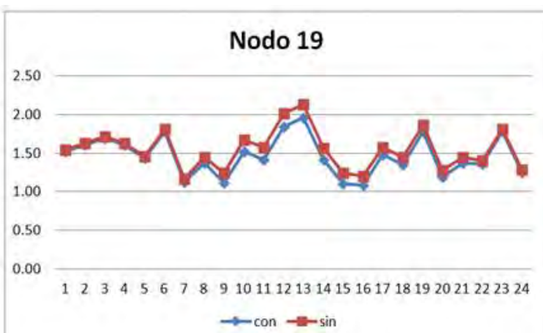
L=600m, d=6”, q=5 l/s



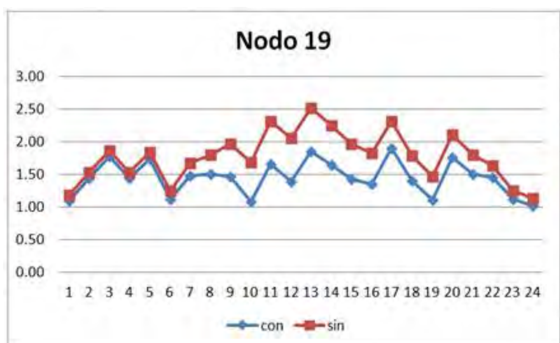
L=600m, d=6”, q=7.5 l/s



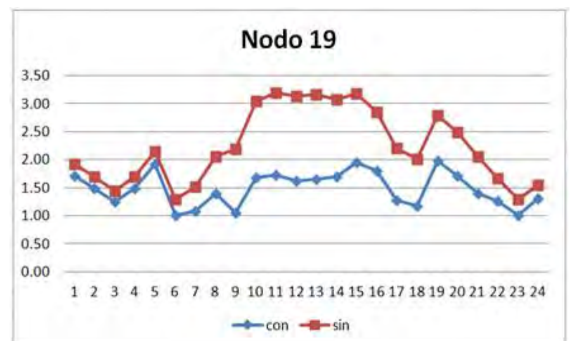
L=600m, d=8”, q=2.5 l/s



L=600m, d=8”, q=5 l/s



L=600m, d=8”, q=7.5 l/s

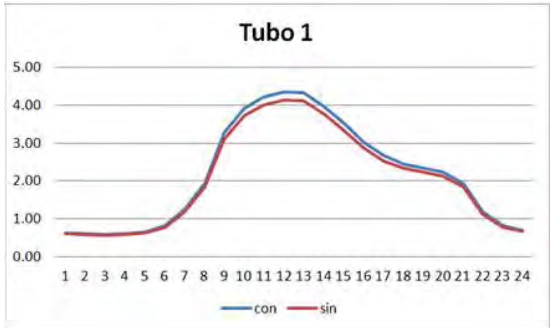


ANEXO 4. GRAFICAS, TRANSFORMACIÓN DE ENERGÍA EN EL TUBO CON Y SIN PÉRDIDAS LOCALES

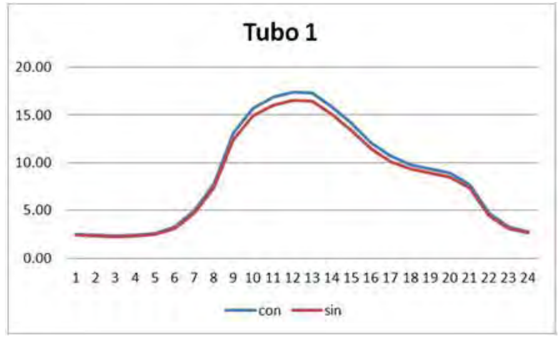
Método Sánchez- Fuentes

Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

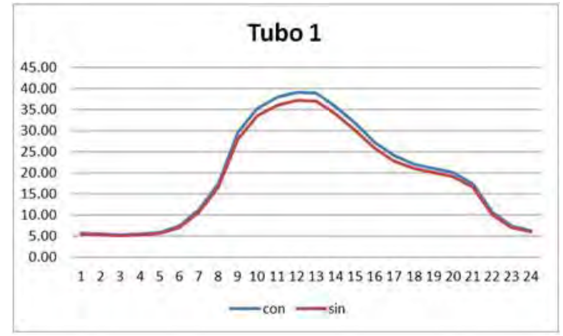
L=100m, d=4”, q=2.5 l/s



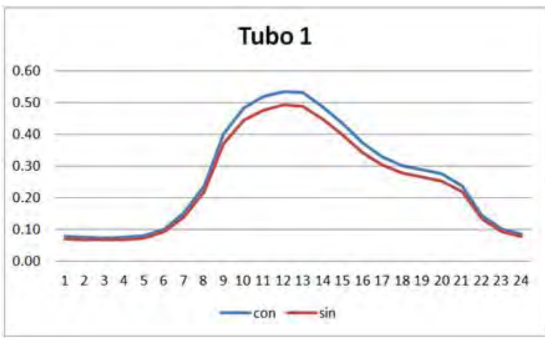
L=100m, d=4”, q=5 l/s



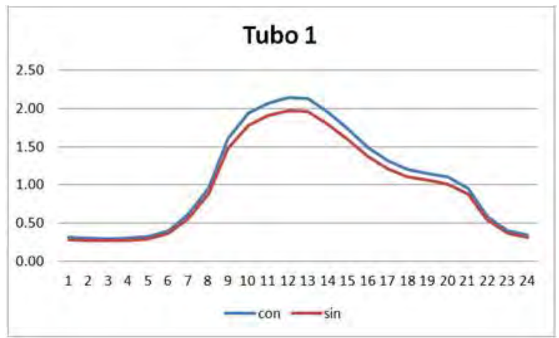
L=100m, d=4”, q=7.5 l/s



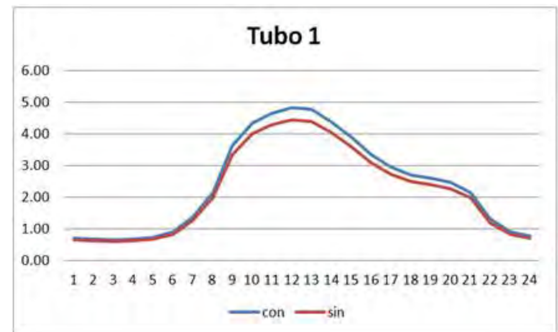
L=100m, d=6”, q=2.5 l/s



L=100m, d=6”, q=5 l/s



L=100m, d=6”, q=7.5 l/s



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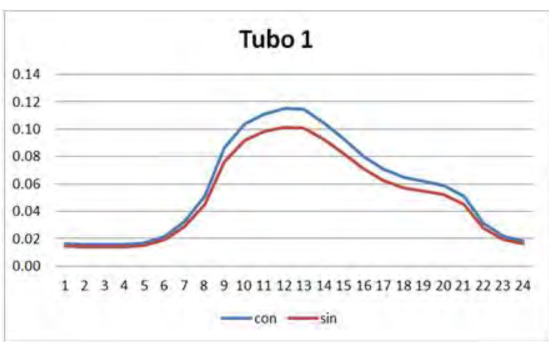
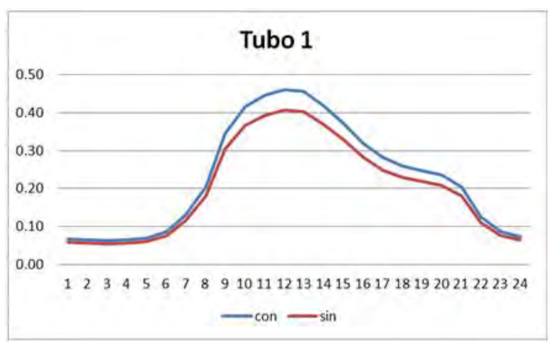
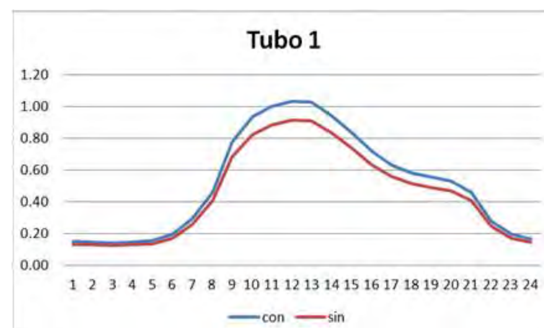


L=100m, d=8”, q=5 l/s

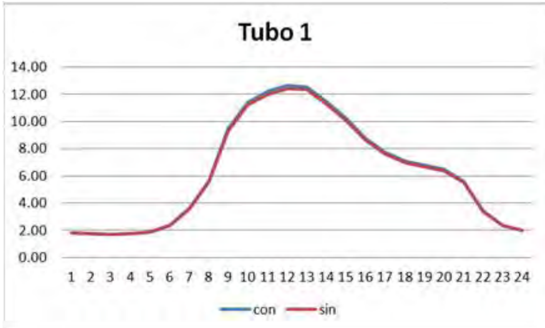


L=100m, d=8”, q=7.5 l/s

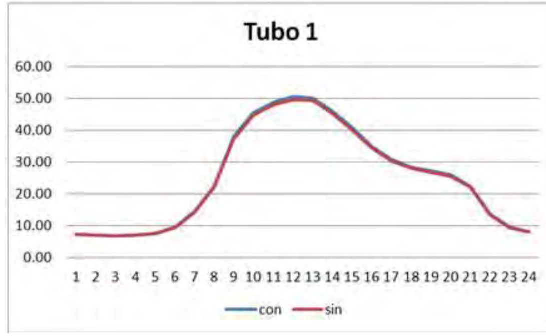


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=300m, d=4”, q=2.5 l/s



L=300m, d=4”, q=5 l/s



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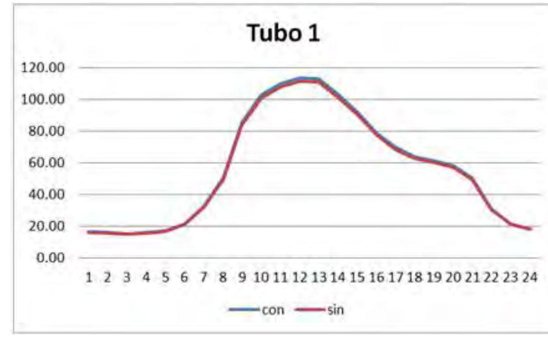
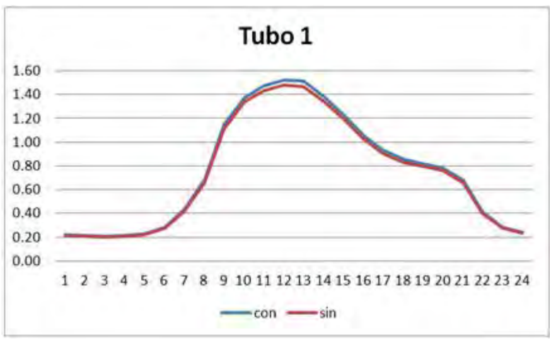
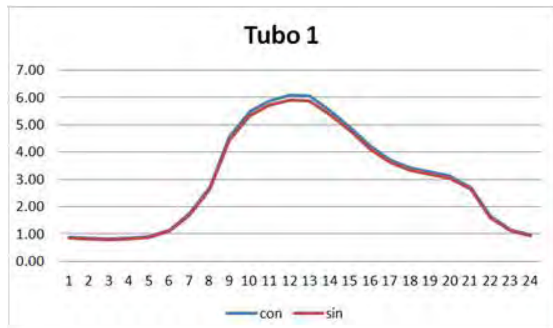


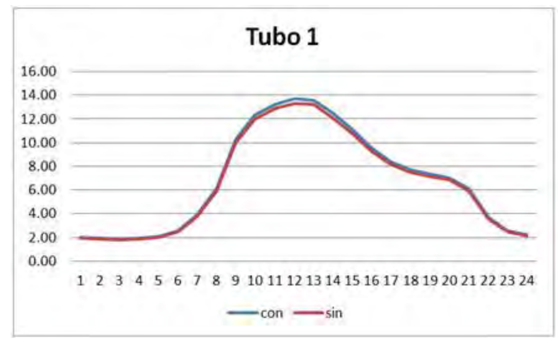
L=300m, d=6”, q=2.5 l/s



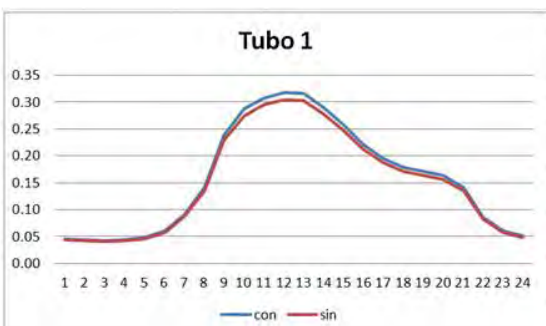
L=300m, d=6”, q=5 l/s



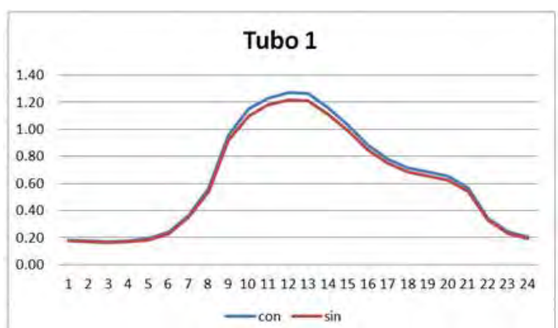
L=300m, d=6”, q=7.5 l/s



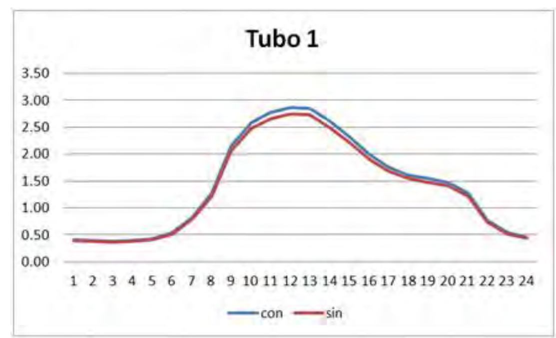
L=300m, d=8”, q=2.5 l/s



L=300m, d=8”, q=5 l/s

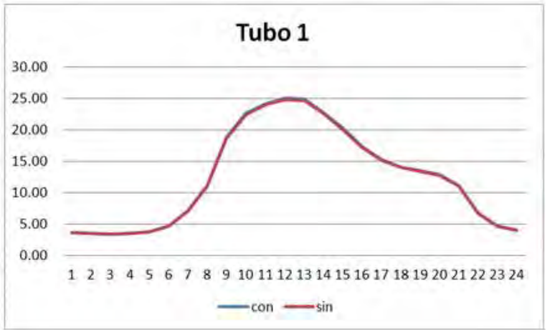


L=300m, d=8”, q=7.5 l/s

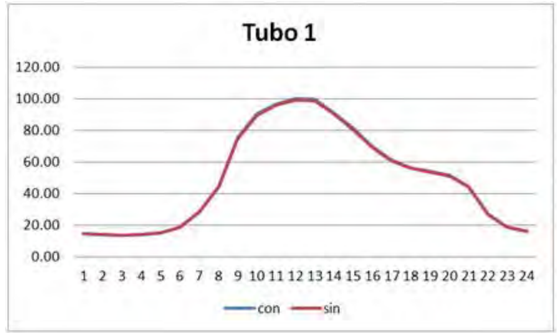


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

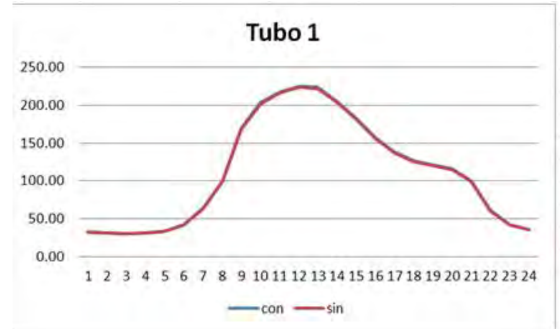
L=600m, d=4", q=2.5 l/s



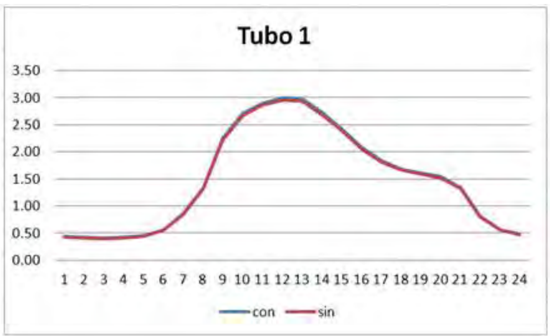
L=600m, d=4", q=5 l/s



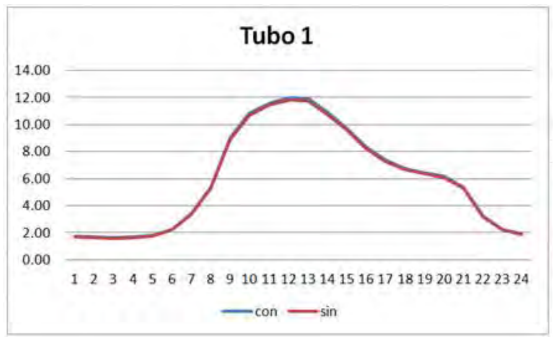
L=600m, d=4", q=7.5 l/s



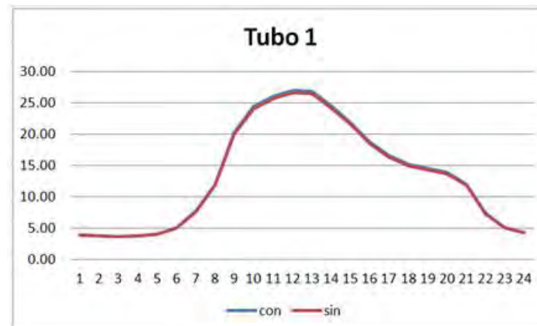
L=600m, d=6", q=2.5 l/s



L=600m, d=6", q=5 l/s



L=600m, d=6", q=7.5 l/s



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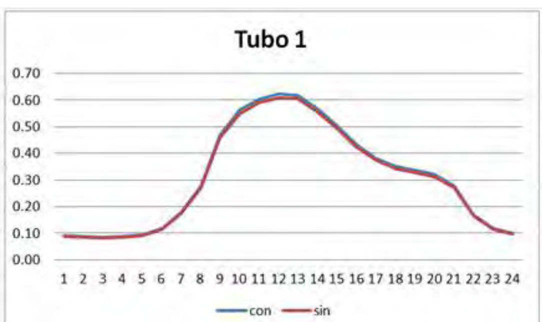
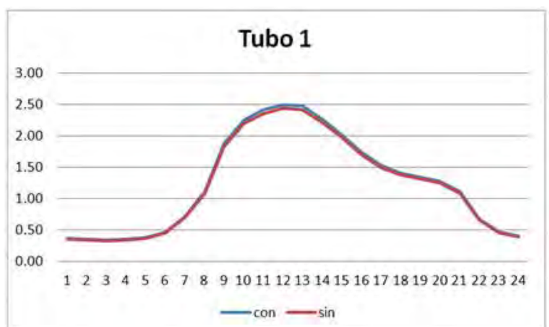
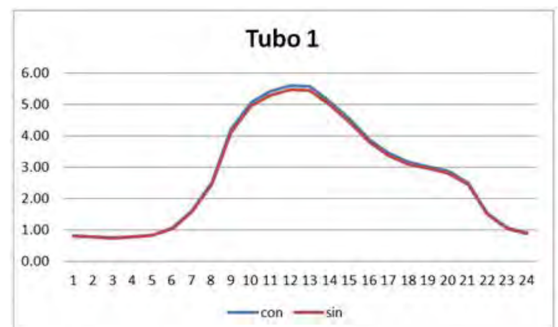


L=600m, d=8", q=5 l/s

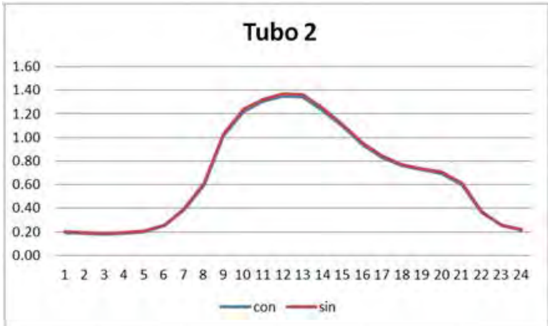


L=600m, d=8", q=7.5 l/s



Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=100m, d=4”, q=2.5 l/s



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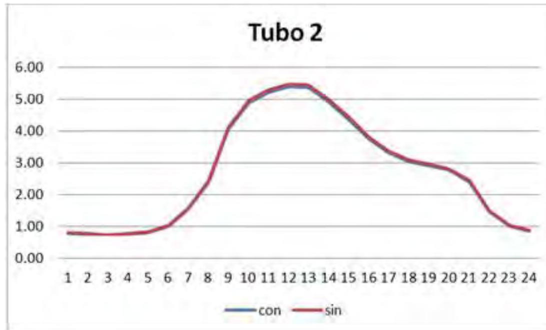
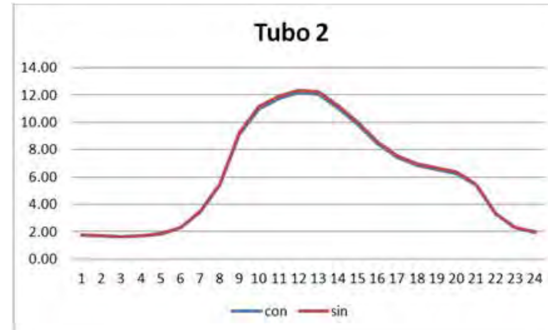


L=100m, d=4”, q=7.5 l/s



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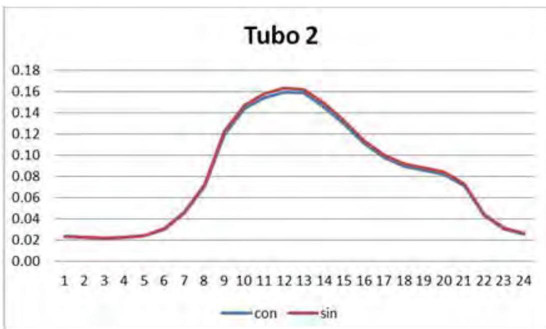
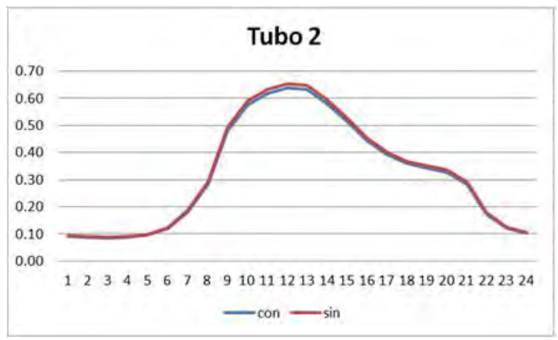
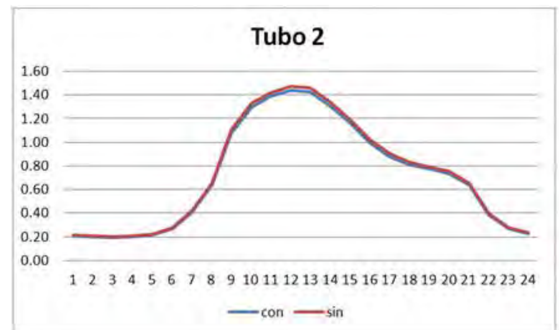


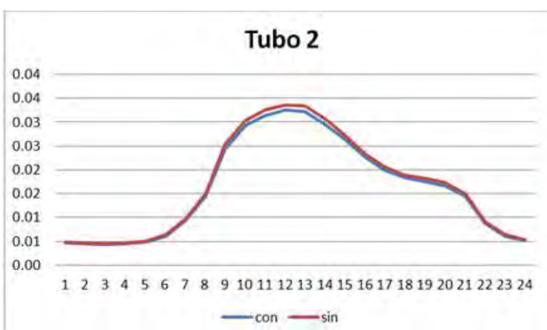
L=100m, d=6”, q=5 l/s



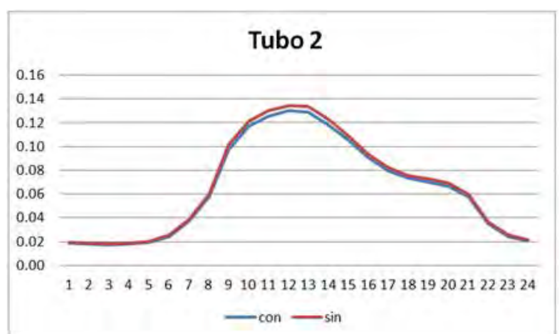
L=100m, d=6”, q=7.5 l/s



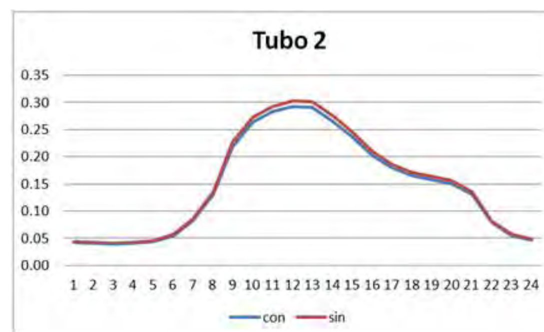
L=100m, d=8”, q=2.5 l/s



L=100m, d=8”, q=5 l/s

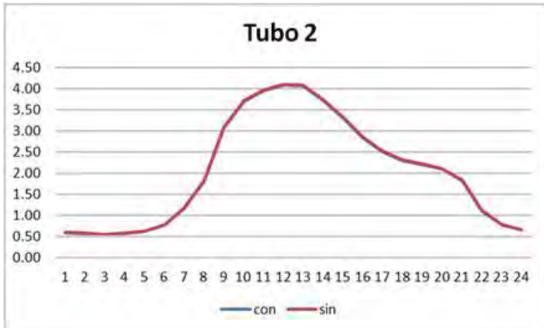


L=100m, d=8”, q=7.5 l/s

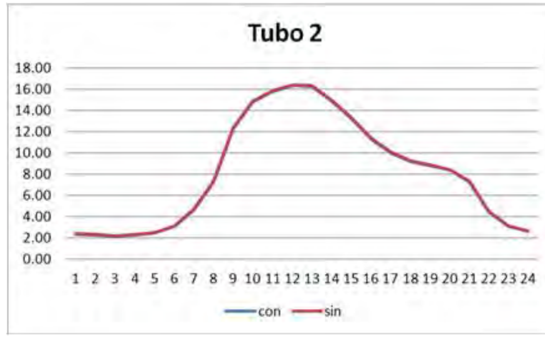


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

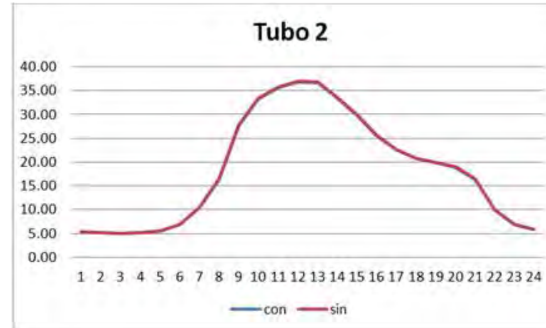
L=300m, d=4”, q=2.5 l/s



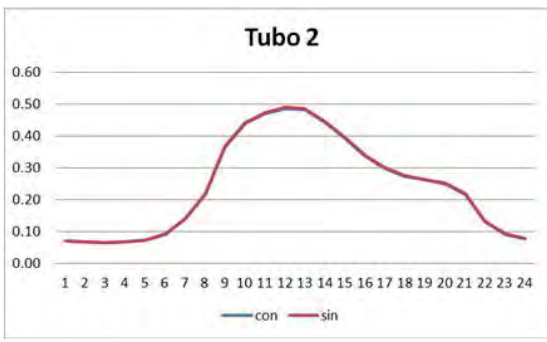
L=300m, d=4”, q=5 l/s



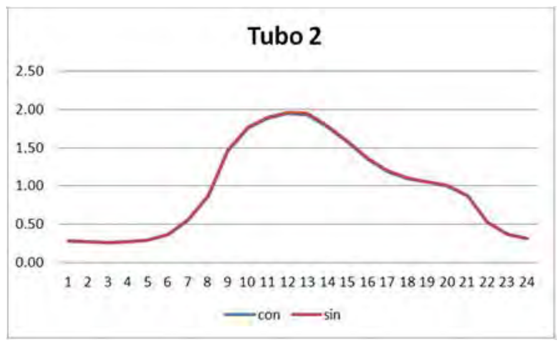
L=300m, d=4”, q=7.5 l/s



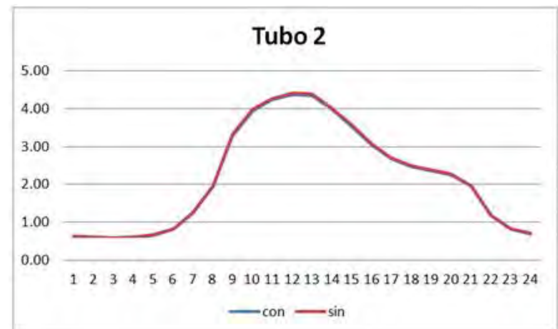
L=300m, d=6”, q=2.5 l/s



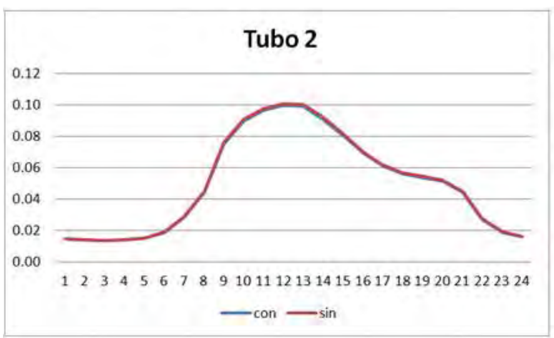
L=300m, d=6”, q=5 l/s



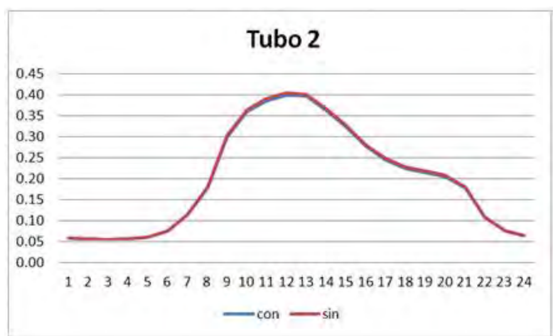
L=300m, d=6”, q=7.5 l/s



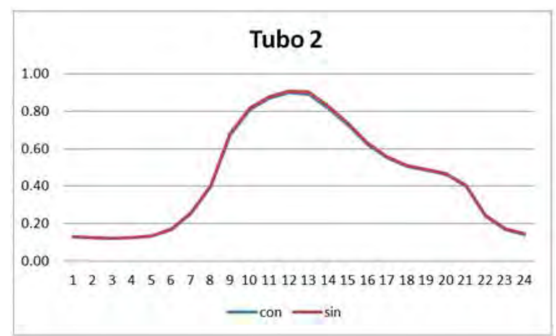
L=300m, d=8”, q=2.5 l/s



L=300m, d=8”, q=5 l/s

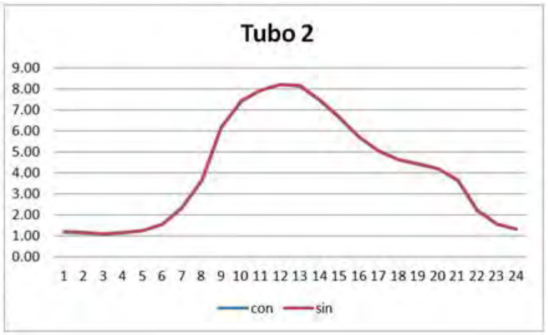


L=300m, d=8”, q=7.5 l/s

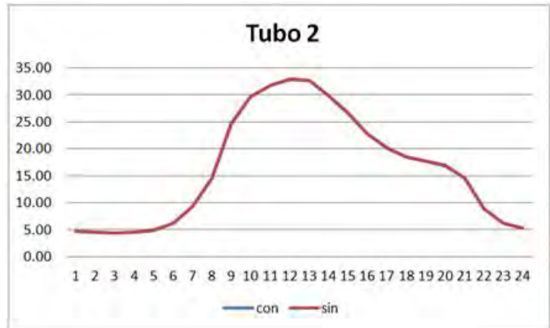


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

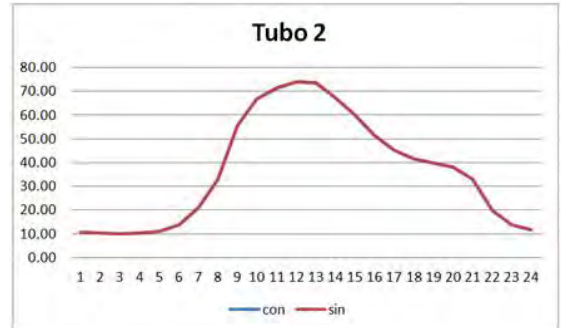
L=600m, d=4", q=2.5 l/s



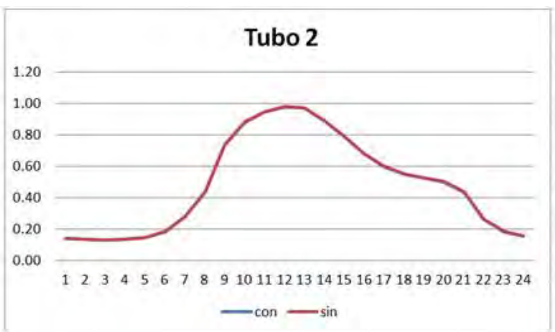
L=600m, d=4", q=5 l/s



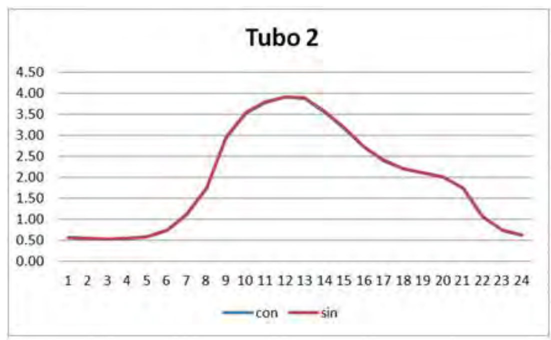
L=600m, d=4", q=7.5 l/s



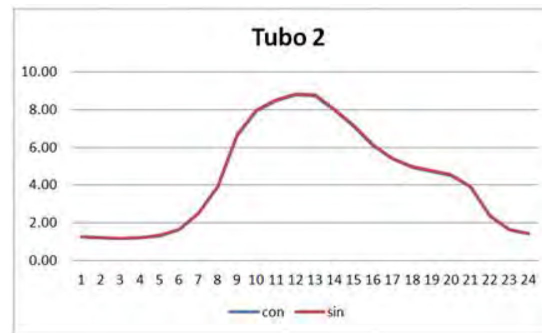
L=600m, d=6", q=2.5 l/s



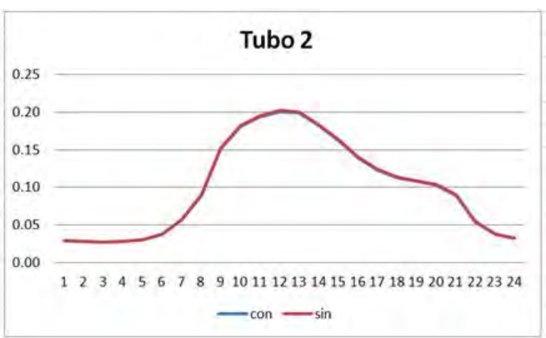
L=600m, d=6", q=5 l/s



L=600m, d=6", q=7.5 l/s



L=600m, d=8", q=2.5 l/s



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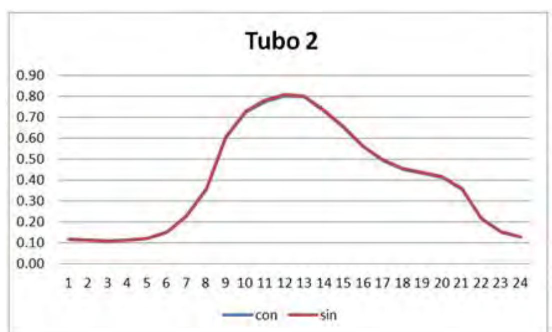
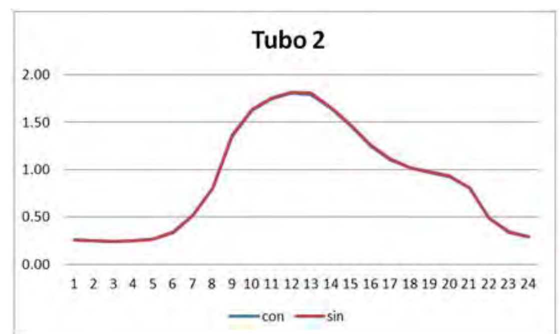
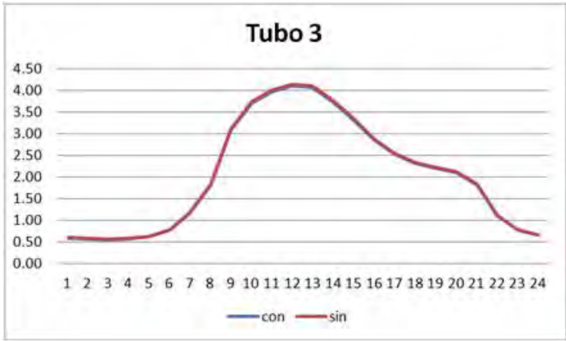


L=600m, d=8", q=7.5 l/s

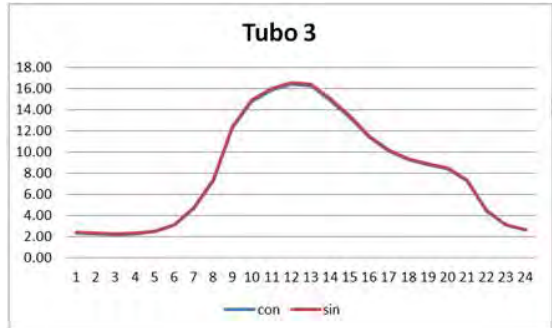


Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

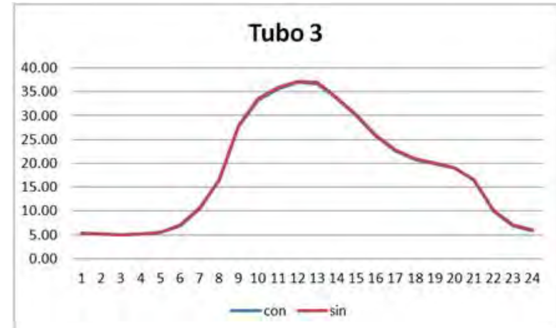
L=100m, d=4”, q=2.5 l/s



L=100m, d=4”, q=5 l/s



L=100m, d=4”, q=7.5 l/s



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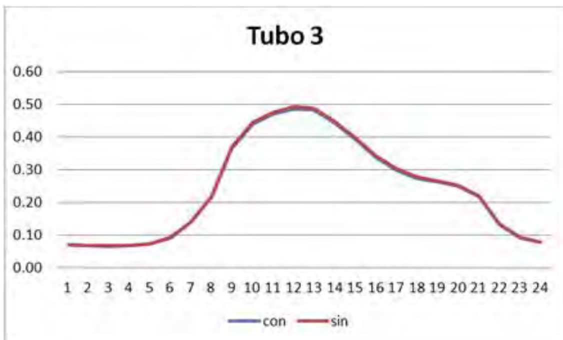
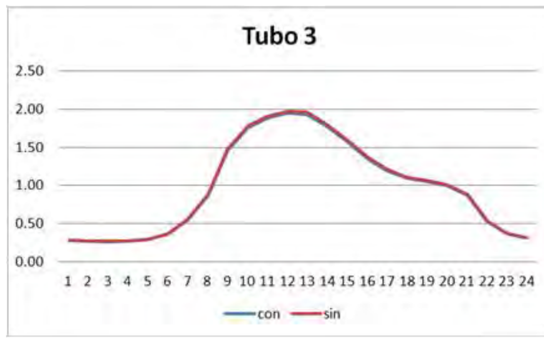
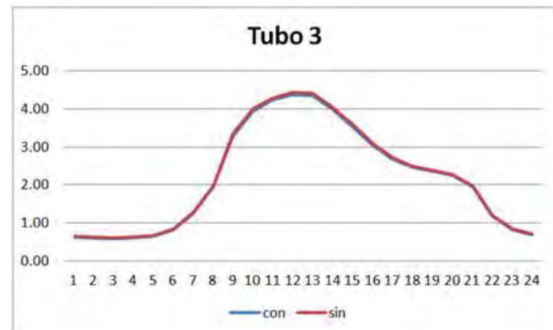


L=100m, d=6”, q=5 l/s



L=100m, d=6”, q=7.5 l/s



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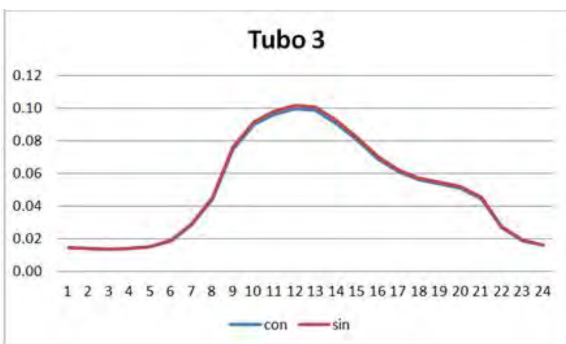
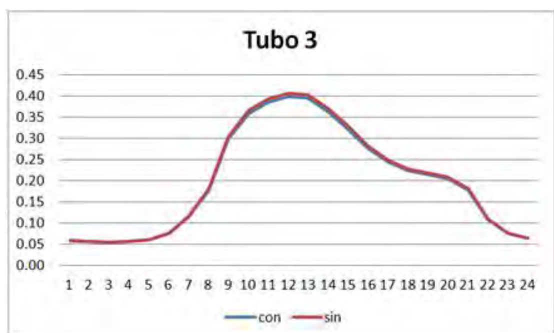


L=100m, d=8”, q=5 l/s



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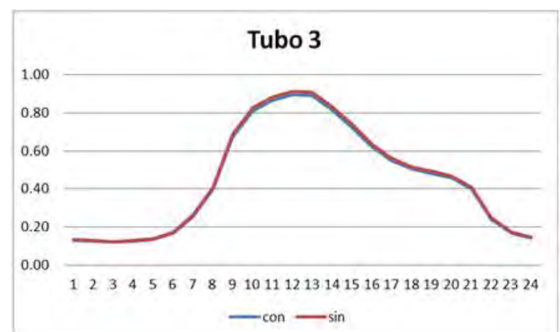
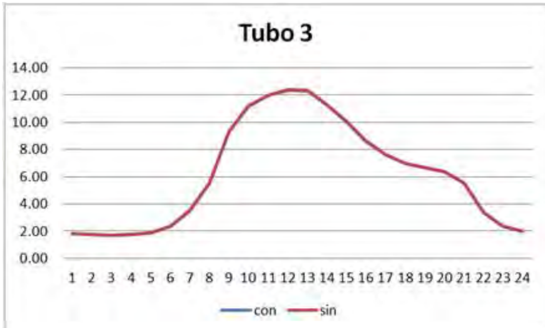


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=300m, d=4”, q=2.5 l/s



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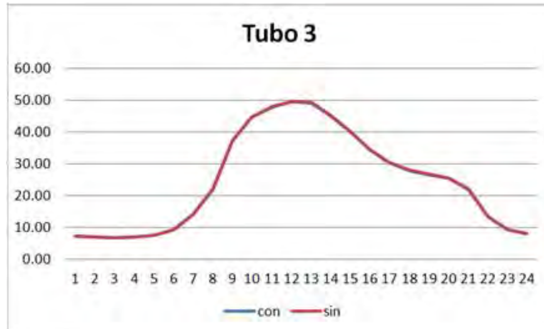

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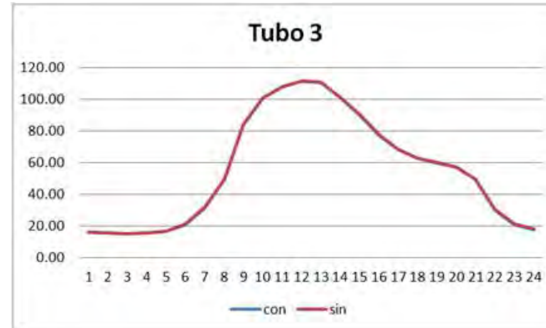

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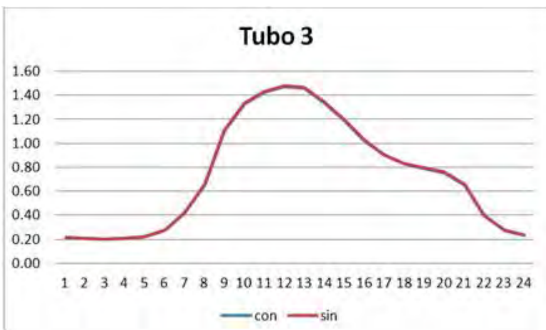

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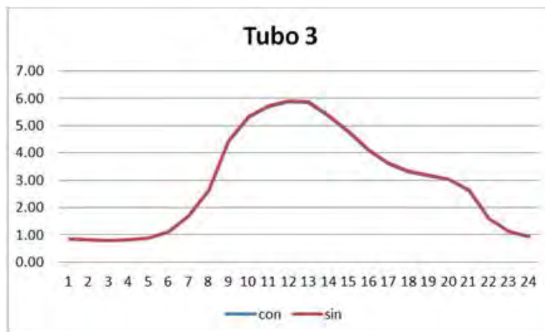

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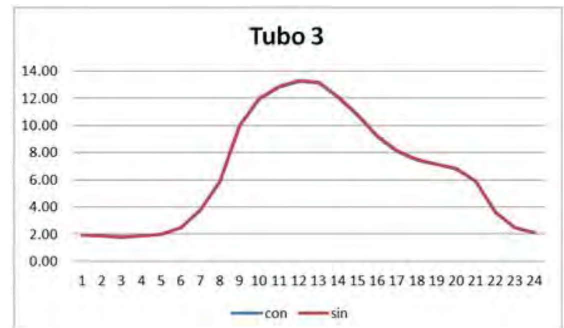

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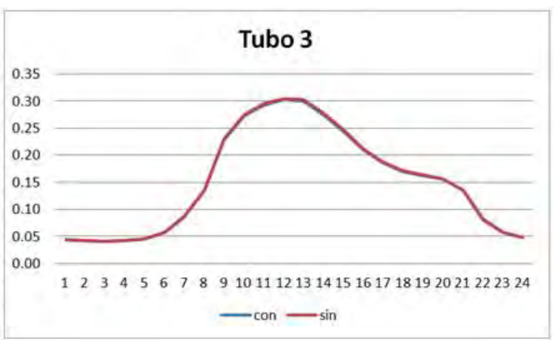

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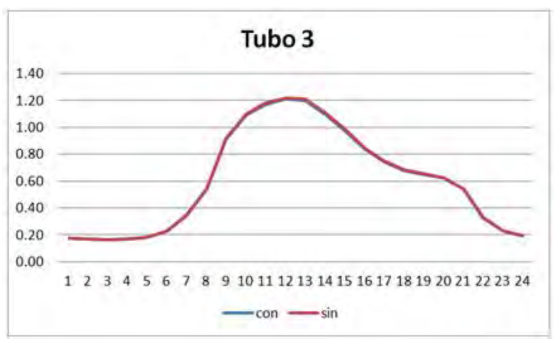
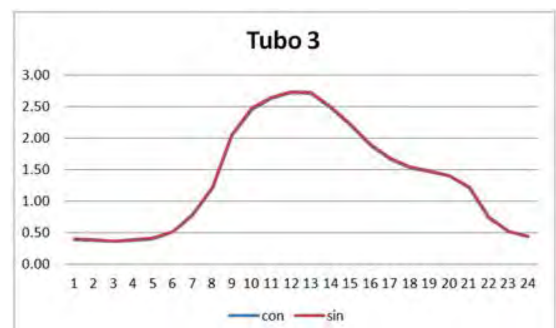
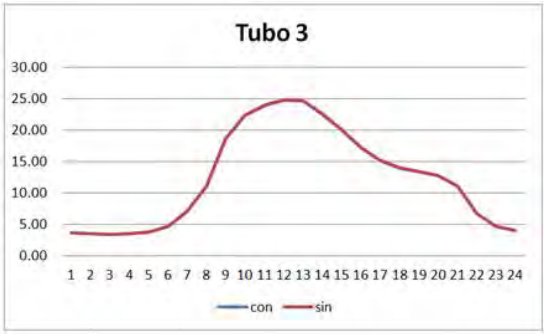


L=300m, d=8”, q=7.5 l/s

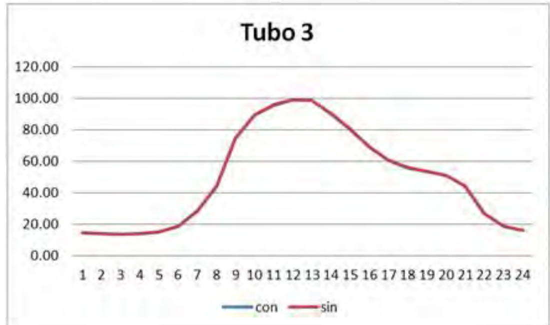


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=600m, d=4", q=2.5 l/s



L=600m, d=4", q=5 l/s



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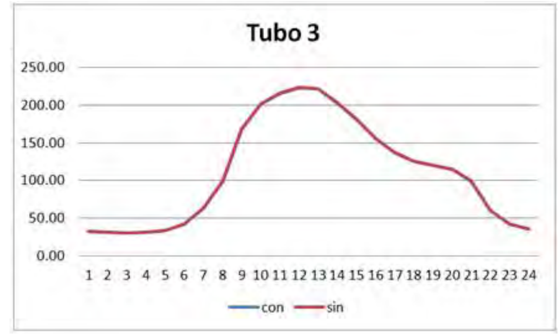

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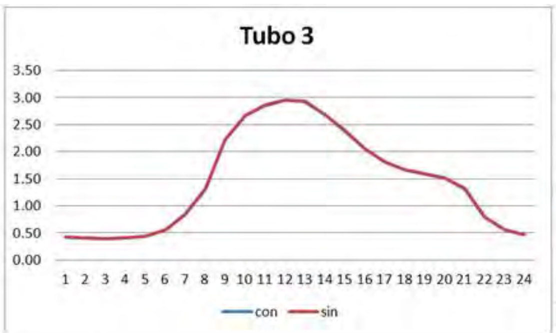
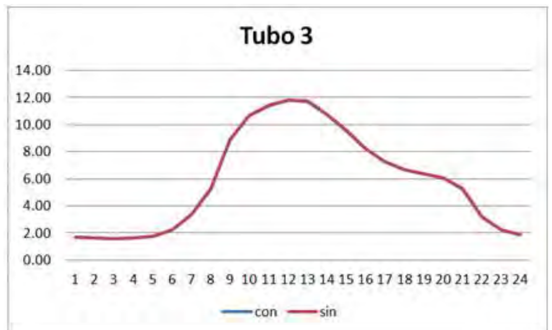


L=600m, d=6", q=5 l/s



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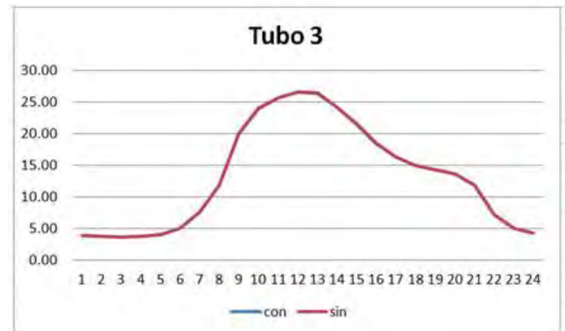

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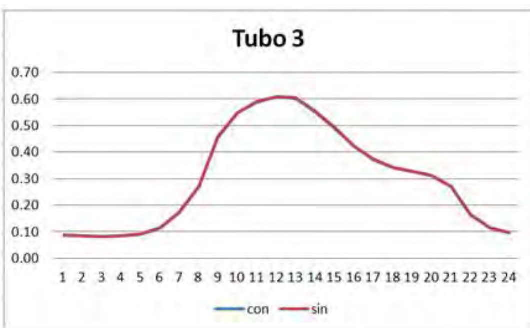

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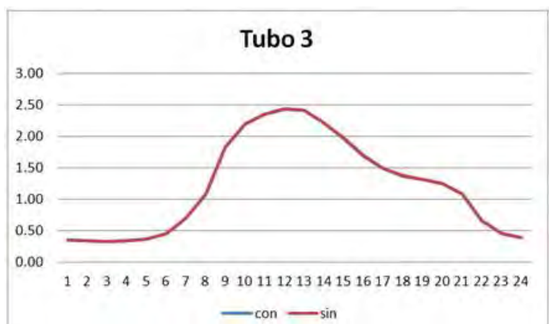

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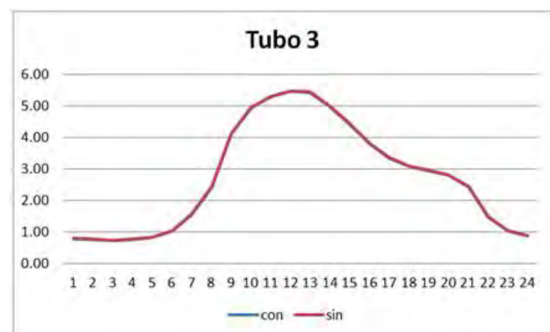
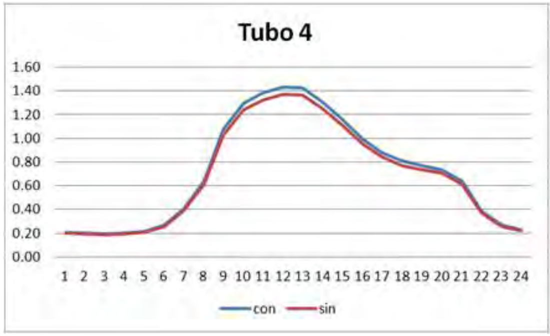


Anexo 4. Transformación de energía en tubo {M S-F}　　eje x: horas, eje y:metros

L=100m, d=4”, q=2.5 l/s



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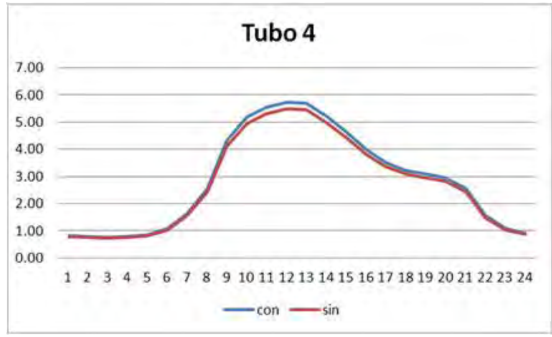

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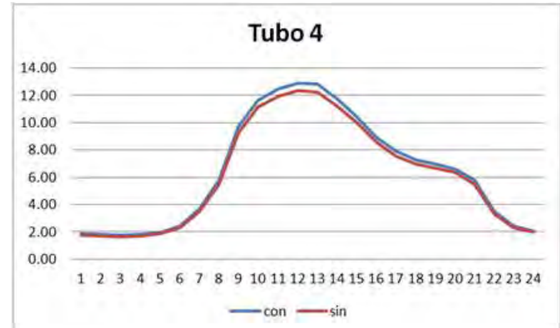

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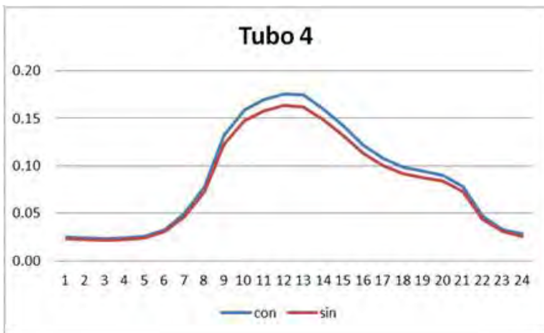

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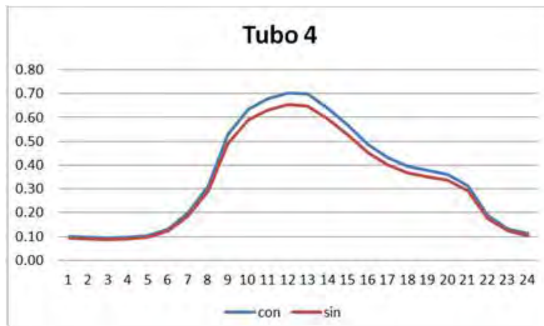

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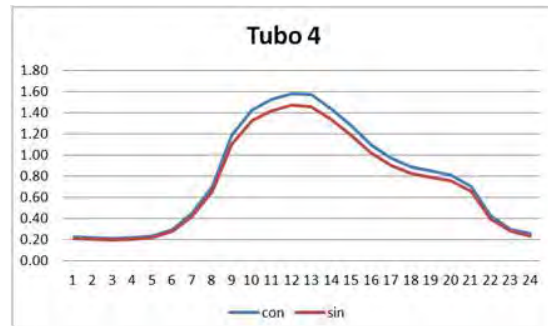

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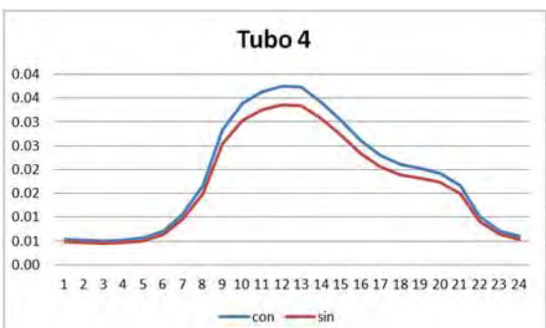

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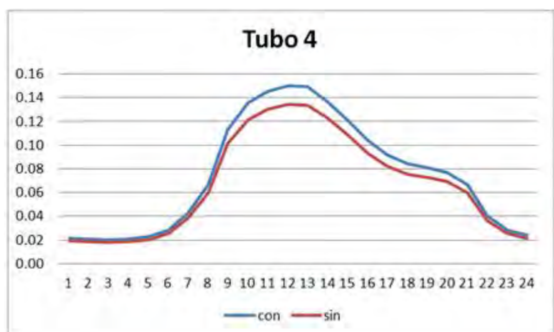

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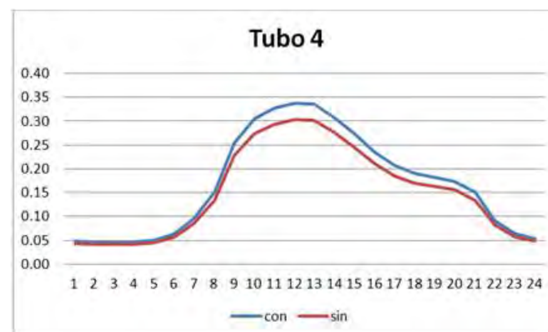
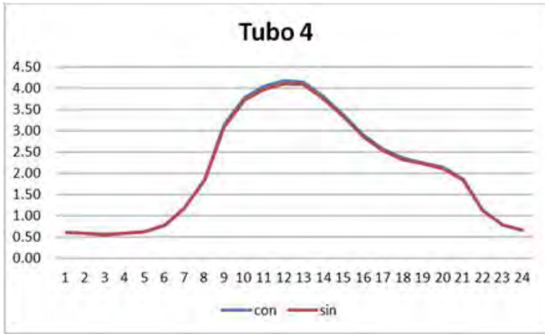
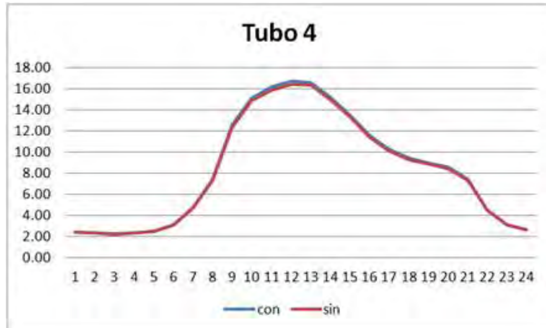


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=300m, d=4”, q=2.5 l/s



L=300m, d=4”, q=5 l/s



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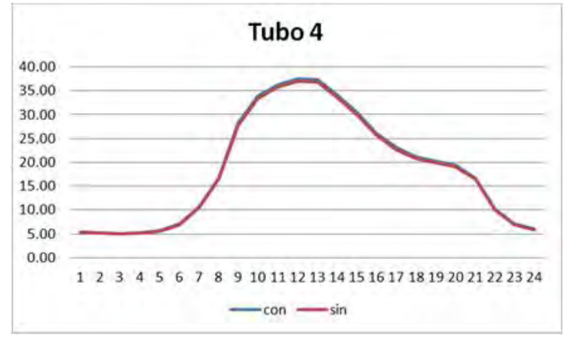
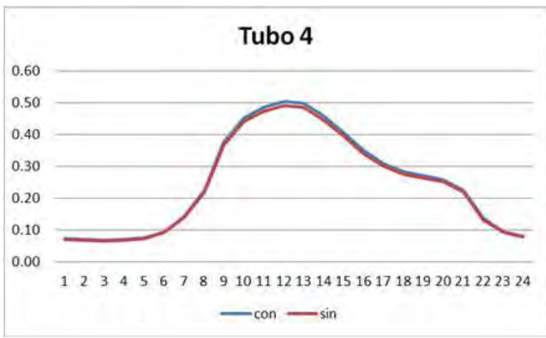


L=300m, d=6”, q=2.5 l/s



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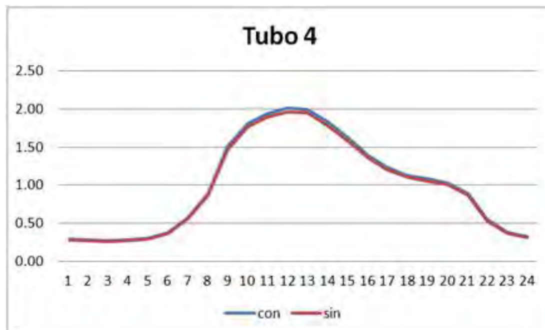

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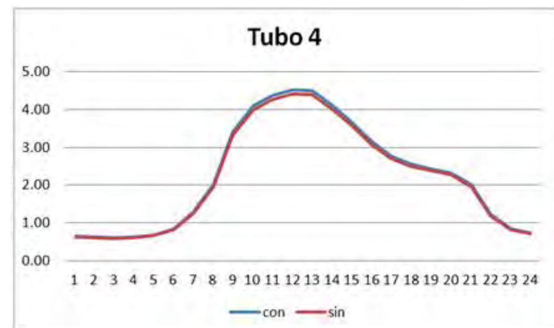

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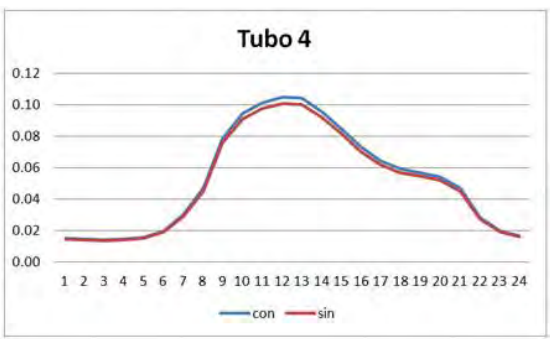
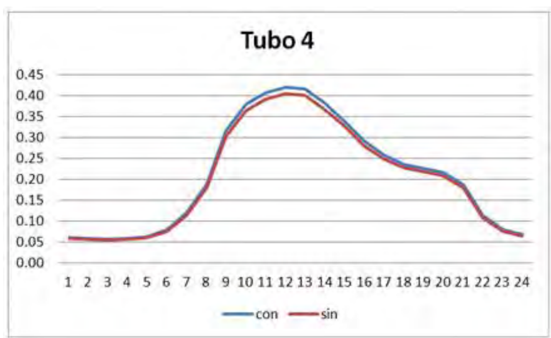
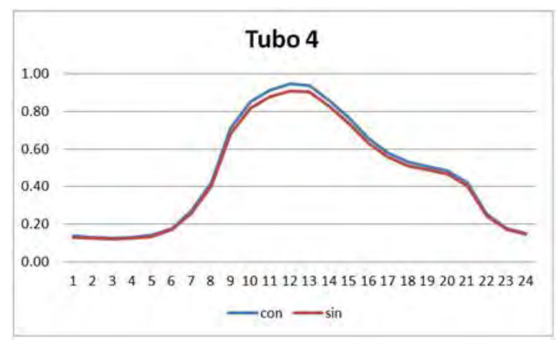


L=300m, d=8”, q=5 l/s

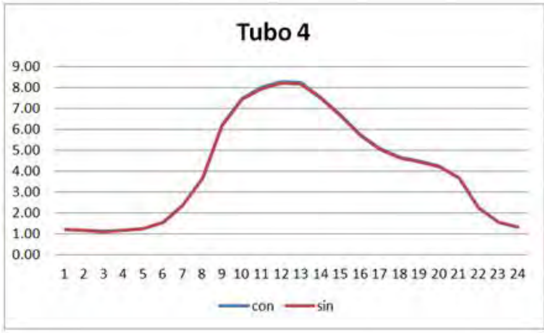


L=300m, d=8”, q=7.5 l/s

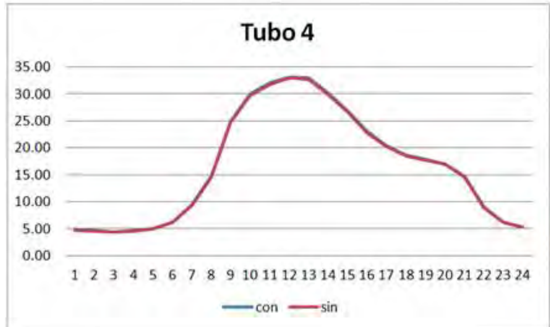


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=600m, d=4”, q=2.5 l/s



L=600m, d=4”, q=5 l/s



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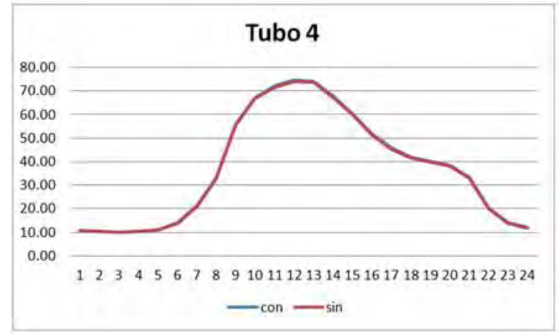
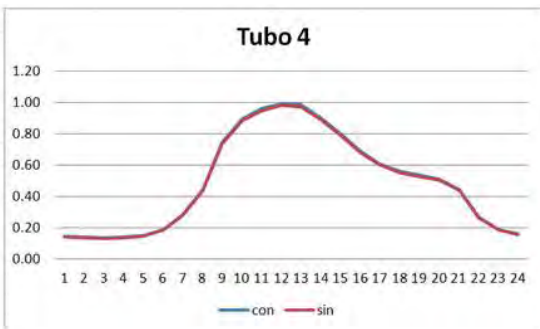
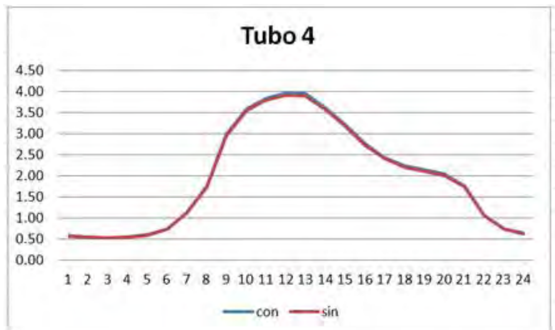


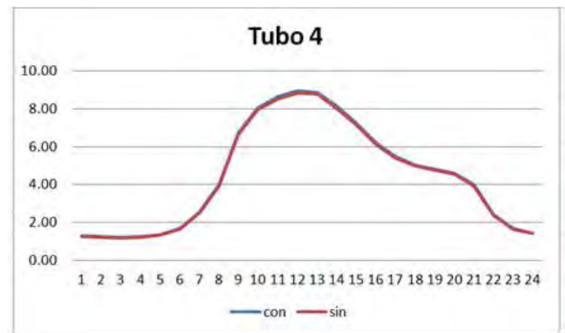
L=600m, d=6”, q=2.5 l/s



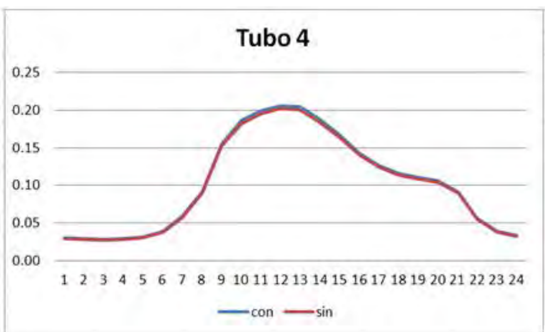
L=600m, d=6”, q=5 l/s



L=600m, d=6”, q=7.5 l/s



L=600m, d=8”, q=2.5 l/s



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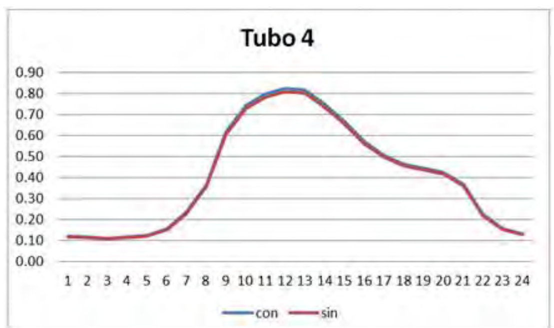
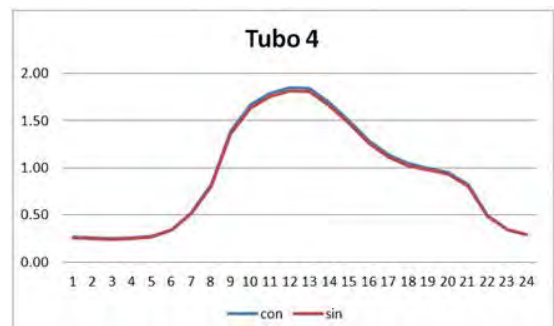
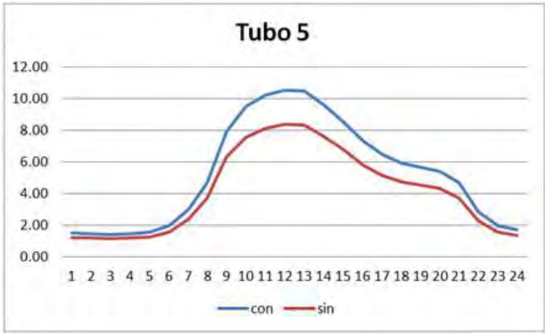


L=600m, d=8”, q=7.5 l/s



Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=100m, d=4”, q=2.5 l/s



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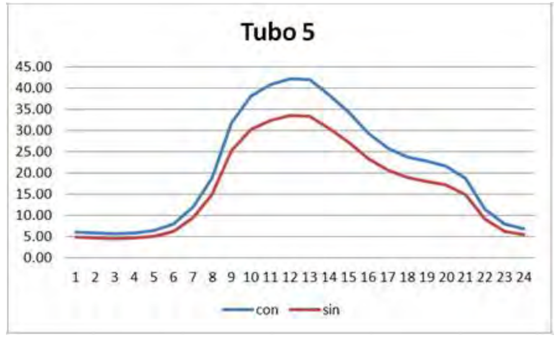
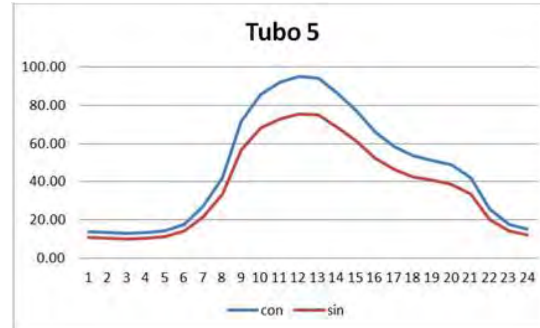
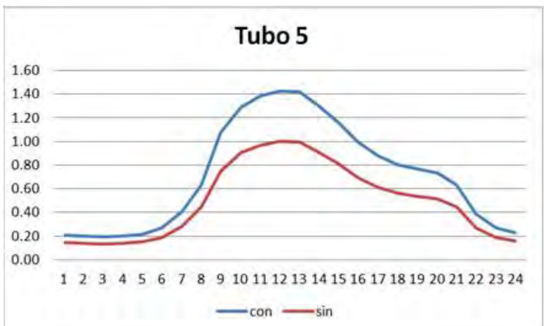


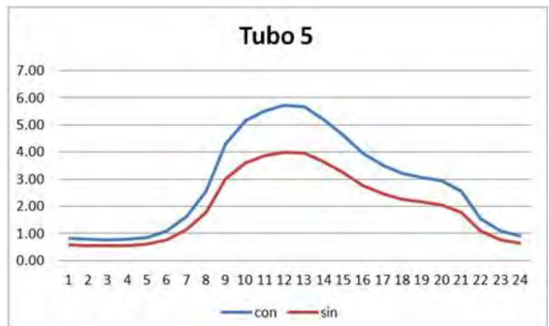
L=100m, d=4”, q=7.5 l/s



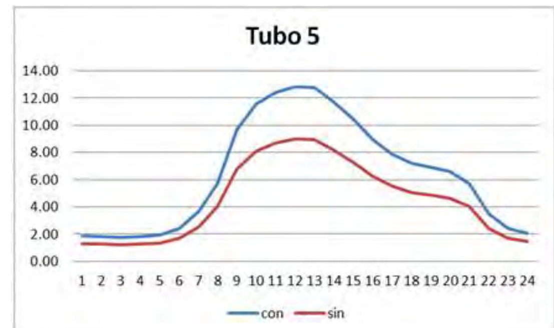
L=100m, d=6”, q=2.5 l/s



L=100m, d=6”, q=5 l/s



L=100m, d=6”, q=7.5 l/s



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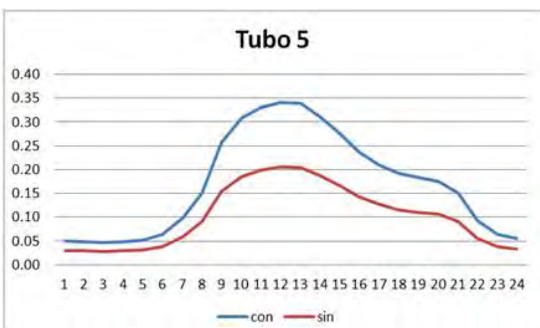
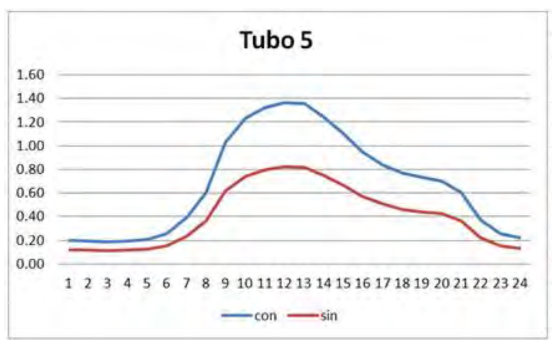
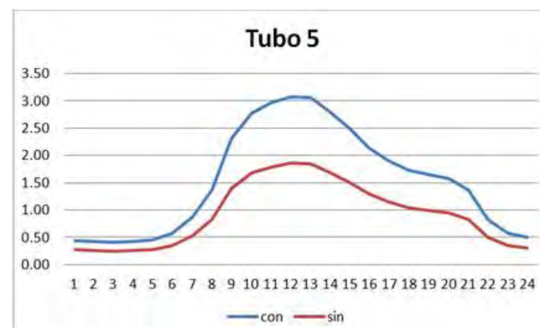


L=100m, d=8”, q=5 l/s

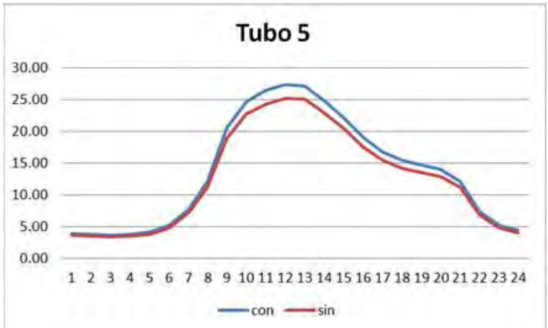


L=100m, d=8”, q=7.5 l/s

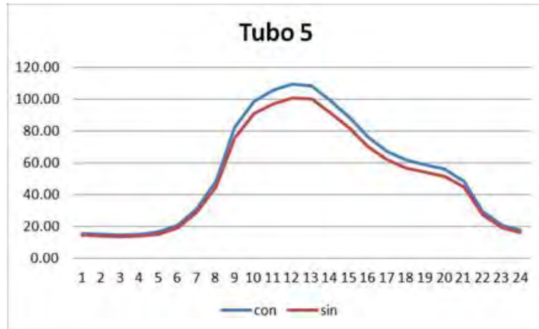


Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

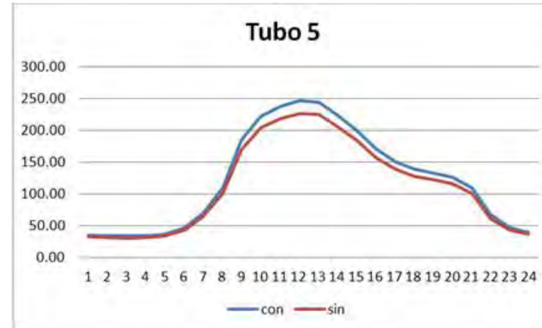
L=300m, d=4”, q=2.5 l/s



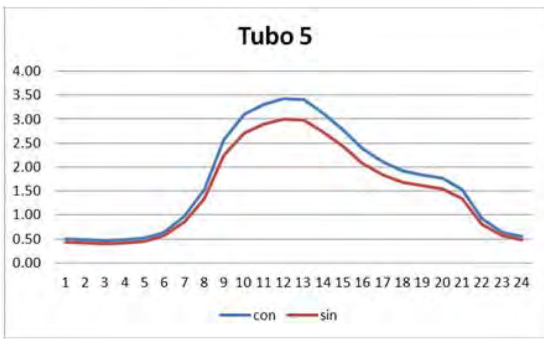
L=300m, d=4”, q=5 l/s



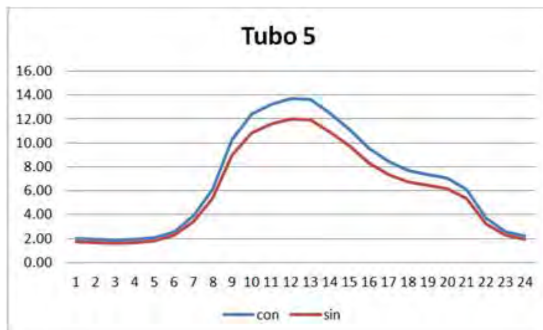
L=300m, d=4”, q=7.5 l/s



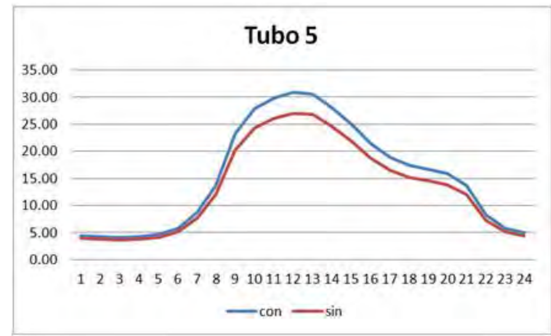
L=300m, d=6”, q=2.5 l/s



L=300m, d=6”, q=5 l/s



L=300m, d=6”, q=7.5 l/s



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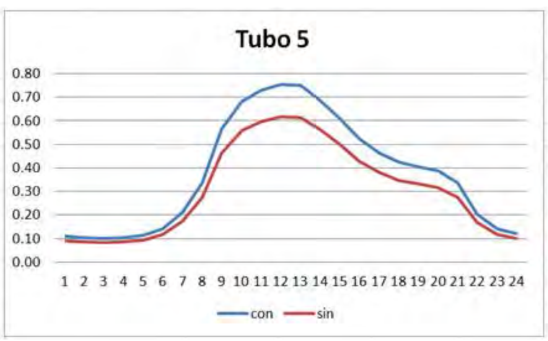
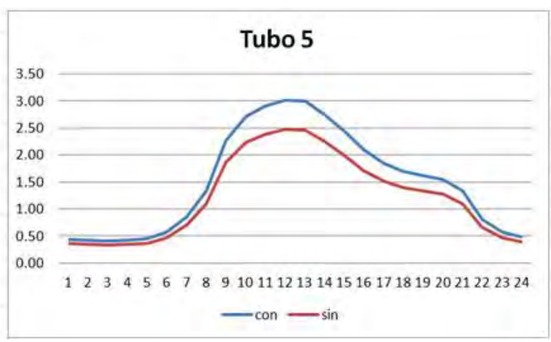
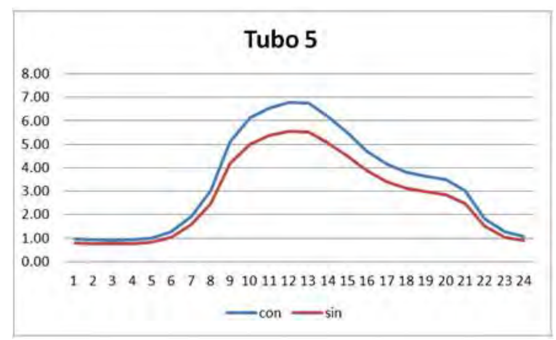


L=300m, d=8”, q=5 l/s

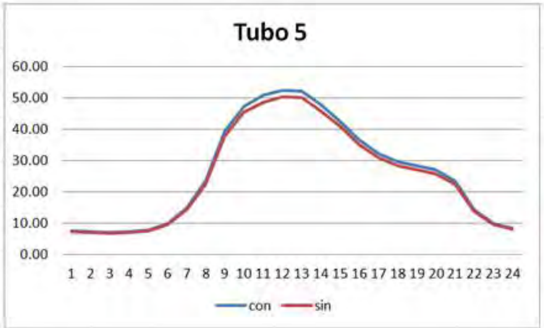


L=300m, d=8”, q=7.5 l/s



Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

L=600m, d=4”, q=2.5 l/s



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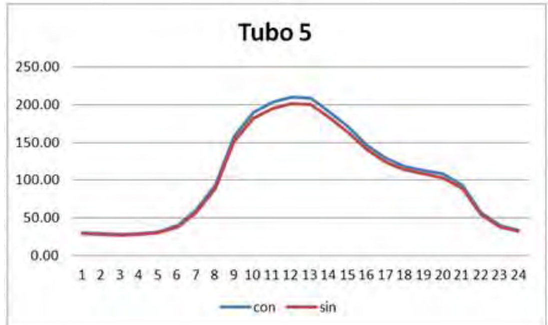

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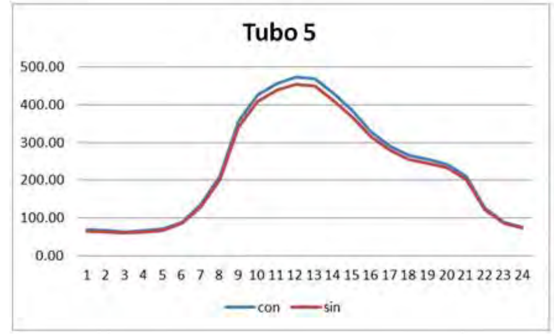
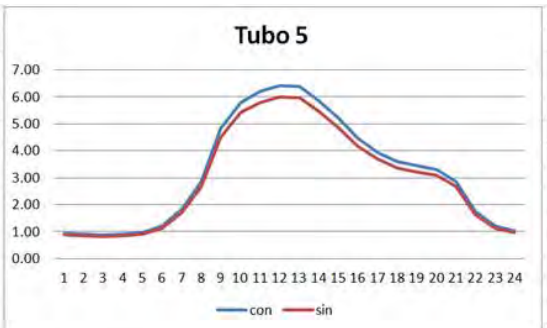
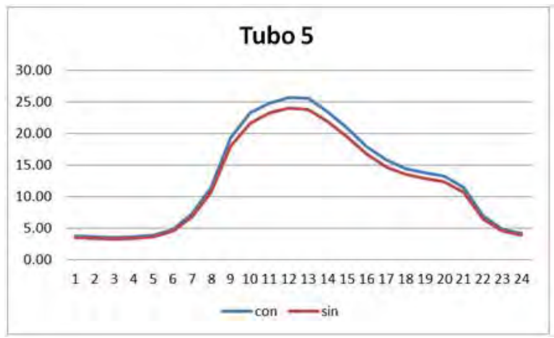


L=600m, d=6”, q=2.5 l/s



L=600m, d=6”, q=5 l/s



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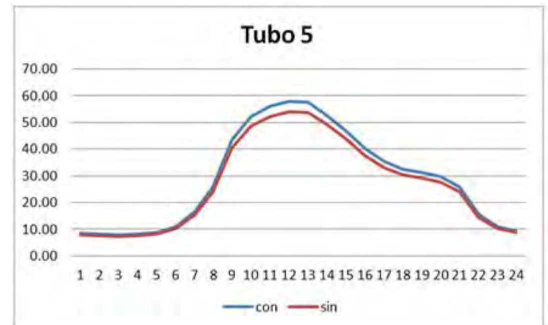

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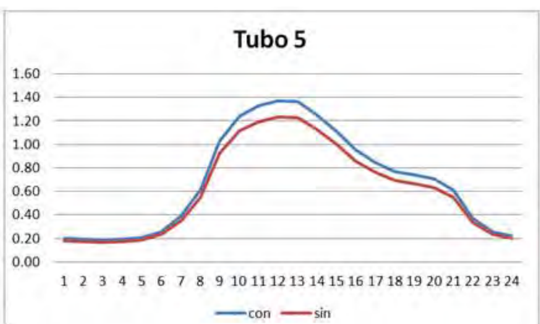
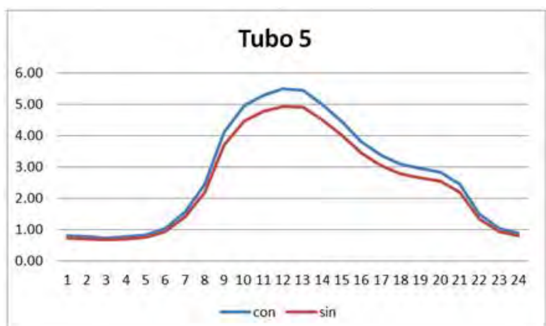
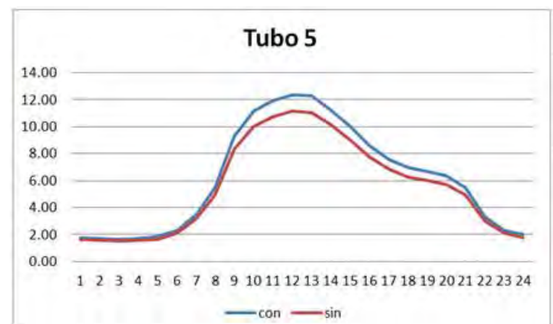


L=600m, d=8”, q=5 l/s

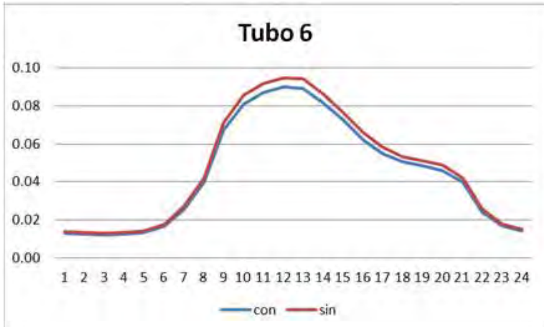


L=600m, d=8”, q=7.5 l/s



Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

L=100m, d=4”, q=2.5 l/s



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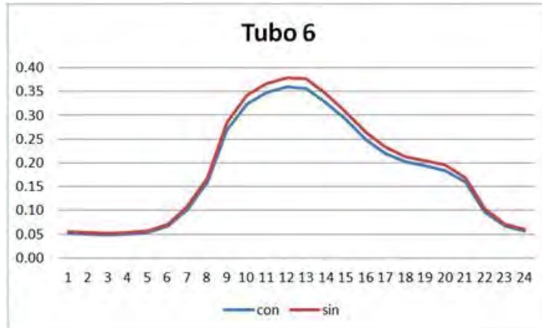

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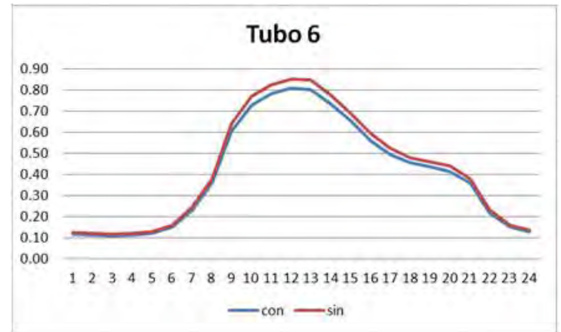
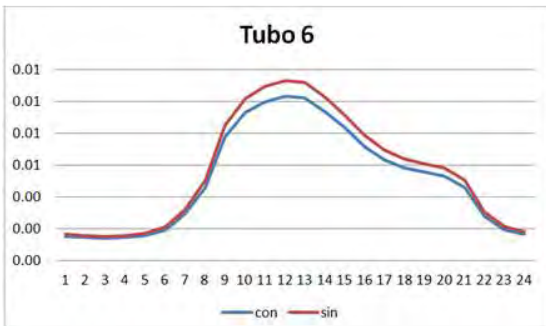


L=100m, d=6”, q=2.5 l/s



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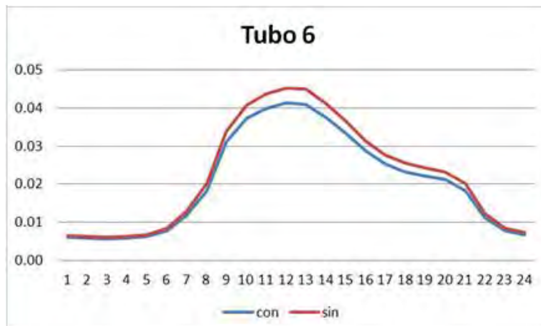

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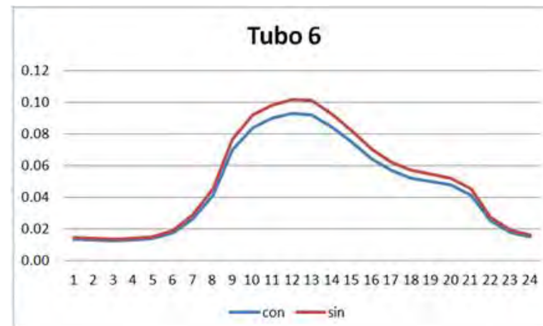

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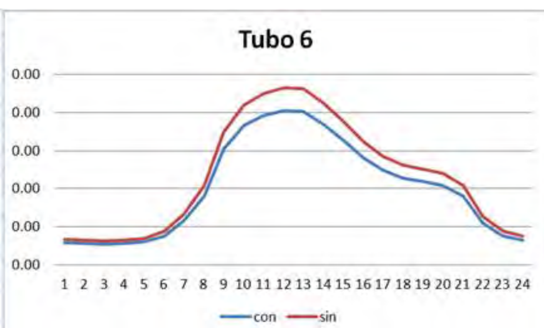
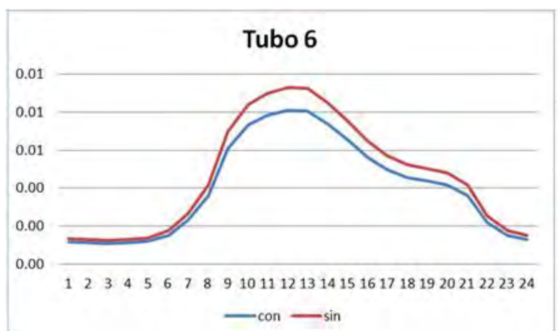
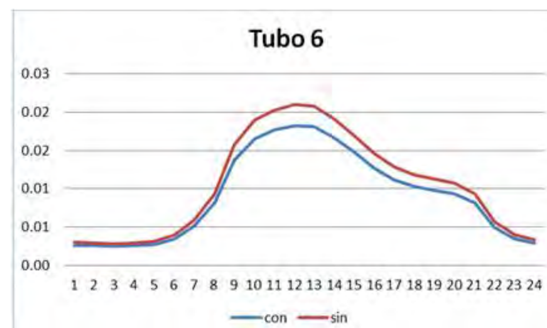


L=100m, d=8”, q=5 l/s

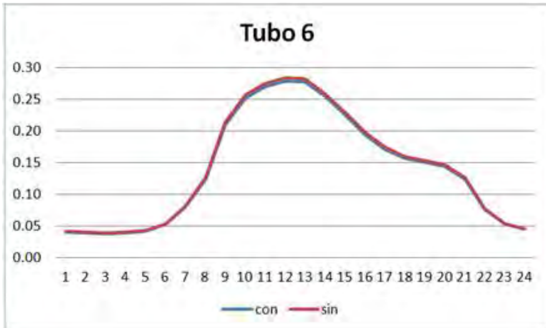


L=100m, d=8”, q=7.5 l/s

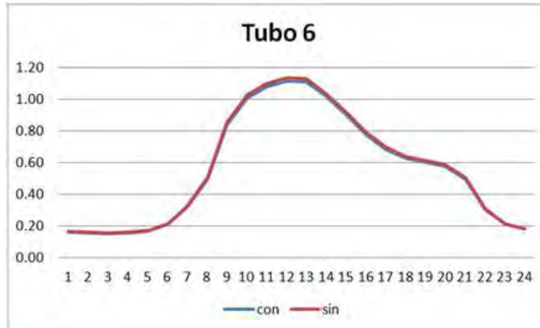


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=300m, d=4”, q=2.5 l/s



L=300m, d=4”, q=5 l/s



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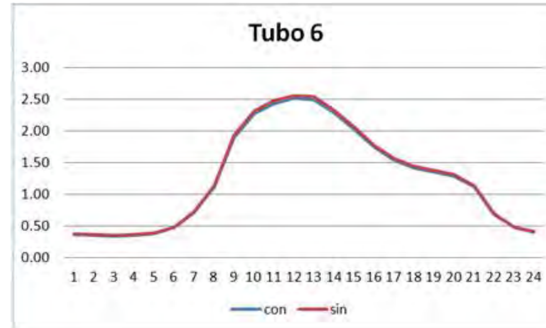
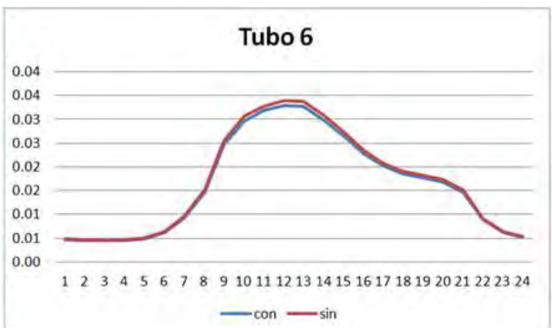
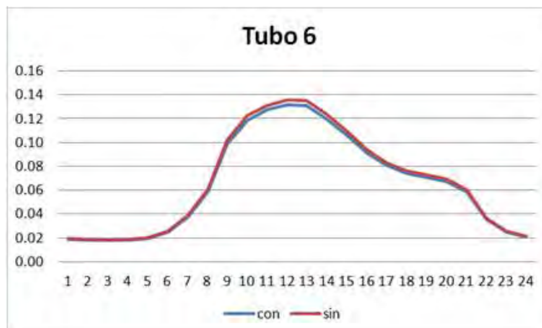


L=300m, d=6”, q=2.5 l/s



L=300m, d=6”, q=5 l/s



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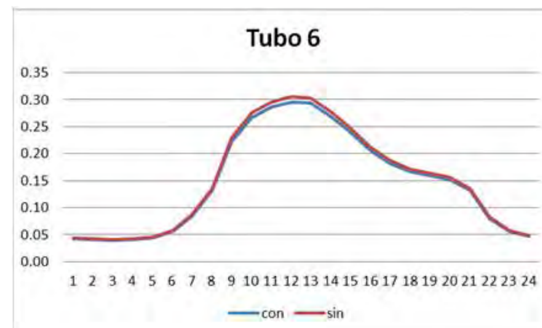

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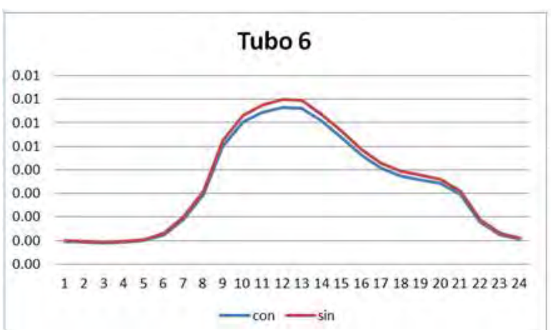
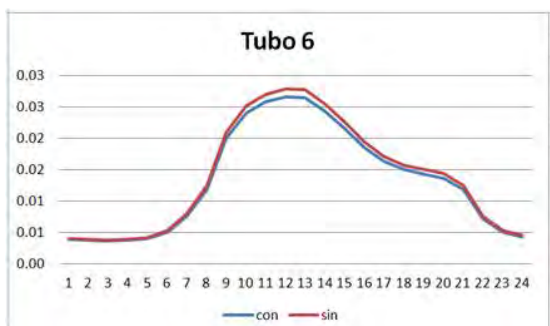
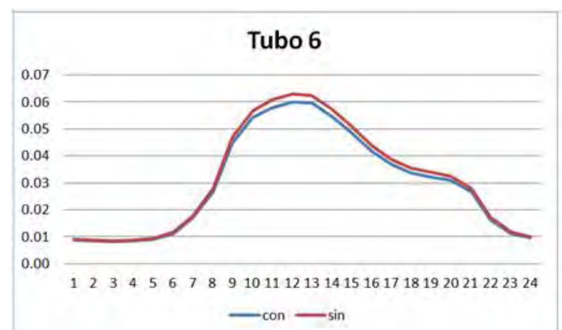


L=300m, d=8”, q=5 l/s

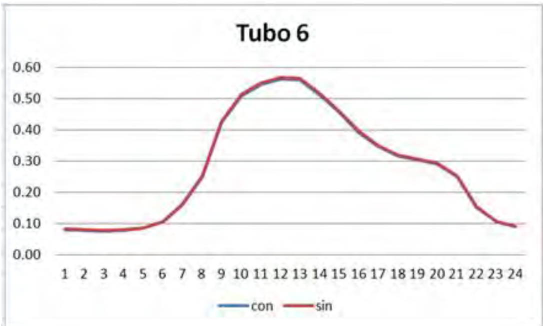


L=300m, d=8”, q=7.5 l/s

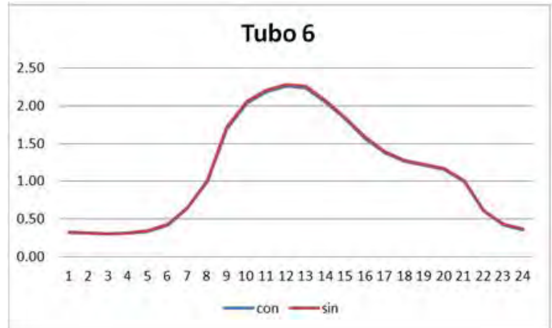


Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

L=600m, d=4", q=2.5 l/s



L=600m, d=4", q=5 l/s



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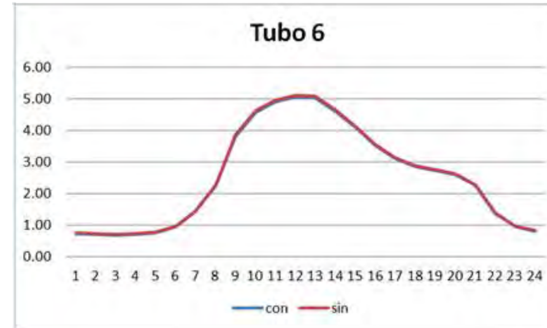
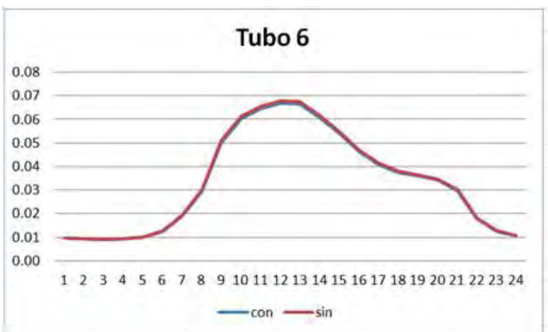
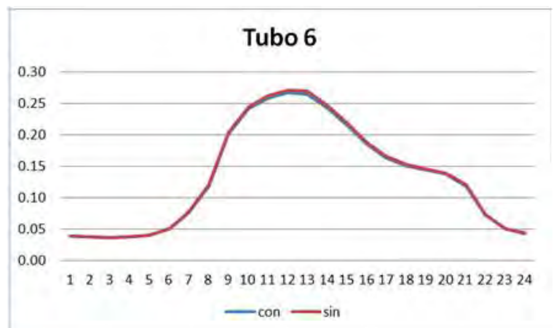


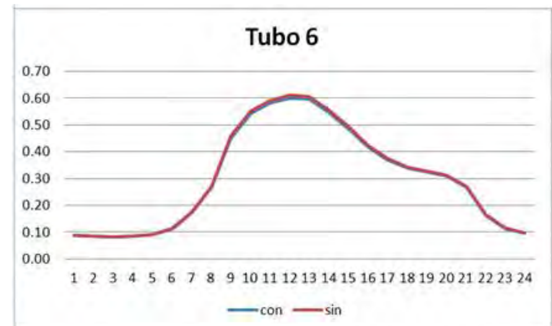
L=600m, d=6", q=2.5 l/s



L=600m, d=6", q=5 l/s



L=600m, d=6", q=7.5 l/s



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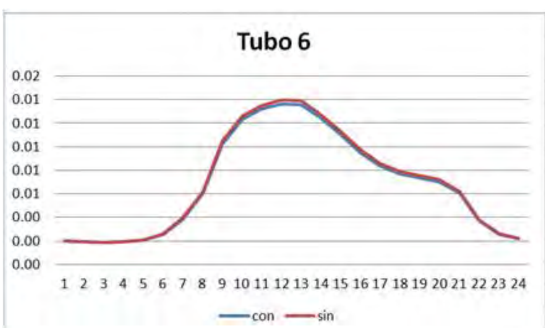
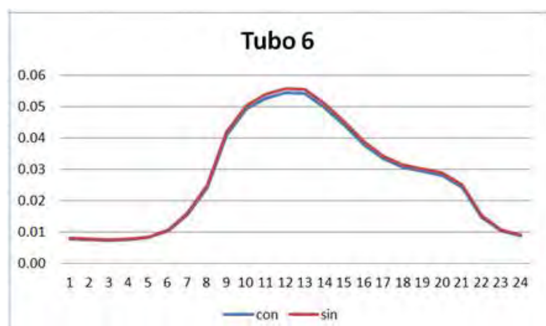
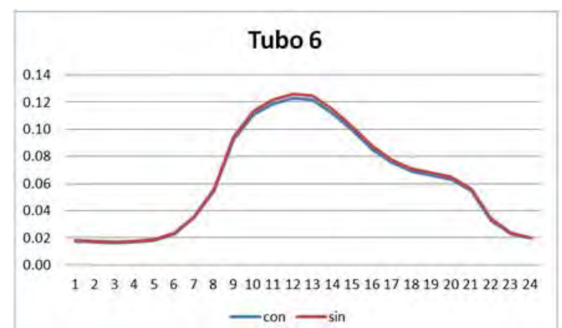


L=600m, d=8", q=5 l/s

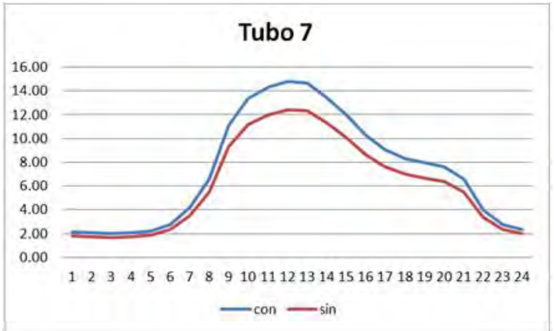


L=600m, d=8", q=7.5 l/s

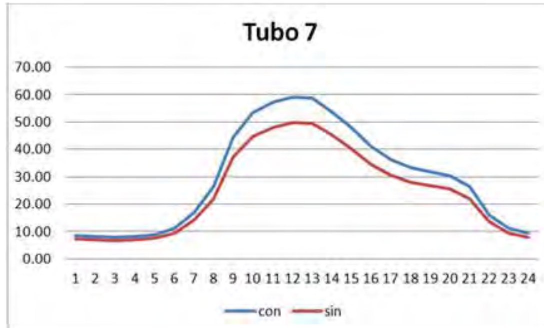


Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

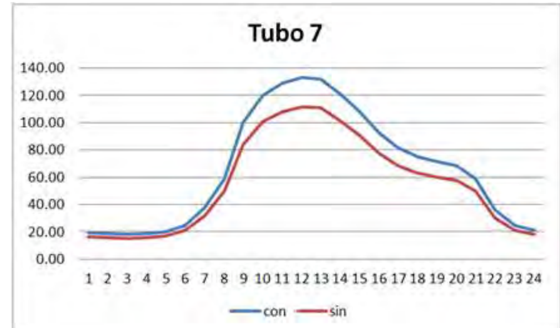
L=100m, d=4”, q=2.5 l/s



L=100m, d=4”, q=5 l/s



L=100m, d=4”, q=7.5 l/s



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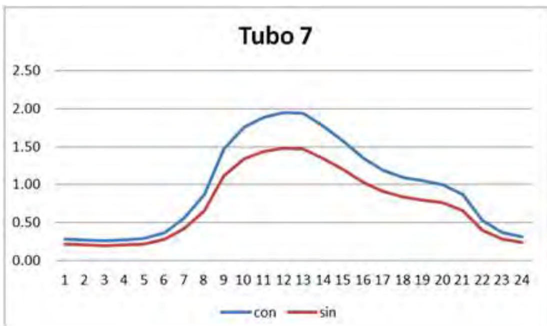

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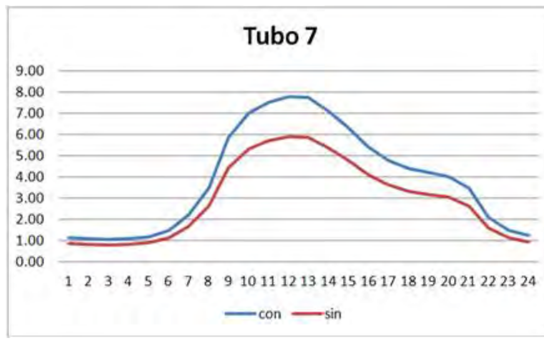

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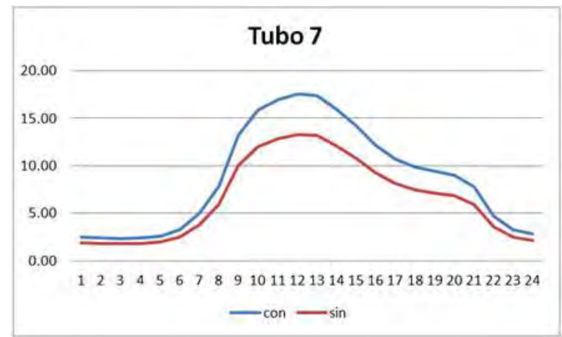

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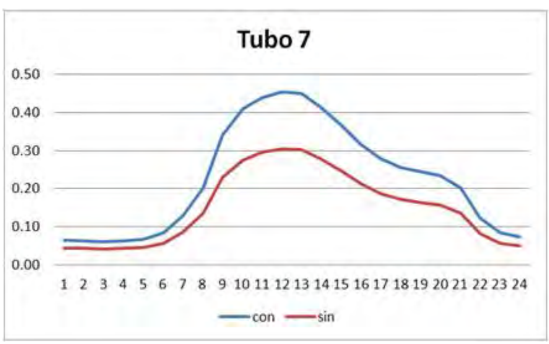

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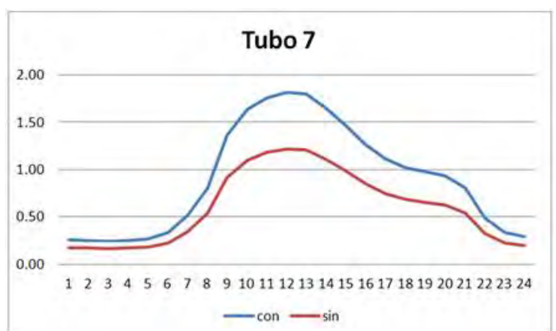

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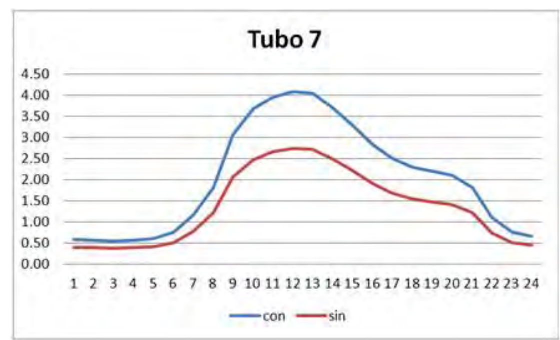
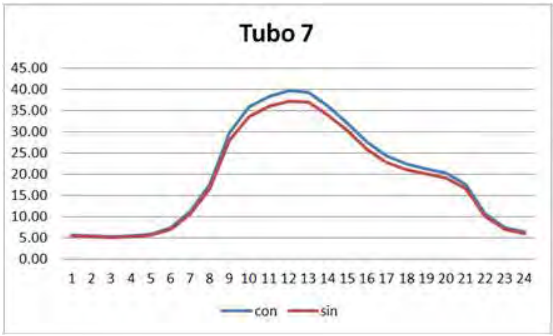
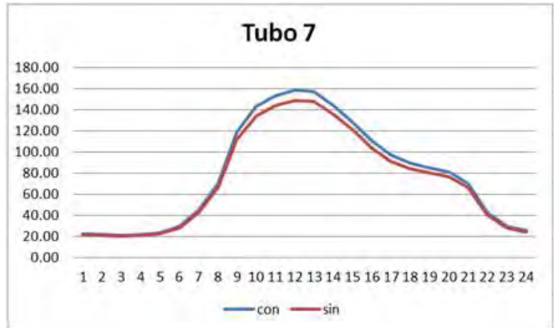


Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

L=300m, d=4", q=2.5 l/s



L=300m, d=4", q=5 l/s



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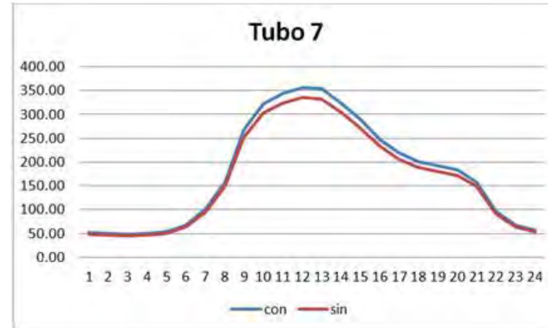

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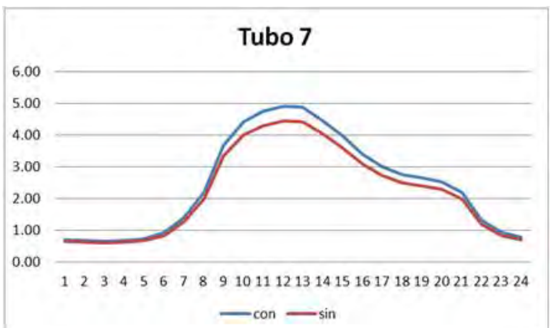
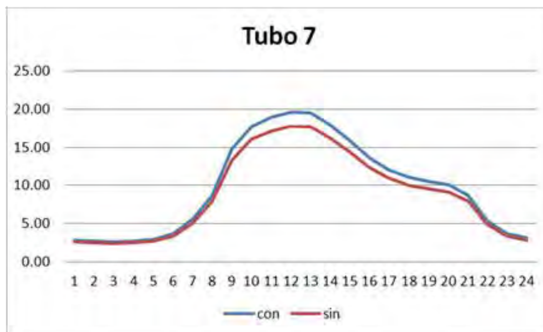


L=300m, d=6", q=5 l/s



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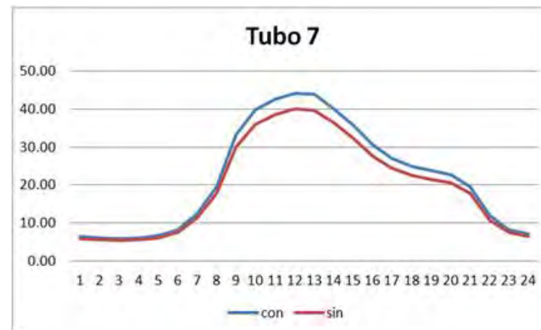

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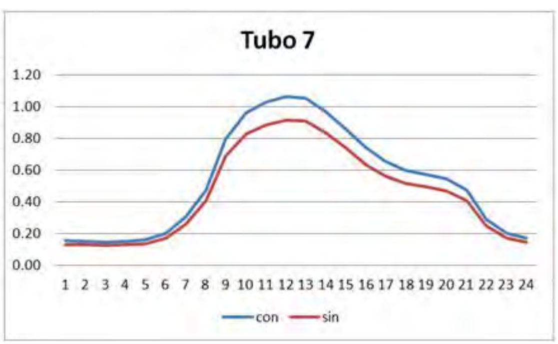

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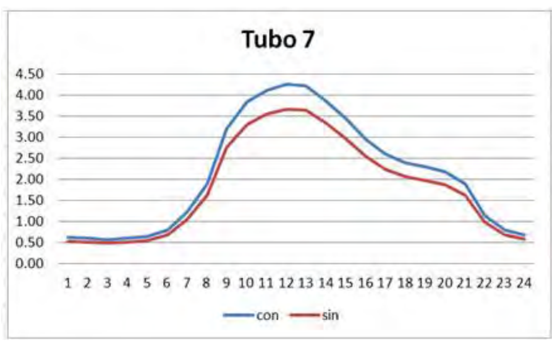
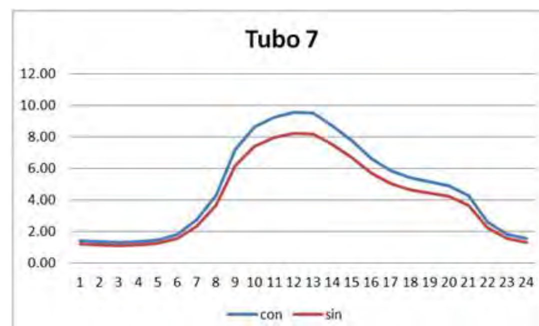
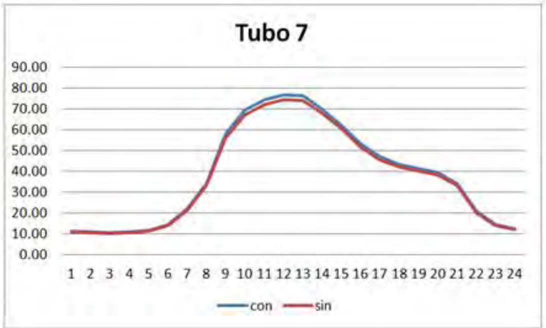


L=300m, d=8", q=7.5 l/s

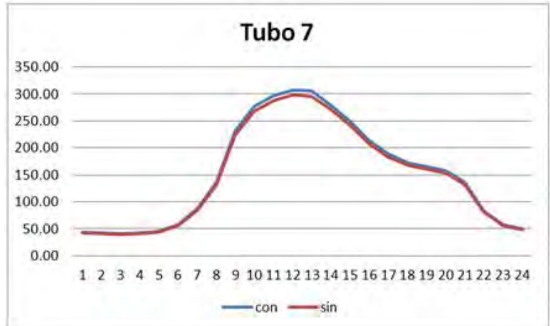


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

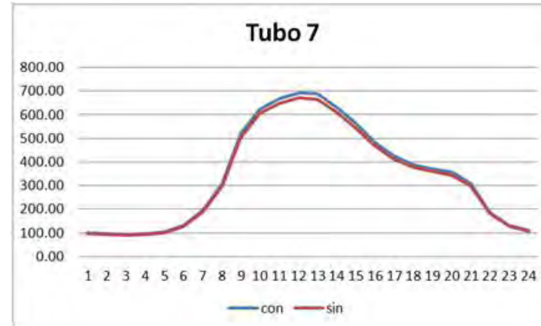
L=600m, d=4”, q=2.5 l/s



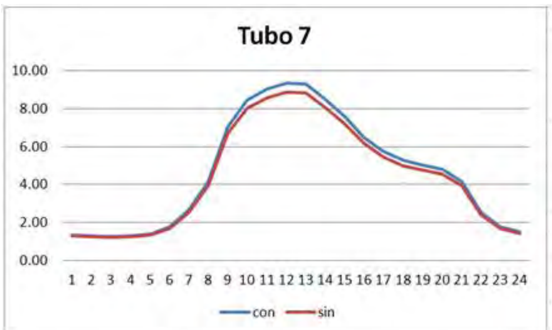
L=600m, d=4”, q=5 l/s



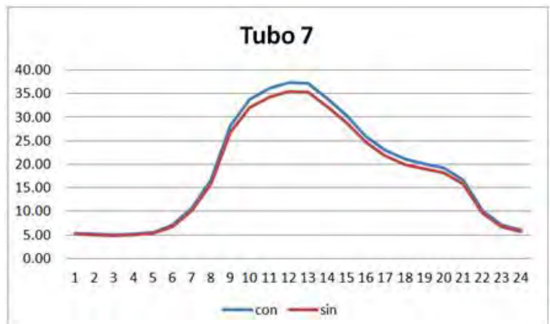
L=600m, d=4”, q=7.5 l/s



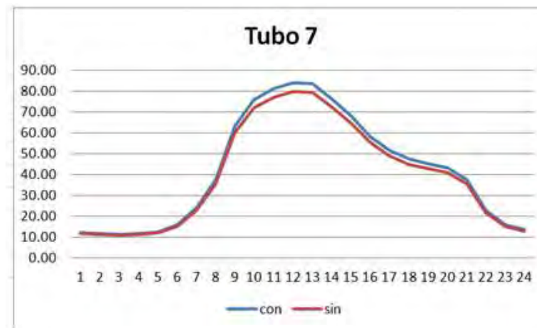
L=600m, d=6”, q=2.5 l/s



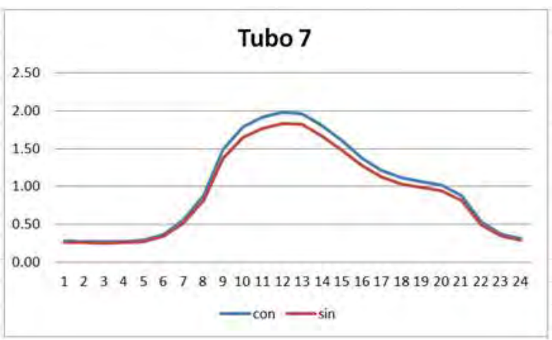
L=600m, d=6”, q=5 l/s



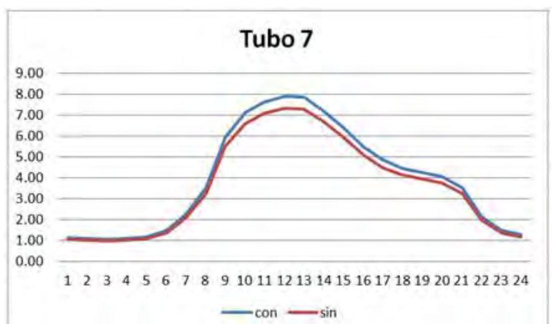
L=600m, d=6”, q=7.5 l/s



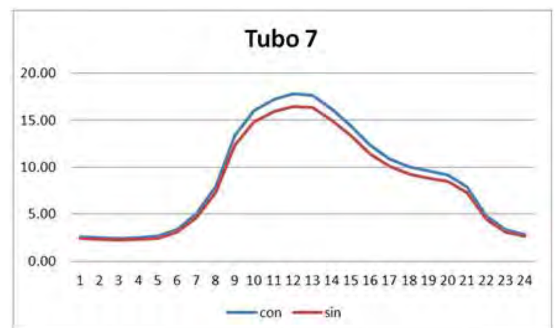
L=600m, d=8”, q=2.5 l/s



L=600m, d=8”, q=5 l/s

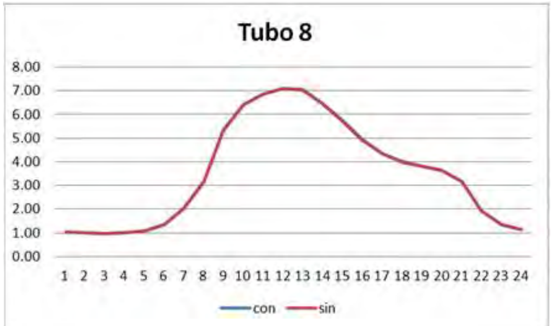


L=600m, d=8”, q=7.5 l/s



Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

L=100m, d=4”, q=2.5 l/s



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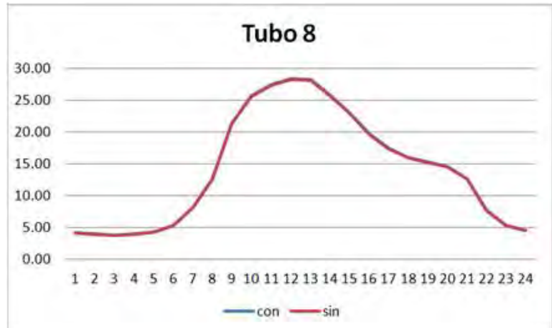

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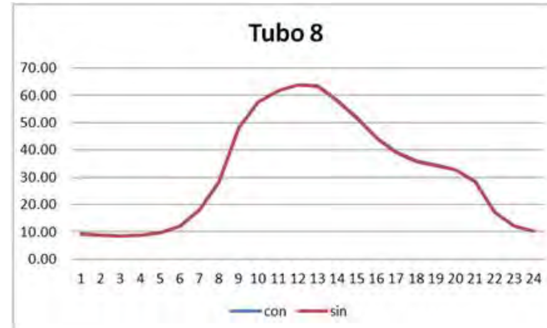
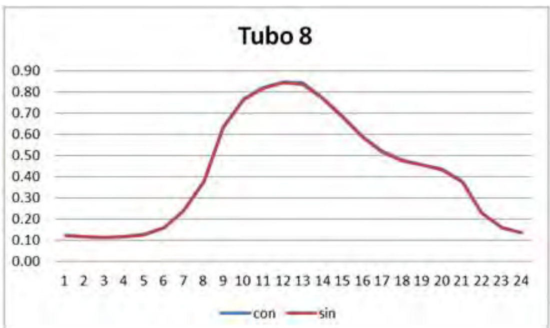


L=100m, d=6”, q=2.5 l/s



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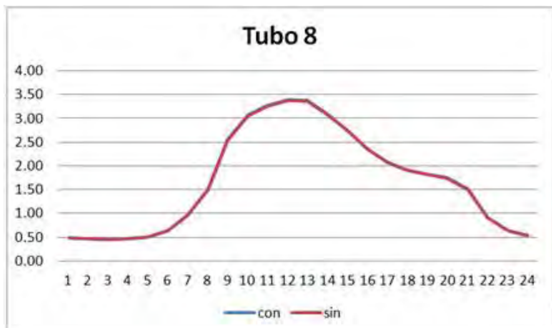
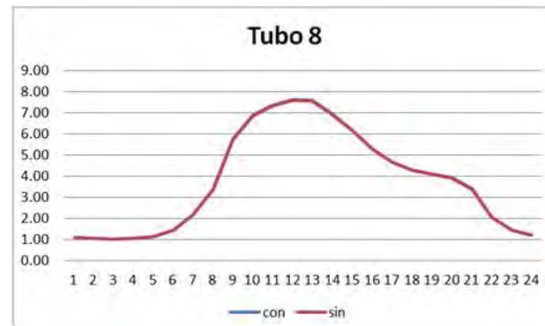


L=100m, d=6”, q=7.5 l/s



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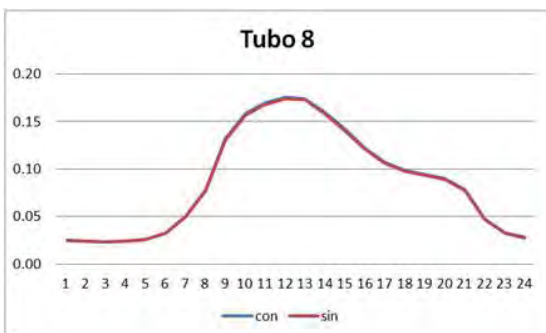

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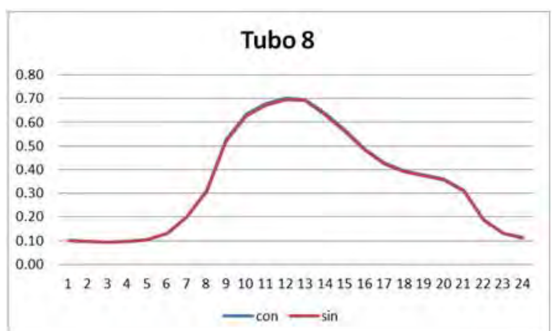

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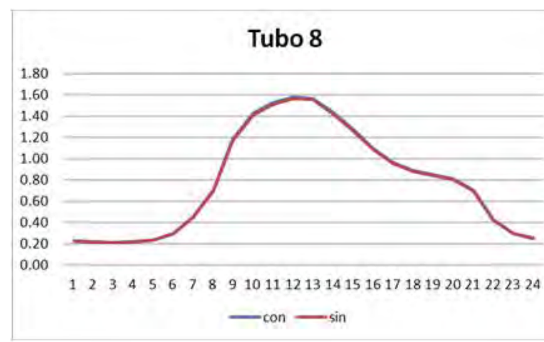
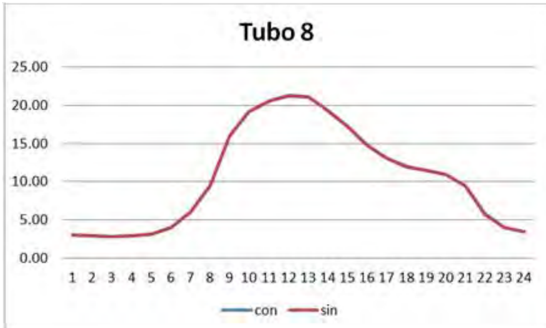


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=300m, d=4", q=2.5 l/s



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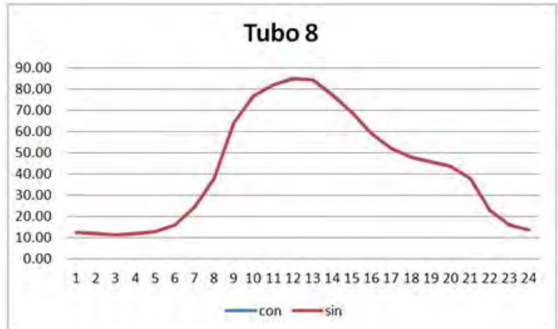

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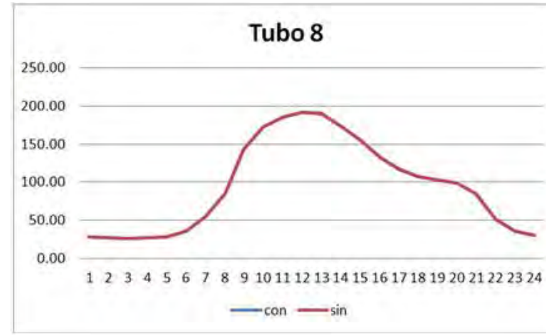

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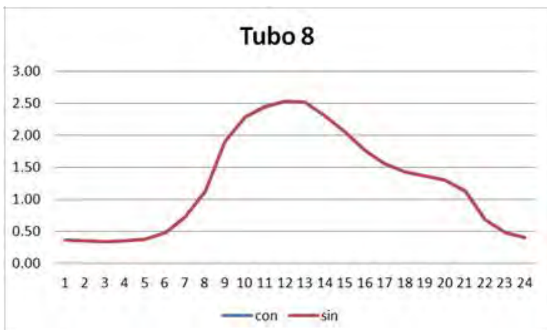

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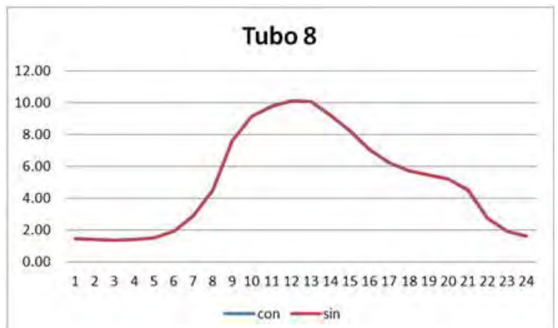

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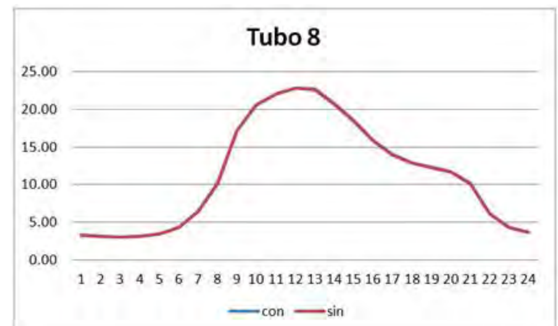

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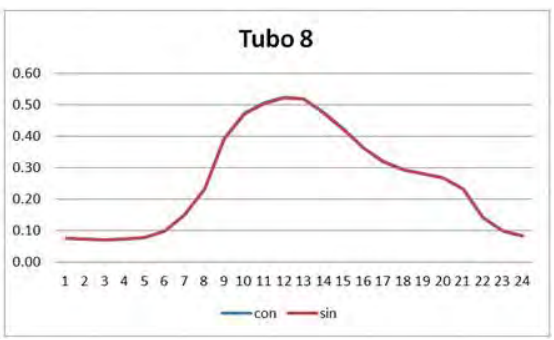

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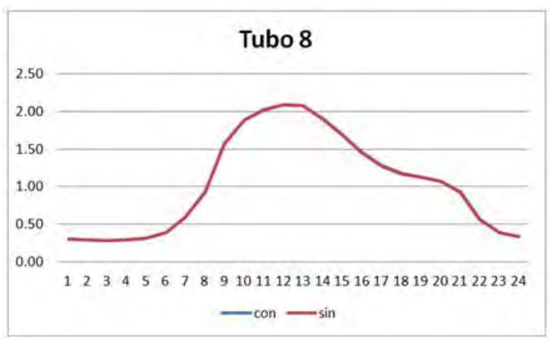
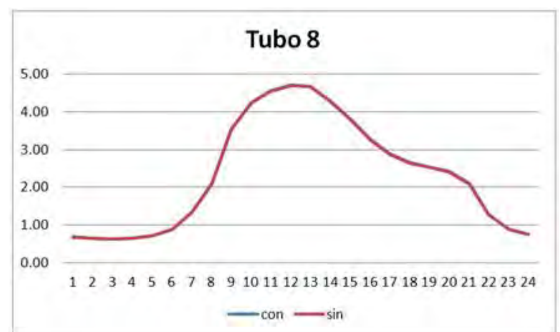
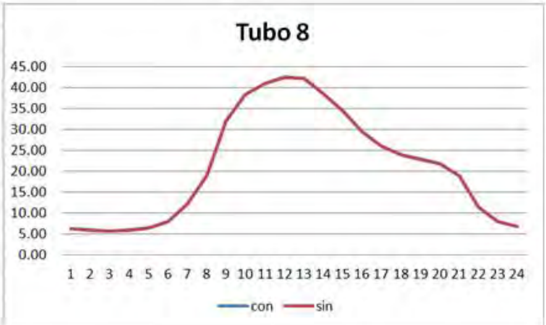


L=300m, d=8", q=7.5 l/s



Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=600m, d=4”, q=2.5 l/s



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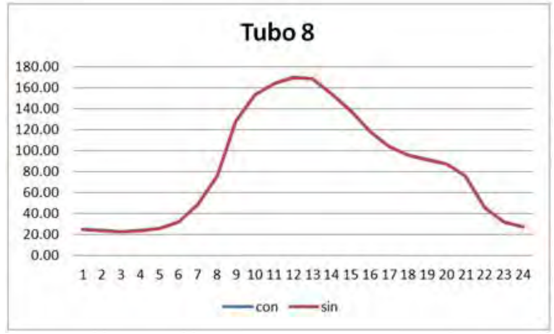

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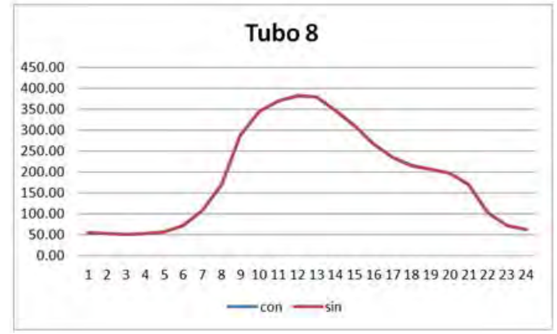

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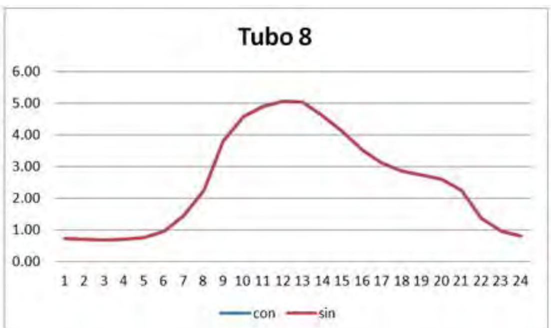

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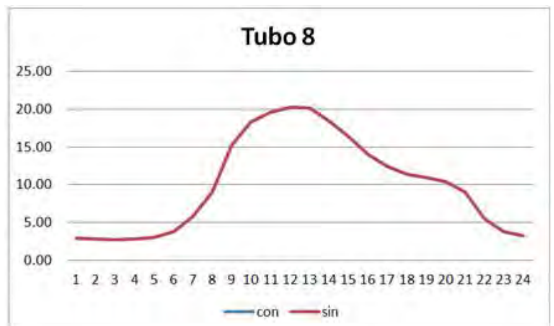

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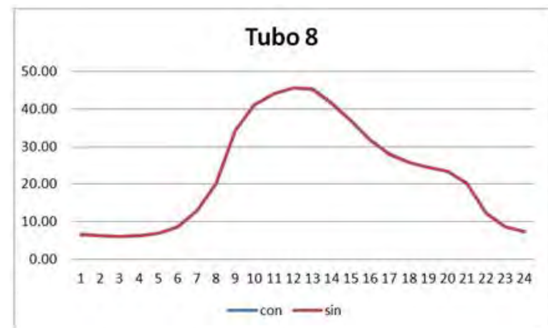

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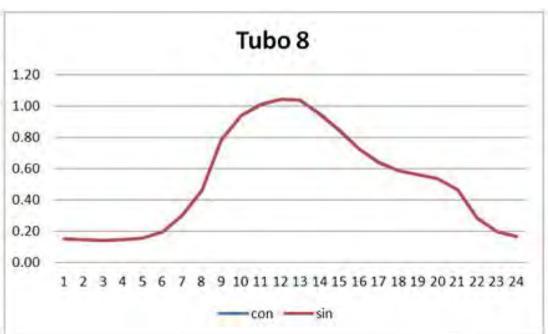

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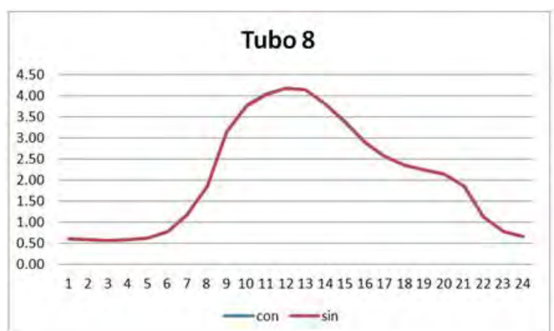

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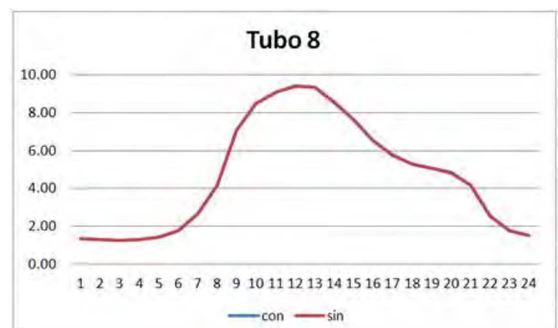
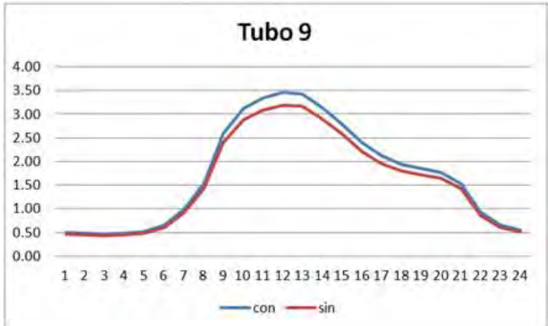


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=100m, d=4”, q=2.5 l/s



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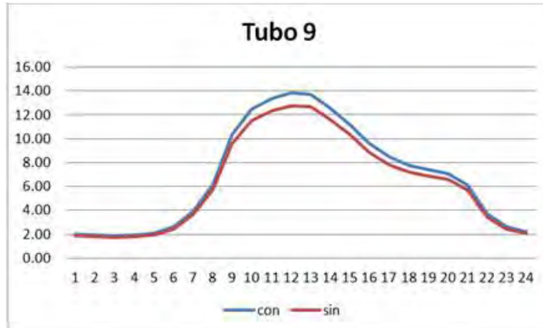

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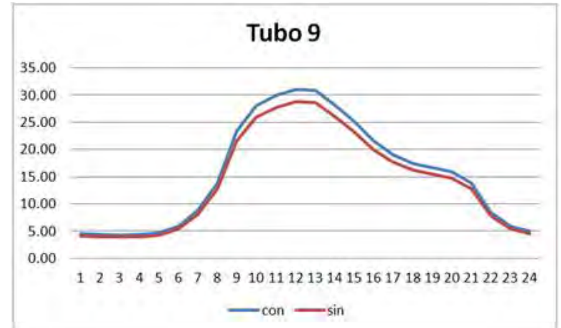

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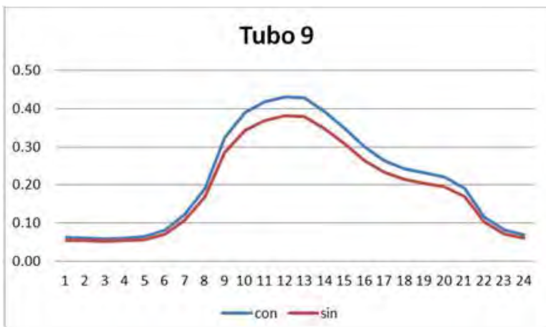

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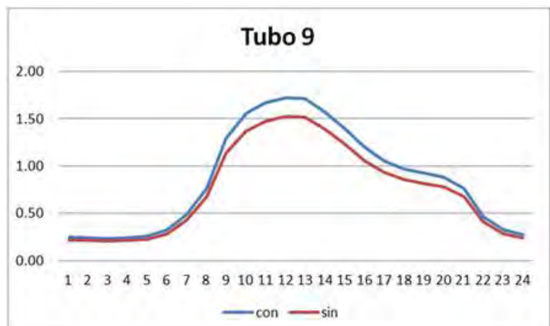

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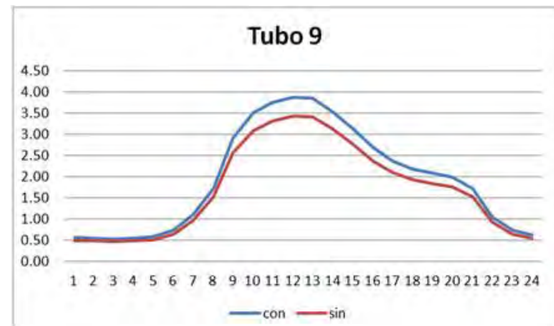

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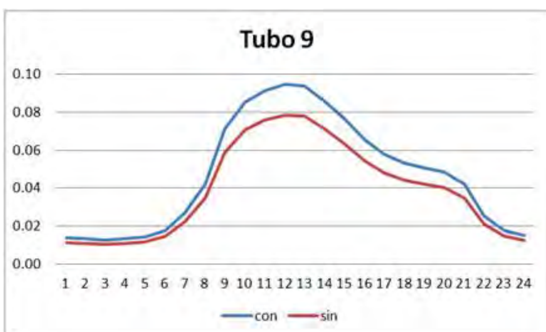

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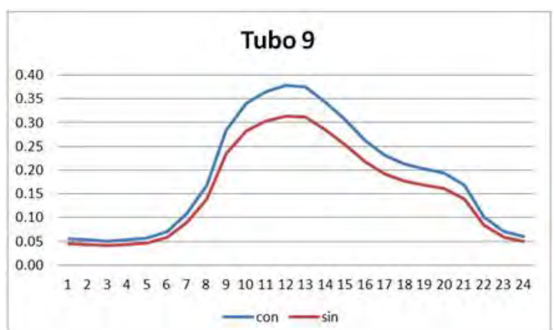
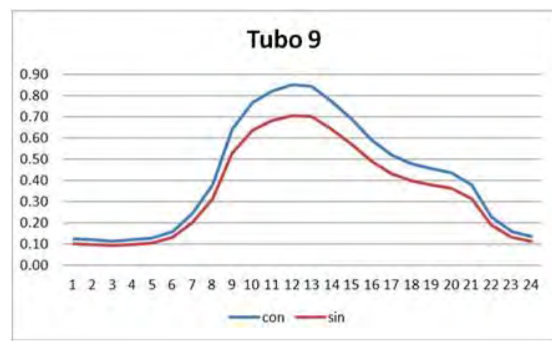
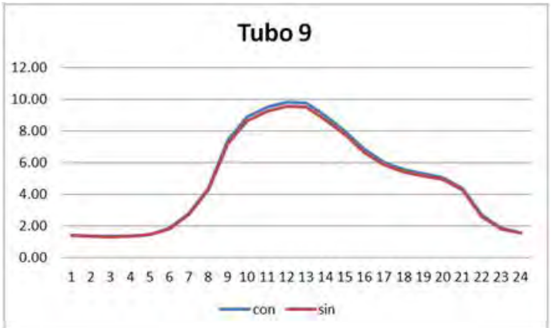


L=100m, d=8”, q=7.5 l/s

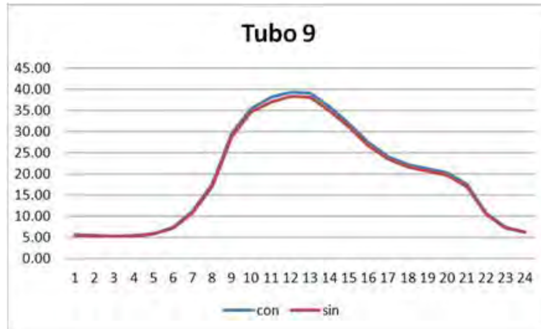


Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

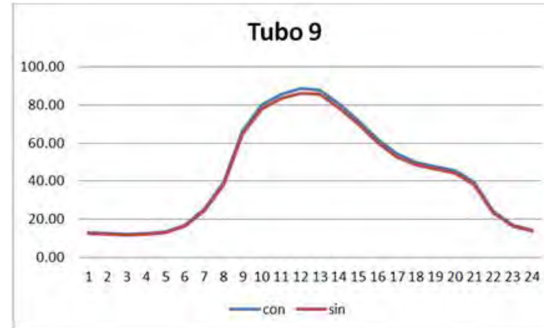
L=300m, d=4", q=2.5 l/s



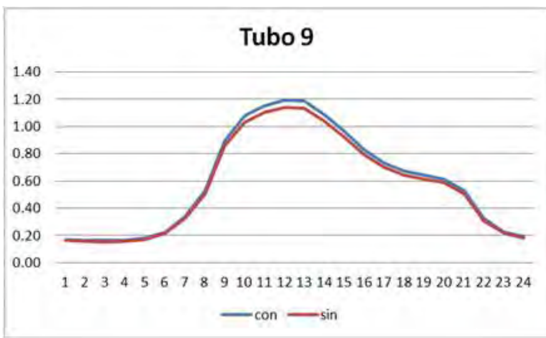
L=300m, d=4", q=5 l/s



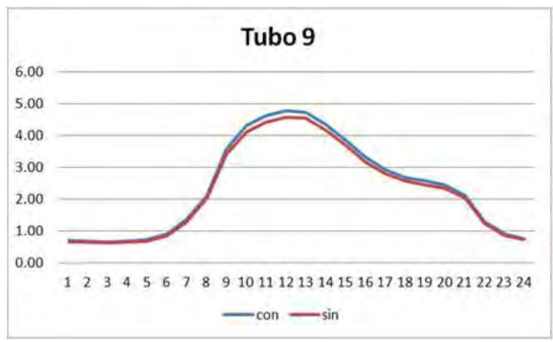
L=300m, d=4", q=7.5 l/s



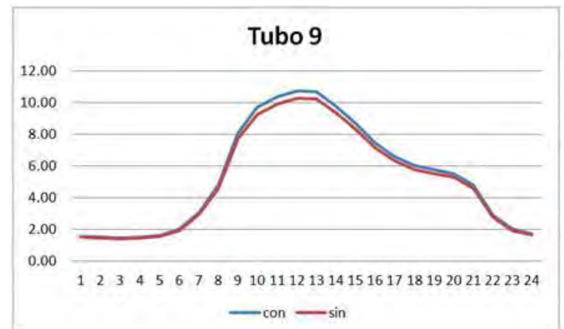
L=300m, d=6", q=2.5 l/s



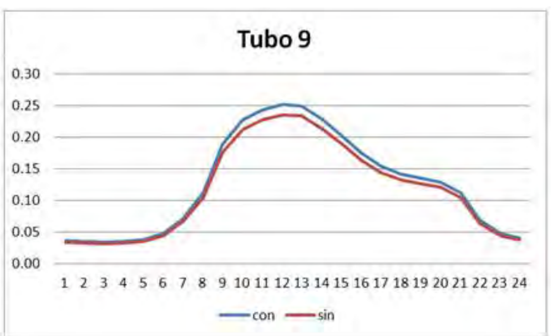
L=300m, d=6", q=5 l/s



L=300m, d=6", q=7.5 l/s



L=300m, d=8", q=2.5 l/s



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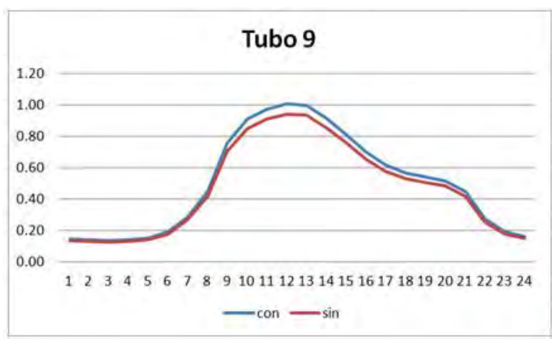
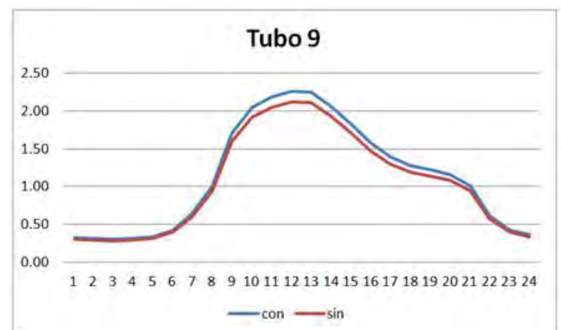
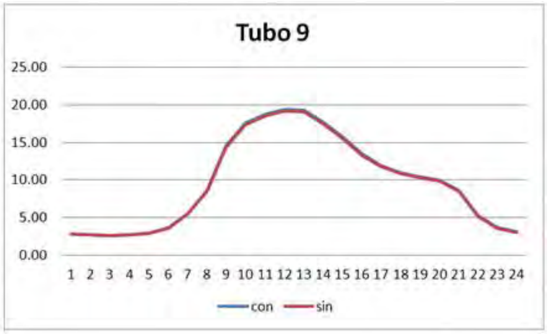


L=300m, d=8", q=7.5 l/s

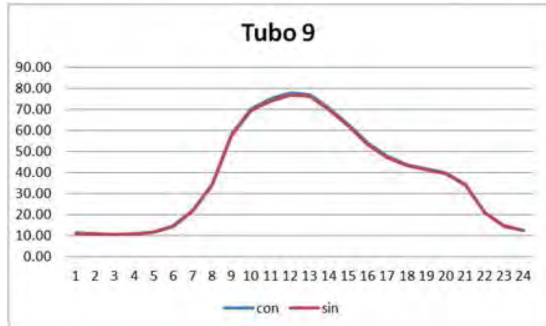


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

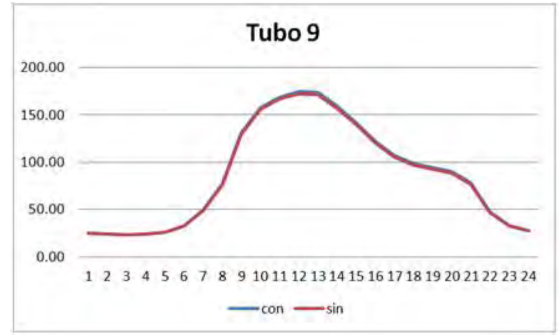
L=600m, d=4", q=2.5 l/s



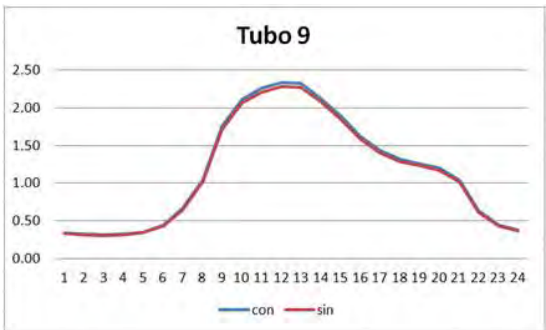
L=600m, d=4", q=5 l/s



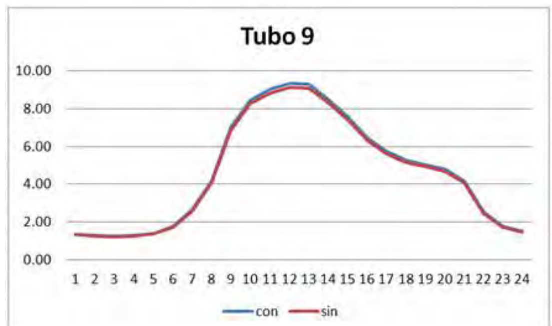
L=600m, d=4", q=7.5 l/s



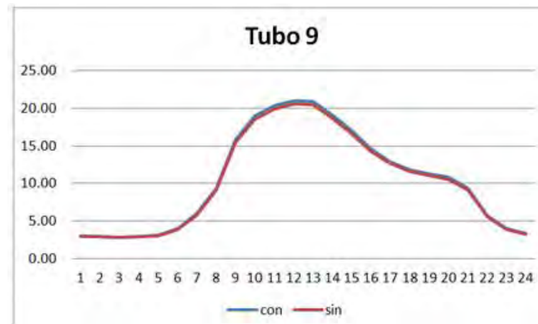
L=600m, d=6", q=2.5 l/s



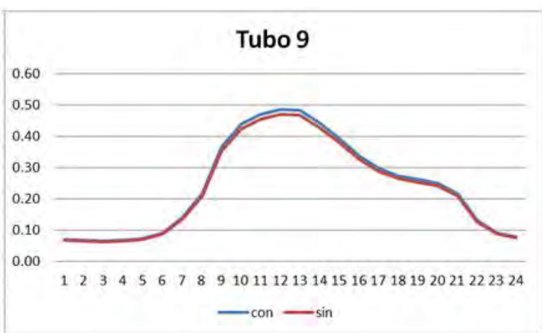
L=600m, d=6", q=5 l/s



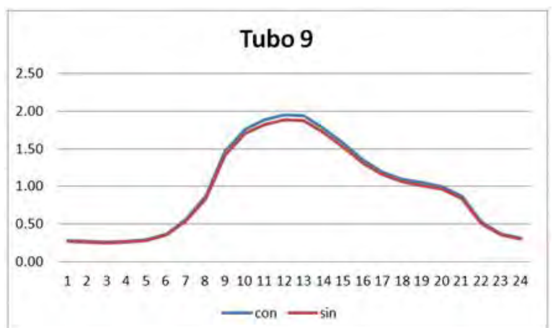
L=600m, d=6", q=7.5 l/s



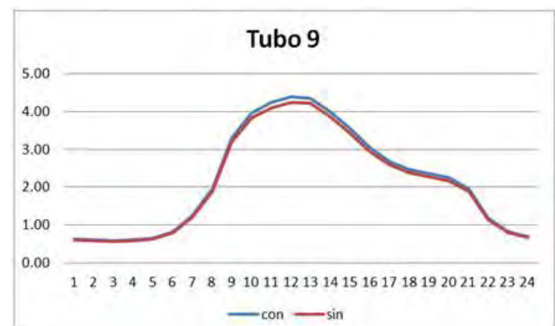
L=600m, d=8", q=2.5 l/s



L=600m, d=8", q=5 l/s

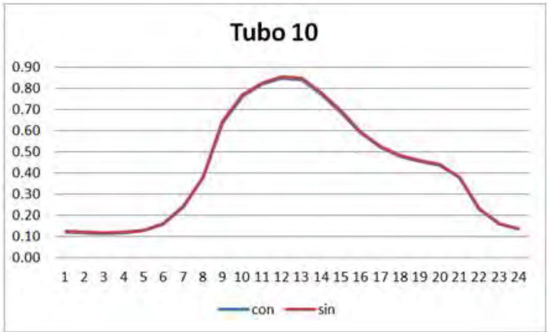


L=600m, d=8", q=7.5 l/s

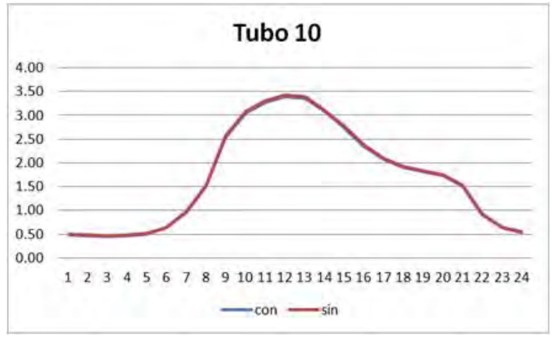


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

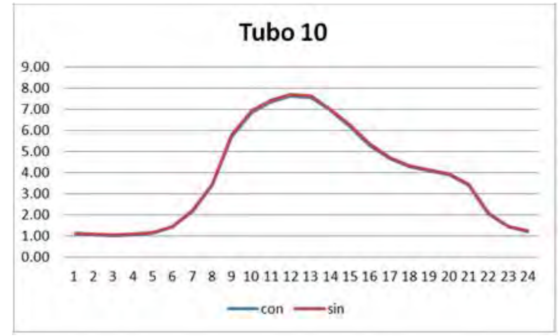
L=100m, d=4”, q=2.5 l/s



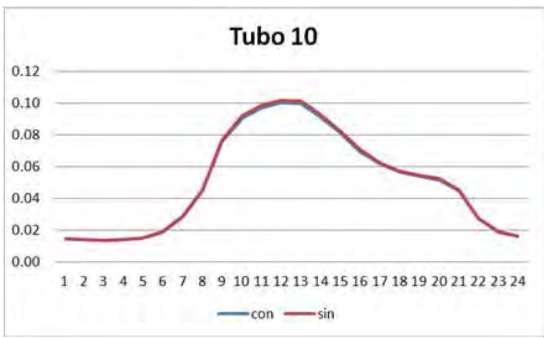
L=100m, d=4”, q=5 l/s



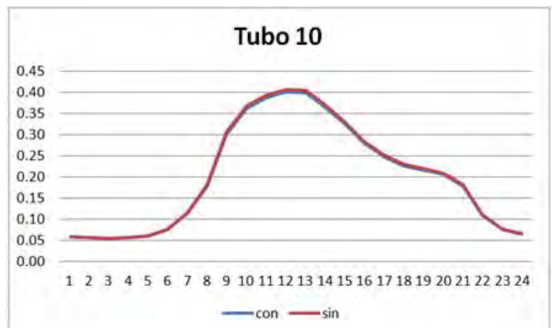
L=100m, d=4”, q=7.5 l/s



L=100m, d=6”, q=2.5 l/s



L=100m, d=6”, q=5 l/s



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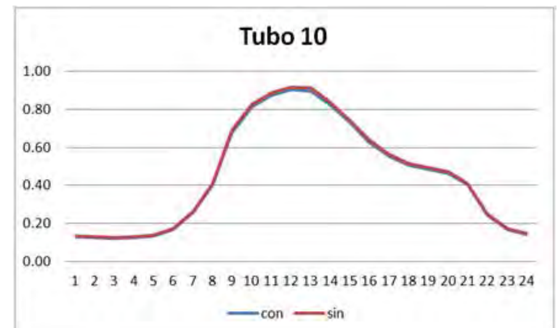

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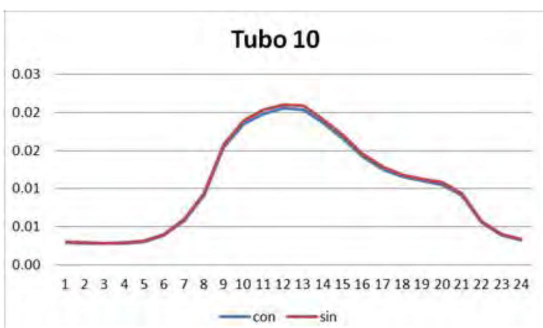
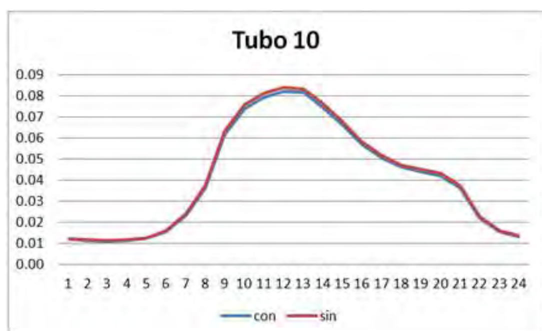
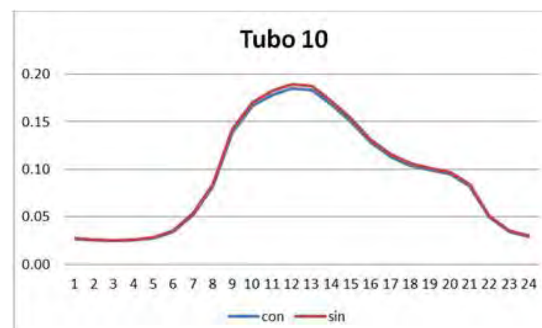


L=100m, d=8”, q=5 l/s

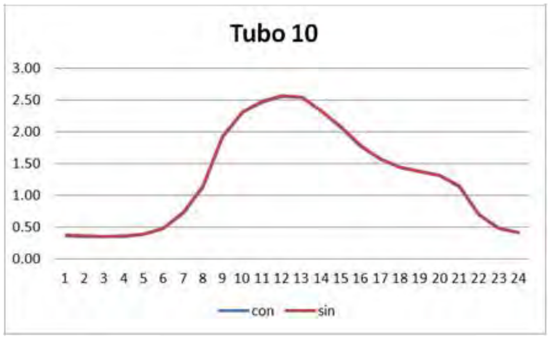


L=100m, d=8”, q=7.5 l/s

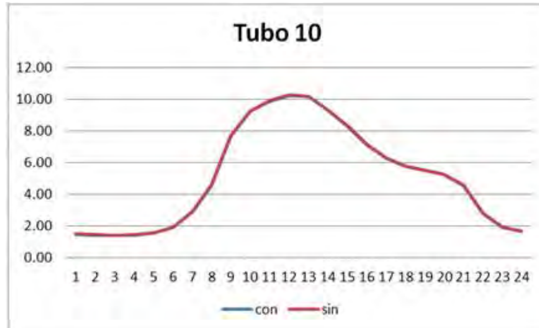


Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

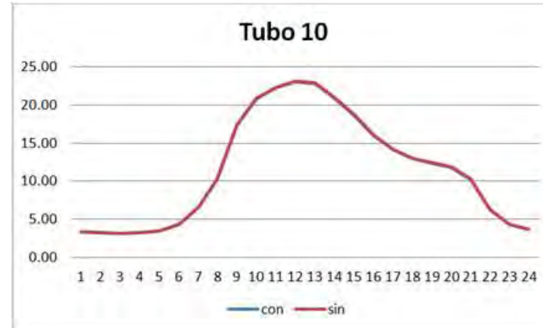
L=300m, d=4”, q=2.5 l/s



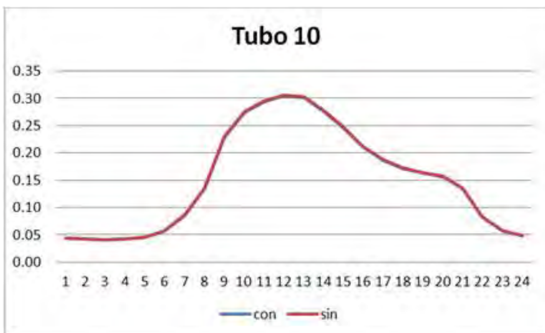
L=300m, d=4”, q=5 l/s



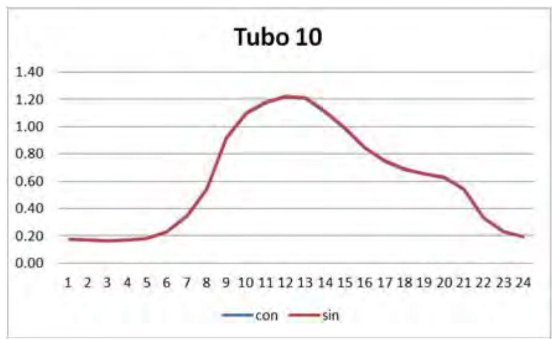
L=300m, d=4”, q=7.5 l/s



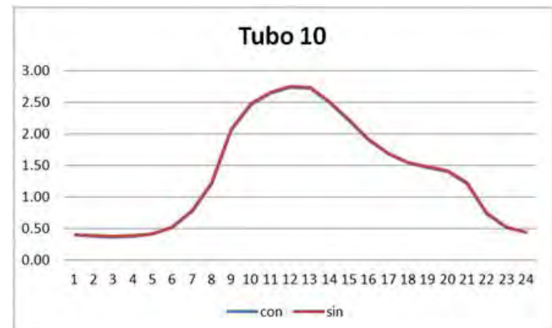
L=300m, d=6”, q=2.5 l/s



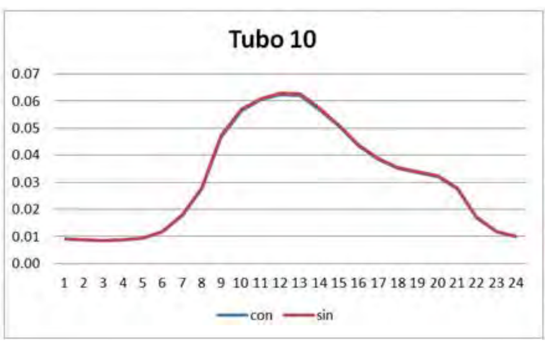
L=300m, d=6”, q=5 l/s



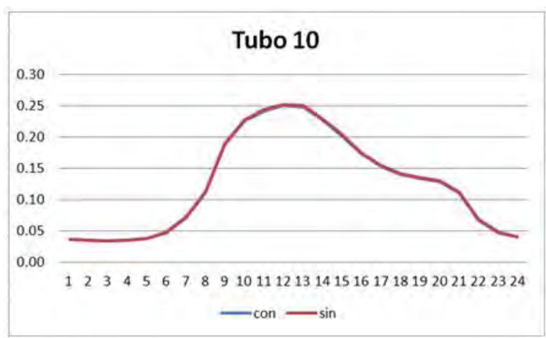
L=300m, d=6”, q=7.5 l/s



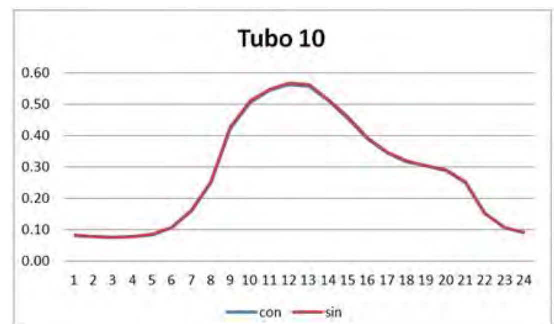
L=300m, d=8”, q=2.5 l/s



L=300m, d=8”, q=5 l/s

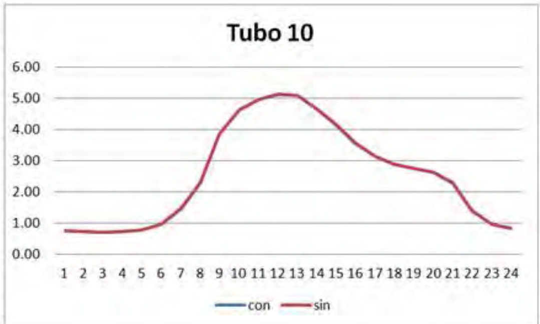


L=300m, d=8”, q=7.5 l/s

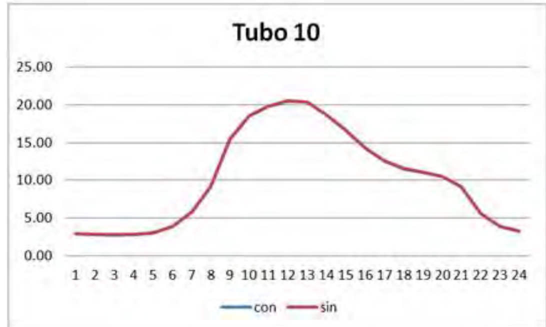


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

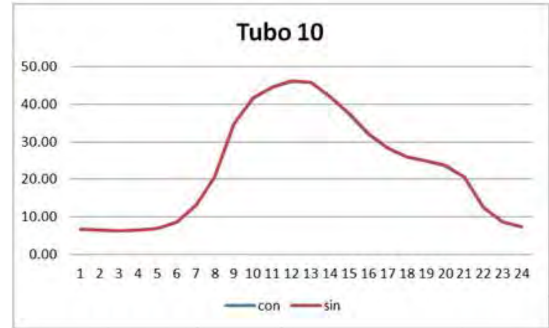
L=600m, d=4”, q=2.5 l/s



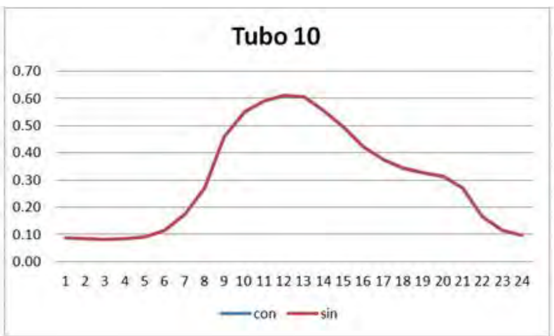
L=600m, d=4”, q=5 l/s



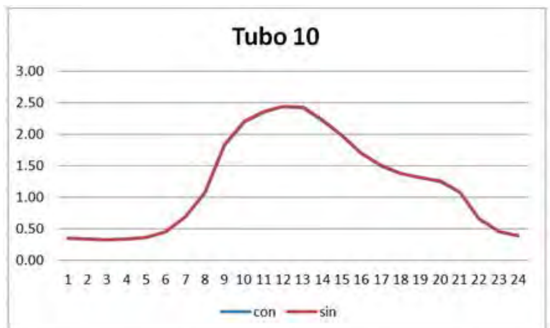
L=600m, d=4”, q=7.5 l/s



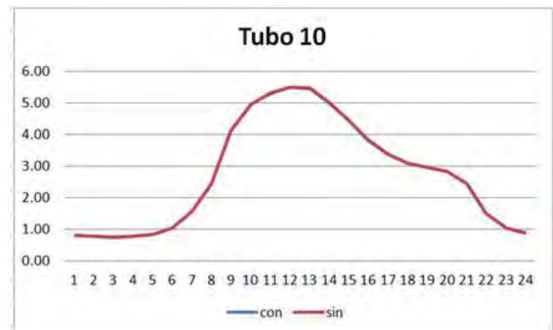
L=600m, d=6”, q=2.5 l/s



L=600m, d=6”, q=5 l/s



L=600m, d=6”, q=7.5 l/s



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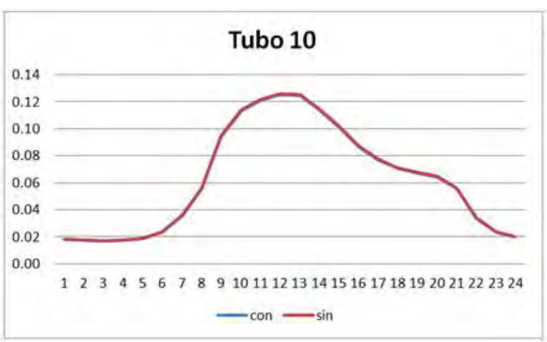
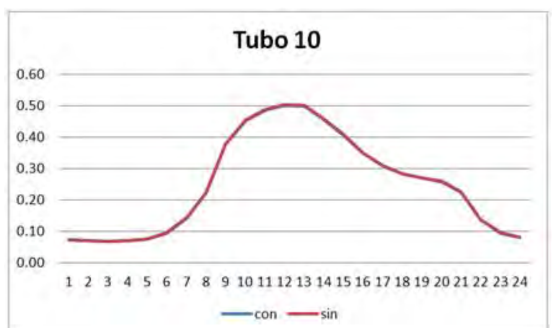
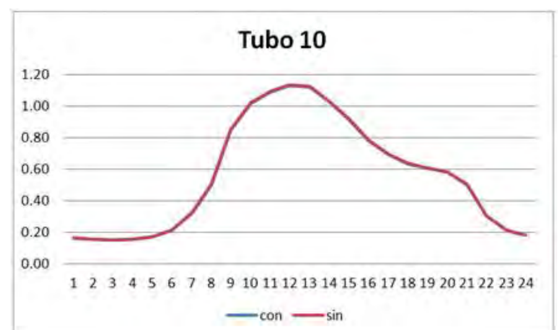


L=600m, d=8”, q=5 l/s

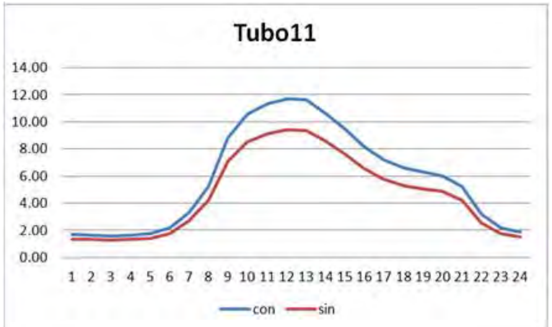


L=600m, d=8”, q=7.5 l/s

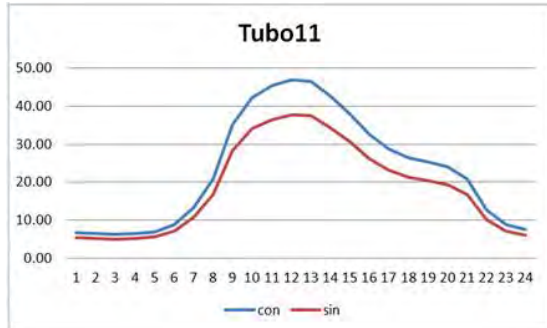


Anexo 4. Transformación de energía en tubo {M S-F}　　　eje x: horas, eje y:metros

L=100m, d=4”, q=2.5 l/s



L=100m, d=4”, q=5 l/s



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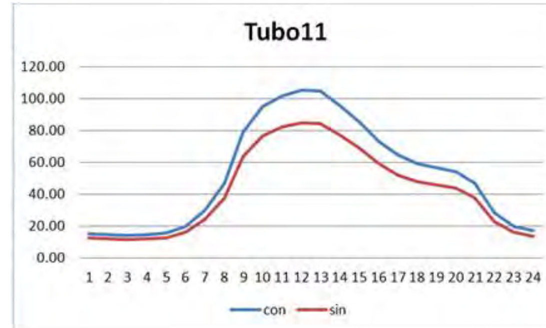
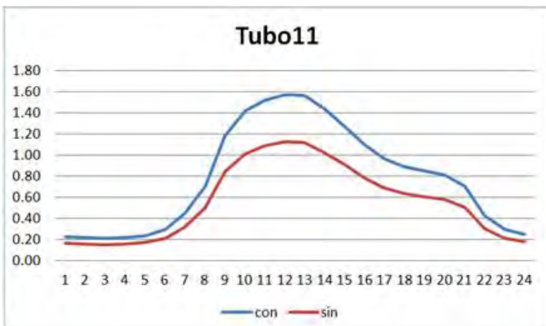


L=100m, d=6”, q=2.5 l/s



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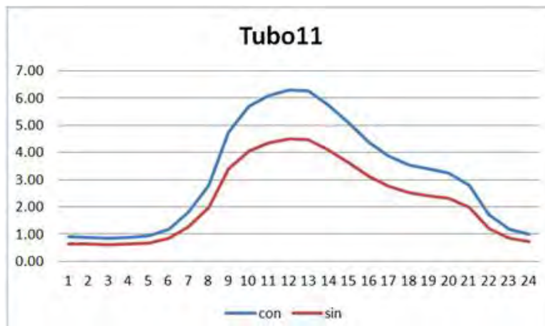

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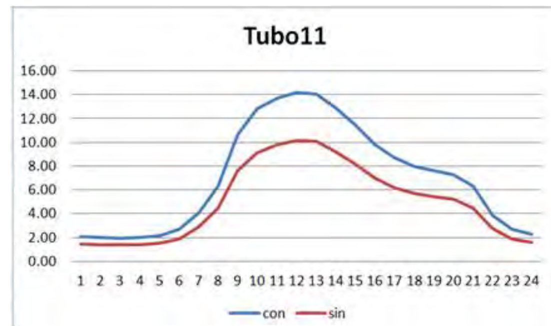

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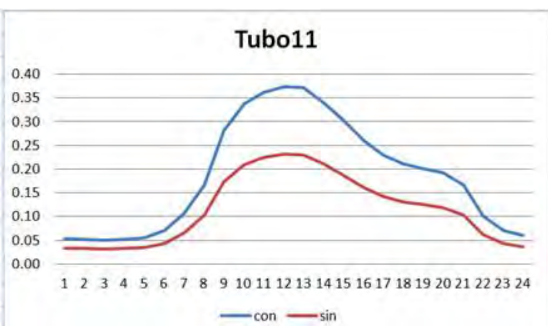
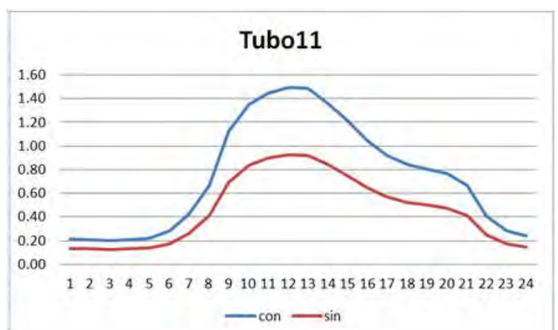
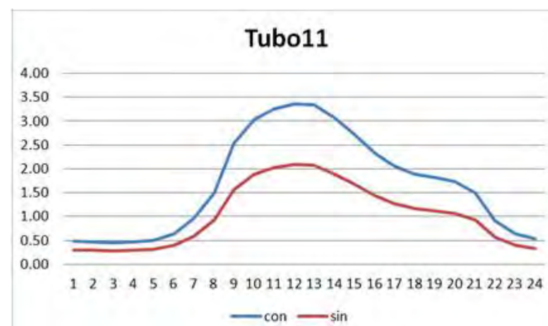


L=100m, d=8”, q=5 l/s

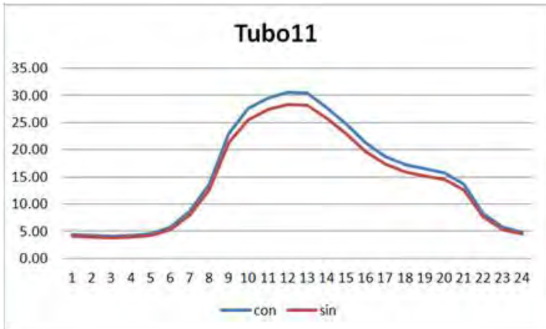


L=100m, d=8”, q=7.5 l/s

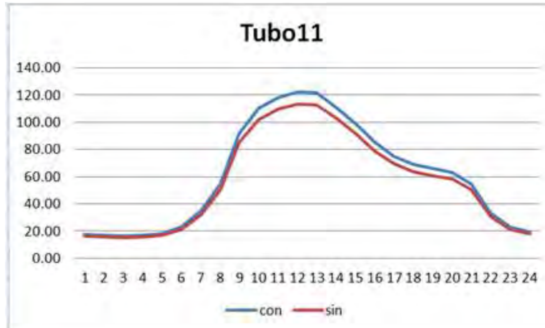


Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

L=300m, d=4”, q=2.5 l/s



L=300m, d=4”, q=5 l/s



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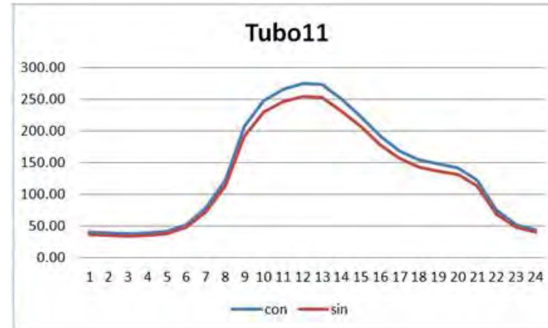
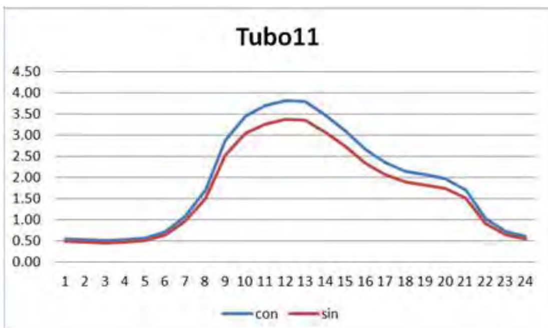
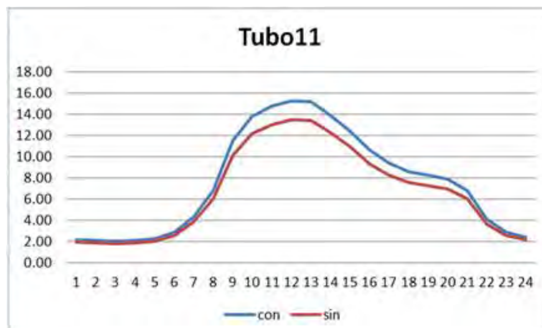


L=300m, d=6”, q=2.5 l/s



L=300m, d=6”, q=5 l/s



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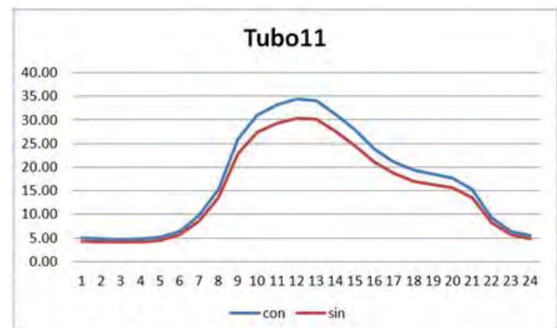
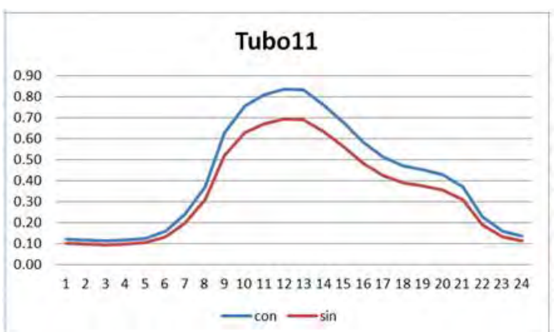
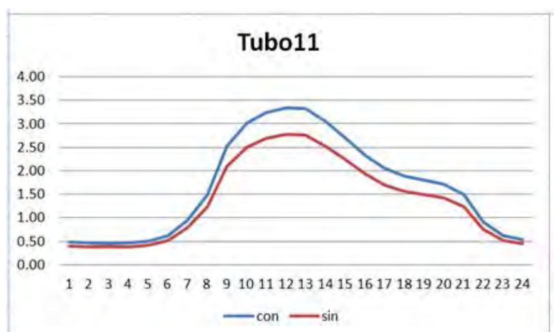


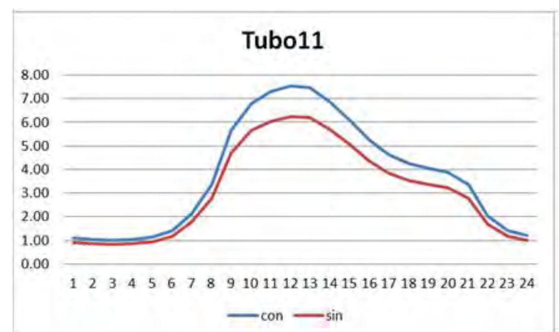
L=300m, d=8”, q=2.5 l/s



L=300m, d=8”, q=5 l/s

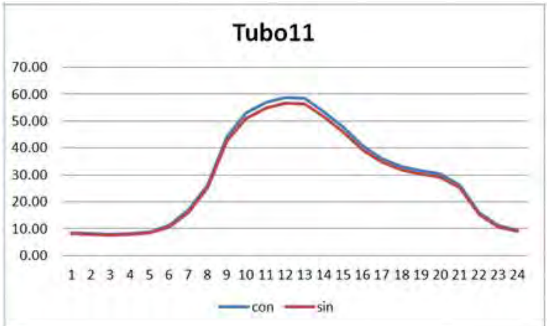


L=300m, d=8”, q=7.5 l/s

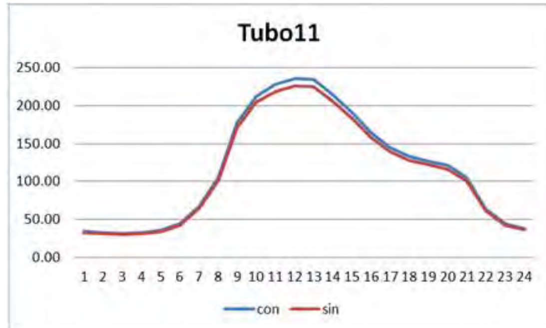


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

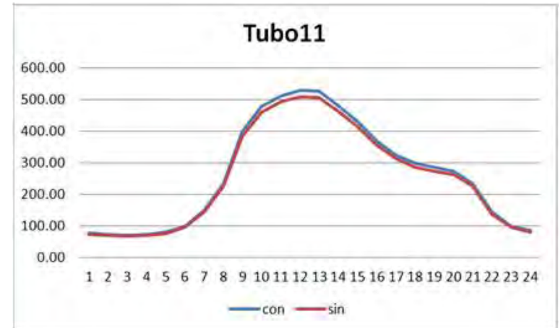
L=600m, d=4”, q=2.5 l/s



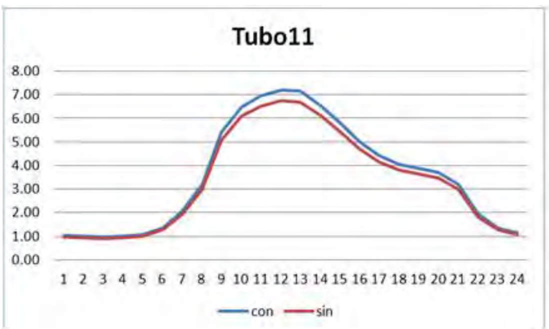
L=600m, d=4”, q=5 l/s



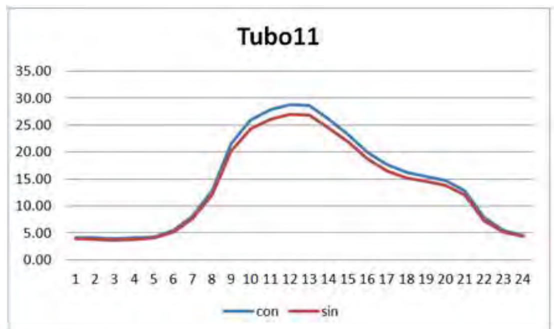
L=600m, d=4”, q=7.5 l/s



L=600m, d=6”, q=2.5 l/s



L=600m, d=6”, q=5 l/s



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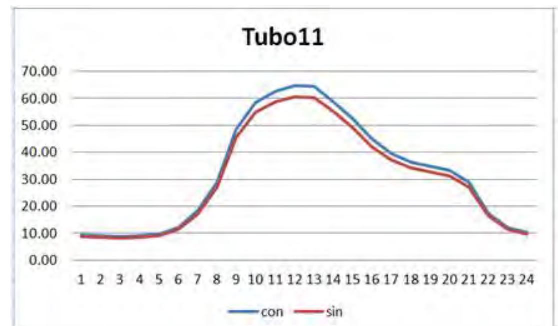

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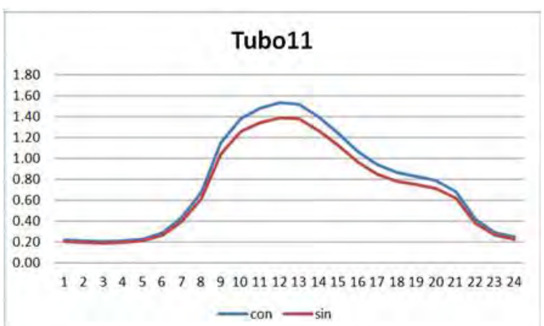

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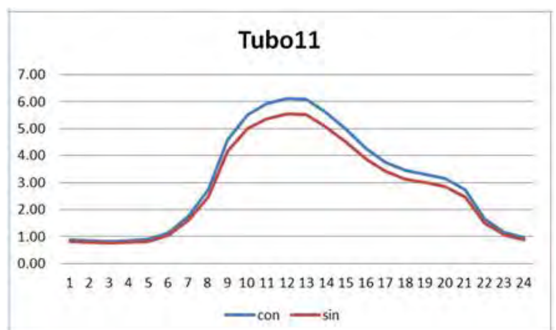

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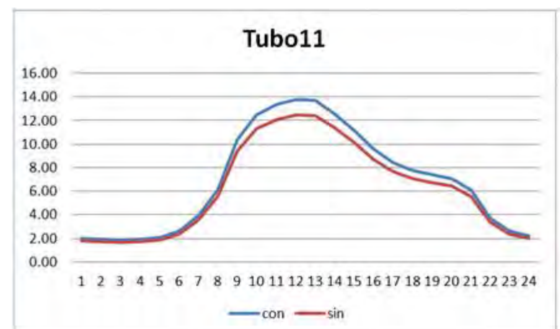
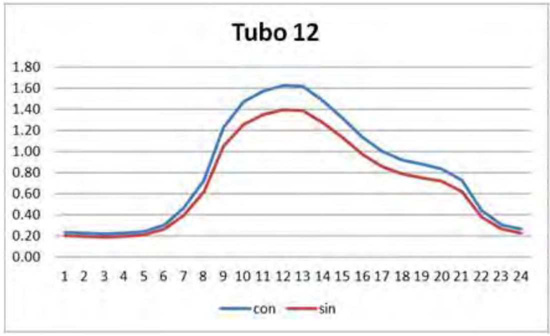


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=100m, d=4”, q=2.5 l/s



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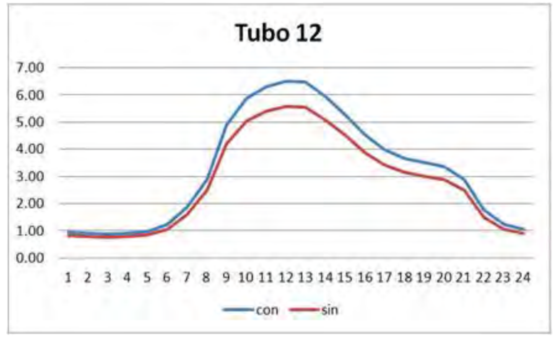
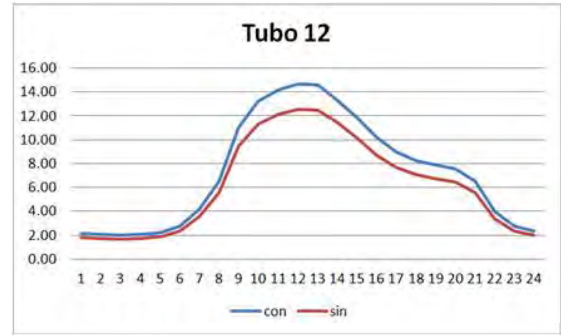


L=100m, d=4”, q=7.5 l/s



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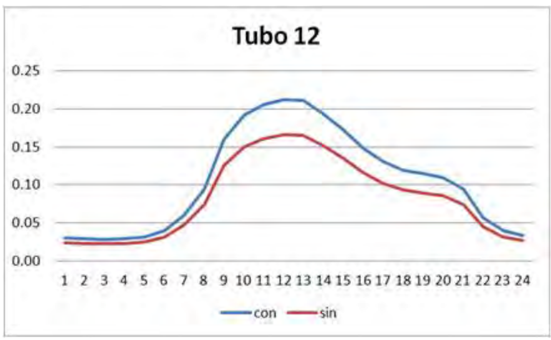

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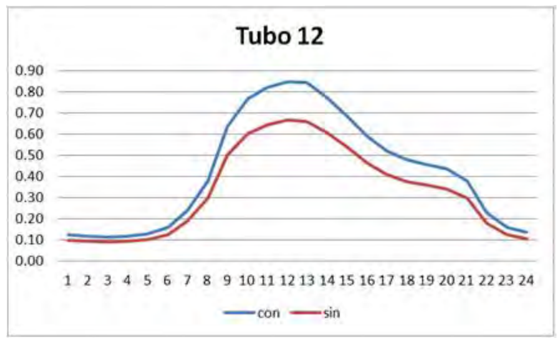

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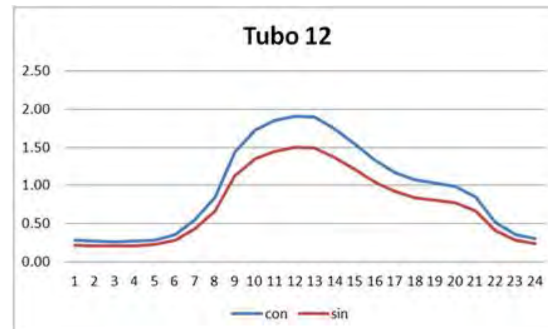

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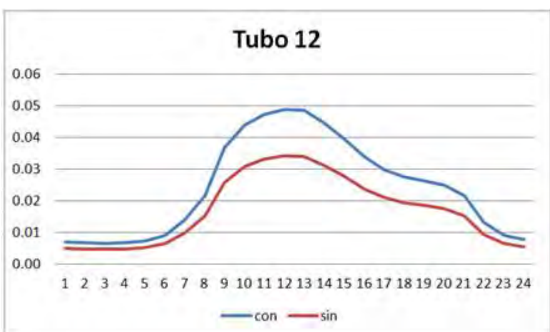

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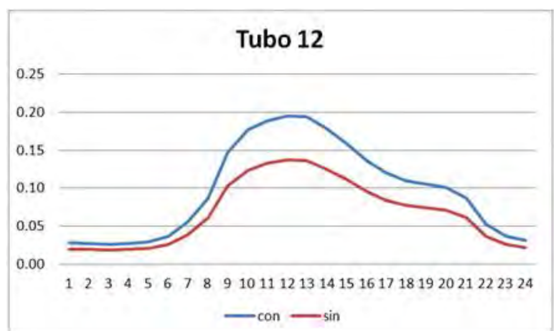
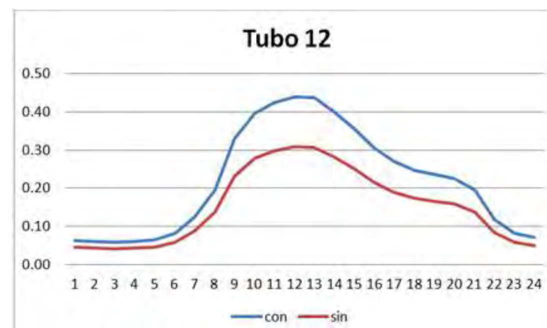
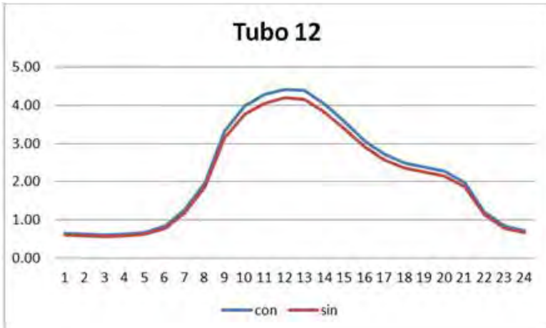


L=100m, d=8”, q=7.5 l/s

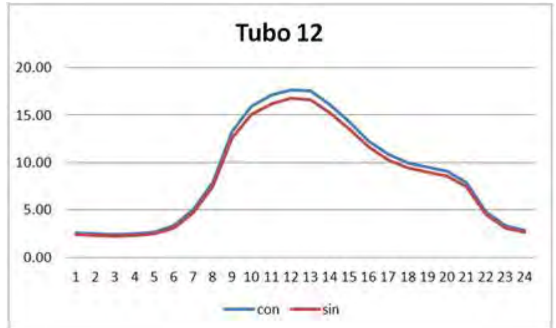


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=300m, d=4”, q=2.5 l/s



L=300m, d=4”, q=5 l/s



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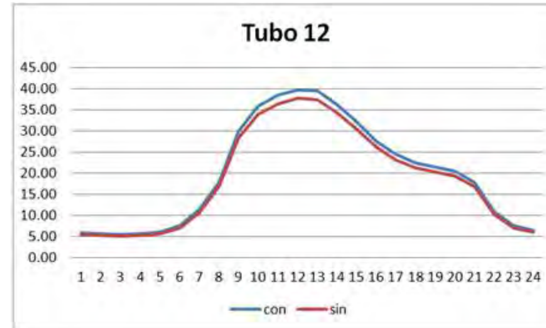
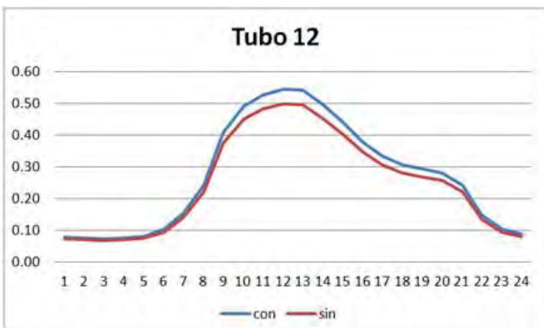
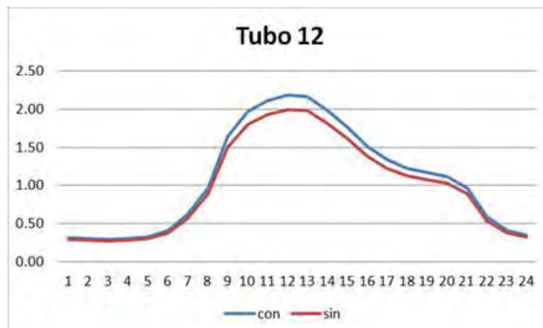


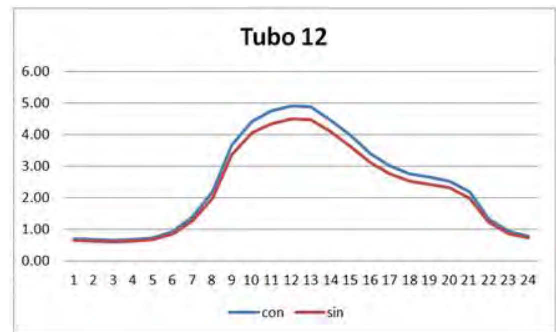
L=300m, d=6”, q=2.5 l/s



L=300m, d=6”, q=5 l/s



L=300m, d=6”, q=7.5 l/s



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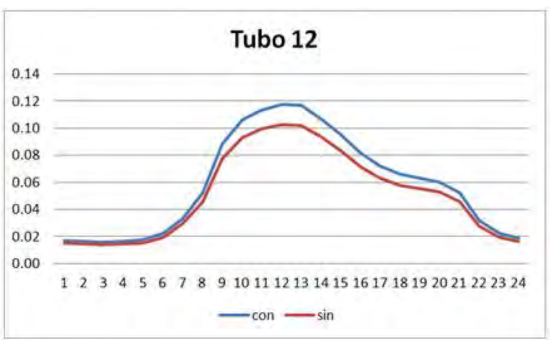
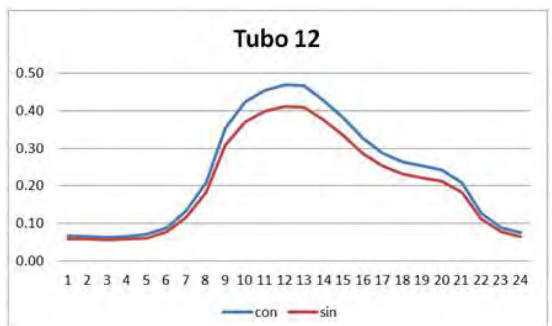
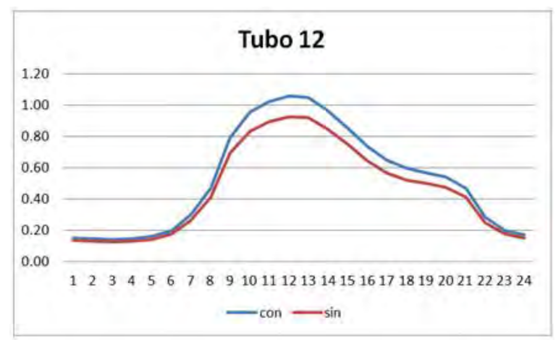


L=300m, d=8”, q=5 l/s

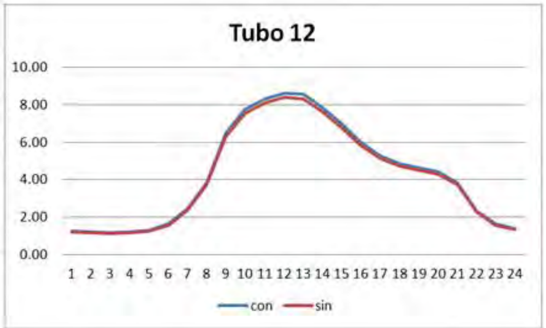


L=300m, d=8”, q=7.5 l/s

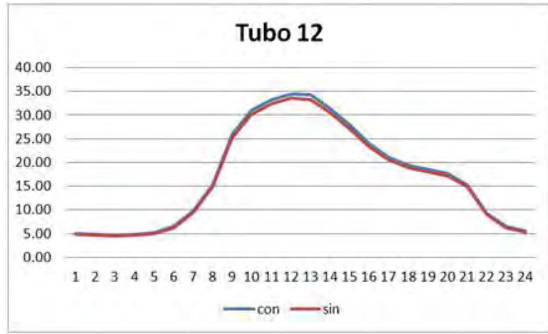


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

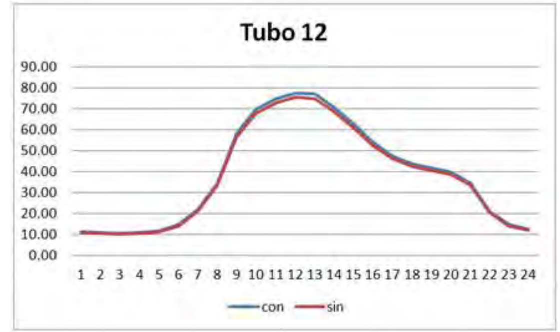
L=600m, d=4”, q=2.5 l/s



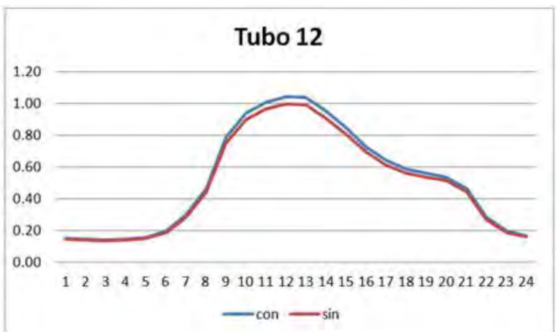
L=600m, d=4”, q=5 l/s



L=600m, d=4”, q=7.5 l/s



L=600m, d=6”, q=2.5 l/s



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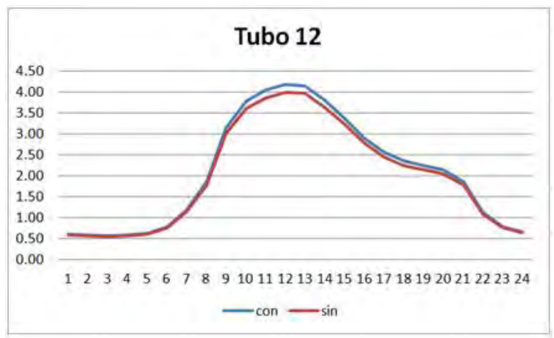
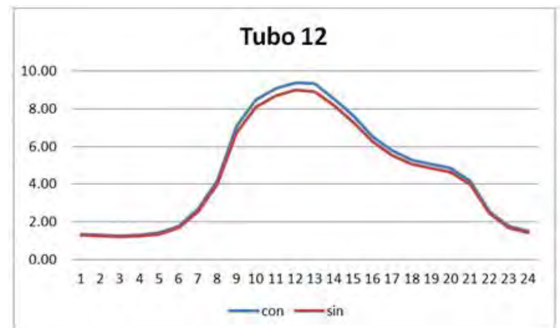
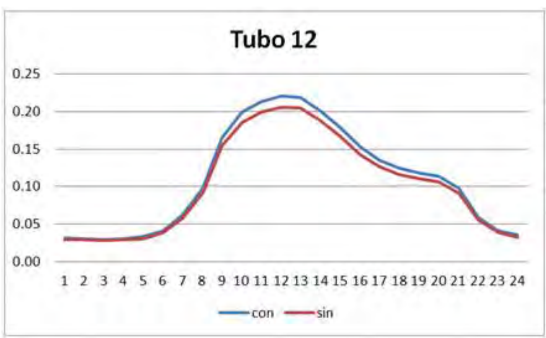


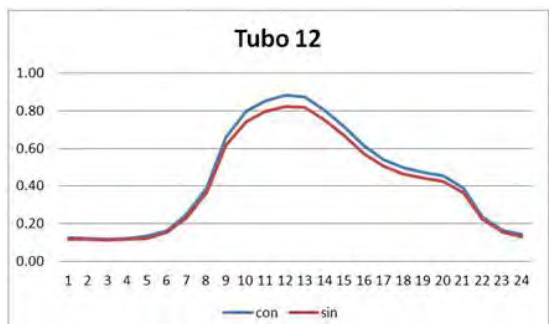
L=600m, d=6”, q=7.5 l/s



L=600m, d=8”, q=2.5 l/s



L=600m, d=8”, q=5 l/s



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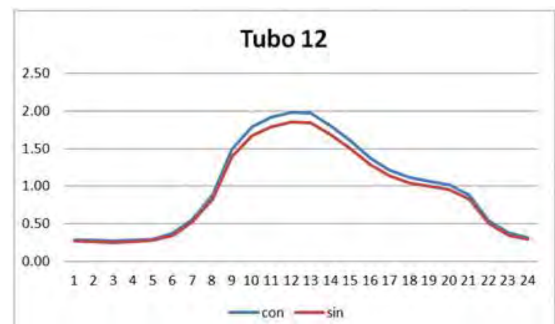
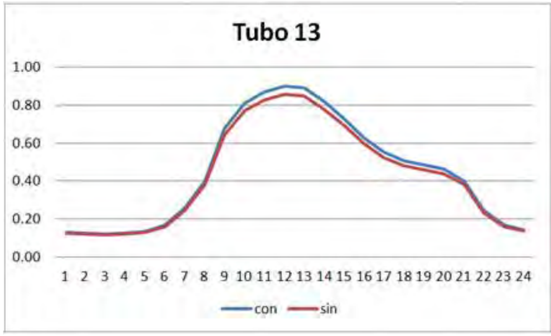
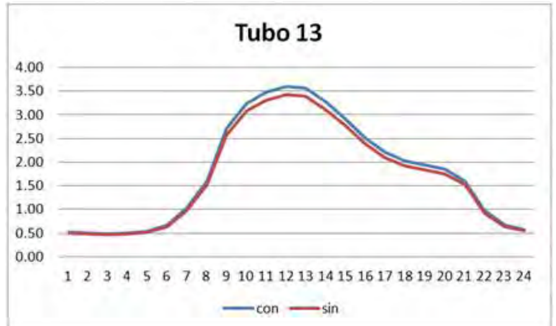


Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

L=100m, d=4”, q=2.5 l/s



L=100m, d=4”, q=5 l/s



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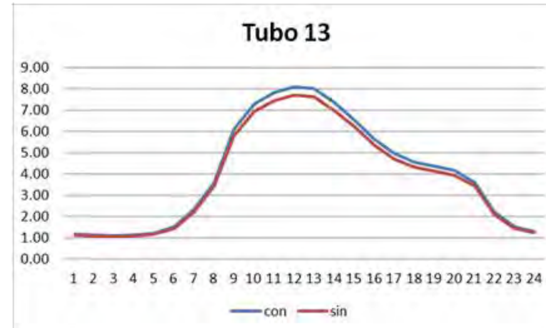

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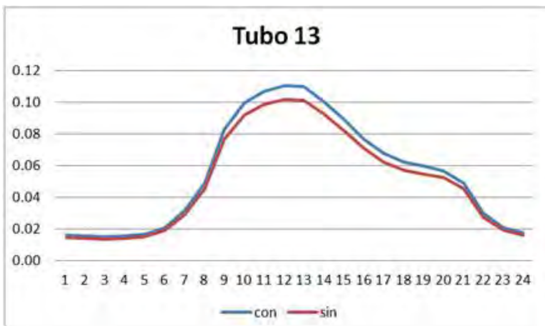
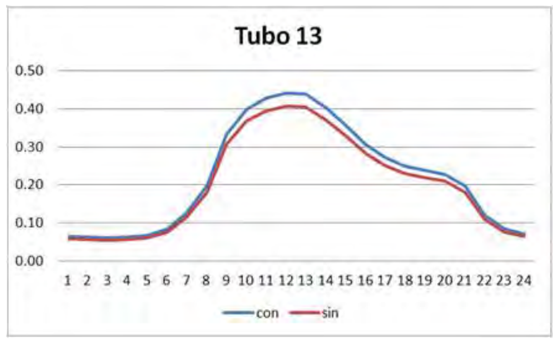


L=100m, d=6”, q=5 l/s



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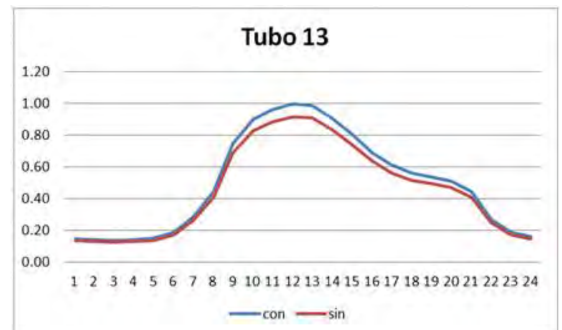

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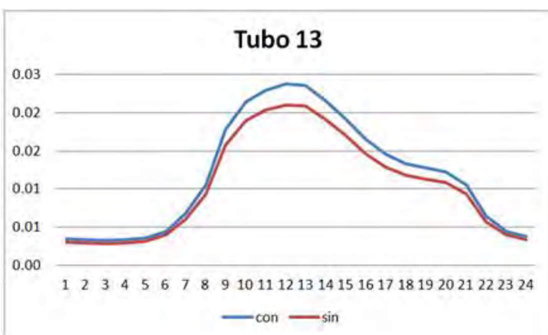
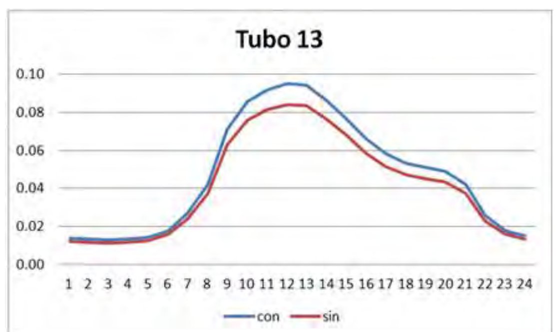


L=100m, d=8”, q=5 l/s



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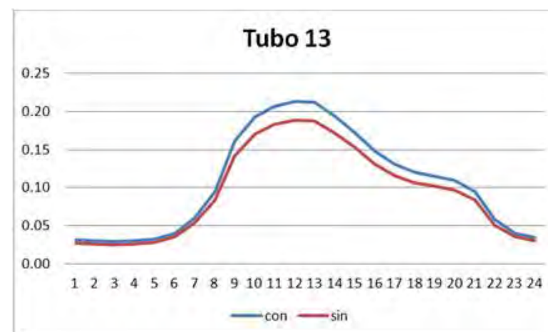
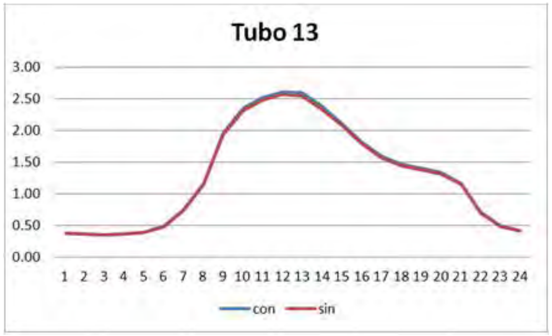


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=300m, d=4”, q=2.5 l/s



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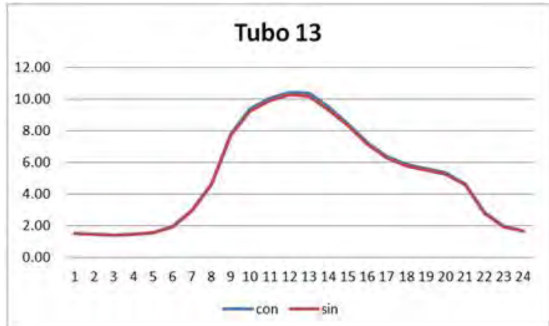

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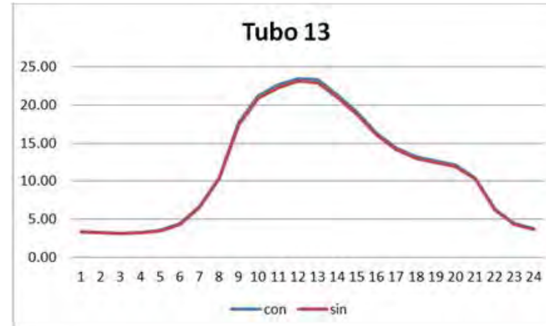

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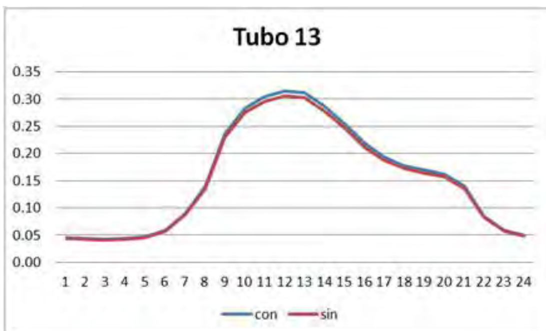
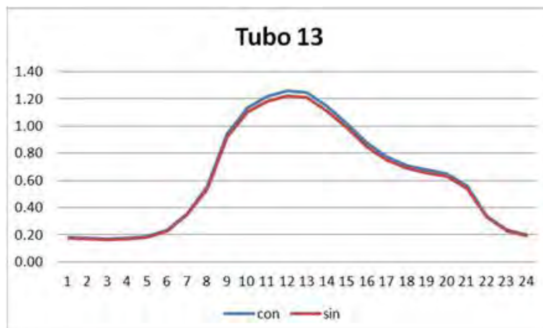


L=300m, d=6”, q=5 l/s



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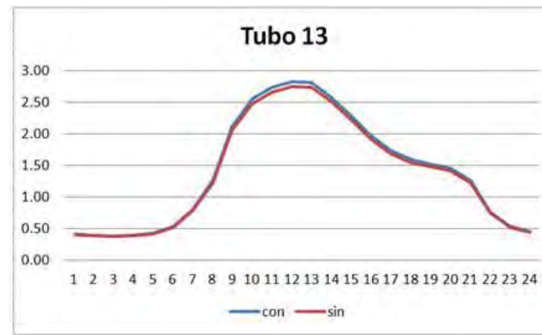

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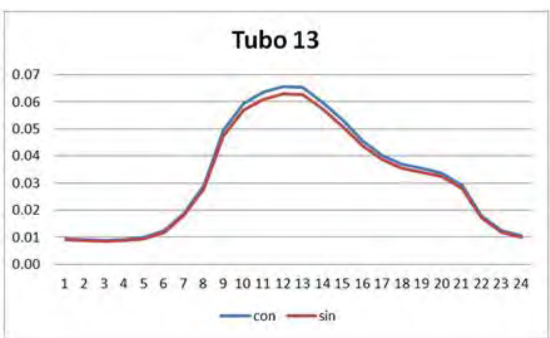
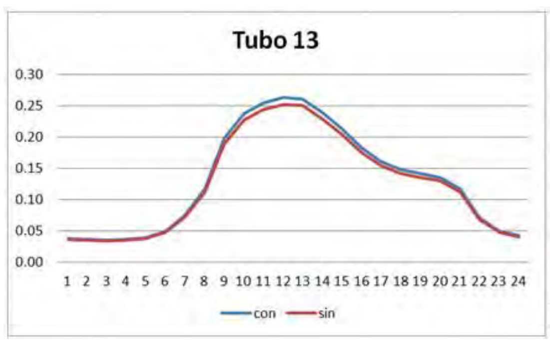
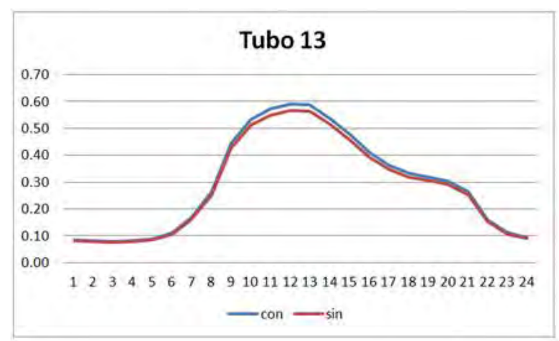


L=300m, d=8”, q=5 l/s

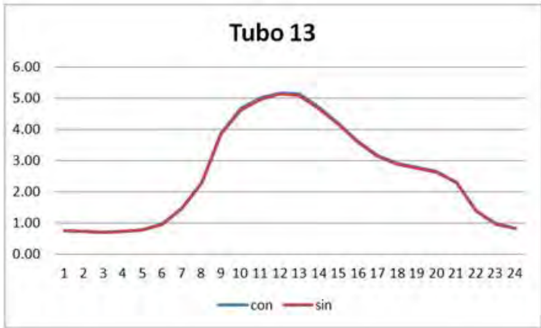


L=300m, d=8”, q=7.5 l/s

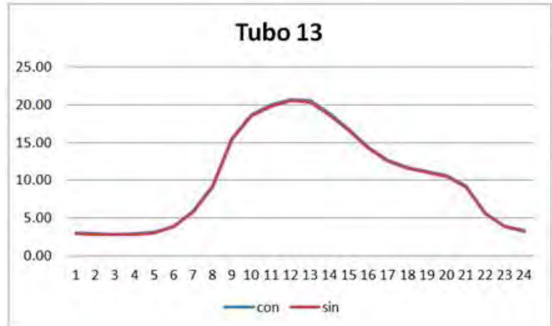


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=600m, d=4”, q=2.5 l/s



L=600m, d=4”, q=5 l/s



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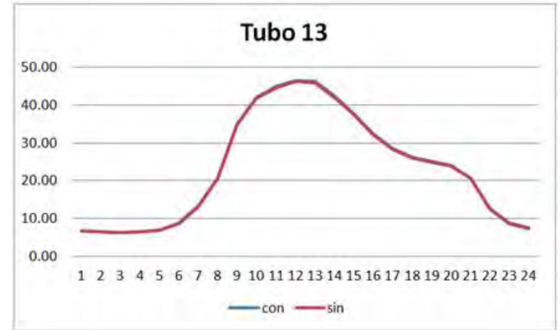

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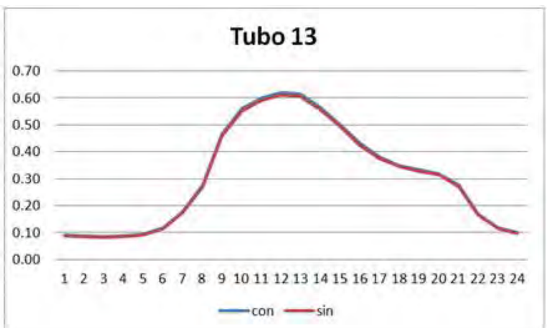

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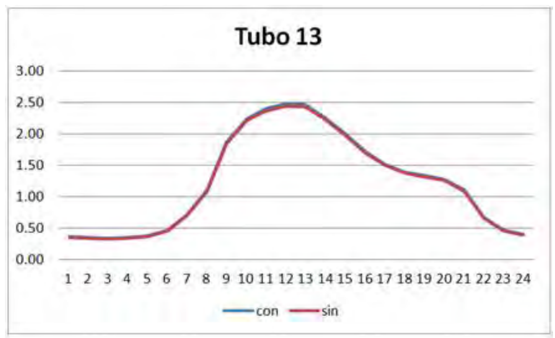
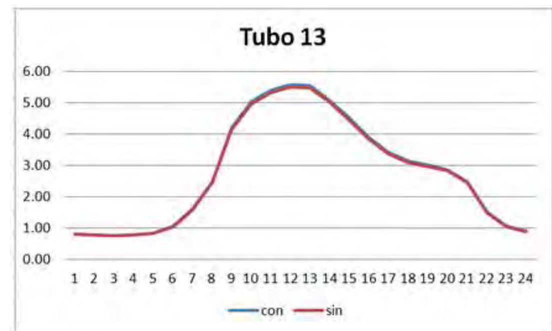


L=600m, d=6”, q=7.5 l/s



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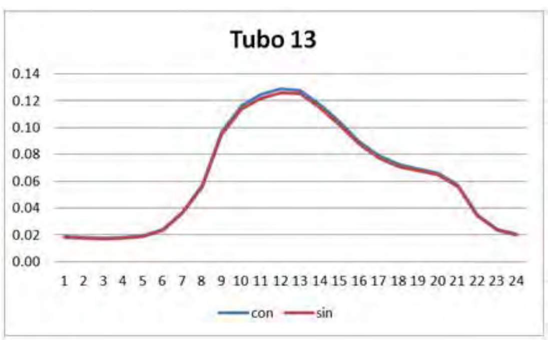

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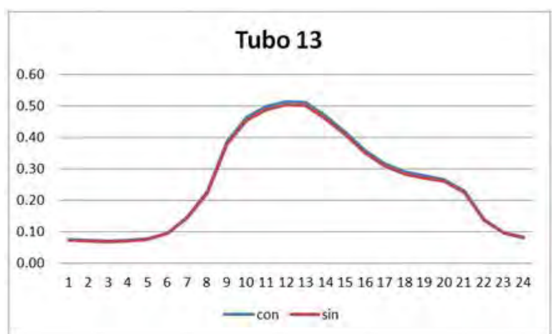

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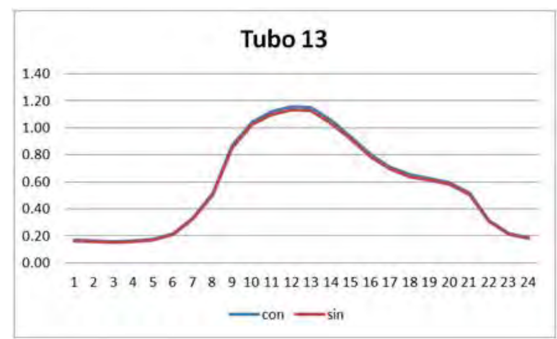
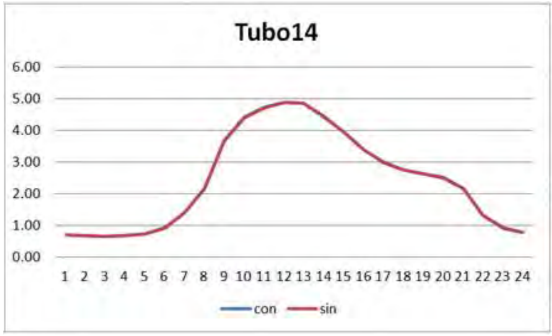


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=100m, d=4”, q=2.5 l/s



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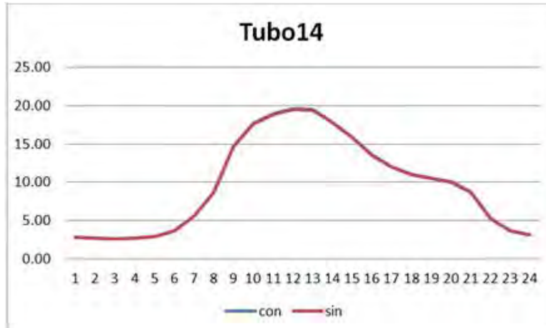

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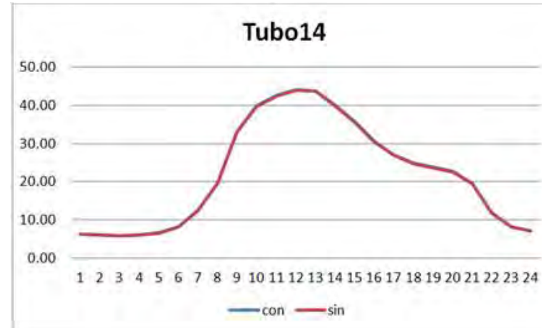

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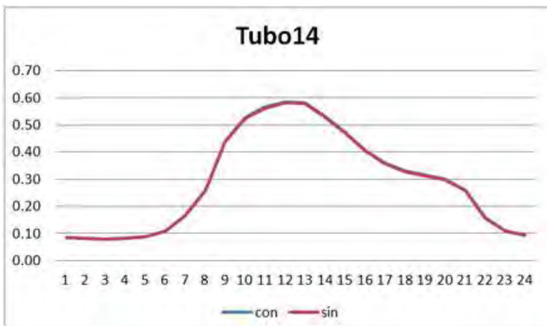
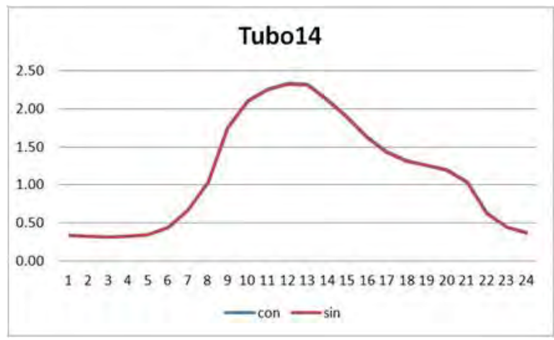
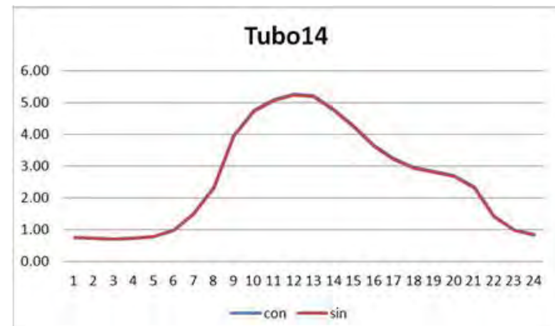


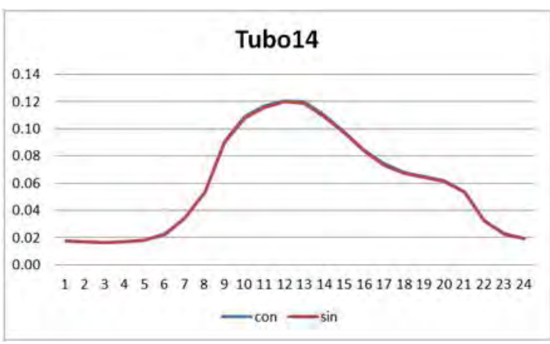
L=100m, d=6”, q=5 l/s



L=100m, d=6”, q=7.5 l/s



L=100m, d=8”, q=2.5 l/s



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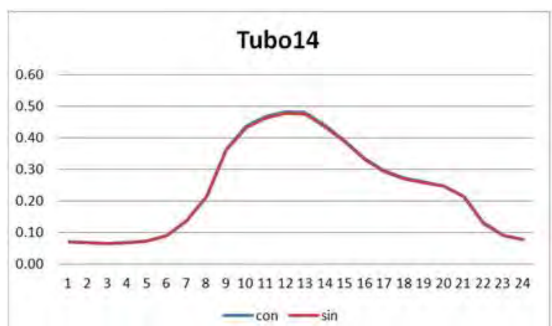
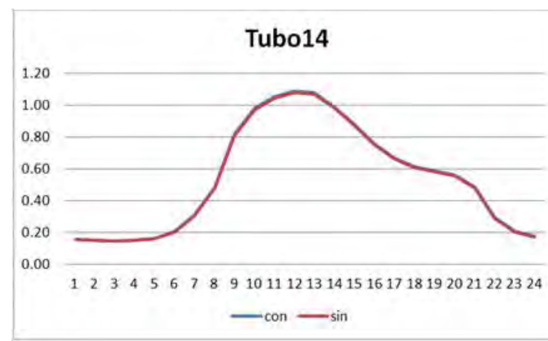
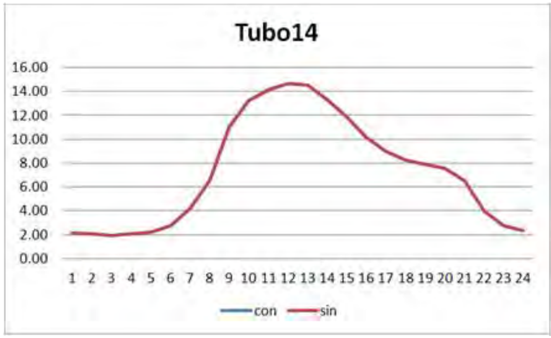


L=100m, d=8”, q=7.5 l/s

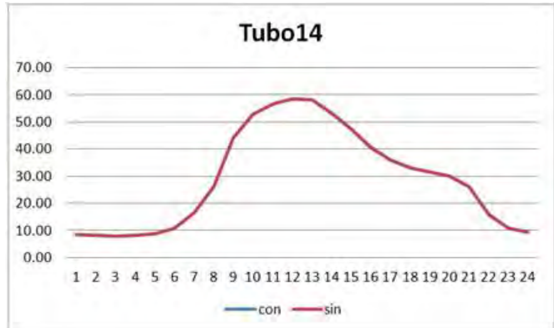


Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

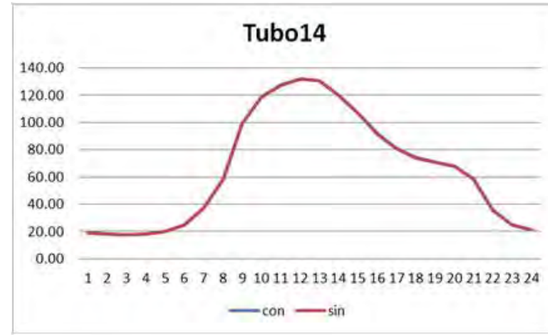
L=300m, d=4", q=2.5 l/s



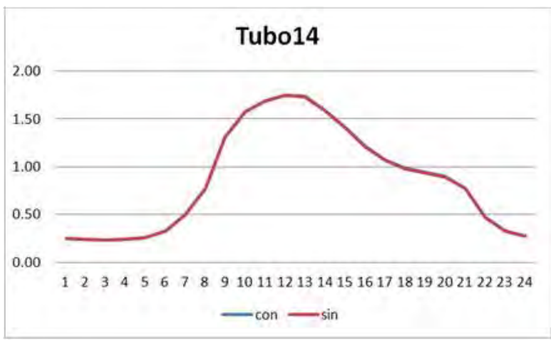
L=300m, d=4", q=5 l/s



L=300m, d=4", q=7.5 l/s



L=300m, d=6", q=2.5 l/s



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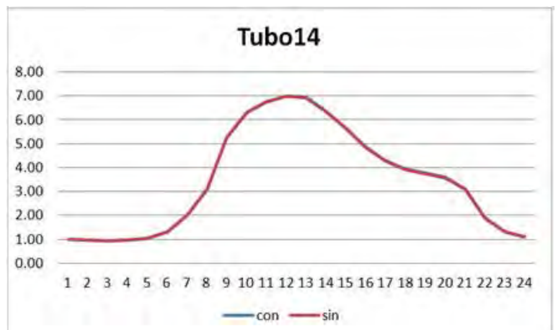
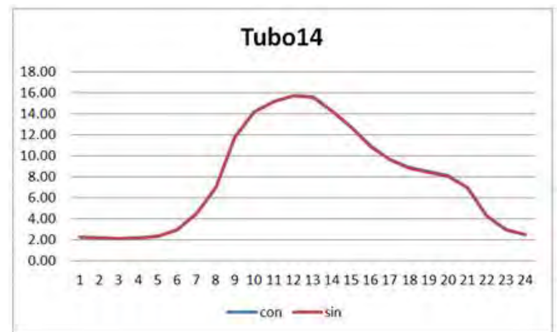


L=300m, d=6", q=7.5 l/s



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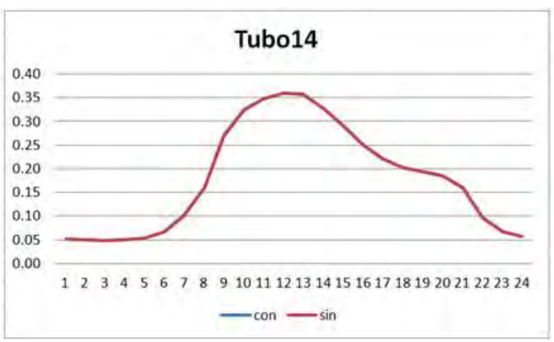
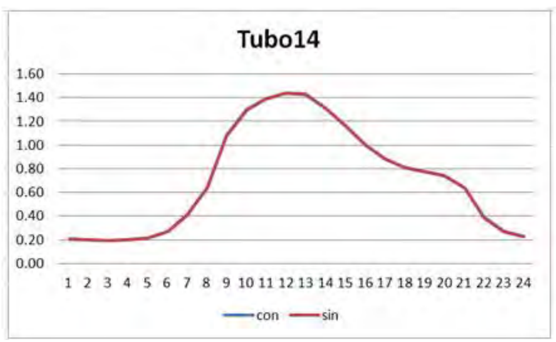
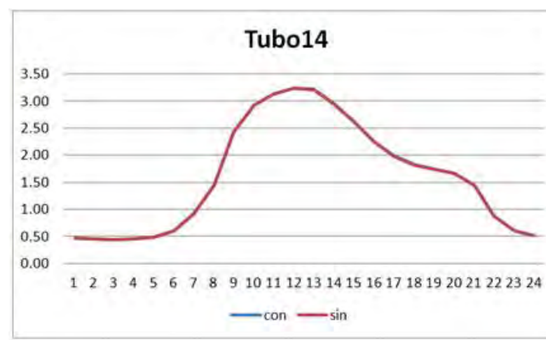


L=300m, d=8", q=5 l/s

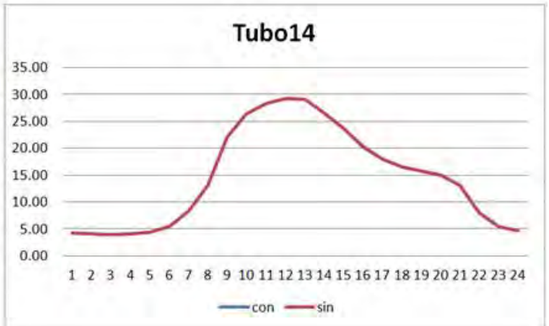


L=300m, d=8", q=7.5 l/s

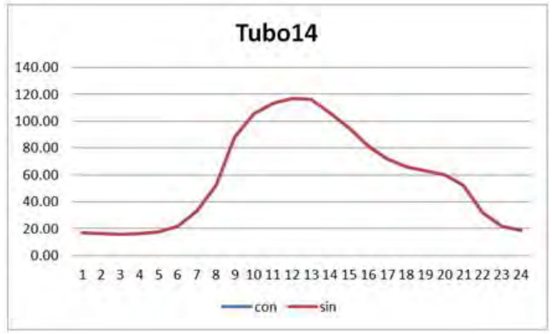


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

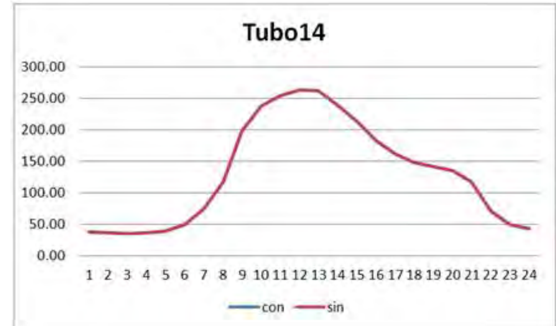
L=600m, d=4”, q=2.5 l/s



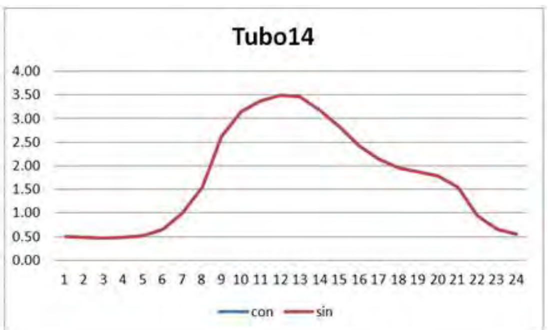
L=600m, d=4”, q=5 l/s



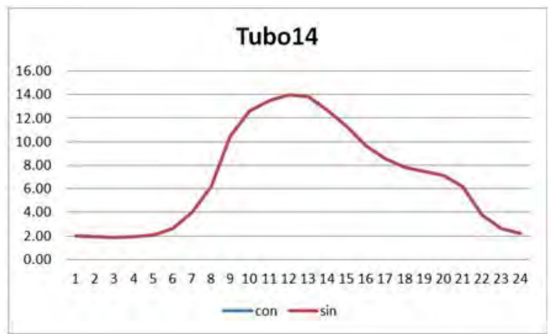
L=600m, d=4”, q=7.5 l/s



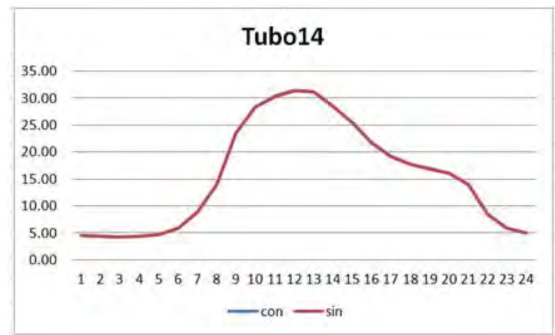
L=600m, d=6”, q=2.5 l/s



L=600m, d=6”, q=5 l/s



L=600m, d=6”, q=7.5 l/s



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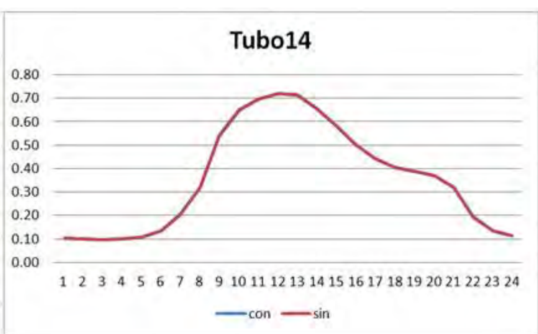
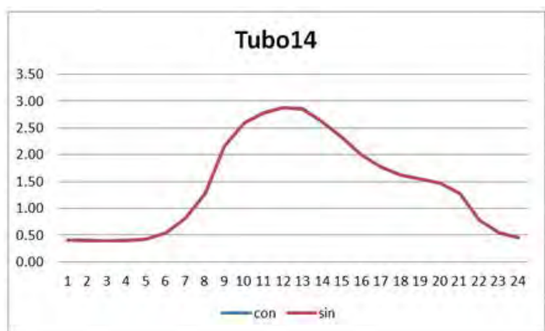
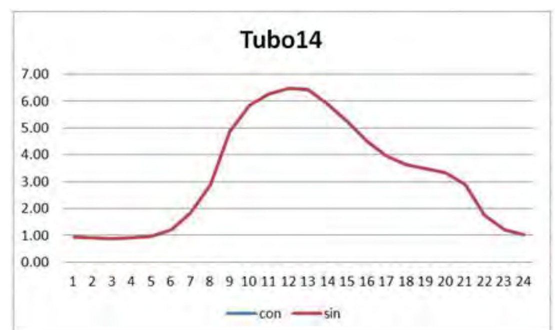


L=600m, d=8”, q=5 l/s

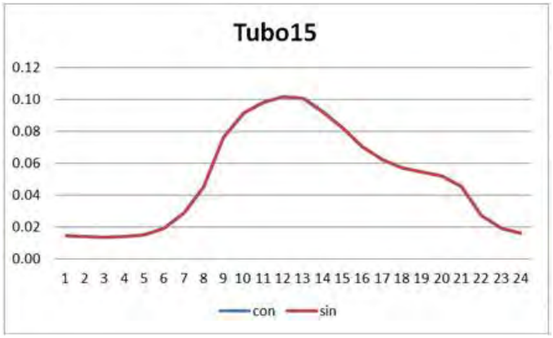


L=600m, d=8”, q=7.5 l/s

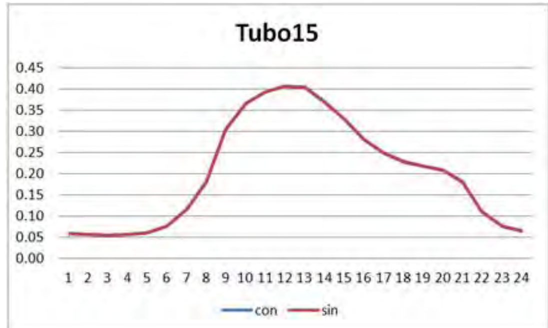


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

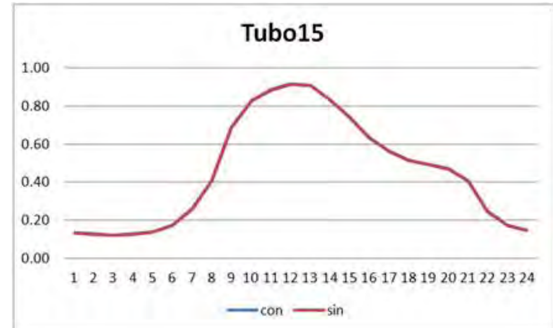
L=100m, d=4”, q=2.5 l/s



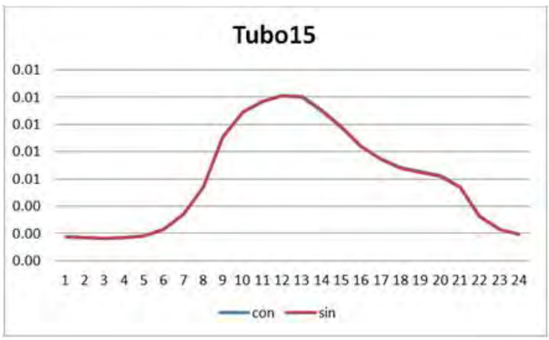
L=100m, d=4”, q=5 l/s



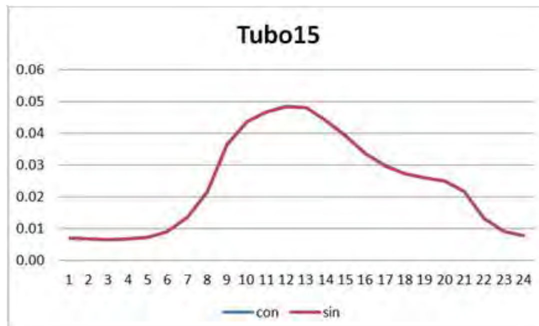
L=100m, d=4”, q=7.5 l/s



L=100m, d=6”, q=2.5 l/s



L=100m, d=6”, q=5 l/s



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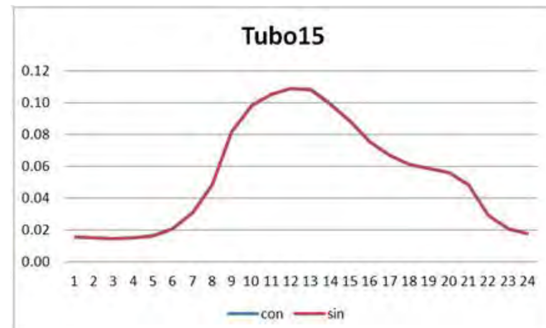
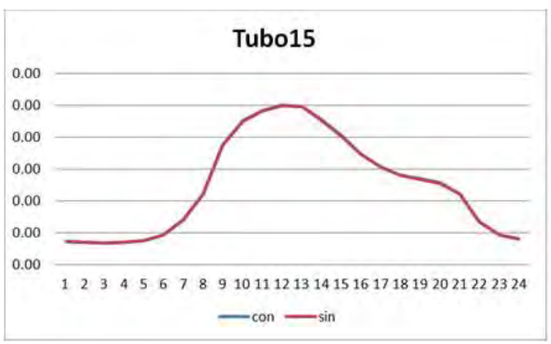
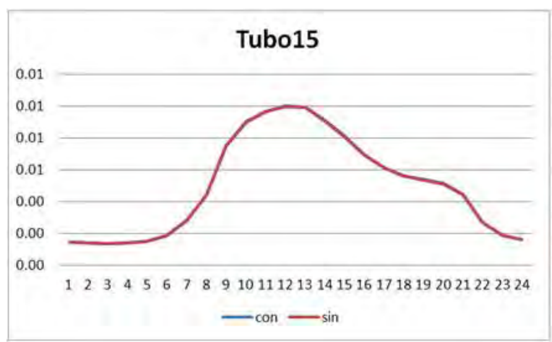


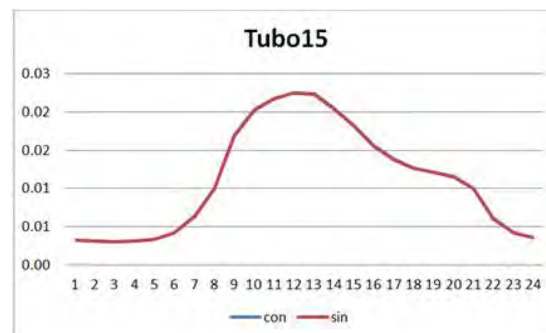
L=100m, d=8”, q=2.5 l/s



L=100m, d=8”, q=5 l/s

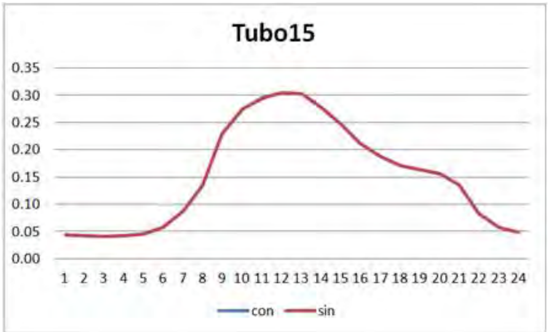


L=100m, d=8”, q=7.5 l/s

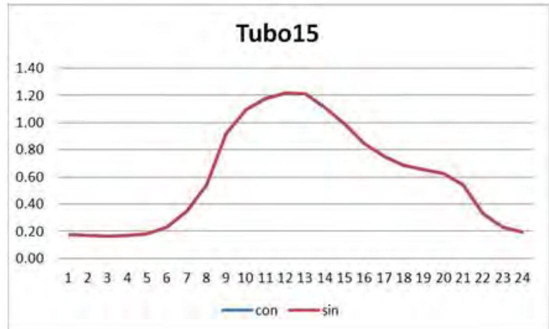


Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

L=300m, d=4”, q=2.5 l/s



L=300m, d=4”, q=5 l/s



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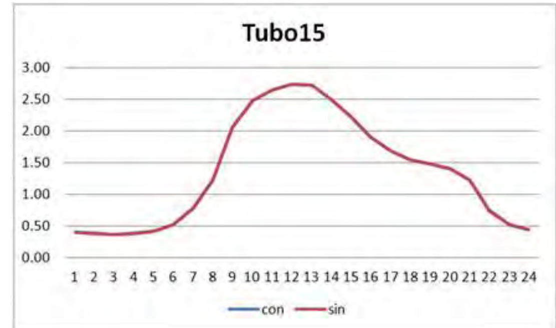

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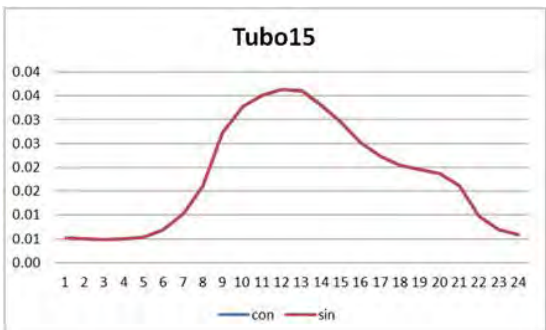

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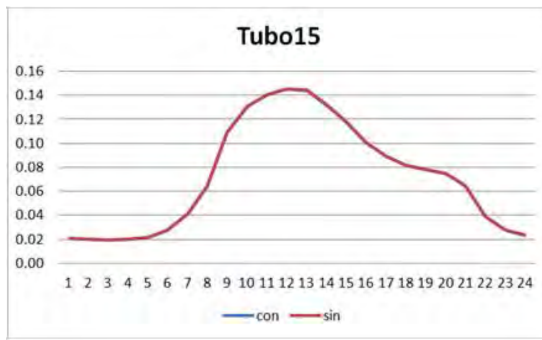

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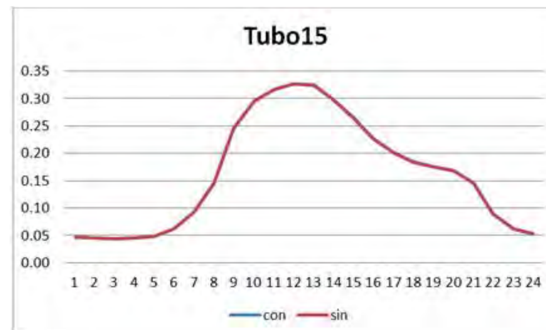

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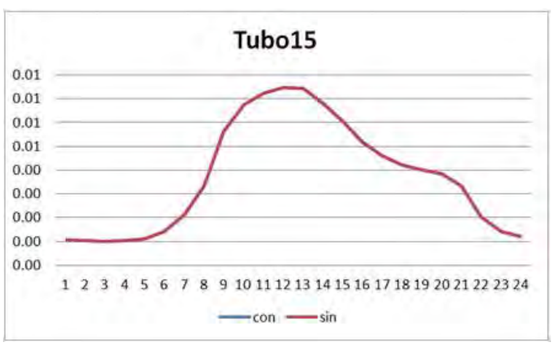

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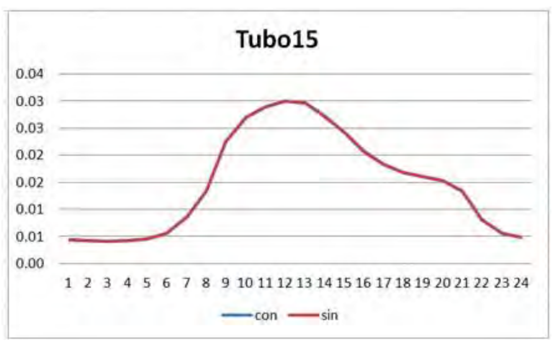
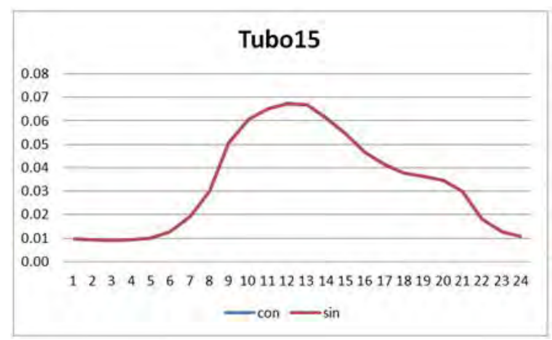


L=300m, d=8”, q=7.5 l/s



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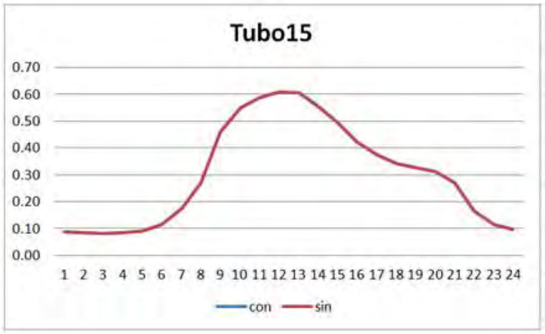

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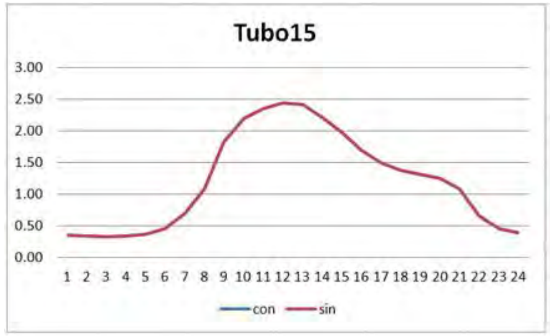

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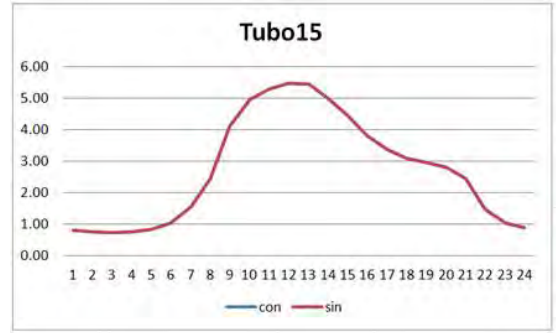

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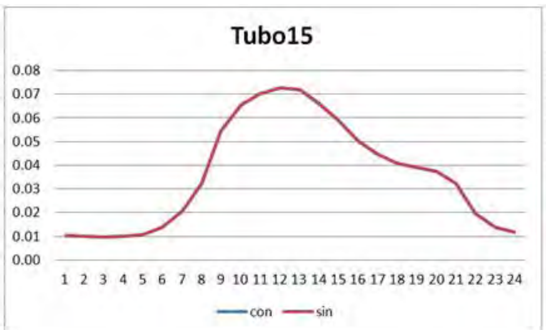

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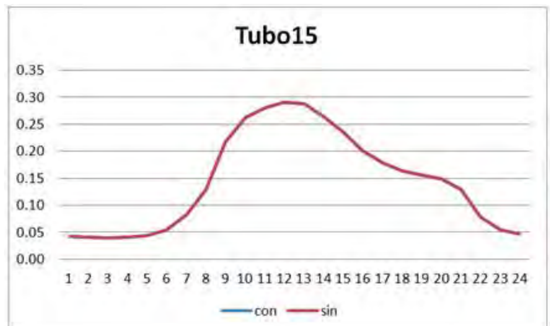

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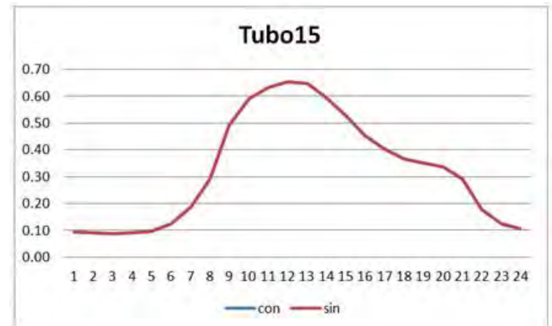

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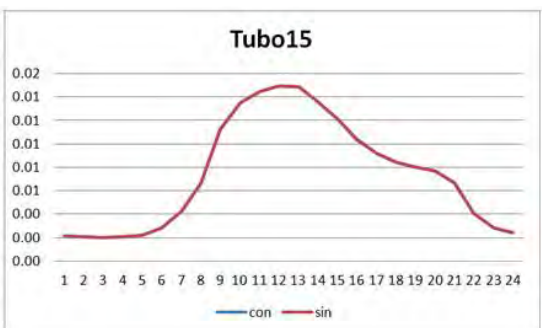
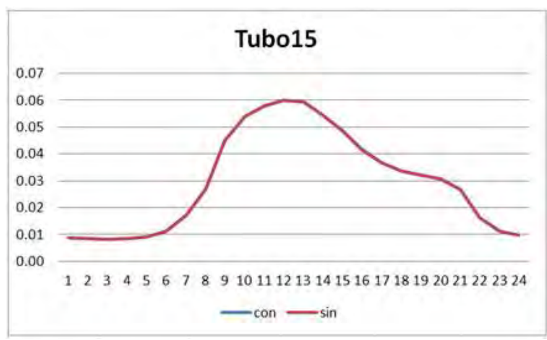
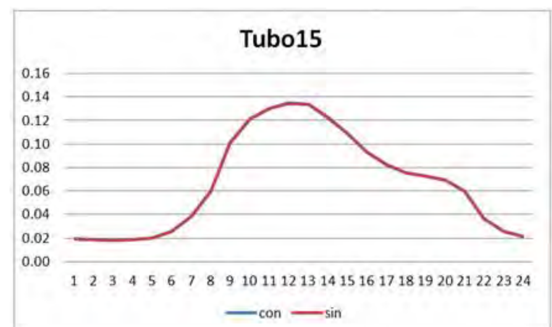


L=600m, d=8", q=5 l/s

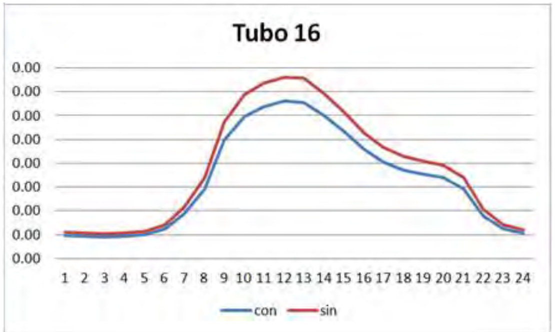


L=600m, d=8", q=7.5 l/s

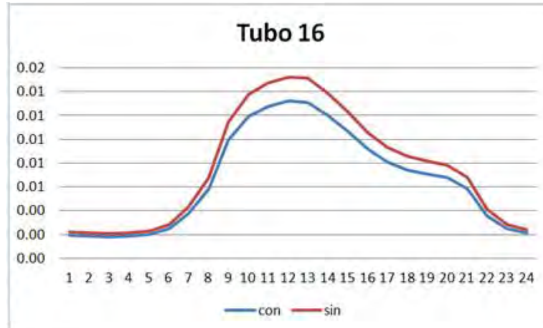


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

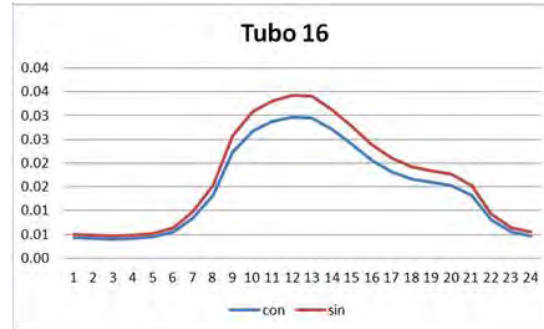
L=100m, d=4”, q=2.5 l/s



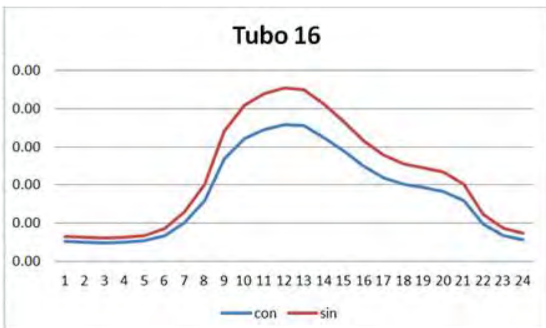
L=100m, d=4”, q=5 l/s



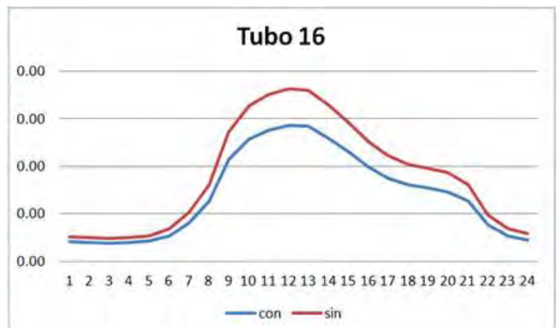
L=100m, d=4”, q=7.5 l/s



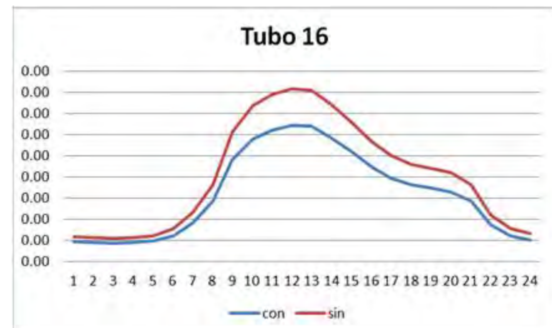
L=100m, d=6”, q=2.5 l/s



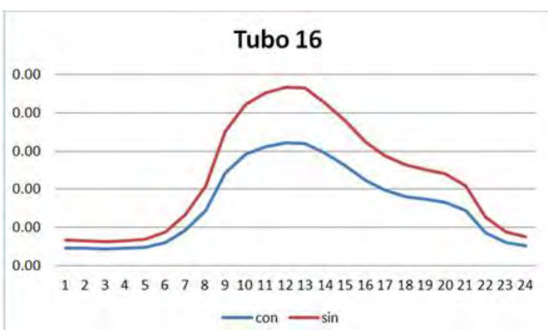
L=100m, d=6”, q=5 l/s



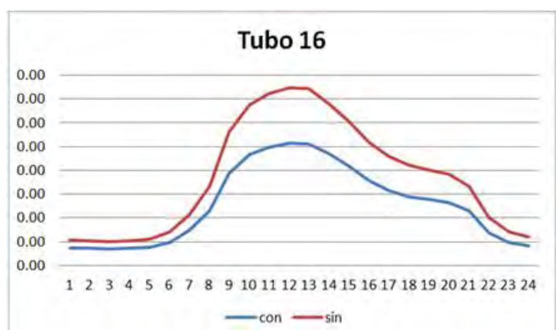
L=100m, d=6”, q=7.5 l/s



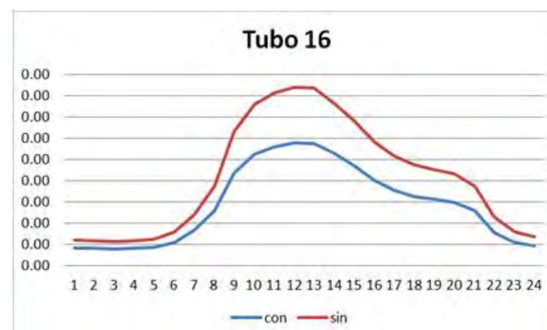
L=100m, d=8”, q=2.5 l/s



L=100m, d=8”, q=5 l/s

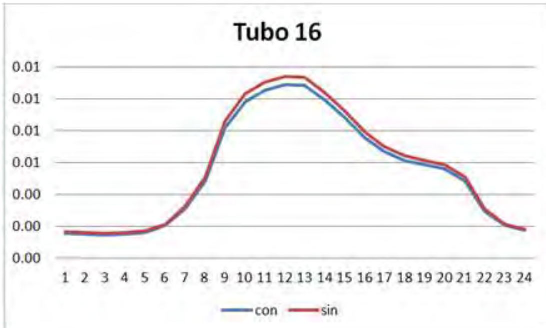


L=100m, d=8”, q=7.5 l/s

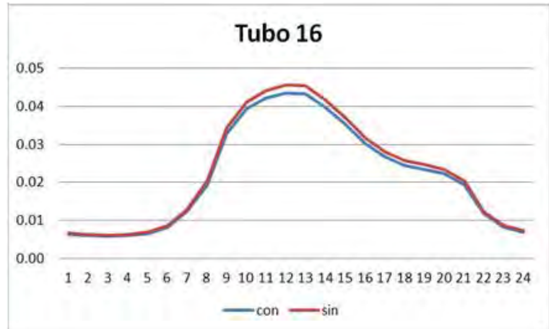


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

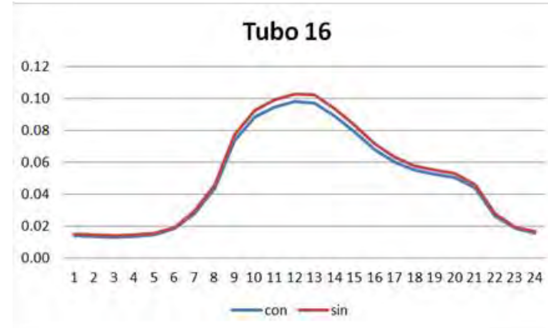
L=300m, d=4", q=2.5 l/s



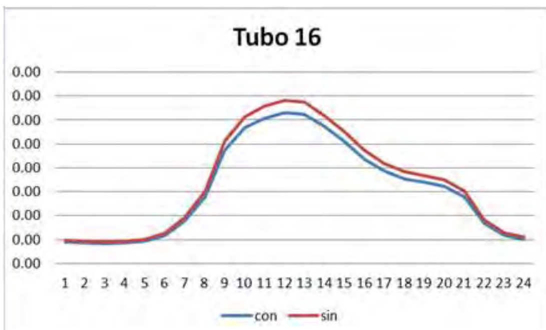
L=300m, d=4", q=5 l/s



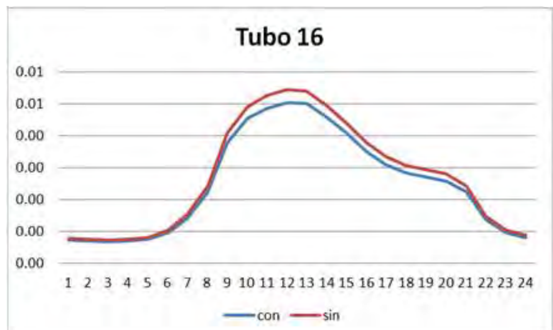
L=300m, d=4", q=7.5 l/s



L=300m, d=6", q=2.5 l/s



L=300m, d=6", q=5 l/s



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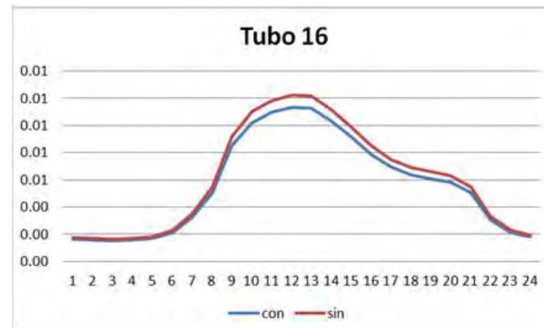
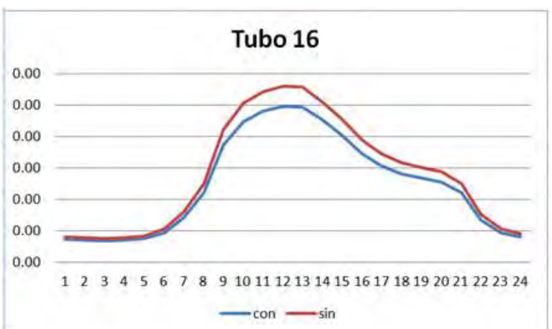
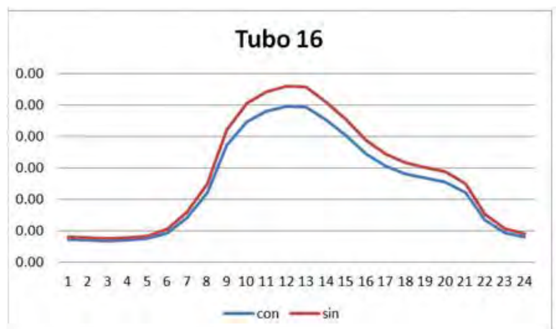


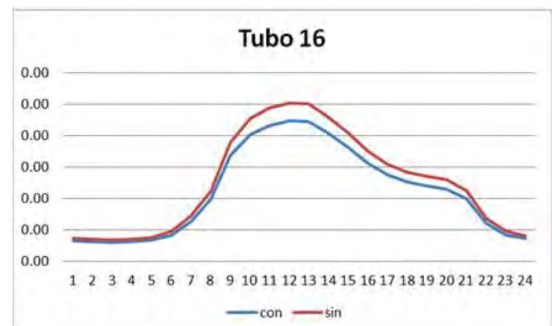
L=300m, d=8", q=2.5 l/s



L=300m, d=8", q=5 l/s

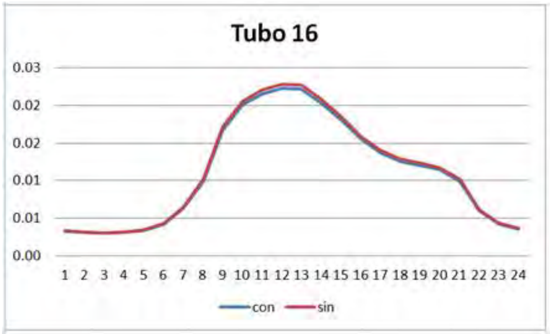


L=300m, d=8", q=7.5 l/s



Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=600m, d=4”, q=2.5 l/s



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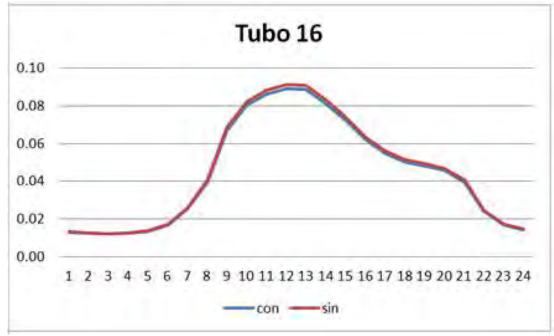
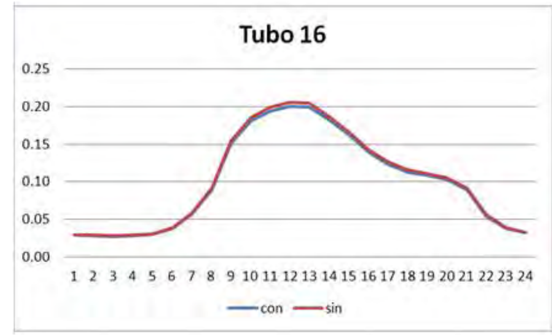
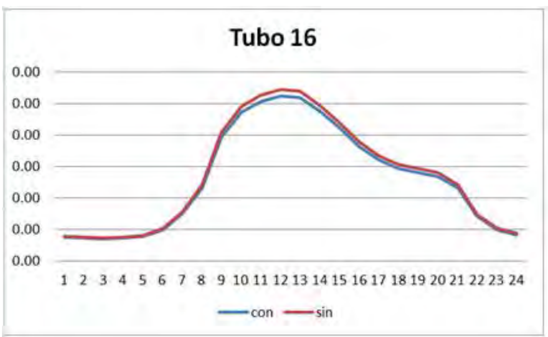


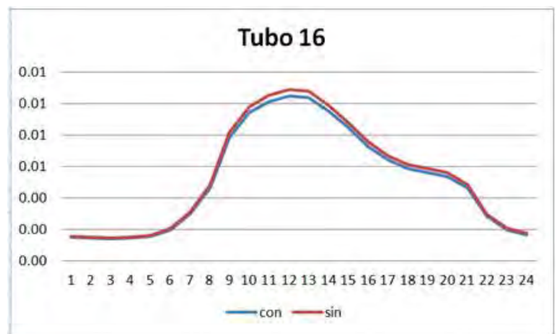
L=600m, d=4”, q=7.5 l/s



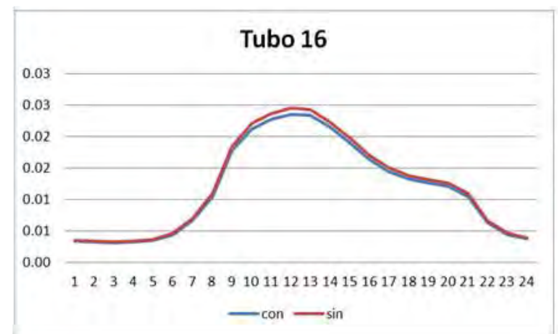
L=600m, d=6”, q=2.5 l/s



L=600m, d=6”, q=5 l/s



L=600m, d=6”, q=7.5 l/s



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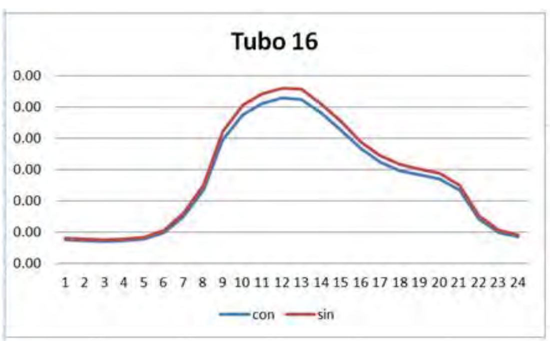
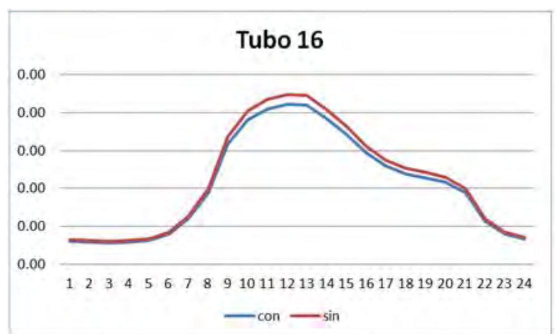
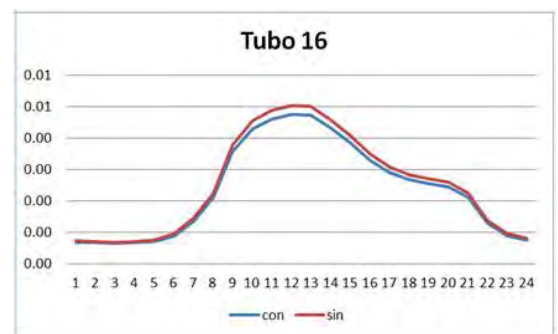


L=600m, d=8”, q=5 l/s

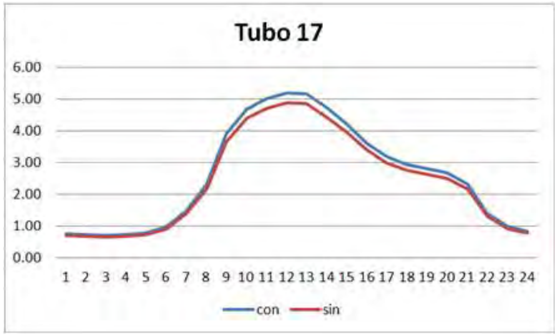


L=600m, d=8”, q=7.5 l/s

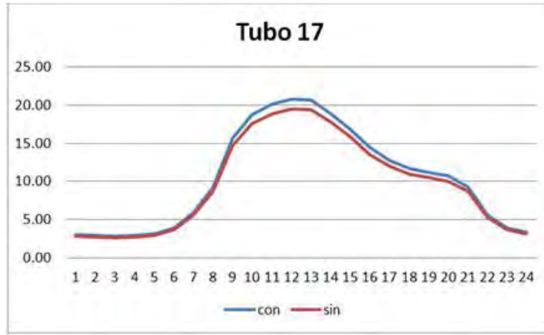


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=100m, d=4", q=2.5 l/s



L=100m, d=4", q=5 l/s



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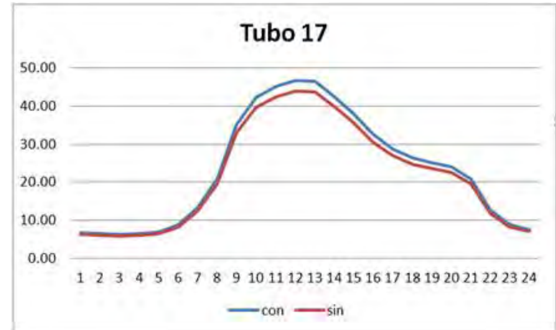
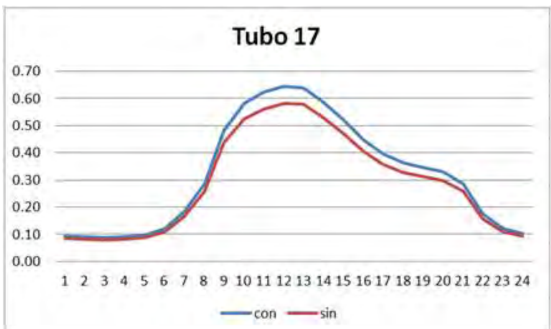
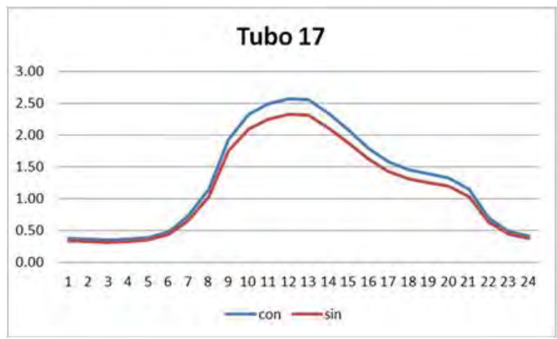


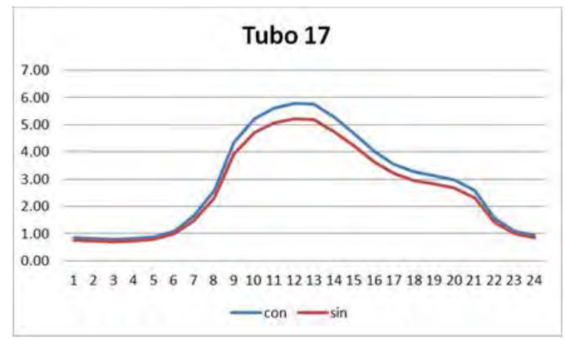
L=100m, d=6", q=2.5 l/s



L=100m, d=6", q=5 l/s



L=100m, d=6", q=7.5 l/s



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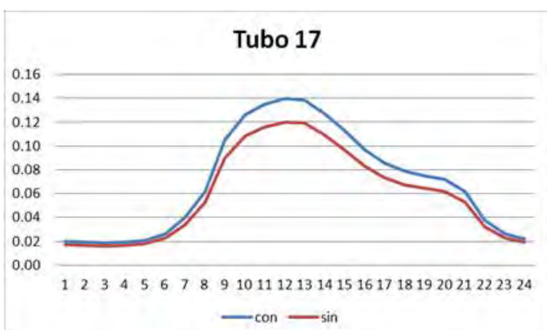
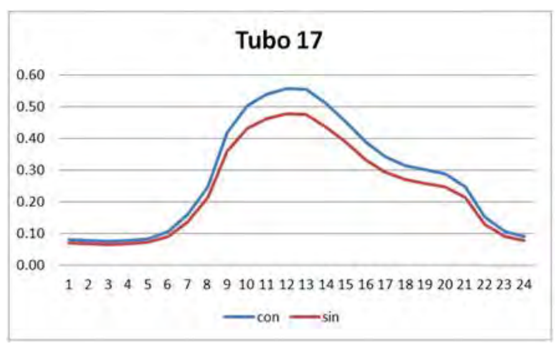
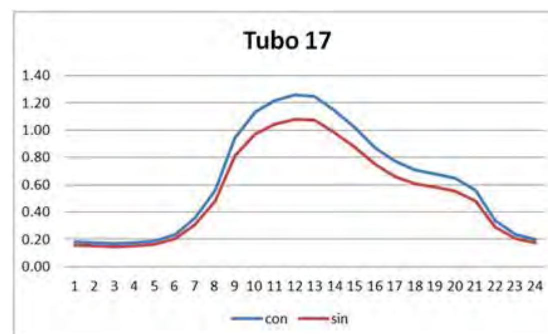


L=100m, d=8", q=5 l/s

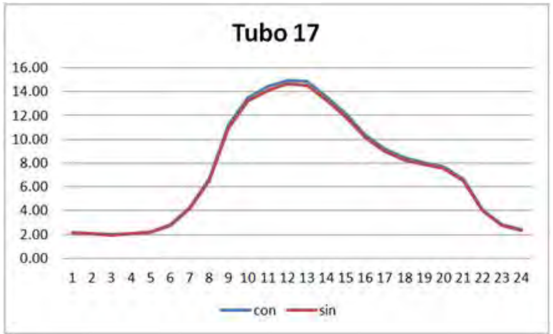


L=100m, d=8", q=7.5 l/s

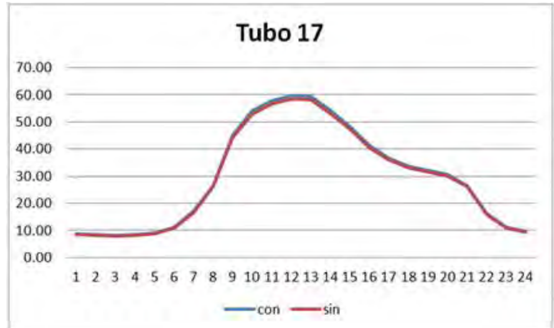


Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

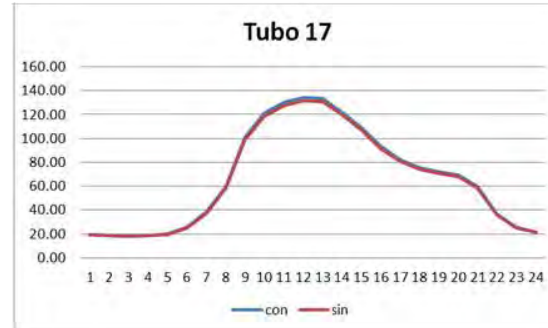
L=300m, d=4”, q=2.5 l/s



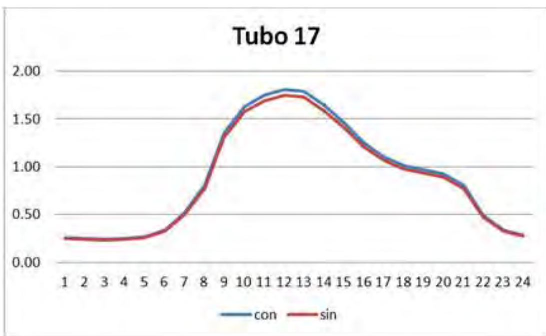
L=300m, d=4”, q=5 l/s



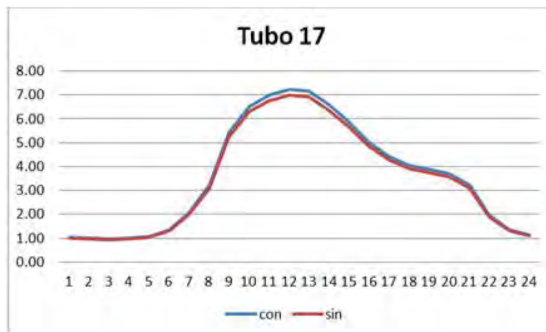
L=300m, d=4”, q=7.5 l/s



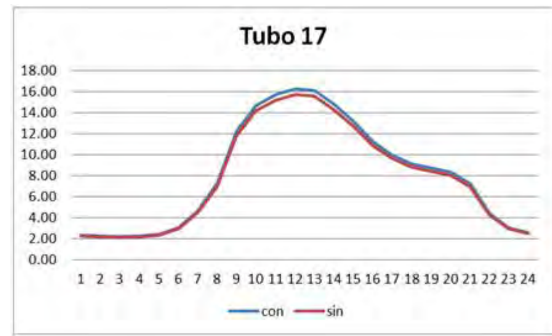
L=300m, d=6”, q=2.5 l/s



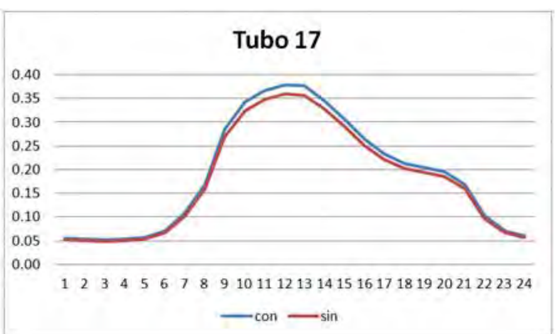
L=300m, d=6”, q=5 l/s



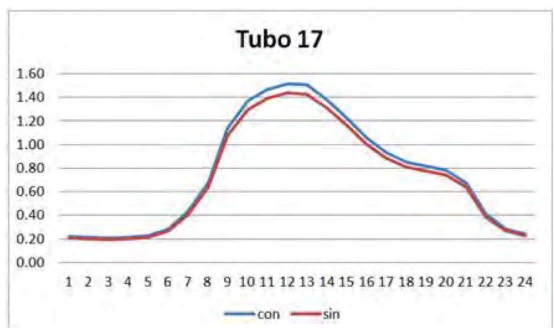
L=300m, d=6”, q=7.5 l/s



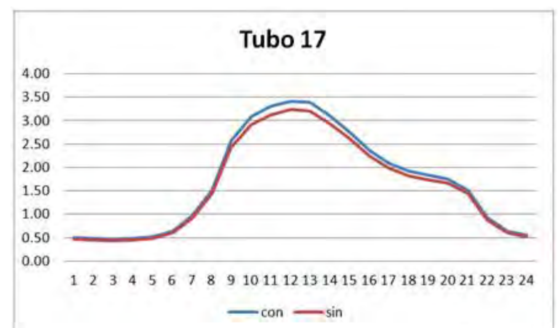
L=300m, d=8”, q=2.5 l/s



L=300m, d=8”, q=5 l/s

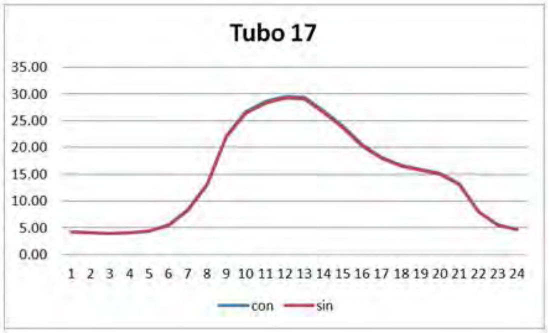


L=300m, d=8”, q=7.5 l/s



 eje x: horas, eje y:metros

L=600m, d=4”, q=2.5 l/s



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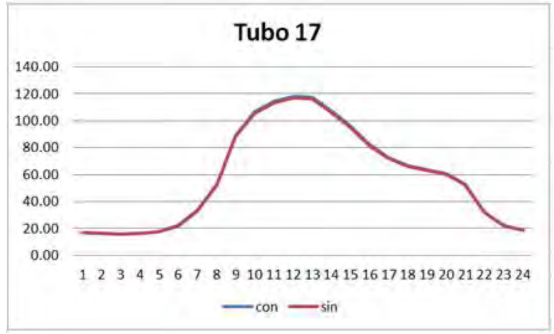

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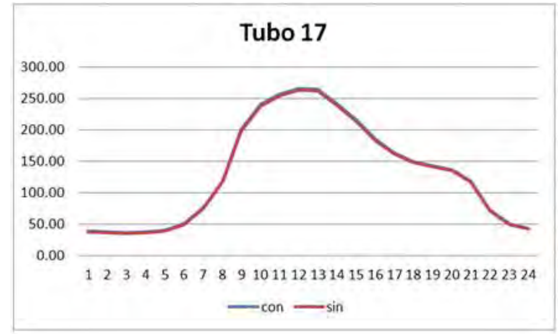

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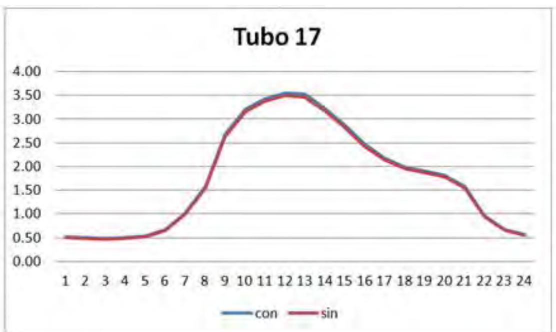

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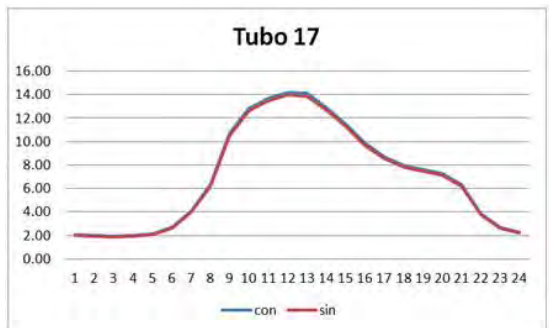

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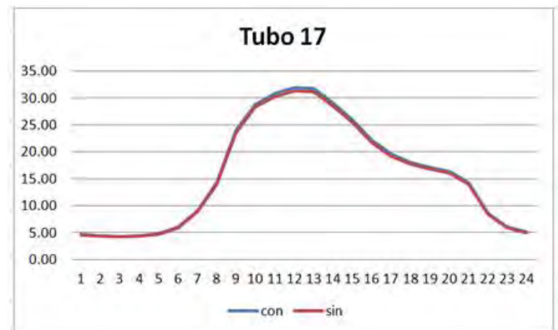

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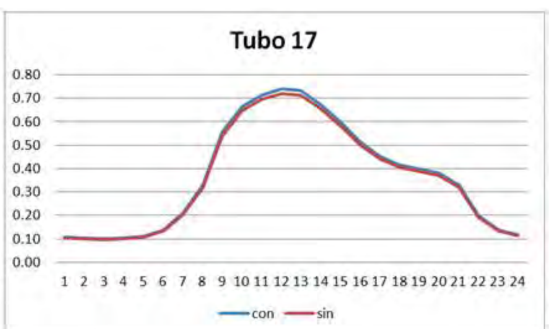
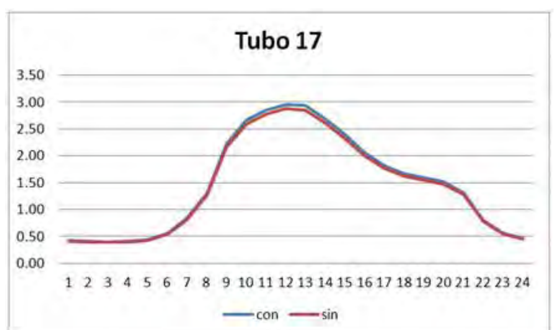
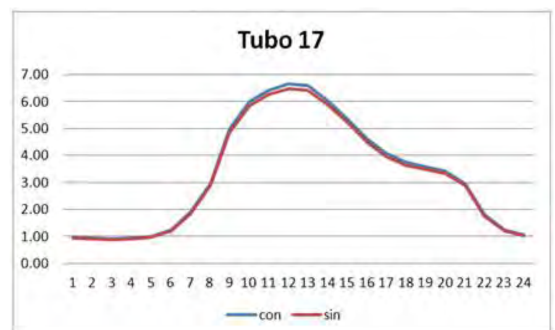


L=600m, d=8”, q=5 l/s

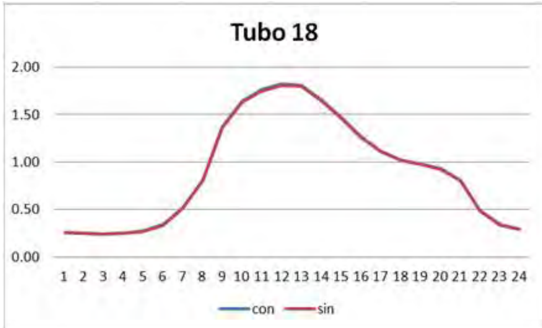


L=600m, d=8”, q=7.5 l/s



Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=100m, d=4”, q=2.5 l/s



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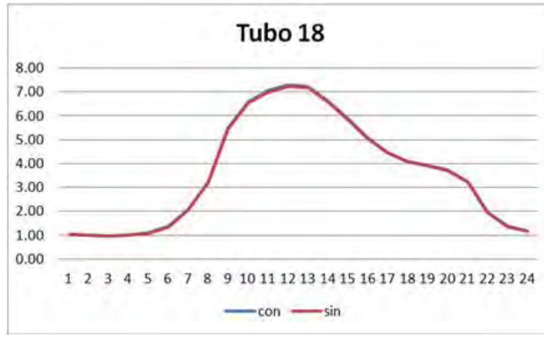

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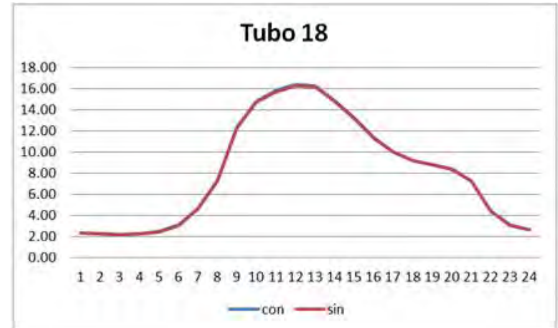

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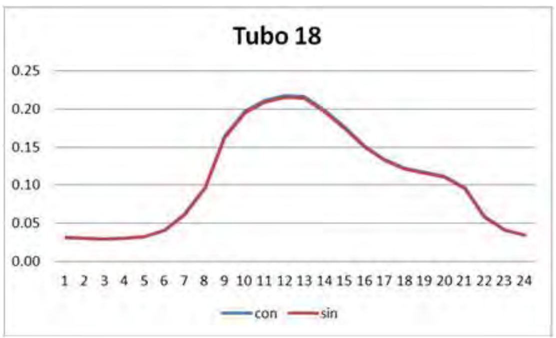

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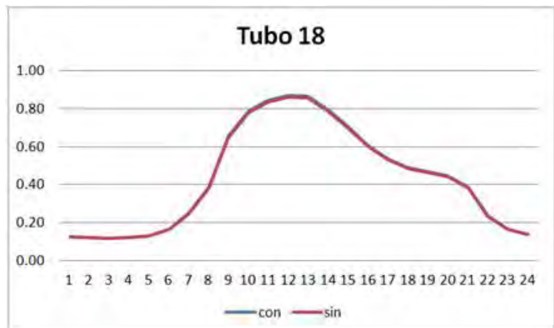

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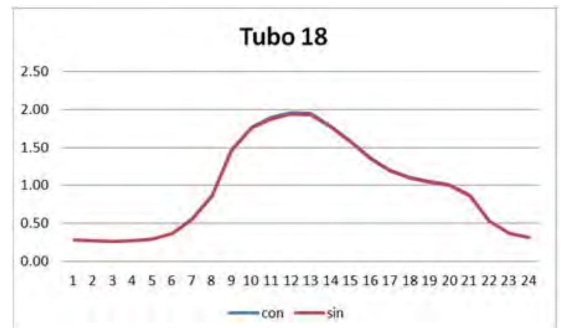

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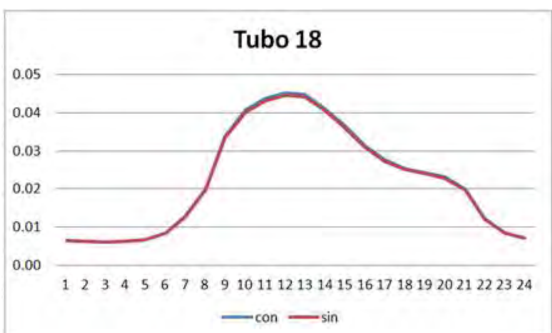

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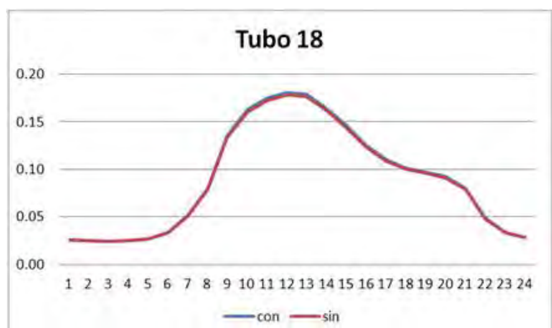
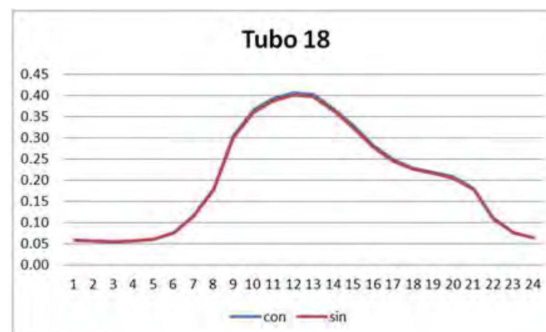
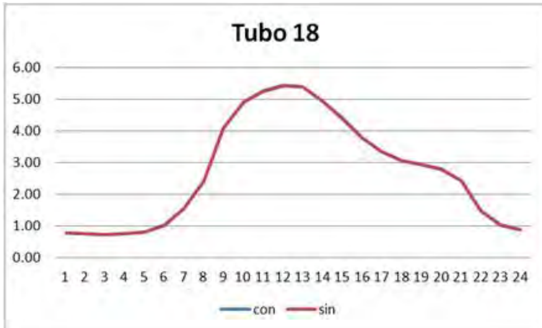


L=100m, d=8”, q=7.5 l/s

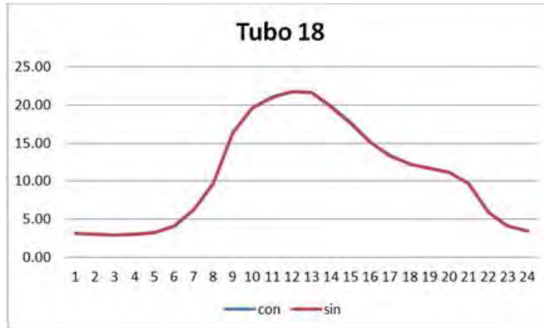


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

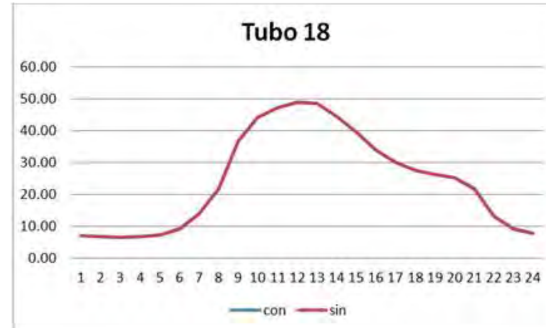
L=300m, d=4”, q=2.5 l/s



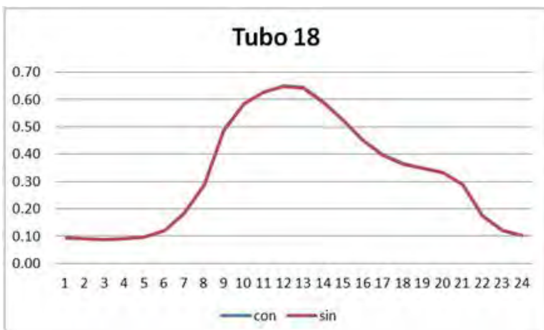
L=300m, d=4”, q=5 l/s



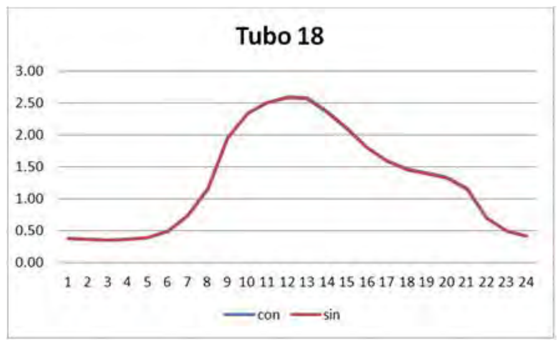
L=300m, d=4”, q=7.5 l/s



L=300m, d=6”, q=2.5 l/s



L=300m, d=6”, q=5 l/s



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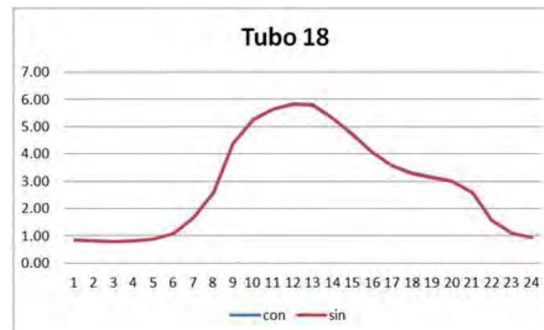

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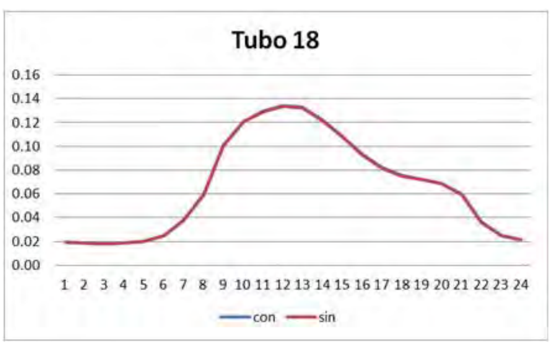
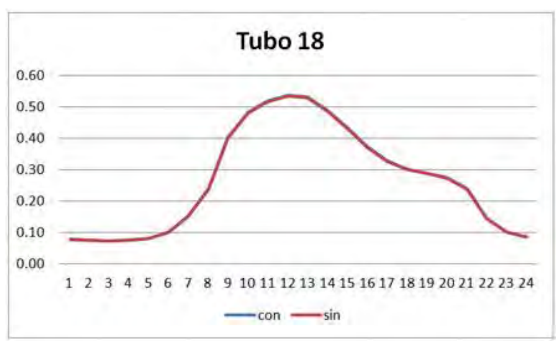
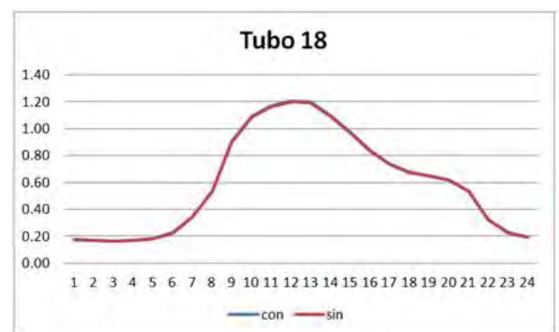


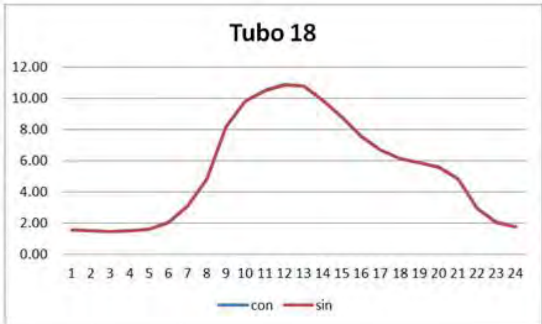
L=300m, d=8”, q=5 l/s



L=300m, d=8”, q=7.5 l/s



L=600m, d=4", q=2.5 l/s



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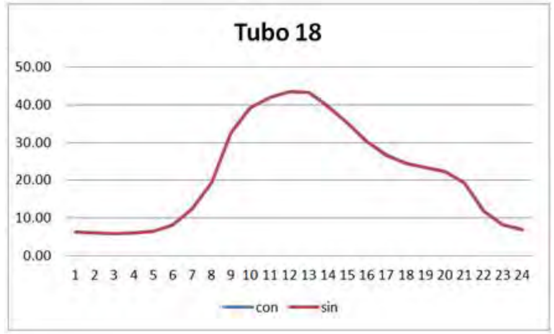

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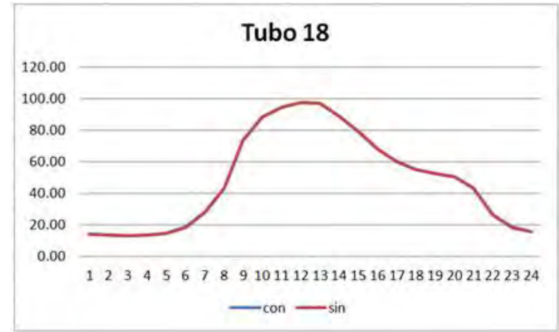

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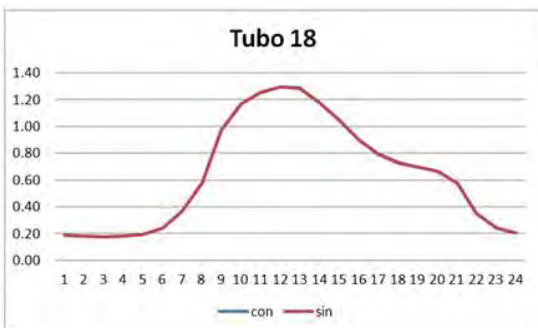

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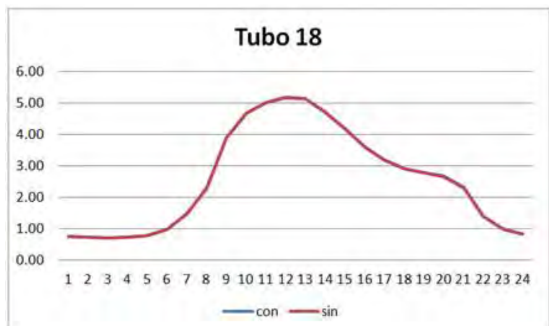

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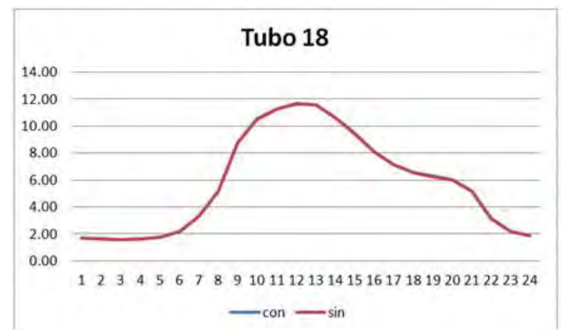
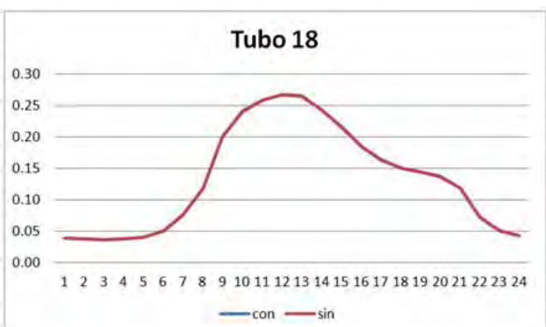
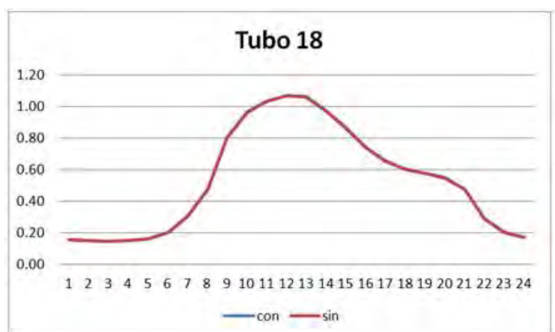


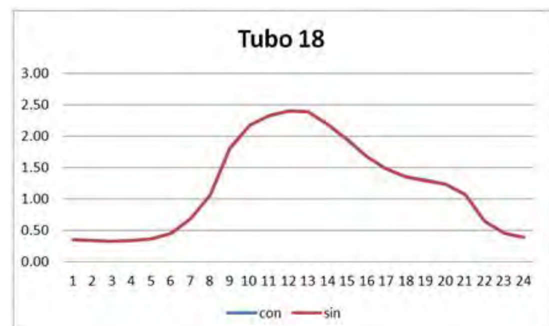
L=600m, d=8", q=2.5 l/s



L=600m, d=8", q=5 l/s

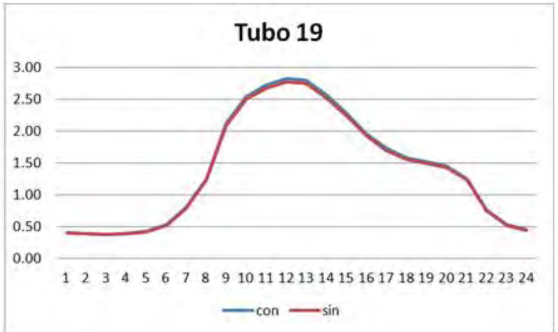


L=600m, d=8", q=7.5 l/s



Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

L=100m, d=4”, q=2.5 l/s



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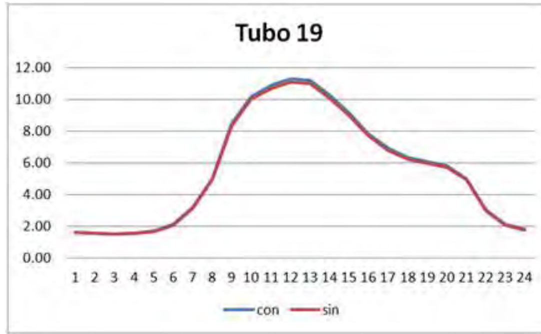

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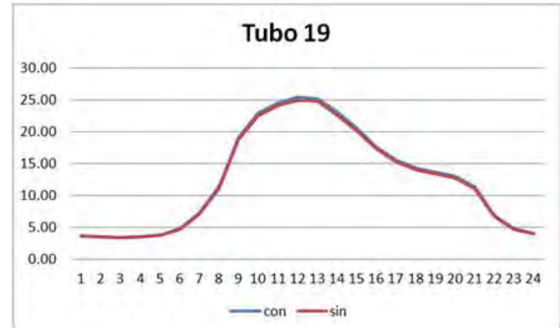
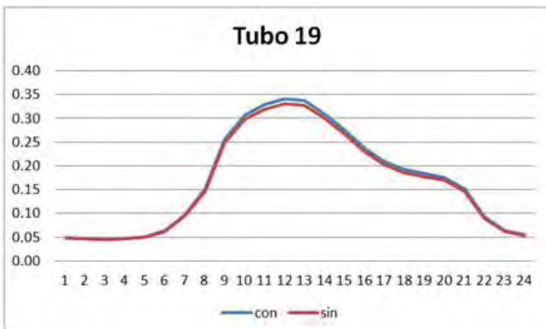
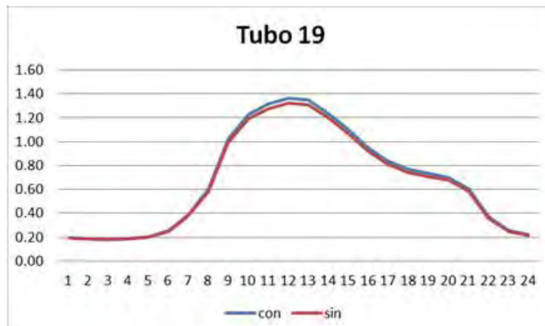


L=100m, d=6”, q=2.5 l/s



L=100m, d=6”, q=5 l/s



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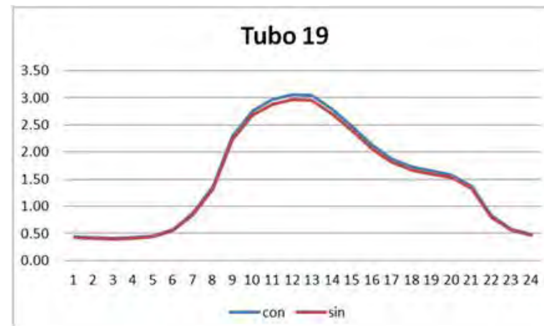

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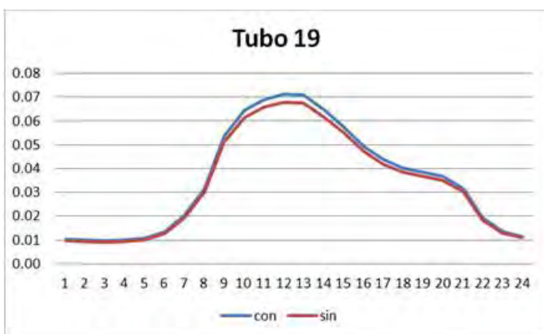

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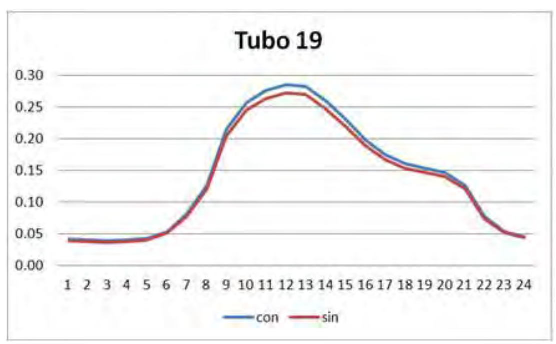
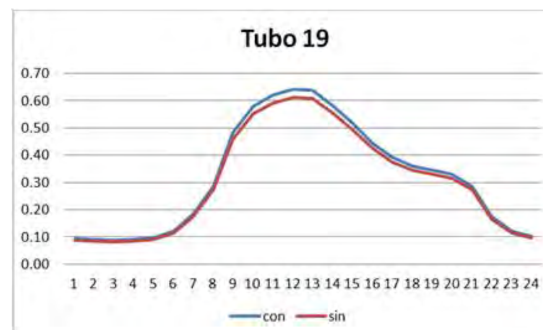
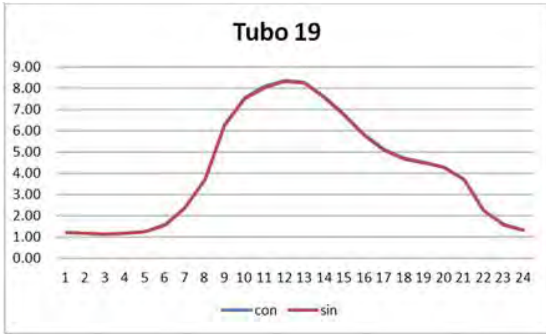


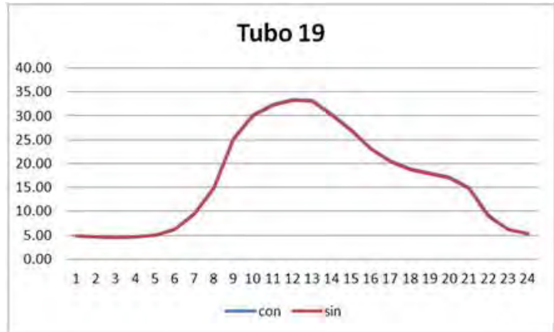
L=100m, d=8”, q=7.5 l/s



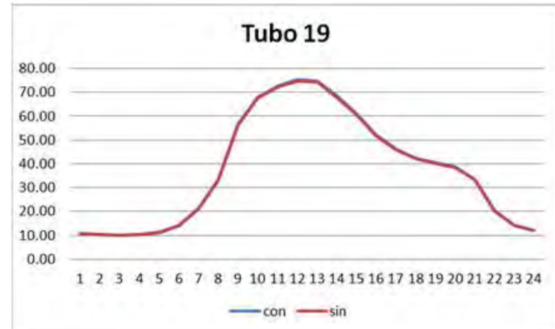
L=300m, d=4”, q=2.5 l/s



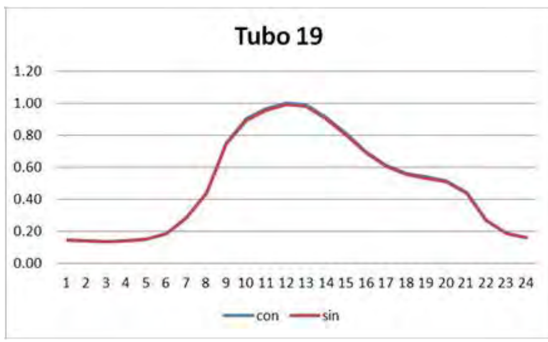
L=300m, d=4”, q=5 l/s



L=300m, d=4”, q=7.5 l/s



L=300m, d=6”, q=2.5 l/s



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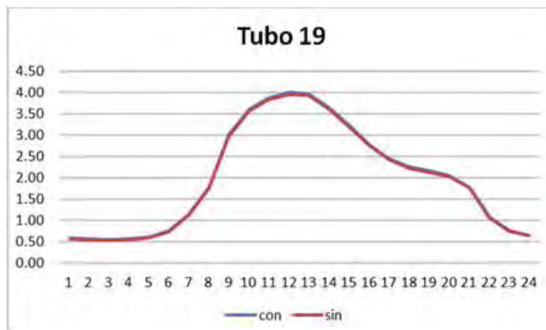

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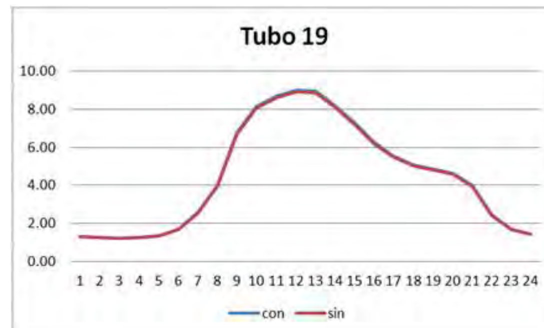

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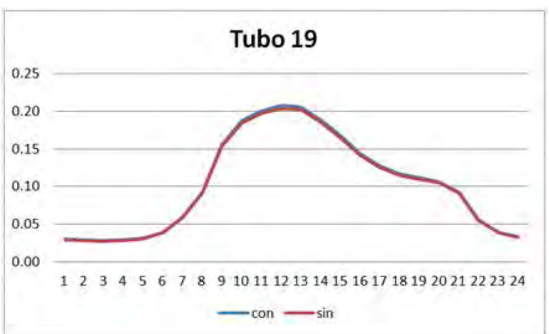
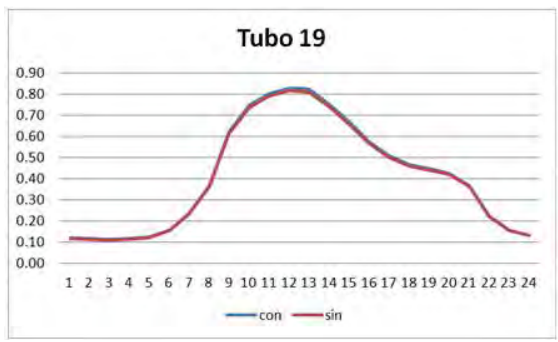
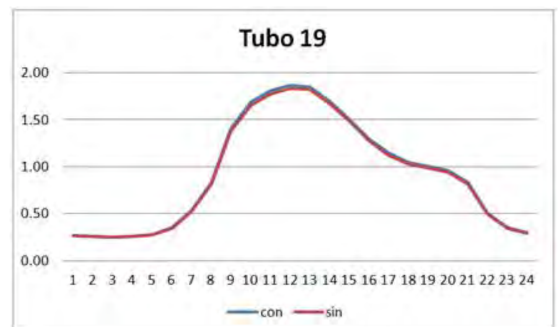


L=300m, d=8”, q=5 l/s

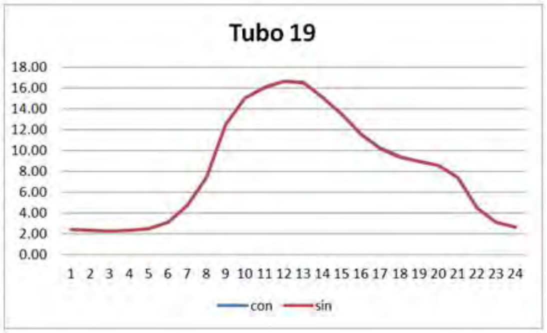


L=300m, d=8”, q=7.5 l/s



Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

L=600m, d=4”, q=2.5 l/s



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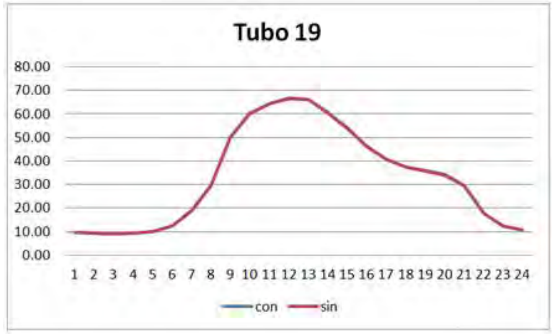

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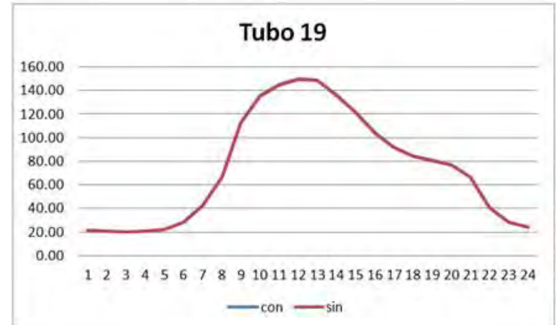
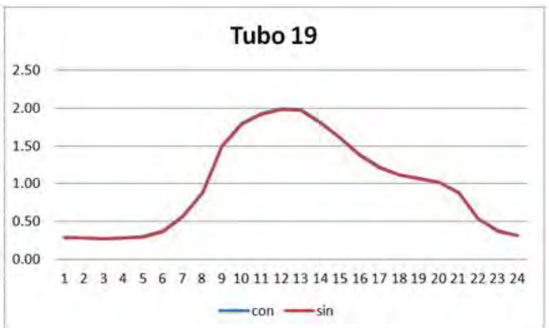
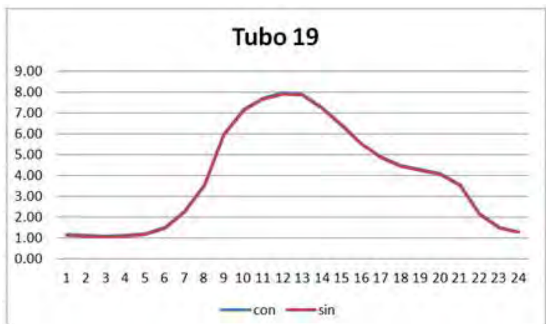


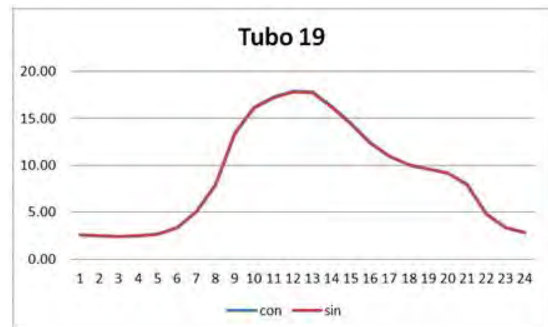
L=600m, d=6”, q=2.5 l/s



L=600m, d=6”, q=5 l/s



L=600m, d=6”, q=7.5 l/s



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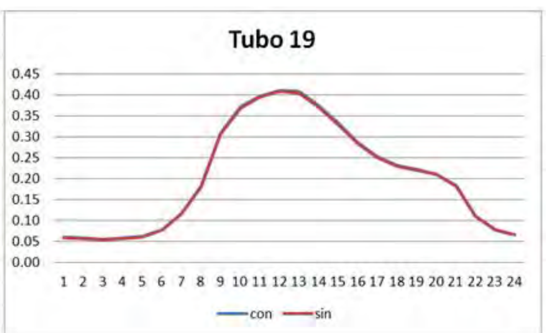
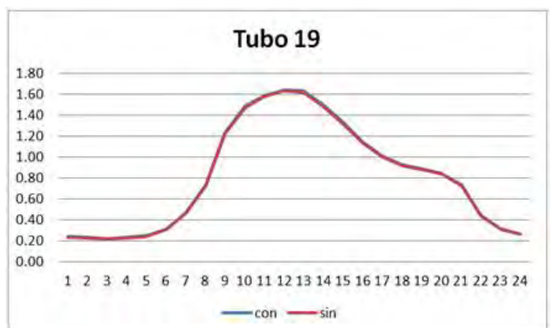
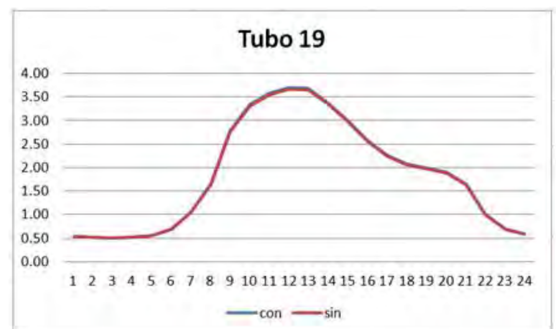


L=600m, d=8”, q=5 l/s

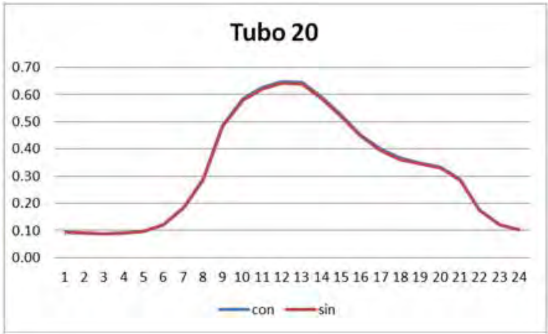


L=600m, d=8”, q=7.5 l/s

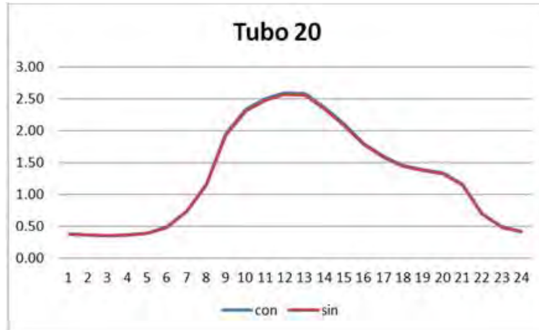


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

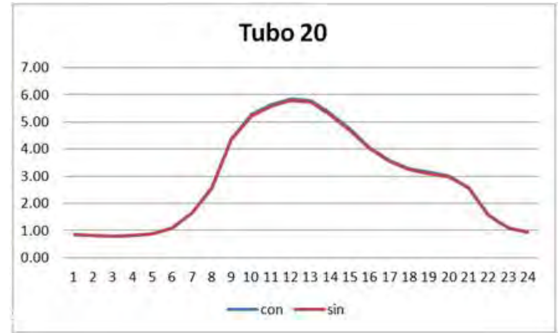
L=100m, d=4”, q=2.5 l/s



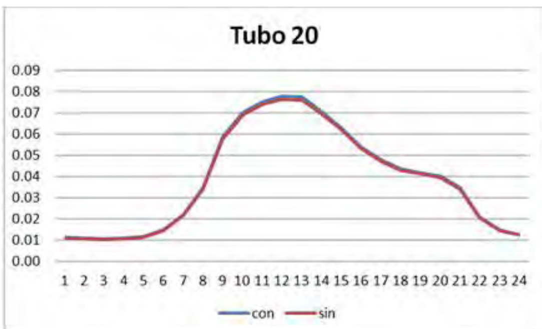
L=100m, d=4”, q=5 l/s



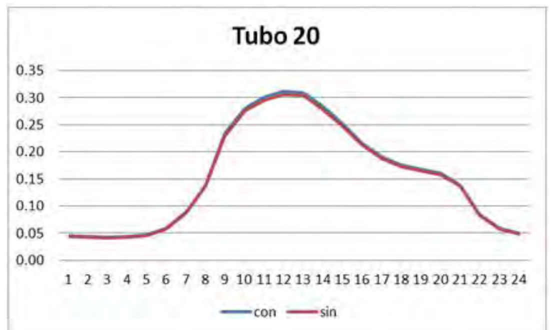
L=100m, d=4”, q=7.5 l/s



L=100m, d=6”, q=2.5 l/s



L=100m, d=6”, q=5 l/s



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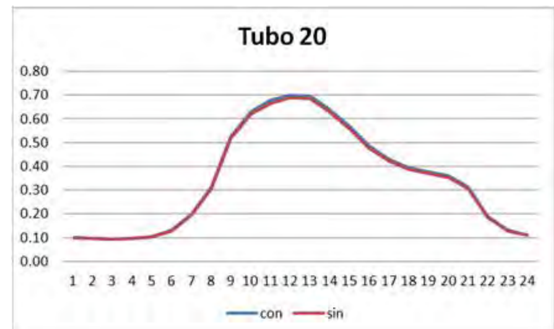

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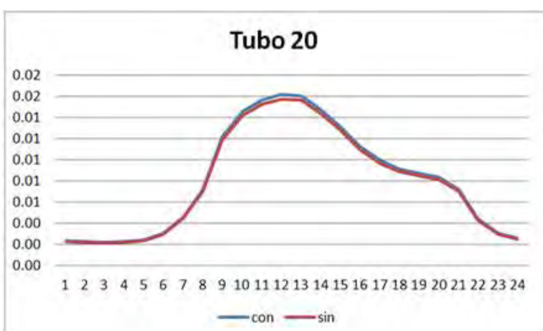
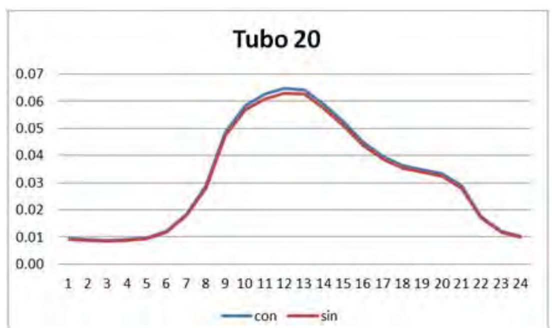


L=100m, d=8”, q=5 l/s



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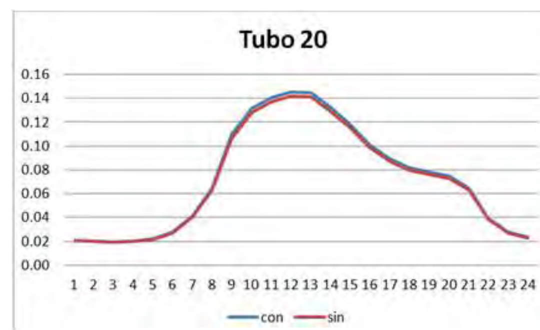
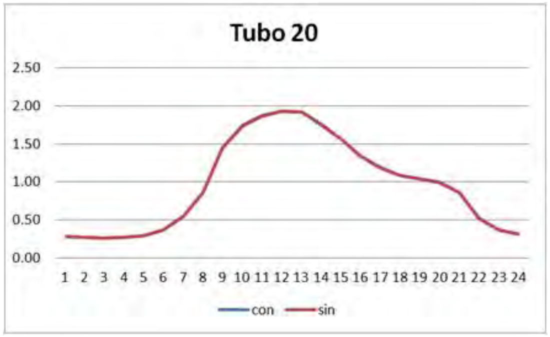


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=300m, d=4”, q=2.5 l/s



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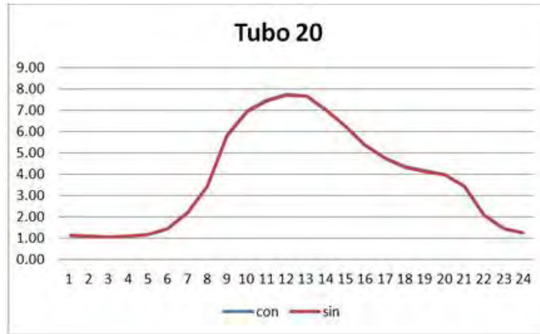

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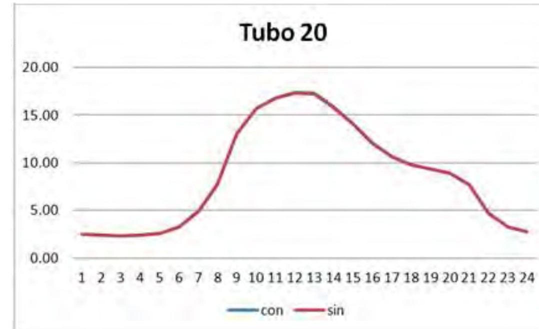

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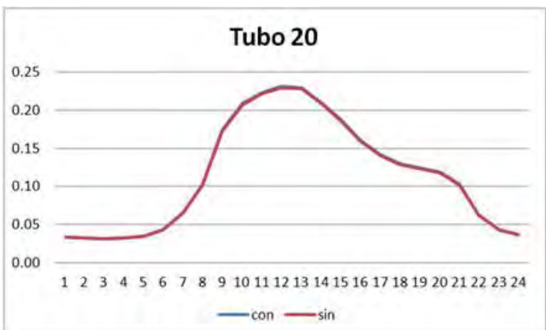

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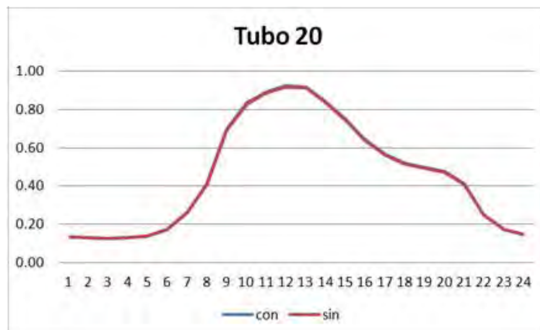

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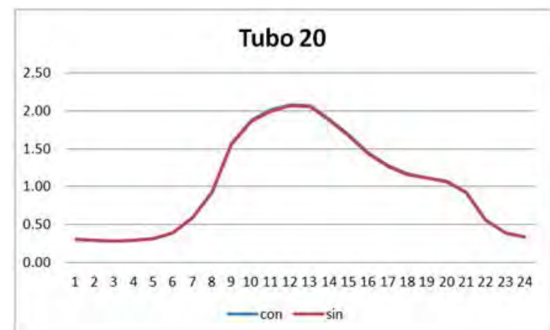

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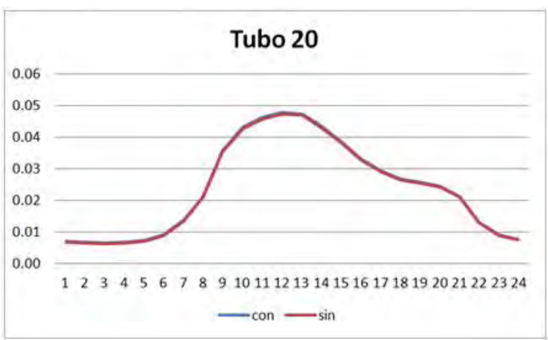
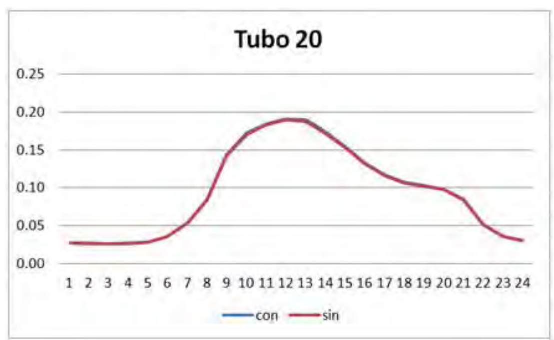


L=300m, d=8”, q=5 l/s



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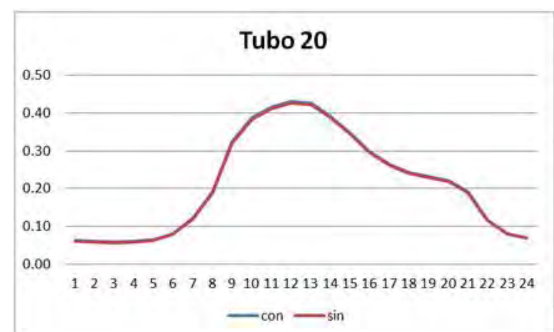

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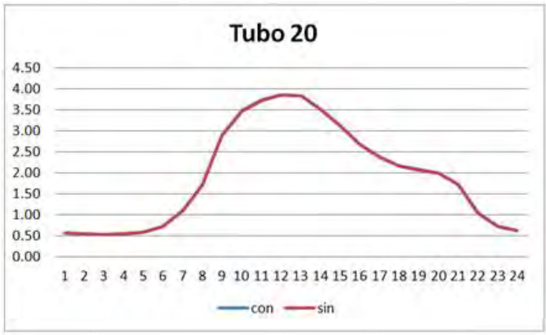

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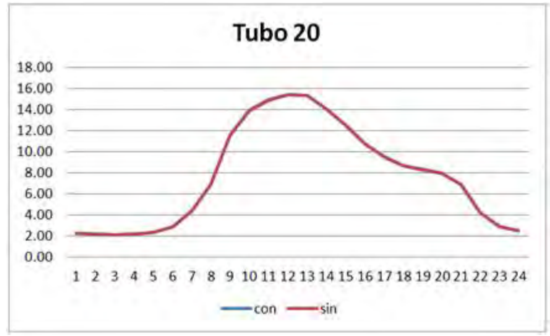

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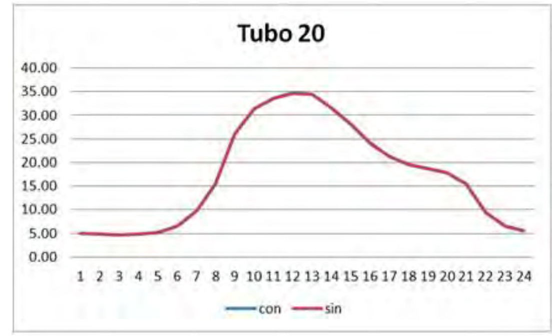

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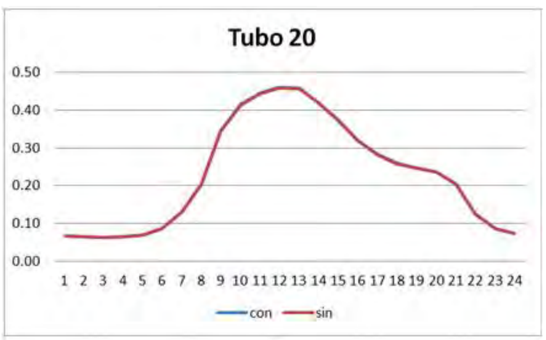
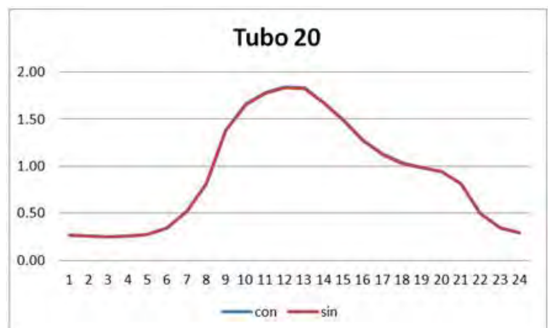


L=600m, d=6”, q=5 l/s



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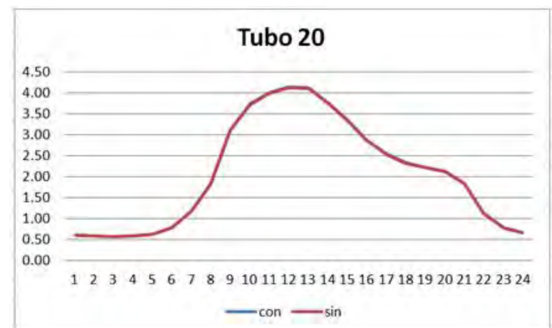

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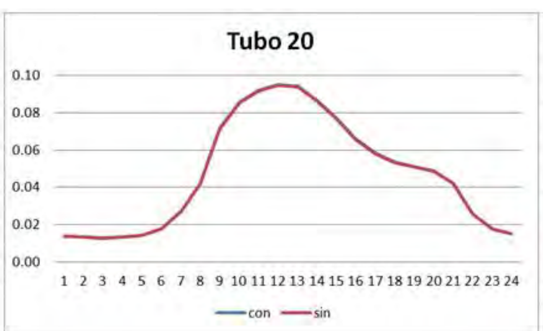
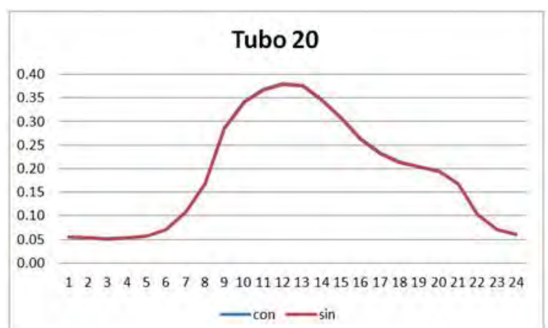
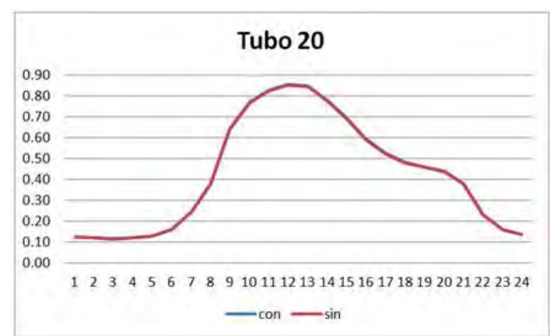


L=600m, d=8”, q=5 l/s

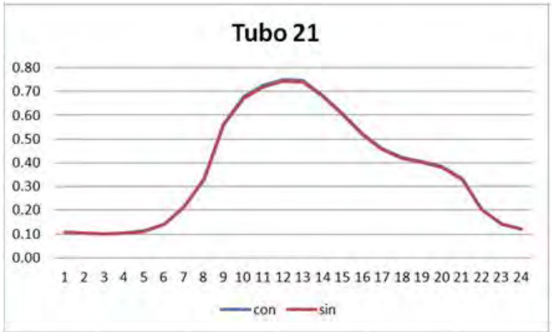


L=600m, d=8”, q=7.5 l/s



Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=100m, d=4”, q=2.5 l/s



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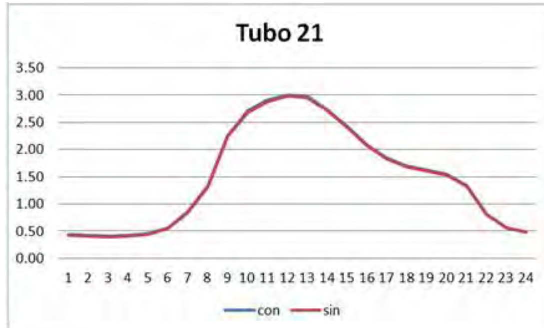

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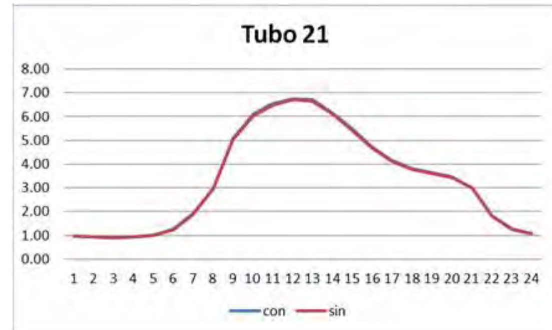

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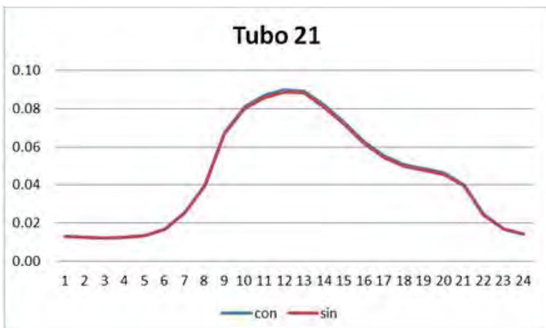
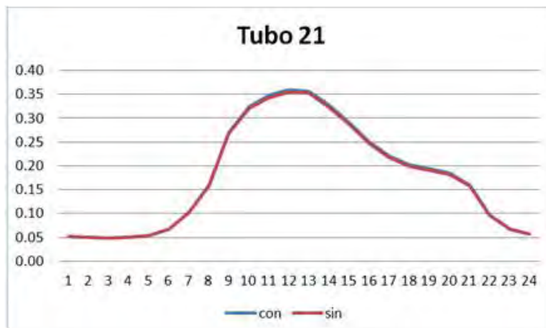


L=100m, d=6”, q=5 l/s



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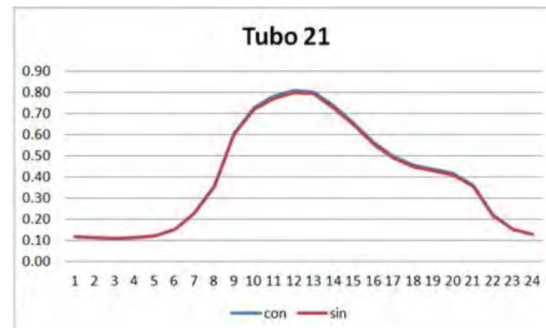
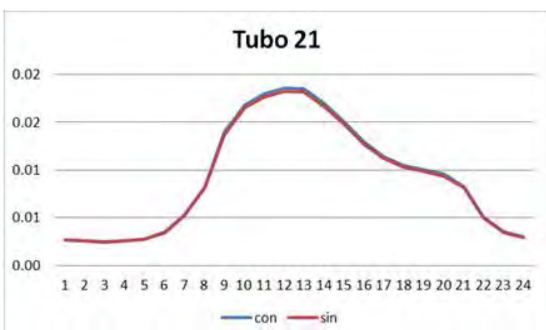
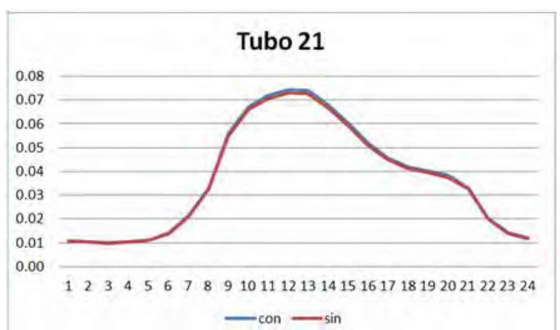


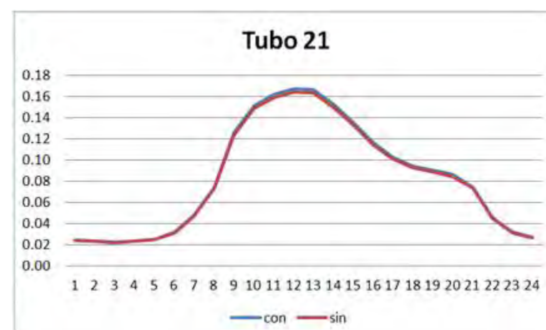
L=100m, d=8”, q=2.5 l/s



L=100m, d=8”, q=5 l/s

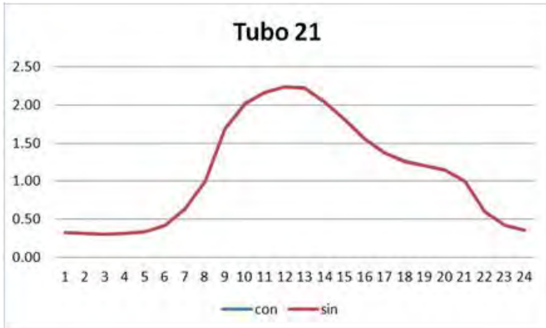


L=100m, d=8”, q=7.5 l/s

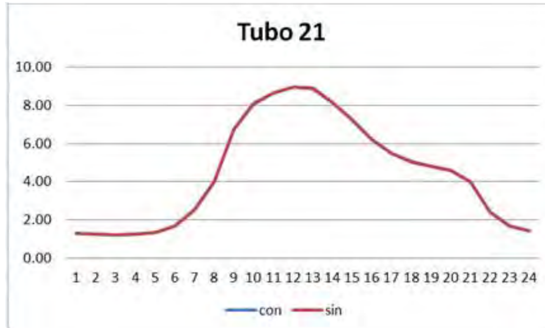


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

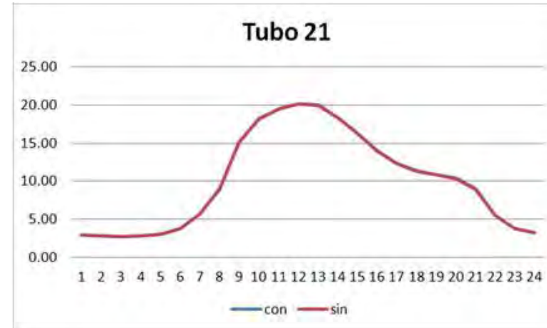
L=300m, d=4”, q=2.5 l/s



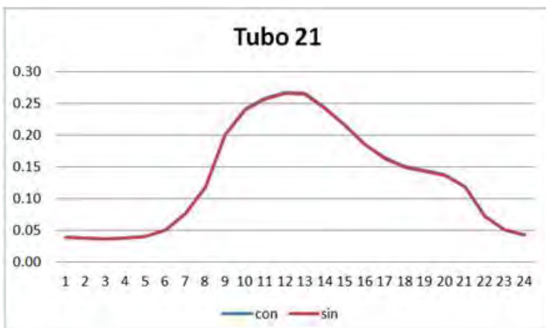
L=300m, d=4”, q=5 l/s



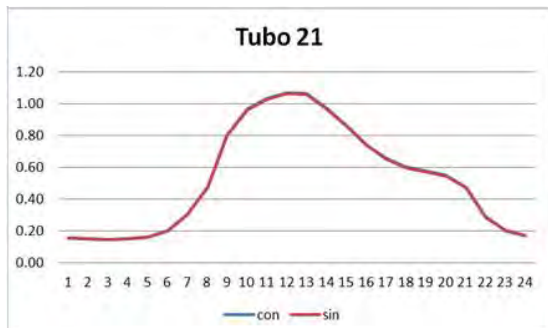
L=300m, d=4”, q=7.5 l/s



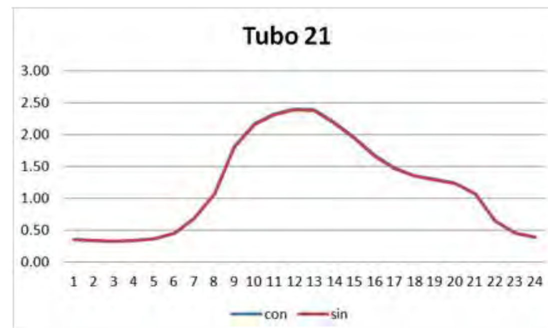
L=300m, d=6”, q=2.5 l/s



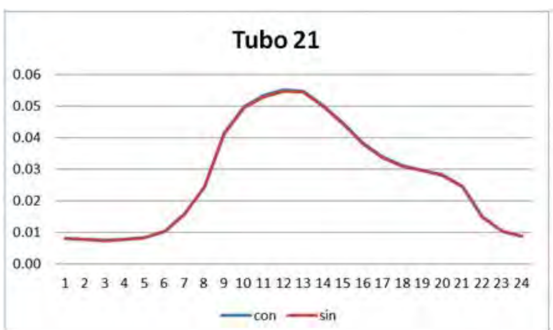
L=300m, d=6”, q=5 l/s



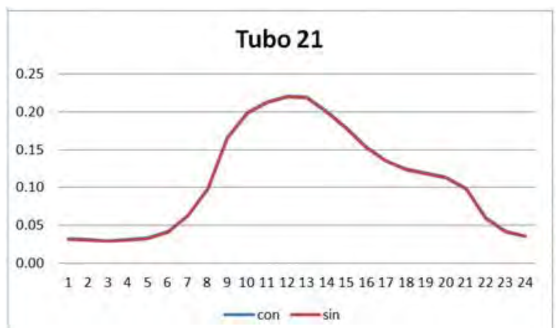
L=300m, d=6”, q=7.5 l/s



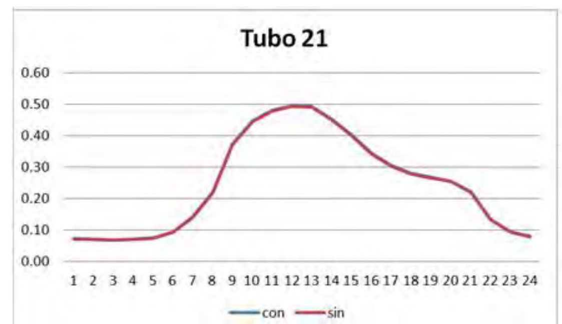
L=300m, d=8”, q=2.5 l/s



L=300m, d=8”, q=5 l/s

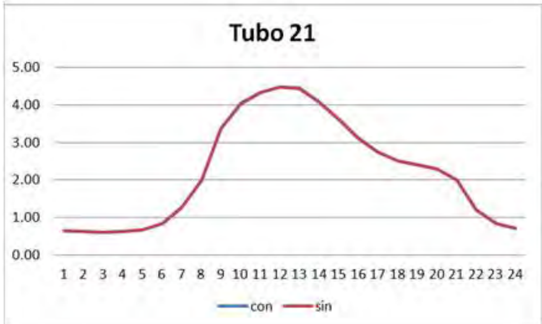


L=300m, d=8”, q=7.5 l/s

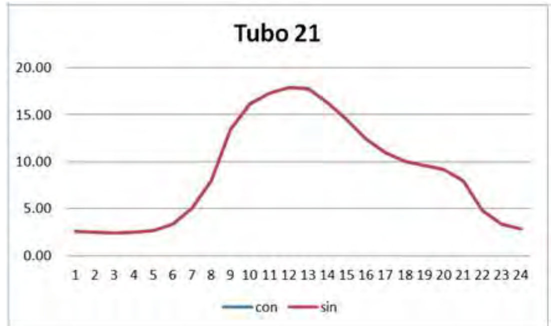


Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

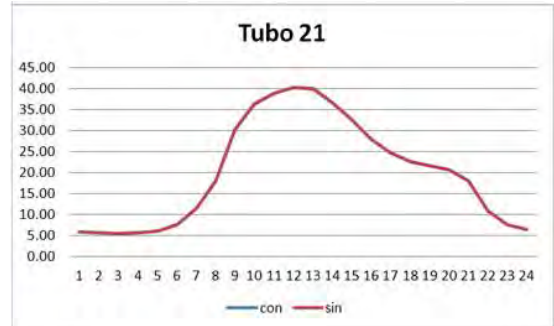
L=600m, d=4”, q=2.5 l/s



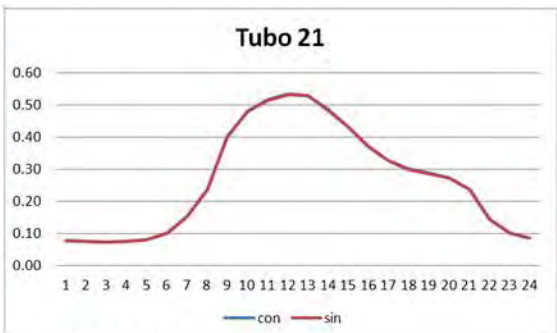
L=600m, d=4”, q=5 l/s



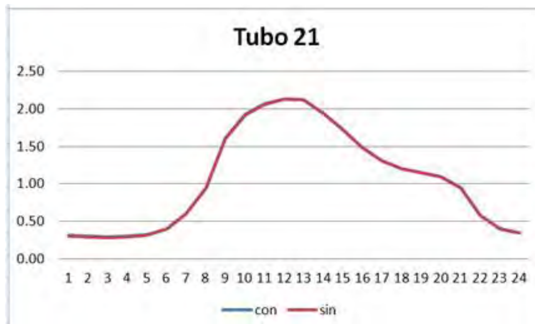
L=600m, d=4”, q=7.5 l/s



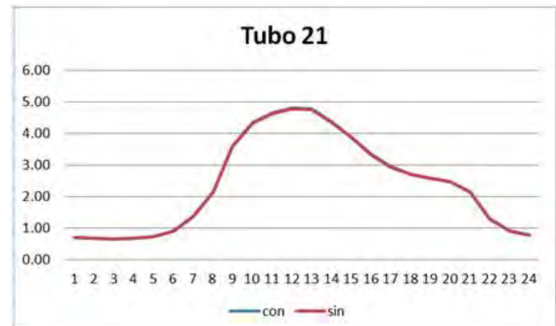
L=600m, d=6”, q=2.5 l/s



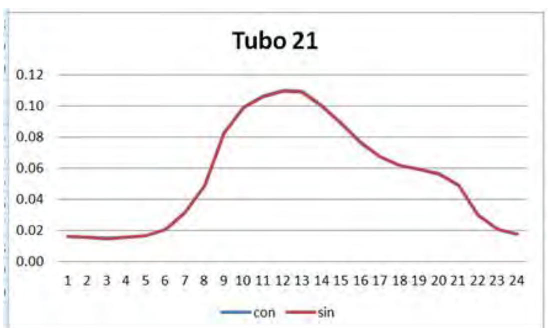
L=600m, d=6”, q=5 l/s



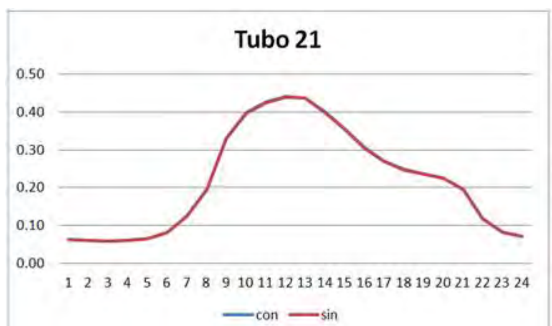
L=600m, d=6”, q=7.5 l/s



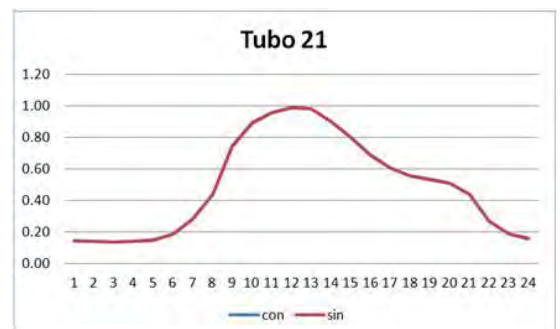
L=600m, d=8”, q=2.5 l/s



L=600m, d=8”, q=5 l/s

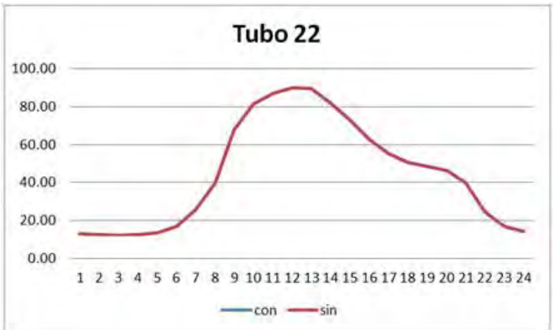


L=600m, d=8”, q=7.5 l/s



Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

L=100m, d=4”, q=2.5 l/s



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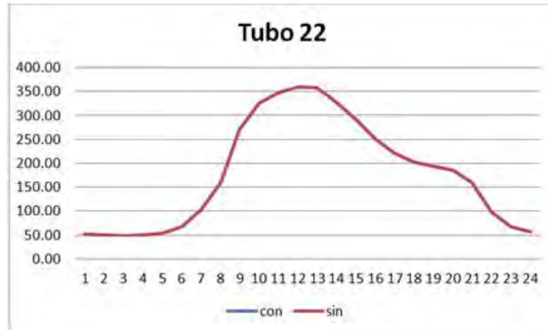
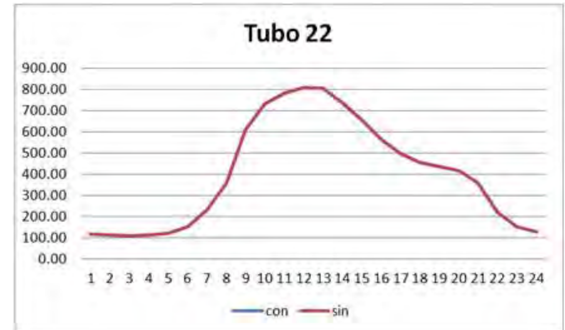
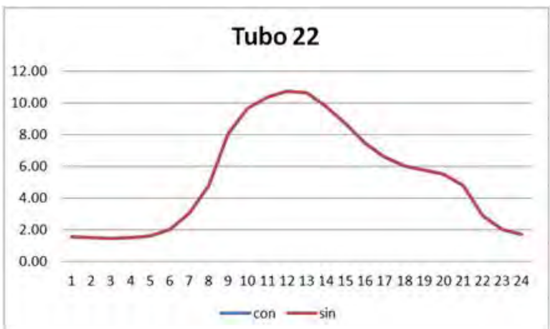


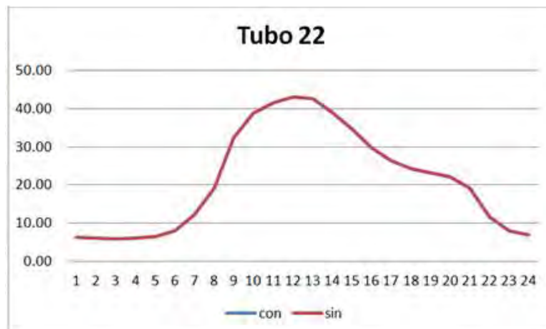
L=100m, d=4”, q=7.5 l/s



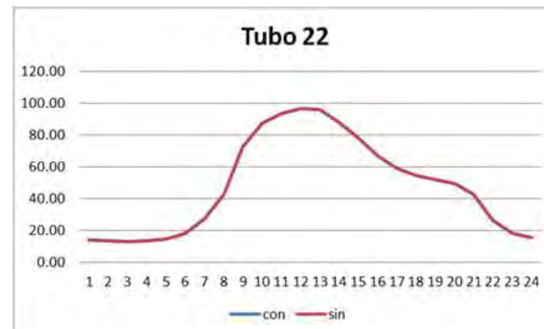
L=100m, d=6”, q=2.5 l/s



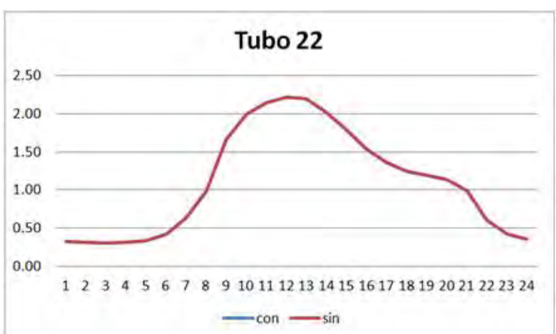
L=100m, d=6”, q=5 l/s



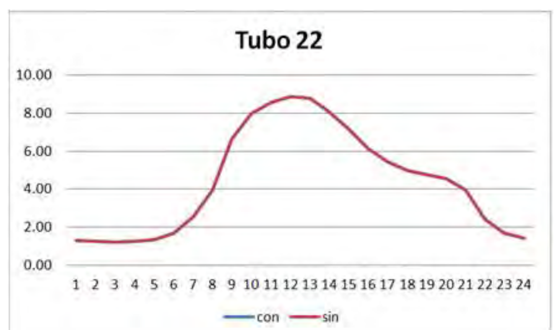
L=100m, d=6”, q=7.5 l/s



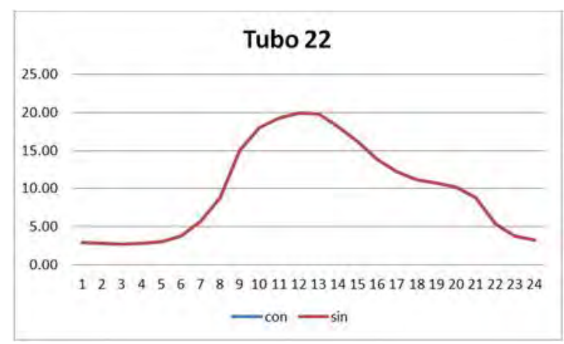
L=100m, d=8”, q=2.5 l/s



L=100m, d=8”, q=5 l/s

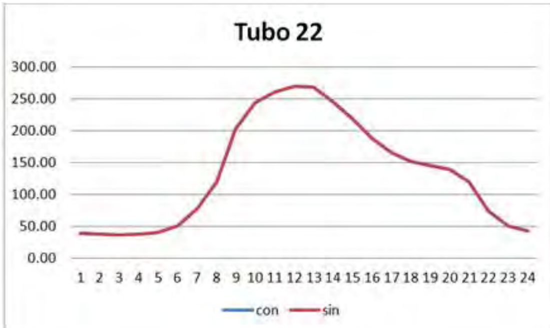


L=100m, d=8”, q=7.5 l/s

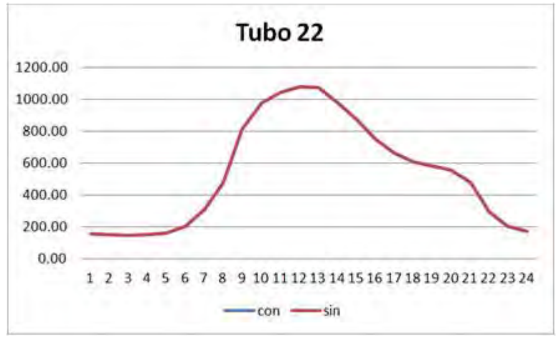


Anexo 4. Transformación de energía en tubo {M S-F} eje x: horas, eje y:metros

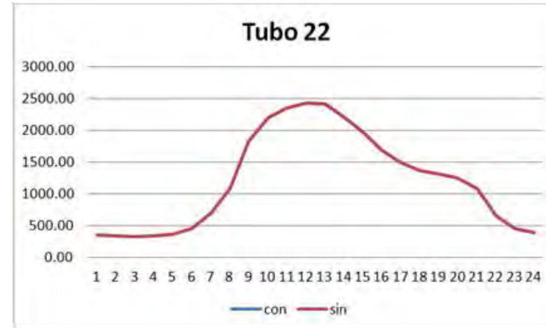
L=300m, d=4”, q=2.5 l/s



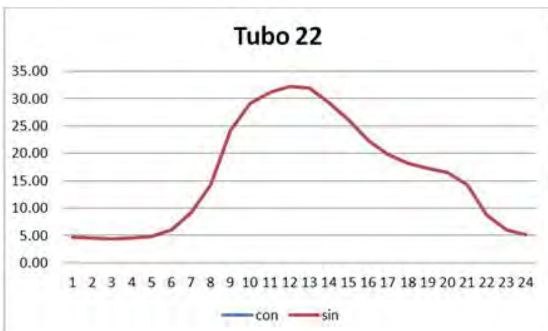
L=300m, d=4”, q=5 l/s



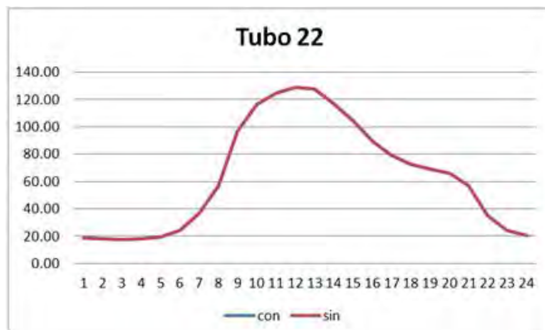
L=300m, d=4”, q=7.5 l/s



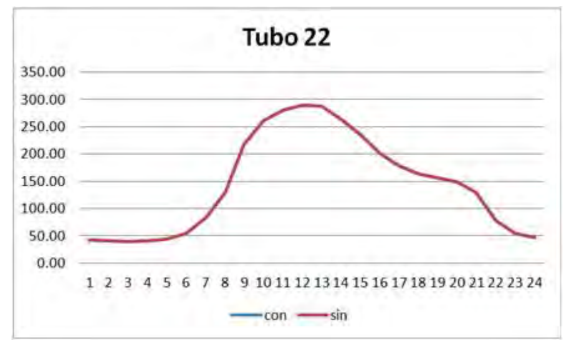
L=300m, d=6”, q=2.5 l/s



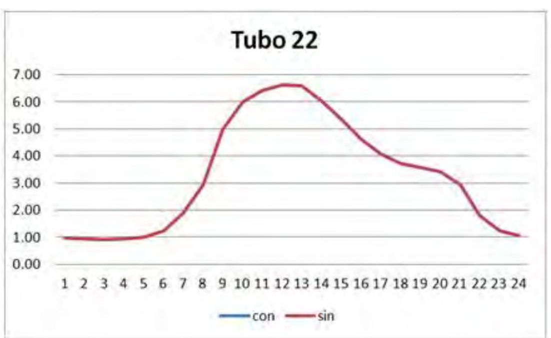
L=300m, d=6”, q=5 l/s



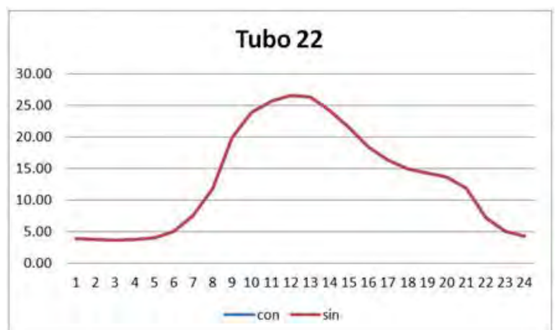
L=300m, d=6”, q=7.5 l/s



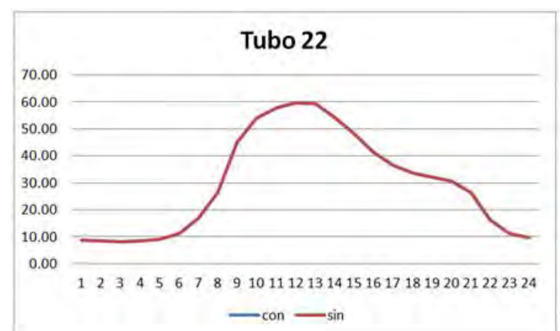
L=300m, d=8”, q=2.5 l/s



L=300m, d=8”, q=5 l/s

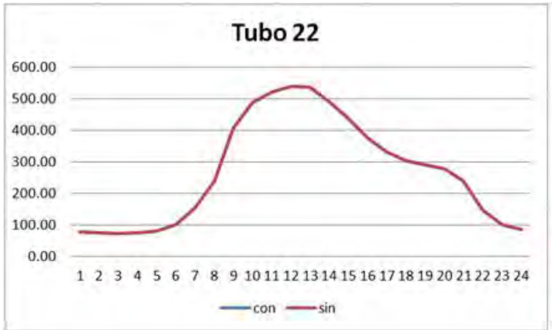


L=300m, d=8”, q=7.5 l/s

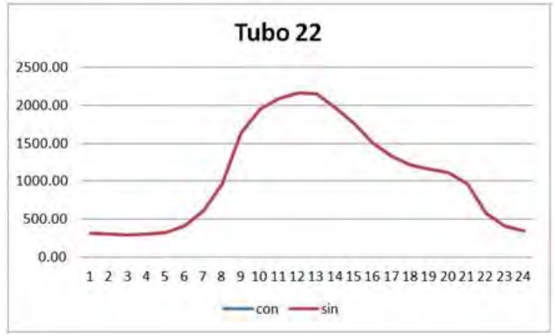


Anexo 4. Transformación de energía en tubo {M S-F}   eje x: horas, eje y:metros

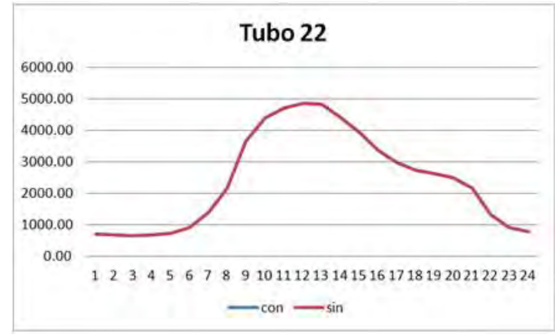
L=600m, d=4", q=2.5 l/s



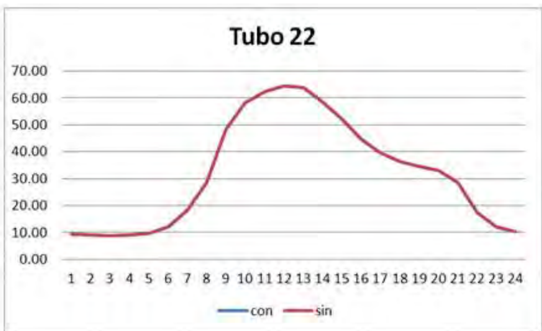
L=600m, d=4", q=5 l/s



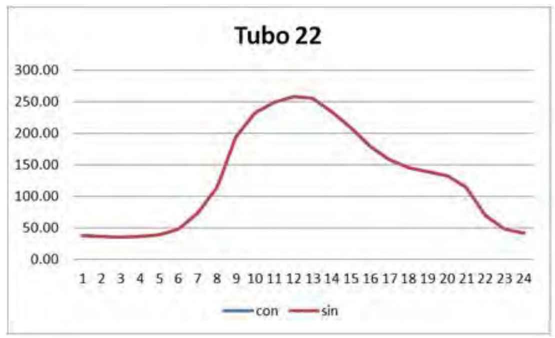
L=600m, d=4", q=7.5 l/s



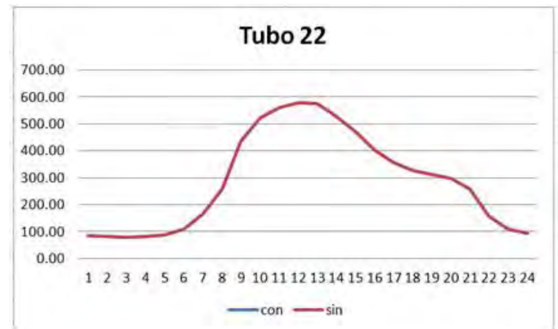
L=600m, d=6", q=2.5 l/s



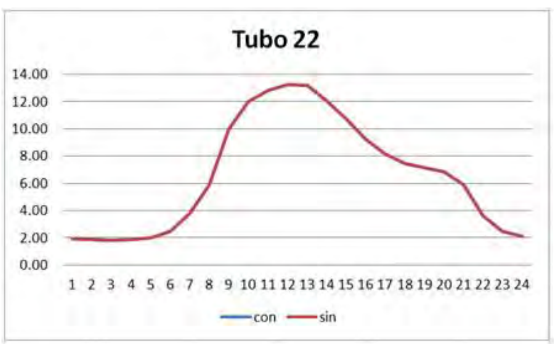
L=600m, d=6", q=5 l/s



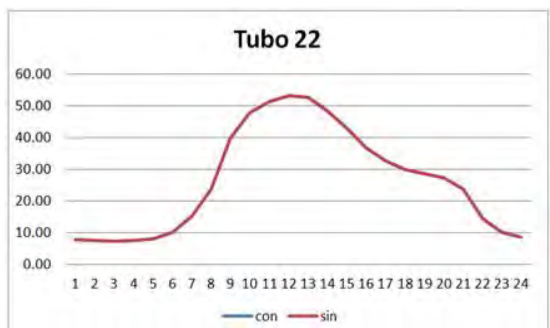
L=600m, d=6", q=7.5 l/s



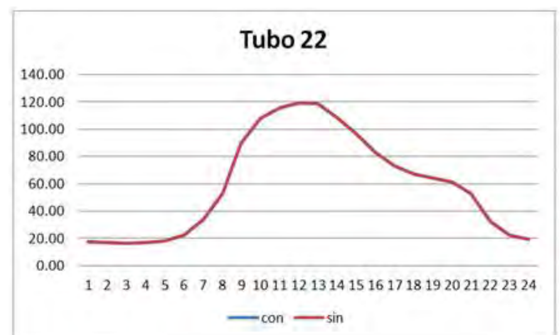
L=600m, d=8", q=2.5 l/s



L=600m, d=8", q=5 l/s



L=600m, d=8", q=7.5 l/s



ANEXO 5. VALORES DE CARGA EN NODO [m]

EPANET

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	m	pulg	l/s	m	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	100	4	2.6	19	8.46	7.92	7.73	8.99	7.53	10.09	8.43	7.52	7.05	6.91	8.82	7.29	6.77	8.19	7.54	7.27	6.88	6.77	6.65
2	100	4	2.5	18	8.19	7.69	7.51	8.68	7.33	9.71	8.16	7.31	6.87	6.75	8.53	7.1	6.62	7.94	7.33	7.08	6.72	6.62	6.5
3	100	4	2.5	17	7.19	6.69	6.51	7.68	6.33	8.71	7.16	6.31	5.87	5.75	7.53	6.1	5.62	6.94	6.33	6.08	5.72	5.62	5.5
4	100	4	2.5	18	8.19	7.69	7.51	8.68	7.33	9.71	8.16	7.31	6.87	6.75	8.53	7.1	6.62	7.94	7.33	7.08	6.72	6.62	6.5
5	100	4	2.6	19	8.46	7.92	7.73	8.99	7.53	10.09	8.43	7.52	7.05	6.91	8.82	7.29	6.77	8.19	7.54	7.27	6.88	6.77	6.65
6	100	4	3	24	10.3	9.6	9.36	10.98	9.1	12.42	10.26	9.08	8.47	8.3	10.77	8.79	8.12	9.95	9.11	8.77	8.26	8.12	7.96
7	100	4	3.6	35	15.85	14.88	14.54	16.8	14.19	18.81	15.8	14.16	13.31	13.07	16.51	13.76	12.83	15.36	14.19	13.72	13.01	12.83	12.61
8	100	4	4.5	54	25.11	23.66	23.15	26.53	22.62	29.55	25.03	22.58	21.31	20.95	26.09	21.98	20.59	24.38	22.63	21.93	20.86	20.59	20.26
9	100	4	5.9	90	42.31	39.93	39.1	44.63	38.24	49.61	42.16	38.18	36.08	35.51	43.91	37.19	34.92	41.12	38.25	37.1	35.37	34.92	34.39
10	100	4	6.5	108	50.92	48.08	47.08	53.68	46.06	59.63	50.74	45.99	43.49	42.8	52.82	44.81	42.1	49.49	46.07	44.7	42.64	42.1	41.47
11	100	4	6.7	116	55.61	52.61	51.56	58.53	50.48	64.83	55.42	50.4	47.76	47.04	57.62	49.15	46.3	54.1	50.48	49.04	46.86	46.29	45.63
12	100	4	6.8	119	56.92	53.84	52.76	59.92	51.65	66.39	56.73	51.57	48.85	48.11	58.99	50.29	47.36	55.38	51.65	50.18	47.93	47.35	46.67
13	100	4	6.8	119	56.92	53.84	52.76	59.92	51.65	66.39	56.73	51.57	48.85	48.11	58.99	50.29	47.36	55.38	51.65	50.18	47.93	47.35	46.67
14	100	4	6.5	109	51.92	49.08	48.08	54.68	47.06	60.63	51.74	46.99	44.49	43.8	53.82	45.81	43.1	50.49	47.07	45.7	43.64	43.1	42.47
15	100	4	6.1	97	46.27	43.74	42.85	48.73	41.95	54.02	46.11	41.88	39.65	39.04	47.97	40.83	38.42	45	41.95	40.73	38.89	38.41	37.85
16	100	4	5.7	83	38.27	36.03	35.25	40.44	34.45	45.11	38.13	34.38	32.42	31.88	39.77	33.46	31.32	37.14	34.45	33.37	31.75	31.32	30.82
17	100	4	5.3	74	34.91	32.95	32.26	36.81	31.56	40.9	34.79	31.51	29.78	29.31	36.22	30.69	28.82	33.93	31.56	30.62	29.19	28.82	28.39
18	100	4	5.1	68	31.59	29.77	29.13	33.37	28.47	37.18	31.48	28.42	26.82	26.37	32.82	27.66	25.92	30.68	28.48	27.6	26.27	25.92	25.51
19	100	4	5	65	29.9	28.14	27.53	31.62	26.89	35.29	29.8	26.84	25.29	24.87	31.09	26.11	24.43	29.02	26.89	26.05	24.76	24.43	24.03
20	100	4	4.9	62	28.19	26.49	25.9	29.84	25.29	33.38	28.09	25.24	23.75	23.34	29.33	24.53	22.91	27.34	25.29	24.47	23.23	22.91	22.53
21	100	4	4.5	54	25.11	23.66	23.15	26.53	22.62	29.55	25.03	22.58	21.31	20.95	26.09	21.98	20.59	24.38	22.63	21.93	20.86	20.59	20.26
22	100	4	3.5	33	14.82	13.9	13.57	15.72	13.24	17.62	14.77	13.21	12.4	12.18	15.44	12.83	11.94	14.36	13.24	12.79	12.12	11.94	11.74
23	100	4	3	24	10.3	9.6	9.36	10.98	9.1	12.42	10.26	9.08	8.47	8.3	10.77	8.79	8.12	9.95	9.11	8.77	8.26	8.12	7.96
24	100	4	2.7	20	8.71	8.13	7.92	9.27	7.72	10.45	8.67	7.7	7.19	7.05	9.1	7.46	6.9	8.41	7.72	7.44	7.01	6.9	6.77

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	100	4	5.2	70	32.26	30.37	29.71	34.1	29.03	38.05	32.15	28.98	27.31	26.85	33.53	28.19	26.39	31.31	29.03	28.12	26.74	26.38	25.96
2	100	4	5.1	67	30.59	28.77	28.13	32.37	27.47	36.18	30.48	27.42	25.82	25.37	31.82	26.66	24.92	29.68	27.48	26.6	25.27	24.92	24.51
3	100	4	5	65	29.9	28.14	27.53	31.62	26.89	35.29	29.8	26.84	25.29	24.87	31.09	26.11	24.43	29.02	26.89	26.05	24.76	24.43	24.03
4	100	4	5.1	67	30.59	28.77	28.13	32.37	27.47	36.18	30.48	27.42	25.82	25.37	31.82	26.66	24.92	29.68	27.48	26.6	25.27	24.92	24.51
5	100	4	5.3	72	32.91	30.95	30.26	34.81	29.56	38.9	32.79	29.51	27.78	27.31	34.22	28.69	26.82	31.93	29.56	28.62	27.19	26.82	26.39
6	100	4	5.9	90	42.31	39.93	39.1	44.63	38.24	49.61	42.16	38.18	36.08	35.51	43.91	37.19	34.92	41.12	38.25	37.1	35.37	34.92	34.39
7	100	4	7.3	136	65.16	61.65	60.42	68.57	59.16	75.95	64.93	59.06	55.97	55.13	67.51	57.61	54.27	63.4	59.16	57.48	54.93	54.27	53.49
8	100	4	9.1	211	104.11	98.85	97.02	109.22	95.14	120.33	103.76	95	90.37	89.12	107.63	92.82	87.84	101.48	95.14	92.63	88.81	87.83	86.68
9	100	4	11.8	356	182.02	173.53	170.59	190.25	167.56	208.27	181.43	167.33	159.86	157.87	187.67	163.83	155.83	177.77	167.55	163.53	157.39	155.81	153.97
10	100	4	13	427	218.24	208.1	204.58	228.07	200.96	249.67	217.52	200.69	191.76	189.38	224.99	196.5	186.95	213.16	200.95	196.15	188.81	186.93	184.73
11	100	4	13.4	458	236.98	226.24	222.53	247.37	218.71	270.23	236.21	218.41	208.97	206.46	244.11	213.99	203.89	231.61	218.69	213.62	205.86	203.87	201.55
12	100	4	13.6	473	245.72	234.69	230.87	256.4	226.94	279.9	244.92	226.64	216.93	214.36	253.05	222.09	211.71	240.2	226.92	221.71	213.74	211.7	209.31
13	100	4	13.6	470	242.72	231.69	227.87	253.4	223.94	276.9	241.92	223.64	213.93	211.36	250.05	219.09	208.71	237.2	223.92	218.71	210.74	208.7	206.31
14	100	4	13	430	221.24	211.1	207.58	231.07	203.96	252.67	220.52	203.69	194.76	192.38	227.99	199.5	189.95	216.16	203.95	199.15	191.81	189.93	187.73
15	100	4	12.3	384	195.9	186.74	183.56	204.78	180.29	224.25	195.25	180.04	171.98	169.83	202	176.27	167.63	191.31	180.28	175.95	169.31	167.61	165.63
16	100	4	11.4	329	165.94	157.98	155.21	173.66	152.37	190.56	165.38	152.15	145.14	143.27	171.24	148.86	141.35	161.95	152.36	148.59	142.82	141.34	139.6
17	100	4	10.7	291	146.23	139.14	136.68	153.1	134.15	168.12	145.74	133.96	127.72	126.05	150.95	131.03	124.34	142.68	134.14	130.78	125.64	124.32	122.78
18	100	4	10.2	267	134.65	128.17	125.91	140.95	123.59	154.69	134.21	123.41	117.7	116.17	138.98	120.73	114.6	131.4	123.59	120.5	115.8	114.59	113.17
19	100	4	10	255	127.48	121.22	119.04	133.55	116.81	146.79	127.05	116.64	111.13	109.65	131.65	114.05	108.13	124.34	116.8	113.83	109.29	108.12	106.76
20	100	4	9.8	244	121.21	115.18	113.09	127.06	110.93	139.81	120.8	110.77	105.46	104.04	125.23	108.28	102.57	118.19	110.93	108.06	103.69	102.56	101.25
21	100	4	9.1	211	104.11	98.85	97.02	109.22	95.14	120.33	103.76	95	90.37	89.12	107.63	92.82	87.84	101.48	95.14	92.63	88.81	87.83	86.68
22	100	4	7.1	129	61.73	58.39	57.23	64.97	56.03	71.99	61.52	55.94	53	52.2	63.97	54.55	51.38	60.06	56.03	54.43	52.01	51.37	50.64
23	100	4	5.9	90	42.31	39.93	39.1	44.63	38.24	49.61	42.16	38.18	36.08	35.51	43.91	37.19	34.92	41.12	38.25	37.1	35.37	34.92	34.39
24	100	4	5.5	77	35.13	33.04	32.3	37.17	31.55	41.54	35	31.49	29.65	29.14	36.54	30.62	28.63	34.08	31.55	30.55	29.02	28.62	28.16

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	100	4	7.8	155	74.85	70.89	69.5	78.7	68.08	87.05	74.59	67.97	64.48	63.54	77.5	66.33	62.57	72.86	68.08	66.19	63.31	62.56	61.69
2	100	4	7.6	149	72.64	68.86	67.54	76.31	66.18	84.27	72.39	66.08	62.75	61.85	75.17	64.51	60.92	70.74	66.18	64.38	61.63	60.92	60.09
3	100	4	7.5	144	69.5	65.81	64.52	73.09	63.2	80.85	69.26	63.1	59.85	58.97	71.97	61.57	58.07	67.65	63.2	61.44	58.75	58.06	57.25
4	100	4	7.6	149	72.64	68.86	67.54	76.31	66.18	84.27	72.39	66.08	62.75	61.85	75.17	64.51	60.92	70.74	66.18	64.38	61.63	60.92	60.09
5	100	4	7.9	160	77.92	73.87	72.45	81.87	70.99	90.41	77.66	70.88	67.31	66.34	80.64	69.2	65.35	75.89	71	69.06	66.11	65.34	64.45
6	100	4	8.9	201	98.47	93.41	91.66	103.37	89.85	114.03	98.13	89.71	85.26	84.07	101.84	87.62	82.84	95.93	89.85	87.44	83.77	82.83	81.72
7	100	4	10.9	304	154.11	146.78	144.23	161.22	141.61	176.76	153.6	141.41	134.96	133.23	159	138.38	131.46	150.44	141.61	138.13	132.81	131.45	129.85
8	100	4	13.6	473	245.72	234.69	230.87	256.4	226.94	279.9	244.92	226.64	216.93	214.36	253.05	222.09	211.71	240.2	226.92	221.71	213.74	211.7	209.31
9	100	4	17.7	799	424.99	407.02	400.82	442.37	394.44	480.88	423.64	393.95	378.14	373.99	436.9	386.56	369.72	416.01	394.39	385.95	372.99	369.69	365.84
10	100	4	19.4	960	514.91	493.6	486.26	535.51	478.7	581.27	513.29	478.12	459.37	454.47	529.02	469.37	449.43	504.26	478.64	468.65	453.29	449.39	444.84
11	100	4	20.1	1028	551.9	529.14	521.31	573.91	513.23	622.83	550.17	512.62	492.59	487.37	566.98	503.27	481.98	540.54	513.17	502.51	486.1	481.95	477.08
12	100	4	20.5	1063	568.73	545.12	537	591.56	528.62	642.32	566.93	527.98	507.21	501.79	584.37	518.29	496.21	556.94	528.55	517.5	500.49	496.18	491.14
13	100	4	20.4	1056	566.31	542.91	534.86	588.92	526.56	639.23	564.52	525.92	505.34	499.97	581.8	516.32	494.44	554.62	526.49	515.53	498.67	494.41	489.41
14	100	4	19.5	967	517.54	496.03	488.62	538.34	480.99	584.55	515.91	480.4	461.47	456.53	531.79	471.57	451.43	506.79	480.92	470.84	455.33	451.4	446.8
15	100	4	18.4	862	459.45	440.13	433.48	478.12	426.62	519.55	457.99	426.09	409.1	404.65	472.24	418.16	400.07	449.79	426.57	417.51	403.57	400.04	395.9
16	100	4	17	739	392.52	375.84	370.09	408.65	364.16	444.35	391.28	363.71	349.04	345.18	403.58	356.86	341.22	384.18	364.12	356.29	344.25	341.19	337.61
17	100	4	16	653	344.08	329.18	324.03	358.5	318.73	390.36	342.98	318.33	305.21	301.76	353.97	312.2	298.21	336.63	318.7	311.69	300.92	298.18	294.98
18	100	4	15.3	599	315.13	301.42	296.68	328.41	291.8	357.71	314.13	291.42	279.35	276.17	324.24	285.78	272.89	308.27	291.77	285.31	275.4	272.87	269.91
19	100	4	15	573	299.56	286.33	281.77	312.36	277.06	340.59	298.59	276.7	265.06	261.99	308.34	271.26	258.83	292.94	277.03	270.8	261.25	258.81	255.96
20	100	4	14.7	547	283.79	271.06	266.65	296.12	262.12	323.31	282.87	261.77	250.56	247.6	292.25	256.53	244.55	277.42	262.09	256.09	246.88	244.53	241.79
21	100	4	13.6	473	245.72	234.69	230.87	256.4	226.94	279.9	244.92	226.64	216.93	214.36	253.05	222.09	211.71	240.2	226.92	221.71	213.74	211.7	209.31
22	100	4	10.6	289	146.76	139.79	137.37	153.51	134.88	168.27	146.28	134.69	128.56	126.92	151.4	131.82	125.24	143.27	134.88	131.57	126.52	125.23	123.71
23	100	4	8.9	201	98.47	93.41	91.66	103.37	89.85	114.03	98.13	89.71	85.26	84.07	101.84	87.62	82.84	95.93	89.85	87.44	83.77	82.83	81.72
24	100	4	8.2	171	83.01	78.67	77.15	87.23	75.6	96.39	82.73	75.48	71.65	70.62	85.92	73.68	69.56	80.83	75.6	73.52	70.37	69.55	68.59

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	100	6	2.6	4	2.51	2.43	2.4	2.58	2.37	2.75	2.5	2.37	2.3	2.28	2.56	2.34	2.26	2.47	2.37	2.34	2.28	2.26	2.25
2	100	6	2.5	3	1.61	1.54	1.51	1.68	1.49	1.83	1.61	1.48	1.42	1.4	1.66	1.45	1.38	1.57	1.49	1.45	1.4	1.38	1.37
3	100	6	2.5	3	1.61	1.54	1.51	1.68	1.49	1.83	1.61	1.48	1.42	1.4	1.66	1.45	1.38	1.57	1.49	1.45	1.4	1.38	1.37
4	100	6	2.5	3	1.61	1.54	1.51	1.68	1.49	1.83	1.61	1.48	1.42	1.4	1.66	1.45	1.38	1.57	1.49	1.45	1.4	1.38	1.37
5	100	6	2.6	4	2.51	2.43	2.4	2.58	2.37	2.75	2.5	2.37	2.3	2.28	2.56	2.34	2.26	2.47	2.37	2.34	2.28	2.26	2.25
6	100	6	3	4	2.07	1.97	1.93	2.16	1.89	2.38	2.06	1.89	1.8	1.77	2.13	1.85	1.75	2.01	1.89	1.84	1.77	1.75	1.73
7	100	6	3.6	6	3.3	3.16	3.12	3.44	3.06	3.74	3.29	3.06	2.93	2.9	3.4	3	2.87	3.23	3.06	3	2.89	2.86	2.83
8	100	6	4.5	8	3.95	3.74	3.67	4.15	3.59	4.6	3.93	3.58	3.4	3.34	4.08	3.49	3.29	3.84	3.59	3.49	3.33	3.29	3.24
9	100	6	5.9	12	5.34	5	4.88	5.67	4.76	6.4	5.31	4.75	4.44	4.36	5.56	4.6	4.27	5.17	4.75	4.59	4.34	4.27	4.2
10	100	6	6.5	14	6.05	5.64	5.5	6.44	5.35	7.31	6.01	5.34	4.97	4.87	6.31	5.16	4.77	5.84	5.34	5.15	4.85	4.77	4.68
11	100	6	6.7	15	6.59	6.16	6.01	7	5.85	7.93	6.55	5.84	5.45	5.35	6.87	5.66	5.24	6.37	5.85	5.64	5.33	5.24	5.15
12	100	6	6.8	16	7.36	6.91	6.76	7.78	6.6	8.73	7.32	6.59	6.19	6.08	7.64	6.4	5.98	7.13	6.6	6.38	6.06	5.97	5.88
13	100	6	6.8	16	7.36	6.91	6.76	7.78	6.6	8.73	7.32	6.59	6.19	6.08	7.64	6.4	5.98	7.13	6.6	6.38	6.06	5.97	5.88
14	100	6	6.5	14	6.05	5.64	5.5	6.44	5.35	7.31	6.01	5.34	4.97	4.87	6.31	5.16	4.77	5.84	5.34	5.15	4.85	4.77	4.68
15	100	6	6.1	13	5.92	5.56	5.43	6.27	5.3	7.05	5.89	5.29	4.96	4.88	6.16	5.14	4.79	5.74	5.3	5.12	4.86	4.79	4.71
16	100	6	5.7	11	4.75	4.43	4.32	5.06	4.2	5.75	4.72	4.19	3.9	3.83	4.96	4.06	3.75	4.59	4.2	4.04	3.81	3.75	3.67
17	100	6	5.3	10	4.53	4.25	4.15	4.8	4.05	5.41	4.51	4.04	3.79	3.72	4.71	3.92	3.65	4.39	4.05	3.91	3.71	3.65	3.59
18	100	6	5.1	10	4.9	4.64	4.55	5.16	4.46	5.72	4.88	4.45	4.21	4.15	5.07	4.34	4.08	4.77	4.45	4.33	4.13	4.08	4.02
19	100	6	5	9	4.09	3.83	3.74	4.33	3.65	4.87	4.06	3.65	3.42	3.36	4.25	3.54	3.29	3.96	3.65	3.53	3.34	3.29	3.24
20	100	6	4.9	9	4.26	4.02	3.93	4.5	3.85	5.02	4.24	3.84	3.62	3.56	4.42	3.74	3.5	4.14	3.84	3.73	3.55	3.5	3.44
21	100	6	4.5	8	3.95	3.74	3.67	4.15	3.59	4.6	3.93	3.58	3.4	3.34	4.08	3.49	3.29	3.84	3.59	3.49	3.33	3.29	3.24
22	100	6	3.5	5	2.44	2.31	2.26	2.57	2.21	2.85	2.43	2.21	2.09	2.06	2.53	2.15	2.02	2.37	2.21	2.15	2.05	2.02	1.99
23	100	6	3	4	2.07	1.97	1.93	2.16	1.89	2.38	2.06	1.89	1.8	1.77	2.13	1.85	1.75	2.01	1.89	1.84	1.77	1.75	1.73
24	100	6	2.7	4	2.4	2.32	2.29	2.48	2.26	2.66	2.4	2.26	2.18	2.16	2.46	2.22	2.14	2.36	2.26	2.22	2.16	2.14	2.12

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	100	6	5.2	10	4.72	4.45	4.35	4.98	4.25	5.56	4.7	4.25	4	3.94	4.9	4.13	3.87	4.58	4.25	4.12	3.92	3.87	3.81
2	100	6	5.1	9	3.9	3.64	3.55	4.16	3.46	4.72	3.88	3.45	3.21	3.15	4.07	3.34	3.08	3.77	3.45	3.33	3.13	3.08	3.02
3	100	6	5	9	4.09	3.83	3.74	4.33	3.65	4.87	4.06	3.65	3.42	3.36	4.25	3.54	3.29	3.96	3.65	3.53	3.34	3.29	3.24
4	100	6	5.1	9	3.9	3.64	3.55	4.16	3.46	4.72	3.88	3.45	3.21	3.15	4.07	3.34	3.08	3.77	3.45	3.33	3.13	3.08	3.02
5	100	6	5.3	10	4.53	4.25	4.15	4.8	4.05	5.41	4.51	4.04	3.79	3.72	4.71	3.92	3.65	4.39	4.05	3.91	3.71	3.65	3.59
6	100	6	5.9	12	5.34	5	4.88	5.67	4.76	6.4	5.31	4.75	4.44	4.36	5.56	4.6	4.27	5.17	4.75	4.59	4.34	4.27	4.2
7	100	6	7.3	18	12.53	12.25	12.15	12.8	12.05	13.41	12.51	12.04	11.79	11.72	12.71	11.92	11.65	12.39	12.05	11.91	11.71	11.65	11.59
8	100	6	9.1	27	12.21	11.45	11.19	12.93	10.92	14.56	12.13	10.9	10.22	10.05	12.69	10.58	9.86	11.82	10.91	10.55	10	9.86	9.7
9	100	6	11.8	44	20.06	18.85	18.43	21.22	18	23.86	19.93	17.97	16.87	16.59	20.83	17.45	16.3	19.44	17.98	17.41	16.52	16.3	16.03
10	100	6	13	53	24.34	22.9	22.4	25.72	21.88	28.88	24.19	21.84	20.53	20.2	25.26	21.22	19.85	23.6	21.85	21.17	20.12	19.85	19.53
11	100	6	13.4	57	26.68	25.15	24.63	28.13	24.08	31.48	26.52	24.04	22.65	22.3	27.65	23.38	21.93	25.89	24.05	23.33	22.22	21.93	21.6
12	100	6	13.6	59	27.83	26.26	25.72	29.33	25.16	32.77	27.66	25.12	23.69	23.33	28.83	24.45	22.96	27.02	25.13	24.39	23.25	22.95	22.61
13	100	6	13.6	58	26.83	25.26	24.72	28.33	24.16	31.77	26.66	24.12	22.69	22.33	27.83	23.45	21.96	26.02	24.13	23.39	22.25	21.95	21.61
14	100	6	13	53	24.34	22.9	22.4	25.72	21.88	28.88	24.19	21.84	20.53	20.2	25.26	21.22	19.85	23.6	21.85	21.17	20.12	19.85	19.53
15	100	6	12.3	48	22.14	20.84	20.39	23.39	19.92	26.24	22.01	19.88	18.7	18.4	22.97	19.33	18.08	21.47	19.9	19.28	18.33	18.08	17.8
16	100	6	11.4	41	18.54	17.41	17.02	19.63	16.61	22.11	18.43	16.58	15.55	15.29	19.27	16.09	15.01	17.96	16.59	16.05	15.22	15.01	14.76
17	100	6	10.7	37	17.03	16.02	15.67	18	15.31	20.2	16.93	15.28	14.37	14.13	17.68	14.85	13.89	16.51	15.29	14.82	14.08	13.89	13.66
18	100	6	10.2	34	15.73	14.8	14.48	16.61	14.15	18.63	15.63	14.12	13.29	13.07	16.32	13.73	12.84	15.25	14.13	13.69	13.02	12.84	12.64
19	100	6	10	32	14.39	13.49	13.18	15.24	12.86	17.19	14.3	12.84	12.03	11.82	14.96	12.46	11.6	13.93	12.85	12.42	11.77	11.6	11.41
20	100	6	9.8	31	14.03	13.17	12.87	14.86	12.56	16.73	13.95	12.54	11.76	11.56	14.58	12.17	11.35	13.59	12.55	12.14	11.51	11.35	11.16
21	100	6	9.1	27	12.21	11.45	11.19	12.93	10.92	14.56	12.13	10.9	10.22	10.05	12.69	10.58	9.86	11.82	10.91	10.55	10	9.86	9.7
22	100	6	7.1	17	7.64	7.16	7	8.1	6.82	9.13	7.6	6.81	6.38	6.27	7.95	6.61	6.15	7.4	6.82	6.59	6.24	6.15	6.04
23	100	6	5.9	12	5.34	5	4.88	5.67	4.76	6.4	5.31	4.75	4.44	4.36	5.56	4.6	4.27	5.17	4.75	4.59	4.34	4.27	4.2
24	100	6	5.5	11	5.15	4.85	4.74	5.44	4.63	6.08	5.12	4.62	4.35	4.28	5.34	4.5	4.21	4.99	4.63	4.48	4.26	4.21	4.14

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	100	6	7.8	20	8.87	8.3	8.11	9.42	7.9	10.64	8.82	7.89	7.37	7.24	9.24	7.64	7.1	8.58	7.89	7.62	7.21	7.1	6.97
2	100	6	7.6	19	8.39	7.85	7.66	8.91	7.47	10.08	8.34	7.45	6.96	6.83	8.74	7.22	6.7	8.11	7.46	7.2	6.8	6.7	6.58
3	100	6	7.5	19	8.65	8.12	7.94	9.15	7.74	10.3	8.6	7.73	7.25	7.13	8.99	7.5	7	8.38	7.74	7.49	7.1	7	6.88
4	100	6	7.6	19	8.39	7.85	7.66	8.91	7.47	10.08	8.34	7.45	6.96	6.83	8.74	7.22	6.7	8.11	7.46	7.2	6.8	6.7	6.58
5	100	6	7.9	21	9.61	9.03	8.82	10.16	8.61	11.42	9.55	8.6	8.07	7.94	9.98	8.35	7.79	9.31	8.61	8.33	7.9	7.79	7.66
6	100	6	8.9	26	11.8	11.08	10.83	12.49	10.57	14.06	11.73	10.55	9.9	9.73	12.27	10.24	9.55	11.43	10.56	10.22	9.69	9.55	9.39
7	100	6	10.9	38	17.34	16.29	15.93	18.34	15.55	20.62	17.23	15.53	14.58	14.34	18.01	15.08	14.08	16.8	15.54	15.04	14.28	14.08	13.85
8	100	6	13.6	59	27.83	26.26	25.72	29.33	25.16	32.77	27.66	25.12	23.69	23.33	28.83	24.45	22.96	27.02	25.13	24.39	23.25	22.95	22.61
9	100	6	17.7	98	47.04	44.5	43.63	49.47	42.72	55.09	46.76	42.65	40.33	39.75	48.66	41.56	39.15	45.73	42.66	41.47	39.61	39.14	38.59
10	100	6	19.4	117	56.5	53.49	52.46	59.37	51.38	66.05	56.17	51.3	48.56	47.87	58.41	50.01	47.16	54.95	51.32	49.91	47.71	47.16	46.5
11	100	6	20.1	126	61.35	58.13	57.03	64.41	55.88	71.55	60.99	55.79	52.87	52.14	63.38	54.42	51.38	59.69	55.82	54.31	51.97	51.37	50.67
12	100	6	20.5	130	62.91	59.58	58.44	66.09	57.25	73.5	62.54	57.16	54.13	53.37	65.02	55.73	52.58	61.2	57.18	55.62	53.19	52.57	51.85
13	100	6	20.4	129	62.53	59.22	58.09	65.68	56.91	73.01	62.16	56.82	53.82	53.06	64.62	55.41	52.28	60.82	56.84	55.3	52.89	52.28	51.56
14	100	6	19.5	118	56.92	53.88	52.83	59.81	51.75	66.56	56.58	51.66	48.9	48.21	58.84	50.36	47.49	55.35	51.68	50.26	48.04	47.48	46.82
15	100	6	18.4	106	51.21	48.48	47.54	53.81	46.56	59.86	50.91	46.49	44	43.38	52.94	45.32	42.73	49.8	46.51	45.23	43.23	42.73	42.13
16	100	6	17	91	43.74	41.38	40.57	46	39.73	51.21	43.49	39.66	37.52	36.98	45.24	38.65	36.41	42.53	39.68	38.57	36.85	36.41	35.89
17	100	6	16	80	37.8	35.69	34.96	39.82	34.21	44.48	37.57	34.15	32.23	31.75	39.14	33.25	31.24	36.71	34.17	33.17	31.63	31.24	30.78
18	100	6	15.3	74	35.18	33.23	32.57	37.04	31.87	41.32	34.97	31.82	30.05	29.6	36.42	30.98	29.14	34.18	31.83	30.92	29.49	29.13	28.71
19	100	6	15	71	33.59	31.71	31.07	35.38	30.39	39.51	33.39	30.34	28.64	28.21	34.78	29.54	27.76	32.62	30.36	29.48	28.1	27.76	27.34
20	100	6	14.7	67	30.97	29.16	28.54	32.7	27.89	36.68	30.78	27.84	26.2	25.79	32.12	27.07	25.35	30.04	27.86	27.01	25.69	25.35	24.95
21	100	6	13.6	59	27.83	26.26	25.72	29.33	25.16	32.77	27.66	25.12	23.69	23.33	28.83	24.45	22.96	27.02	25.13	24.39	23.25	22.95	22.61
22	100	6	10.6	36	16.38	15.38	15.04	17.33	14.68	19.49	16.28	14.66	13.76	13.53	17.01	14.23	13.29	15.87	14.67	14.2	13.47	13.28	13.06
23	100	6	8.9	26	11.8	11.08	10.83	12.49	10.57	14.06	11.73	10.55	9.9	9.73	12.27	10.24	9.55	11.43	10.56	10.22	9.69	9.55	9.39
24	100	6	8.2	22	9.8	9.17	8.96	10.39	8.73	11.74	9.74	8.72	8.15	8.01	10.2	8.45	7.86	9.48	8.72	8.43	7.97	7.85	7.72

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	100	8	2.6	2	1.63	1.61	1.6	1.64	1.59	1.69	1.62	1.59	1.57	1.57	1.64	1.58	1.56	1.61	1.59	1.58	1.57	1.56	1.56
2	100	8	2.5	2	1.65	1.63	1.63	1.67	1.62	1.71	1.65	1.62	1.6	1.6	1.66	1.61	1.59	1.64	1.62	1.61	1.6	1.59	1.59
3	100	8	2.5	2	1.65	1.63	1.63	1.67	1.62	1.71	1.65	1.62	1.6	1.6	1.66	1.61	1.59	1.64	1.62	1.61	1.6	1.59	1.59
4	100	8	2.5	2	1.65	1.63	1.63	1.67	1.62	1.71	1.65	1.62	1.6	1.6	1.66	1.61	1.59	1.64	1.62	1.61	1.6	1.59	1.59
5	100	8	2.6	2	1.63	1.61	1.6	1.64	1.59	1.69	1.62	1.59	1.57	1.57	1.64	1.58	1.56	1.61	1.59	1.58	1.57	1.56	1.56
6	100	8	3	2	1.51	1.49	1.48	1.54	1.47	1.59	1.51	1.47	1.45	1.44	1.53	1.46	1.43	1.5	1.47	1.46	1.44	1.43	1.43
7	100	8	3.6	2	1.32	1.29	1.28	1.36	1.26	1.44	1.32	1.26	1.23	1.22	1.35	1.25	1.21	1.31	1.26	1.25	1.22	1.21	1.2
8	100	8	4.5	3	1.99	1.93	1.91	2.04	1.9	2.15	1.98	1.89	1.85	1.83	2.02	1.87	1.82	1.96	1.89	1.87	1.83	1.82	1.81
9	100	8	5.9	4	2.34	2.25	2.22	2.42	2.19	2.61	2.33	2.19	2.11	2.09	2.39	2.15	2.07	2.29	2.19	2.15	2.08	2.07	2.05
10	100	8	6.5	4	2.02	1.91	1.88	2.12	1.84	2.34	2.01	1.84	1.74	1.72	2.08	1.79	1.69	1.96	1.84	1.79	1.71	1.69	1.67
11	100	8	6.7	4	1.9	1.8	1.76	2.01	1.72	2.25	1.89	1.71	1.61	1.59	1.97	1.67	1.56	1.85	1.71	1.66	1.58	1.56	1.54
12	100	8	6.8	4	1.85	1.73	1.7	1.95	1.66	2.2	1.83	1.65	1.55	1.52	1.92	1.6	1.49	1.79	1.65	1.6	1.52	1.49	1.47
13	100	8	6.8	4	1.85	1.73	1.7	1.95	1.66	2.2	1.83	1.65	1.55	1.52	1.92	1.6	1.49	1.79	1.65	1.6	1.52	1.49	1.47
14	100	8	6.5	4	2.02	1.91	1.88	2.12	1.84	2.34	2.01	1.84	1.74	1.72	2.08	1.79	1.69	1.96	1.84	1.79	1.71	1.69	1.67
15	100	8	6.1	4	2.23	2.14	2.11	2.32	2.08	2.53	2.22	2.07	1.99	1.97	2.29	2.03	1.95	2.19	2.07	2.03	1.96	1.95	1.92
16	100	8	5.7	4	2.44	2.36	2.33	2.52	2.3	2.7	2.43	2.3	2.22	2.2	2.49	2.26	2.18	2.4	2.3	2.26	2.2	2.18	2.17
17	100	8	5.3	3	1.63	1.56	1.54	1.7	1.51	1.86	1.63	1.51	1.44	1.43	1.68	1.48	1.41	1.6	1.51	1.48	1.42	1.41	1.39
18	100	8	5.1	3	1.73	1.66	1.64	1.79	1.61	1.94	1.72	1.61	1.55	1.53	1.77	1.58	1.52	1.69	1.61	1.58	1.53	1.52	1.5
19	100	8	5	3	1.77	1.71	1.69	1.83	1.66	1.97	1.76	1.66	1.6	1.59	1.81	1.63	1.57	1.74	1.66	1.63	1.58	1.57	1.55
20	100	8	4.9	3	1.82	1.75	1.73	1.88	1.71	2.01	1.81	1.71	1.65	1.64	1.86	1.68	1.62	1.78	1.71	1.68	1.63	1.62	1.61
21	100	8	4.5	3	1.99	1.93	1.91	2.04	1.9	2.15	1.98	1.89	1.85	1.83	2.02	1.87	1.82	1.96	1.89	1.87	1.83	1.82	1.81
22	100	8	3.5	2	1.36	1.32	1.31	1.39	1.3	1.46	1.35	1.3	1.27	1.26	1.38	1.28	1.25	1.34	1.3	1.28	1.26	1.25	1.24
23	100	8	3	2	1.51	1.49	1.48	1.54	1.47	1.59	1.51	1.47	1.45	1.44	1.53	1.46	1.43	1.5	1.47	1.46	1.44	1.43	1.43
24	100	8	2.7	2	1.6	1.58	1.57	1.62	1.56	1.67	1.6	1.56	1.54	1.54	1.61	1.55	1.53	1.59	1.56	1.55	1.54	1.53	1.53

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	100	8	5.2	3	1.68	1.61	1.59	1.75	1.56	1.9	1.67	1.56	1.5	1.48	1.72	1.53	1.46	1.65	1.56	1.53	1.48	1.46	1.45
2	100	8	5.1	3	1.73	1.66	1.64	1.79	1.61	1.94	1.72	1.61	1.55	1.53	1.77	1.58	1.52	1.69	1.61	1.58	1.53	1.52	1.5
3	100	8	5	3	1.77	1.71	1.69	1.83	1.66	1.97	1.76	1.66	1.6	1.59	1.81	1.63	1.57	1.74	1.66	1.63	1.58	1.57	1.55
4	100	8	5.1	3	1.73	1.66	1.64	1.79	1.61	1.94	1.72	1.61	1.55	1.53	1.77	1.58	1.52	1.69	1.61	1.58	1.53	1.52	1.5
5	100	8	5.3	3	1.63	1.56	1.54	1.7	1.51	1.86	1.63	1.51	1.44	1.43	1.68	1.48	1.41	1.6	1.51	1.48	1.42	1.41	1.39
6	100	8	5.9	4	2.34	2.25	2.22	2.42	2.19	2.61	2.33	2.19	2.11	2.09	2.39	2.15	2.07	2.29	2.19	2.15	2.08	2.07	2.05
7	100	8	7.3	5	2.55	2.42	2.38	2.67	2.33	2.95	2.53	2.33	2.21	2.18	2.63	2.27	2.15	2.48	2.33	2.27	2.17	2.15	2.12
8	100	8	9.1	7	3.33	3.14	3.07	3.51	3	3.93	3.3	3	2.82	2.78	3.44	2.91	2.73	3.23	3	2.91	2.76	2.73	2.69
9	100	8	11.8	11	5.07	4.77	4.66	5.36	4.55	6.05	5.03	4.54	4.26	4.19	5.26	4.41	4.11	4.91	4.54	4.4	4.17	4.11	4.05
10	100	8	13	12	4.91	4.55	4.42	5.26	4.29	6.08	4.86	4.28	3.94	3.86	5.14	4.12	3.77	4.72	4.28	4.11	3.84	3.77	3.69
11	100	8	13.4	13	5.5	5.12	4.99	5.87	4.85	6.74	5.45	4.84	4.48	4.39	5.74	4.67	4.3	5.3	4.83	4.65	4.37	4.3	4.21
12	100	8	13.6	13	5.29	4.9	4.76	5.67	4.62	6.56	5.24	4.61	4.24	4.15	5.54	4.44	4.06	5.09	4.61	4.42	4.13	4.06	3.97
13	100	8	13.6	13	5.29	4.9	4.76	5.67	4.62	6.56	5.24	4.61	4.24	4.15	5.54	4.44	4.06	5.09	4.61	4.42	4.13	4.06	3.97
14	100	8	13	12	4.91	4.55	4.42	5.26	4.29	6.08	4.86	4.28	3.94	3.86	5.14	4.12	3.77	4.72	4.28	4.11	3.84	3.77	3.69
15	100	8	12.3	11	4.6	4.27	4.16	4.91	4.04	5.65	4.56	4.03	3.72	3.65	4.8	3.88	3.57	4.43	4.03	3.87	3.63	3.57	3.49
16	100	8	11.4	10	4.44	4.15	4.05	4.71	3.95	5.35	4.4	3.94	3.67	3.61	4.61	3.81	3.54	4.29	3.94	3.8	3.59	3.54	3.47
17	100	8	10.7	9	4.05	3.79	3.71	4.29	3.61	4.87	4.02	3.61	3.37	3.31	4.21	3.49	3.25	3.92	3.61	3.49	3.3	3.25	3.19
18	100	8	10.2	8	3.47	3.23	3.15	3.69	3.07	4.21	3.44	3.06	2.84	2.79	3.61	2.96	2.73	3.34	3.06	2.95	2.78	2.73	2.68
19	100	8	10	8	3.63	3.4	3.33	3.84	3.24	4.35	3.6	3.24	3.03	2.98	3.77	3.14	2.92	3.51	3.24	3.13	2.96	2.92	2.87
20	100	8	9.8	8	3.79	3.57	3.5	4	3.42	4.48	3.76	3.41	3.21	3.16	3.92	3.32	3.11	3.67	3.41	3.31	3.15	3.11	3.06
21	100	8	9.1	7	3.33	3.14	3.07	3.51	3	3.93	3.3	3	2.82	2.78	3.44	2.91	2.73	3.23	3	2.91	2.76	2.73	2.69
22	100	8	7.1	5	2.67	2.55	2.51	2.79	2.46	3.05	2.66	2.46	2.35	2.32	2.75	2.41	2.29	2.61	2.46	2.4	2.31	2.29	2.26
23	100	8	5.9	4	2.34	2.25	2.22	2.42	2.19	2.61	2.33	2.19	2.11	2.09	2.39	2.15	2.07	2.29	2.19	2.15	2.08	2.07	2.05
24	100	8	5.5	3	1.54	1.46	1.44	1.61	1.41	1.78	1.53	1.41	1.34	1.32	1.59	1.37	1.3	1.5	1.41	1.37	1.31	1.3	1.28

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	100	8	7.8	5	2.23	2.09	2.04	2.37	1.99	2.69	2.21	1.98	1.85	1.81	2.32	1.92	1.78	2.16	1.98	1.91	1.81	1.78	1.75
2	100	8	7.6	5	2.36	2.22	2.18	2.49	2.13	2.8	2.34	2.12	2	1.96	2.45	2.06	1.93	2.29	2.12	2.06	1.96	1.93	1.9
3	100	8	7.5	5	2.42	2.29	2.24	2.55	2.19	2.85	2.41	2.19	2.07	2.04	2.51	2.13	2	2.35	2.19	2.13	2.03	2	1.97
4	100	8	7.6	5	2.36	2.22	2.18	2.49	2.13	2.8	2.34	2.12	2	1.96	2.45	2.06	1.93	2.29	2.12	2.06	1.96	1.93	1.9
5	100	8	7.9	6	3.17	3.02	2.97	3.31	2.91	3.63	3.15	2.91	2.77	2.74	3.26	2.85	2.7	3.09	2.91	2.84	2.73	2.7	2.67
6	100	8	8.9	7	3.47	3.29	3.23	3.65	3.16	4.05	3.45	3.16	2.99	2.94	3.59	3.08	2.9	3.38	3.16	3.07	2.93	2.9	2.86
7	100	8	10.9	9	3.88	3.61	3.52	4.13	3.43	4.72	3.84	3.42	3.17	3.11	4.04	3.3	3.05	3.74	3.42	3.29	3.1	3.05	2.99
8	100	8	13.6	13	4.98	4.57	4.42	5.37	4.28	6.3	4.92	4.26	3.88	3.79	5.23	4.08	3.69	4.76	4.26	4.07	3.76	3.69	3.6
9	100	8	17.7	22	9.45	8.81	8.59	10.05	8.36	11.51	9.36	8.34	7.74	7.6	9.84	8.06	7.44	9.11	8.33	8.03	7.56	7.44	7.3
10	100	8	19.4	26	11.12	10.36	10.1	11.83	9.83	13.57	11.01	9.81	9.1	8.93	11.58	9.47	8.75	10.72	9.8	9.44	8.89	8.75	8.58
11	100	8	20.1	28	12.1	11.29	11.02	12.87	10.73	14.72	11.99	10.7	9.95	9.76	12.6	10.35	9.57	11.67	10.7	10.32	9.72	9.57	9.39
12	100	8	20.5	28	11.51	10.67	10.38	12.3	10.08	14.22	11.39	10.06	9.27	9.09	12.02	9.69	8.89	11.07	10.05	9.66	9.04	8.89	8.7
13	100	8	20.4	28	11.66	10.83	10.54	12.44	10.24	14.35	11.54	10.22	9.44	9.26	12.16	9.85	9.06	11.22	10.21	9.83	9.21	9.06	8.88
14	100	8	19.5	26	10.97	10.21	9.95	11.7	9.67	13.45	10.86	9.65	8.93	8.76	11.44	9.31	8.58	10.57	9.64	9.29	8.72	8.58	8.41
15	100	8	18.4	23	9.51	8.82	8.59	10.16	8.34	11.73	9.41	8.32	7.68	7.52	9.93	8.02	7.36	9.15	8.31	7.99	7.49	7.36	7.21
16	100	8	17	20	8.35	7.76	7.55	8.91	7.34	10.27	8.27	7.32	6.77	6.63	8.72	7.06	6.49	8.04	7.32	7.04	6.6	6.49	6.36
17	100	8	16	18	7.59	7.06	6.88	8.09	6.68	9.31	7.52	6.67	6.17	6.05	7.92	6.43	5.92	7.31	6.67	6.42	6.02	5.92	5.81
18	100	8	15.3	17	7.42	6.93	6.76	7.88	6.58	9	7.35	6.57	6.11	6	7.72	6.35	5.88	7.16	6.57	6.34	5.97	5.88	5.77
19	100	8	15	16	6.76	6.29	6.13	7.21	5.96	8.29	6.7	5.94	5.5	5.4	7.05	5.74	5.28	6.51	5.94	5.72	5.37	5.28	5.18
20	100	8	14.7	15	6.1	5.65	5.49	6.53	5.33	7.57	6.04	5.31	4.89	4.78	6.38	5.11	4.67	5.86	5.31	5.1	4.76	4.67	4.57
21	100	8	13.6	13	5.29	4.9	4.76	5.67	4.62	6.56	5.24	4.61	4.24	4.15	5.54	4.44	4.06	5.09	4.61	4.42	4.13	4.06	3.97
22	100	8	10.6	9	4.14	3.88	3.8	4.37	3.71	4.94	4.1	3.7	3.47	3.41	4.29	3.59	3.35	4	3.7	3.58	3.39	3.35	3.29
23	100	8	8.9	7	3.47	3.29	3.23	3.65	3.16	4.05	3.45	3.16	2.99	2.94	3.59	3.08	2.9	3.38	3.16	3.07	2.93	2.9	2.86
24	100	8	8.2	6	2.97	2.81	2.75	3.12	2.7	3.47	2.95	2.69	2.55	2.51	3.06	2.62	2.47	2.88	2.69	2.62	2.5	2.47	2.44

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	300	4	2.6	52	20.6	19.02	18.45	22.17	17.88	25.28	20.59	17.83	16.48	16.08	21.72	17.19	15.67	19.83	17.91	17.13	15.98	15.66	15.3
2	300	4	2.5	50	20.77	19.3	18.77	22.24	18.23	25.13	20.76	18.19	16.93	16.55	21.82	17.59	16.17	20.05	18.27	17.54	16.46	16.17	15.83
3	300	4	2.5	48	18.77	17.3	16.77	20.24	16.23	23.13	18.76	16.19	14.93	14.55	19.82	15.59	14.17	18.05	16.27	15.54	14.46	14.17	13.83
4	300	4	2.5	50	20.77	19.3	18.77	22.24	18.23	25.13	20.76	18.19	16.93	16.55	21.82	17.59	16.17	20.05	18.27	17.54	16.46	16.17	15.83
5	300	4	2.6	54	22.6	21.02	20.45	24.17	19.88	27.28	22.59	19.83	18.48	18.08	23.72	19.19	17.67	21.83	19.91	19.13	17.98	17.66	17.3
6	300	4	3	67	26.2	24.15	23.42	28.23	22.68	32.26	26.18	22.62	20.88	20.35	27.65	21.79	19.82	25.2	22.72	21.71	20.22	19.82	19.36
7	300	4	3.6	101	43.99	41.14	40.12	46.81	39.09	52.42	43.96	39.02	36.6	35.87	46	37.87	35.14	42.6	39.16	37.76	35.69	35.14	34.49
8	300	4	4.5	156	70.01	65.75	64.22	74.24	62.69	82.66	69.96	62.58	58.96	57.88	73.03	60.87	56.8	67.93	62.79	60.7	57.61	56.79	55.83
9	300	4	5.9	263	121.09	114.11	111.63	128	109.13	141.82	121.01	108.94	103.04	101.29	126.03	106.16	99.53	117.7	109.3	105.9	100.85	99.52	97.97
10	300	4	6.5	316	146.15	137.83	134.88	154.39	131.9	170.9	146.05	131.67	124.63	122.55	152.04	128.35	120.46	142.11	132.09	128.04	122.03	120.44	118.6
11	300	4	6.7	339	159.32	150.52	147.4	168.03	144.25	185.48	159.21	144.01	136.57	134.38	165.54	140.51	132.17	155.05	144.46	140.18	133.83	132.15	130.21
12	300	4	6.8	350	165.3	156.26	153.06	174.25	149.82	192.18	165.19	149.58	141.93	139.68	171.7	145.98	137.42	160.92	150.03	145.64	139.12	137.4	135.4
13	300	4	6.8	348	163.3	154.26	151.06	172.25	147.82	190.18	163.19	147.58	139.93	137.68	169.7	143.98	135.42	158.92	148.03	143.64	137.12	135.4	133.4
14	300	4	6.5	318	148.15	139.83	136.88	156.39	133.9	172.9	148.05	133.67	126.63	124.55	154.04	130.35	122.46	144.11	134.09	130.04	124.03	122.44	120.6
15	300	4	6.1	284	133.04	125.63	122.99	140.38	120.34	155.07	132.95	120.14	113.86	112.01	138.29	117.18	110.14	129.44	120.51	116.9	111.54	110.13	108.48
16	300	4	5.7	244	110.88	104.33	102	117.37	99.65	130.34	110.8	99.47	93.92	92.28	115.52	96.85	90.63	107.69	99.8	96.61	91.87	90.61	89.15
17	300	4	5.3	215	98.65	92.92	90.87	104.34	88.81	115.7	98.59	88.66	83.79	82.35	102.72	86.36	80.9	95.86	88.95	86.15	81.99	80.89	79.61
18	300	4	5.1	198	89.64	84.29	82.39	94.95	80.47	105.53	89.58	80.32	75.78	74.44	93.44	78.18	73.08	87.04	80.59	77.98	74.1	73.07	71.88
19	300	4	5	189	84.54	79.38	77.54	89.66	75.68	99.86	84.48	75.54	71.17	69.87	88.2	73.48	68.56	82.03	75.8	73.28	69.54	68.55	67.4
20	300	4	4.9	181	80.37	75.39	73.62	85.3	71.83	95.14	80.31	71.7	67.47	66.22	83.89	69.7	64.96	77.95	71.95	69.51	65.91	64.95	63.84
21	300	4	4.5	156	70.01	65.75	64.22	74.24	62.69	82.66	69.96	62.58	58.96	57.88	73.03	60.87	56.8	67.93	62.79	60.7	57.61	56.79	55.83
22	300	4	3.5	96	41.86	39.16	38.19	44.54	37.21	49.87	41.83	37.14	34.84	34.15	43.78	36.05	33.46	40.54	37.27	35.94	33.98	33.45	32.84
23	300	4	3	67	26.2	24.15	23.42	28.23	22.68	32.26	26.18	22.62	20.88	20.35	27.65	21.79	19.82	25.2	22.72	21.71	20.22	19.82	19.36
24	300	4	2.7	57	23.36	21.66	21.05	25.04	20.44	28.36	23.34	20.39	18.95	18.52	24.56	19.71	18.08	22.53	20.48	19.64	18.41	18.08	17.69

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	300	4	5.2	203	90.68	85.14	83.17	96.18	81.18	107.14	90.62	81.02	76.32	74.93	94.61	78.81	73.53	87.99	81.3	78.6	74.58	73.52	72.28
2	300	4	5.1	196	87.64	82.29	80.39	92.95	78.47	103.53	87.58	78.32	73.78	72.44	91.44	76.18	71.08	85.04	78.59	75.98	72.1	71.07	69.88
3	300	4	5	189	84.54	79.38	77.54	89.66	75.68	99.86	84.48	75.54	71.17	69.87	88.2	73.48	68.56	82.03	75.8	73.28	69.54	68.55	67.4
4	300	4	5.1	196	87.64	82.29	80.39	92.95	78.47	103.53	87.58	78.32	73.78	72.44	91.44	76.18	71.08	85.04	78.59	75.98	72.1	71.07	69.88
5	300	4	5.3	210	93.65	87.92	85.87	99.34	83.81	110.7	93.59	83.66	78.79	77.35	97.72	81.36	75.9	90.86	83.95	81.15	76.99	75.89	74.61
6	300	4	5.9	263	121.09	114.11	111.63	128	109.13	141.82	121.01	108.94	103.04	101.29	126.03	106.16	99.53	117.7	109.3	105.9	100.85	99.52	97.97
7	300	4	7.3	398	187.24	176.96	173.31	197.43	169.63	217.86	187.11	169.35	160.66	158.1	194.52	165.26	155.53	182.26	169.87	164.88	157.46	155.5	153.23
8	300	4	9.1	621	303.09	287.7	282.25	318.32	276.76	348.99	302.88	276.34	263.34	259.55	313.98	270.24	255.72	295.64	277.12	269.68	258.6	255.69	252.31
9	300	4	11.8	1049	531.68	506.88	498.13	556.22	489.3	605.81	531.31	488.63	467.72	461.66	549.23	478.85	455.55	519.72	489.89	477.96	460.15	455.5	450.09
10	300	4	13	1260	639.33	609.68	599.24	668.66	588.7	728.01	638.88	587.9	562.93	555.71	660.3	576.23	548.42	625.05	589.41	575.17	553.91	548.36	541.92
11	300	4	13.4	1350	692.88	661.53	650.49	723.89	639.35	786.68	692.4	638.5	612.1	604.48	715.06	626.17	596.78	677.78	640.1	625.05	602.57	596.71	589.91
12	300	4	13.6	1396	720.28	688.06	676.72	752.15	665.27	816.7	719.79	664.4	637.27	629.44	743.07	651.73	621.53	704.77	666.04	650.58	627.48	621.46	614.48
13	300	4	13.6	1386	710.28	678.06	666.72	742.15	655.27	806.7	709.79	654.4	627.27	619.44	733.07	641.73	611.53	694.77	656.04	640.58	617.48	611.46	604.48
14	300	4	13	1269	648.33	618.68	608.24	677.66	597.7	737.01	647.88	596.9	571.93	564.71	669.3	585.23	557.42	634.05	598.41	584.17	562.91	557.36	550.92
15	300	4	12.3	1131	571.71	544.94	535.5	598.2	525.98	651.76	571.31	525.26	502.7	496.16	590.65	514.7	489.57	558.81	526.62	513.75	494.53	489.51	483.69
16	300	4	11.4	970	485.12	461.85	453.63	508.15	445.34	554.68	484.78	444.72	425.09	419.39	501.59	435.53	413.65	473.89	445.9	434.69	417.97	413.6	408.52
17	300	4	10.7	857	426.48	405.76	398.45	446.98	391.06	488.35	426.18	390.5	373.03	367.95	441.14	382.32	362.82	416.48	391.55	381.57	366.68	362.78	358.25
18	300	4	10.2	786	392.41	373.44	366.73	411.19	359.97	449.06	392.14	359.46	343.44	338.78	405.84	351.95	334.08	383.25	360.42	351.26	337.62	334.04	329.89
19	300	4	10	751	371.74	353.44	346.98	389.85	340.45	426.36	371.48	339.96	324.52	320.02	384.69	332.72	315.49	362.9	340.89	332.06	318.9	315.45	311.44
20	300	4	9.8	718	352.82	335.19	328.96	370.27	322.67	405.44	352.57	322.19	307.31	302.97	365.3	315.21	298.6	344.3	323.08	314.57	301.89	298.56	294.7
21	300	4	9.1	621	303.09	287.7	282.25	318.32	276.76	348.99	302.88	276.34	263.34	259.55	313.98	270.24	255.72	295.64	277.12	269.68	258.6	255.69	252.31
22	300	4	7.1	378	177.86	168.09	164.62	187.54	161.12	206.96	177.74	160.85	152.58	150.16	184.78	156.96	147.71	173.12	161.35	156.6	149.55	147.68	145.52
23	300	4	5.9	263	121.09	114.11	111.63	128	109.13	141.82	121.01	108.94	103.04	101.29	126.03	106.16	99.53	117.7	109.3	105.9	100.85	99.52	97.97
24	300	4	5.5	225	100.4	94.26	92.07	106.48	89.87	118.63	100.33	89.71	84.5	82.96	104.75	87.25	81.41	97.41	90.01	87.02	82.58	81.4	80.03

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	300	4	7.8	454	215.57	203.96	199.85	227.06	195.7	250.14	215.42	195.38	185.57	182.69	223.78	190.77	179.79	209.95	195.97	190.34	181.97	179.77	177.21
2	300	4	7.6	439	211.83	200.76	196.84	222.79	192.88	244.8	211.69	192.58	183.22	180.48	219.67	188.18	177.71	206.47	193.14	187.77	179.79	177.68	175.24
3	300	4	7.5	423	201.37	190.56	186.73	212.07	182.87	233.54	201.23	182.57	173.44	170.76	209.02	178.28	168.05	196.13	183.12	177.88	170.09	168.03	165.65
4	300	4	7.6	439	211.83	200.76	196.84	222.79	192.88	244.8	211.69	192.58	183.22	180.48	219.67	188.18	177.71	206.47	193.14	187.77	179.79	177.68	175.24
5	300	4	7.9	471	226.84	214.96	210.75	238.6	206.5	262.23	226.68	206.18	196.14	193.19	235.25	201.46	190.23	221.09	206.78	201.02	192.46	190.2	187.58
6	300	4	8.9	591	286.02	271.24	266.01	300.65	260.74	330.08	285.82	260.34	247.86	244.21	296.48	254.48	240.53	278.87	261.09	253.94	243.3	240.5	237.26
7	300	4	10.9	894	448.26	426.83	419.26	469.47	411.62	512.29	447.95	411.05	392.97	387.72	463.43	402.58	382.42	437.92	412.13	401.81	386.4	382.37	377.69
8	300	4	13.6	1396	720.28	688.06	676.72	752.15	665.27	816.7	719.79	664.4	637.27	629.44	743.07	651.73	621.53	704.77	666.04	650.58	627.48	621.46	614.48
9	300	4	17.7	2358	1246.35	1193.92	1175.52	1298.2	1156.93	1403.65	1245.49	1155.52	1111.45	1098.82	1283.43	1134.99	1086.06	1221.17	1158.19	1133.15	1095.67	1085.95	1074.68
10	300	4	19.4	2833	1510.2	1448.05	1426.26	1571.65	1404.25	1696.81	1509.16	1402.58	1350.38	1335.46	1554.16	1378.29	1320.38	1480.38	1405.75	1376.12	1331.74	1320.26	1306.93
11	300	4	20.1	3035	1620.11	1553.72	1530.47	1685.73	1506.97	1819.48	1618.98	1505.19	1449.45	1433.53	1667.05	1479.26	1417.45	1588.27	1508.57	1476.95	1429.56	1417.32	1403.1
12	300	4	20.5	3138	1669.13	1600.27	1576.16	1737.2	1551.79	1875.97	1667.96	1549.94	1492.14	1475.64	1717.82	1523.05	1458.96	1636.12	1553.45	1520.67	1471.52	1458.83	1444.09
13	300	4	20.4	3118	1662.72	1594.48	1570.58	1730.17	1546.43	1867.68	1661.56	1544.6	1487.32	1470.96	1710.97	1517.95	1454.44	1630	1548.08	1515.59	1466.89	1454.31	1439.7
14	300	4	19.5	2853	1517.23	1454.48	1432.49	1579.27	1410.26	1705.64	1516.17	1408.58	1355.88	1340.82	1561.61	1384.05	1325.6	1487.13	1411.78	1381.87	1337.06	1325.47	1312.02
15	300	4	18.4	2542	1345.56	1289.21	1269.45	1401.26	1249.49	1514.64	1344.62	1247.97	1200.64	1187.08	1385.4	1225.93	1173.39	1318.51	1250.85	1223.96	1183.7	1173.28	1161.18
16	300	4	17	2180	1150.13	1101.47	1084.39	1198.25	1067.13	1296.05	1149.34	1065.82	1024.92	1013.18	1184.54	1046.76	1001.32	1126.75	1068.3	1045.05	1010.25	1001.22	990.74
17	300	4	16	1926	1007.72	964.22	948.94	1050.73	933.5	1138.08	1007.02	932.34	895.75	885.24	1038.48	915.27	874.61	986.81	934.55	913.74	882.61	874.53	865.15
18	300	4	15.3	1766	922.15	882.11	868.03	961.76	853.82	1042.12	921.52	852.74	819.05	809.35	950.48	837.02	799.56	902.89	854.78	835.6	806.93	799.48	790.83
19	300	4	15	1689	876.12	837.52	823.95	914.31	810.24	991.76	875.52	809.2	776.72	767.36	903.43	794.04	757.91	857.55	811.16	792.67	765.03	757.84	749.49
20	300	4	14.7	1613	830.54	793.35	780.27	867.32	767.06	941.92	829.96	766.06	734.76	725.74	856.85	751.45	716.64	812.65	767.95	750.13	723.49	716.56	708.52
21	300	4	13.6	1396	720.28	688.06	676.72	752.15	665.27	816.7	719.79	664.4	637.27	629.44	743.07	651.73	621.53	704.77	666.04	650.58	627.48	621.46	614.48
22	300	4	10.6	850	426.99	406.63	399.44	447.14	392.18	487.8	426.7	391.63	374.45	369.46	441.4	383.58	364.42	417.16	392.66	382.85	368.21	364.37	359.93
23	300	4	8.9	591	286.02	271.24	266.01	300.65	260.74	330.08	285.82	260.34	247.86	244.21	296.48	254.48	240.53	278.87	261.09	253.94	243.3	240.5	237.26
24	300	4	8.2	503	241.27	228.55	224.04	253.86	219.5	279.17	241.1	219.15	208.4	205.26	250.27	214.1	202.08	235.11	219.8	213.64	204.47	202.06	199.26

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	300	6	2.6	8	3.57	3.34	3.26	3.8	3.18	4.24	3.57	3.17	2.98	2.92	3.73	3.08	2.86	3.46	3.18	3.07	2.9	2.86	2.8
2	300	6	2.5	7	2.87	2.66	2.59	3.08	2.51	3.5	2.87	2.5	2.32	2.27	3.02	2.42	2.21	2.77	2.51	2.41	2.25	2.21	2.16
3	300	6	2.5	7	2.87	2.66	2.59	3.08	2.51	3.5	2.87	2.5	2.32	2.27	3.02	2.42	2.21	2.77	2.51	2.41	2.25	2.21	2.16
4	300	6	2.5	7	2.87	2.66	2.59	3.08	2.51	3.5	2.87	2.5	2.32	2.27	3.02	2.42	2.21	2.77	2.51	2.41	2.25	2.21	2.16
5	300	6	2.6	8	3.57	3.34	3.26	3.8	3.18	4.24	3.57	3.17	2.98	2.92	3.73	3.08	2.86	3.46	3.18	3.07	2.9	2.86	2.8
6	300	6	3	9	3.26	2.96	2.86	3.55	2.75	4.13	3.25	2.74	2.49	2.41	3.46	2.62	2.34	3.11	2.76	2.61	2.4	2.34	2.27
7	300	6	3.6	13	5	4.59	4.44	5.4	4.3	6.21	4.99	4.29	3.93	3.83	5.28	4.12	3.73	4.8	4.3	4.1	3.8	3.72	3.63
8	300	6	4.5	20	7.98	7.37	7.15	8.58	6.93	9.79	7.96	6.91	6.39	6.24	8.4	6.67	6.08	7.68	6.94	6.64	6.2	6.08	5.94
9	300	6	5.9	33	13.26	12.26	11.91	14.23	11.55	16.21	13.23	11.52	10.67	10.42	13.95	11.12	10.17	12.77	11.57	11.08	10.36	10.17	9.95
10	300	6	6.5	39	15.41	14.23	13.81	16.58	13.38	18.94	15.39	13.35	12.34	12.04	16.24	12.87	11.74	14.83	13.4	12.83	11.97	11.74	11.47
11	300	6	6.7	42	17.06	15.81	15.37	18.29	14.92	20.79	17.03	14.88	13.81	13.5	17.93	14.38	13.18	16.45	14.94	14.33	13.42	13.18	12.9
12	300	6	6.8	43	17.37	16.09	15.63	18.64	15.17	21.2	17.34	15.14	14.04	13.72	18.27	14.62	13.39	16.74	15.19	14.57	13.64	13.39	13.1
13	300	6	6.8	43	17.37	16.09	15.63	18.64	15.17	21.2	17.34	15.14	14.04	13.72	18.27	14.62	13.39	16.74	15.19	14.57	13.64	13.39	13.1
14	300	6	6.5	39	15.41	14.23	13.81	16.58	13.38	18.94	15.39	13.35	12.34	12.04	16.24	12.87	11.74	14.83	13.4	12.83	11.97	11.74	11.47
15	300	6	6.1	35	14.01	12.96	12.58	15.05	12.2	17.15	13.99	12.17	11.27	11	14.75	11.74	10.74	13.49	12.22	11.7	10.94	10.73	10.5
16	300	6	5.7	30	11.47	10.53	10.2	12.39	9.86	14.25	11.44	9.84	9.04	8.8	12.12	9.46	8.57	11.01	9.88	9.42	8.75	8.57	8.35
17	300	6	5.3	27	10.78	9.96	9.67	11.59	9.38	13.22	10.76	9.35	8.65	8.44	11.35	9.02	8.24	10.38	9.39	8.99	8.39	8.23	8.05
18	300	6	5.1	25	9.88	9.12	8.85	10.64	8.57	12.15	9.87	8.55	7.9	7.7	10.42	8.24	7.51	9.51	8.59	8.21	7.66	7.51	7.34
19	300	6	5	24	9.42	8.69	8.42	10.15	8.16	11.61	9.41	8.14	7.5	7.32	9.94	7.84	7.13	9.06	8.17	7.81	7.27	7.13	6.96
20	300	6	4.9	23	8.95	8.24	7.99	9.65	7.73	11.06	8.93	7.71	7.1	6.92	9.45	7.42	6.74	8.6	7.74	7.4	6.88	6.74	6.58
21	300	6	4.5	20	7.98	7.37	7.15	8.58	6.93	9.79	7.96	6.91	6.39	6.24	8.4	6.67	6.08	7.68	6.94	6.64	6.2	6.08	5.94
22	300	6	3.5	13	5.4	5.01	4.87	5.78	4.73	6.55	5.39	4.72	4.39	4.29	5.67	4.56	4.19	5.21	4.74	4.55	4.26	4.19	4.1
23	300	6	3	9	3.26	2.96	2.86	3.55	2.75	4.13	3.25	2.74	2.49	2.41	3.46	2.62	2.34	3.11	2.76	2.61	2.4	2.34	2.27
24	300	6	2.7	8	3.26	3.01	2.93	3.5	2.84	3.98	3.25	2.83	2.62	2.56	3.43	2.73	2.49	3.14	2.84	2.72	2.54	2.49	2.44

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	300	6	5.2	26	10.34	9.55	9.26	11.12	8.98	12.69	10.32	8.96	8.28	8.08	10.89	8.64	7.88	9.95	8.99	8.61	8.03	7.88	7.7
2	300	6	5.1	25	9.88	9.12	8.85	10.64	8.57	12.15	9.87	8.55	7.9	7.7	10.42	8.24	7.51	9.51	8.59	8.21	7.66	7.51	7.34
3	300	6	5	24	9.42	8.69	8.42	10.15	8.16	11.61	9.41	8.14	7.5	7.32	9.94	7.84	7.13	9.06	8.17	7.81	7.27	7.13	6.96
4	300	6	5.1	25	9.88	9.12	8.85	10.64	8.57	12.15	9.87	8.55	7.9	7.7	10.42	8.24	7.51	9.51	8.59	8.21	7.66	7.51	7.34
5	300	6	5.3	26	9.78	8.96	8.67	10.59	8.38	12.22	9.76	8.35	7.65	7.44	10.35	8.02	7.24	9.38	8.39	7.99	7.39	7.23	7.05
6	300	6	5.9	33	13.26	12.26	11.91	14.23	11.55	16.21	13.23	11.52	10.67	10.42	13.95	11.12	10.17	12.77	11.57	11.08	10.36	10.17	9.95
7	300	6	7.3	49	32.78	31.96	31.67	33.59	31.38	35.22	32.76	31.35	30.65	30.44	33.35	31.02	30.24	32.38	31.39	30.99	30.39	30.23	30.05
8	300	6	9.1	76	32.16	29.98	29.21	34.31	28.43	38.68	32.11	28.37	26.51	25.97	33.68	27.49	25.42	31.09	28.47	27.41	25.83	25.42	24.93
9	300	6	11.8	127	56.09	52.59	51.36	59.53	50.11	66.57	55.99	50.01	47.02	46.16	58.52	48.61	45.29	54.38	50.17	48.48	45.95	45.28	44.51
10	300	6	13	152	67.12	62.95	61.48	71.23	59.99	79.65	67.01	59.87	56.31	55.28	70.03	58.2	54.25	65.08	60.06	58.04	55.03	54.24	53.32
11	300	6	13.4	163	73.2	68.8	67.24	77.54	65.66	86.45	73.08	65.54	61.78	60.69	76.28	63.77	59.6	71.05	65.74	63.61	60.43	59.59	58.62
12	300	6	13.6	168	75.69	71.17	69.57	80.15	67.95	89.31	75.57	67.83	63.95	62.85	78.85	66.01	61.72	73.48	68.03	65.84	62.57	61.71	60.71
13	300	6	13.6	167	74.69	70.17	68.57	79.15	66.95	88.31	74.57	66.83	62.95	61.85	77.85	65.01	60.72	72.48	67.03	64.84	61.57	60.71	59.71
14	300	6	13	153	68.12	63.95	62.48	72.23	60.99	80.65	68.01	60.87	57.31	56.28	71.03	59.2	55.25	66.08	61.06	59.04	56.03	55.24	54.32
15	300	6	12.3	137	60.41	56.64	55.31	64.12	53.96	71.73	60.31	53.86	50.64	49.71	63.04	52.34	48.77	58.57	54.03	52.2	49.48	48.76	47.93
16	300	6	11.4	117	50.48	47.2	46.04	53.71	44.86	60.32	50.39	44.77	41.97	41.16	52.77	43.45	40.34	48.87	44.92	43.33	40.96	40.33	39.61
17	300	6	10.7	104	44.85	41.93	40.89	47.73	39.84	53.61	44.77	39.77	37.26	36.54	46.89	38.59	35.81	43.42	39.89	38.48	36.36	35.8	35.16
18	300	6	10.2	95	40.86	38.18	37.24	43.5	36.28	48.89	40.79	36.2	33.91	33.25	42.73	35.12	32.58	39.55	36.32	35.02	33.08	32.57	31.98
19	300	6	10	91	38.81	36.23	35.31	41.36	34.39	46.56	38.74	34.32	32.1	31.46	40.61	33.27	30.82	37.54	34.43	33.18	31.3	30.81	30.24
20	300	6	9.8	87	36.72	34.23	33.35	39.18	32.46	44.19	36.66	32.39	30.26	29.64	38.46	31.39	29.02	35.5	32.5	31.29	29.49	29.01	28.46
21	300	6	9.1	76	32.16	29.98	29.21	34.31	28.43	38.68	32.11	28.37	26.51	25.97	33.68	27.49	25.42	31.09	28.47	27.41	25.83	25.42	24.93
22	300	6	7.1	47	19.25	17.87	17.37	20.62	16.88	23.4	19.22	16.84	15.65	15.3	20.22	16.28	14.95	18.57	16.9	16.22	15.22	14.95	14.64
23	300	6	5.9	33	13.26	12.26	11.91	14.23	11.55	16.21	13.23	11.52	10.67	10.42	13.95	11.12	10.17	12.77	11.57	11.08	10.36	10.17	9.95
24	300	6	5.5	28	10.64	9.77	9.45	11.5	9.14	13.25	10.62	9.12	8.37	8.14	11.25	8.76	7.92	10.21	9.15	8.73	8.09	7.92	7.72

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	300	6	7.8	56	23.01	21.37	20.78	24.63	20.19	27.93	22.97	20.15	18.74	18.33	24.16	19.48	17.91	22.2	20.22	19.42	18.22	17.91	17.54
2	300	6	7.6	54	22.55	20.98	20.43	24.1	19.86	27.24	22.51	19.82	18.47	18.08	23.65	19.18	17.69	21.78	19.89	19.12	17.98	17.68	17.33
3	300	6	7.5	52	21.31	19.78	19.23	22.82	18.68	25.89	21.27	18.64	17.33	16.95	22.38	18.02	16.56	20.56	18.71	17.96	16.85	16.55	16.21
4	300	6	7.6	54	22.55	20.98	20.43	24.1	19.86	27.24	22.51	19.82	18.47	18.08	23.65	19.18	17.69	21.78	19.89	19.12	17.98	17.68	17.33
5	300	6	7.9	58	24.23	22.54	21.95	25.89	21.34	29.26	24.19	21.3	19.85	19.43	25.4	20.61	19.01	23.4	21.37	20.55	19.33	19	18.63
6	300	6	8.9	72	29.92	27.83	27.09	31.98	26.34	36.18	29.87	26.28	24.49	23.97	31.38	25.44	23.45	28.9	26.38	25.36	23.84	23.44	22.98
7	300	6	10.9	108	46.78	43.76	42.69	49.76	41.61	55.85	46.71	41.53	38.94	38.19	48.89	40.31	37.44	45.3	41.66	40.2	38.01	37.43	36.76
8	300	6	13.6	168	75.69	71.17	69.57	80.15	67.95	89.31	75.57	67.83	63.95	62.85	78.85	66.01	61.72	73.48	68.03	65.84	62.57	61.71	60.71
9	300	6	17.7	284	133.17	125.84	123.26	140.4	120.64	155.28	132.96	120.44	114.17	112.39	138.29	117.5	110.58	129.59	120.76	117.24	111.94	110.57	108.96
10	300	6	19.4	341	161.97	153.28	150.23	170.51	147.14	188.15	161.71	146.9	139.49	137.38	168.01	143.43	135.25	157.73	147.28	143.12	136.86	135.23	133.34
11	300	6	20.1	365	173.69	164.42	161.16	182.81	157.86	201.65	173.41	157.61	149.7	147.45	180.14	153.9	145.18	169.17	158.02	153.57	146.9	145.16	143.14
12	300	6	20.5	377	178.5	168.89	165.51	187.95	162.09	207.49	178.21	161.83	153.62	151.3	185.19	157.99	148.94	173.81	162.25	157.64	150.72	148.92	146.83
13	300	6	20.4	375	178.31	168.78	165.44	187.68	162.04	207.04	178.02	161.79	153.65	151.35	184.94	157.98	149.01	173.66	162.2	157.64	150.78	149	146.92
14	300	6	19.5	343	162.24	153.47	150.39	170.86	147.27	188.67	161.98	147.03	139.54	137.42	168.34	143.52	135.27	157.96	147.41	143.21	136.89	135.25	133.34
15	300	6	18.4	306	143.84	135.96	133.19	151.59	130.38	167.59	143.61	130.17	123.43	121.52	149.32	127.01	119.58	139.99	130.51	126.73	121.05	119.57	117.85
16	300	6	17	262	122.12	115.31	112.91	128.83	110.48	142.64	121.92	110.29	104.47	102.81	126.87	107.56	101.13	118.79	110.59	107.32	102.4	101.12	99.63
17	300	6	16	232	107.08	100.98	98.83	113.08	96.66	125.43	106.91	96.49	91.28	89.79	111.33	94.05	88.29	104.1	96.76	93.83	89.43	88.28	86.94
18	300	6	15.3	213	98.07	92.45	90.47	103.6	88.47	114.97	97.91	88.32	83.51	82.14	101.99	86.06	80.75	95.33	88.56	85.86	81.8	80.74	79.51
19	300	6	15	204	93.23	87.82	85.91	98.57	83.97	109.53	93.08	83.83	79.19	77.87	97.01	81.65	76.53	90.59	84.06	81.45	77.54	76.52	75.33
20	300	6	14.7	194	87.32	82.1	80.26	92.46	78.4	103.03	87.18	78.26	73.79	72.52	90.96	76.16	71.22	84.77	78.49	75.97	72.2	71.21	70.07
21	300	6	13.6	168	75.69	71.17	69.57	80.15	67.95	89.31	75.57	67.83	63.95	62.85	78.85	66.01	61.72	73.48	68.03	65.84	62.57	61.71	60.71
22	300	6	10.6	103	44.87	41.99	40.98	47.7	39.95	53.48	44.79	39.87	37.41	36.7	46.87	38.71	35.98	43.46	40	38.61	36.52	35.98	35.34
23	300	6	8.9	72	29.92	27.83	27.09	31.98	26.34	36.18	29.87	26.28	24.49	23.97	31.38	25.44	23.45	28.9	26.38	25.36	23.84	23.44	22.98
24	300	6	8.2	62	25.83	24.02	23.38	27.6	22.74	31.21	25.78	22.69	21.15	20.7	27.08	21.96	20.24	24.94	22.77	21.89	20.58	20.24	19.84

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	300	8	2.6	3	1.89	1.83	1.81	1.95	1.79	2.06	1.89	1.79	1.74	1.72	1.93	1.77	1.71	1.86	1.79	1.76	1.72	1.71	1.7
2	300	8	2.5	3	1.97	1.91	1.89	2.02	1.87	2.13	1.96	1.87	1.82	1.81	2	1.85	1.8	1.94	1.87	1.85	1.81	1.8	1.78
3	300	8	2.5	3	1.97	1.91	1.89	2.02	1.87	2.13	1.96	1.87	1.82	1.81	2	1.85	1.8	1.94	1.87	1.85	1.81	1.8	1.78
4	300	8	2.5	3	1.97	1.91	1.89	2.02	1.87	2.13	1.96	1.87	1.82	1.81	2	1.85	1.8	1.94	1.87	1.85	1.81	1.8	1.78
5	300	8	2.6	3	1.89	1.83	1.81	1.95	1.79	2.06	1.89	1.79	1.74	1.72	1.93	1.77	1.71	1.86	1.79	1.76	1.72	1.71	1.7
6	300	8	3	3	1.56	1.49	1.46	1.64	1.43	1.78	1.56	1.43	1.37	1.35	1.61	1.4	1.33	1.53	1.44	1.4	1.34	1.33	1.31
7	300	8	3.6	4	2	1.9	1.86	2.1	1.82	2.31	2	1.82	1.73	1.7	2.07	1.78	1.68	1.95	1.82	1.77	1.7	1.68	1.65
8	300	8	4.5	5	2	1.85	1.79	2.15	1.74	2.46	2	1.73	1.6	1.56	2.11	1.67	1.52	1.93	1.74	1.66	1.55	1.52	1.49
9	300	8	5.9	8	3.09	2.84	2.75	3.34	2.66	3.84	3.08	2.65	2.44	2.37	3.26	2.55	2.31	2.97	2.66	2.54	2.36	2.31	2.25
10	300	8	6.5	9	3.14	2.84	2.74	3.43	2.63	4.03	3.13	2.62	2.36	2.29	3.35	2.5	2.21	2.99	2.63	2.49	2.27	2.21	2.14
11	300	8	6.7	10	3.81	3.49	3.38	4.12	3.27	4.75	3.8	3.26	2.99	2.91	4.02	3.13	2.83	3.65	3.27	3.12	2.89	2.83	2.75
12	300	8	6.8	10	3.64	3.31	3.2	3.95	3.08	4.61	3.63	3.07	2.79	2.71	3.86	2.94	2.63	3.48	3.09	2.93	2.69	2.63	2.56
13	300	8	6.8	10	3.64	3.31	3.2	3.95	3.08	4.61	3.63	3.07	2.79	2.71	3.86	2.94	2.63	3.48	3.09	2.93	2.69	2.63	2.56
14	300	8	6.5	9	3.14	2.84	2.74	3.43	2.63	4.03	3.13	2.62	2.36	2.29	3.35	2.5	2.21	2.99	2.63	2.49	2.27	2.21	2.14
15	300	8	6.1	9	3.78	3.52	3.42	4.04	3.33	4.58	3.77	3.32	3.09	3.02	3.97	3.21	2.95	3.65	3.33	3.2	3	2.95	2.89
16	300	8	5.7	8	3.39	3.15	3.07	3.62	2.99	4.09	3.38	2.98	2.78	2.72	3.55	2.88	2.66	3.27	2.99	2.87	2.7	2.66	2.6
17	300	8	5.3	7	2.96	2.76	2.68	3.16	2.61	3.58	2.96	2.6	2.42	2.37	3.1	2.52	2.32	2.86	2.61	2.51	2.36	2.32	2.27
18	300	8	5.1	6	2.24	2.04	1.97	2.42	1.9	2.81	2.23	1.9	1.73	1.68	2.37	1.82	1.63	2.14	1.91	1.81	1.67	1.63	1.59
19	300	8	5	6	2.37	2.18	2.12	2.55	2.05	2.92	2.36	2.04	1.88	1.84	2.5	1.97	1.79	2.28	2.05	1.96	1.82	1.79	1.75
20	300	8	4.9	6	2.5	2.32	2.26	2.68	2.19	3.04	2.49	2.19	2.03	1.99	2.62	2.11	1.94	2.41	2.19	2.11	1.97	1.94	1.9
21	300	8	4.5	5	2	1.85	1.79	2.15	1.74	2.46	2	1.73	1.6	1.56	2.11	1.67	1.52	1.93	1.74	1.66	1.55	1.52	1.49
22	300	8	3.5	4	2.1	2	1.97	2.2	1.93	2.39	2.1	1.93	1.84	1.82	2.17	1.89	1.79	2.05	1.93	1.88	1.81	1.79	1.77
23	300	8	3	3	1.56	1.49	1.46	1.64	1.43	1.78	1.56	1.43	1.37	1.35	1.61	1.4	1.33	1.53	1.44	1.4	1.34	1.33	1.31
24	300	8	2.7	3	1.81	1.75	1.73	1.87	1.71	2	1.81	1.7	1.65	1.63	1.85	1.68	1.62	1.78	1.71	1.68	1.63	1.62	1.6

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	300	8	5.2	6	2.1	1.9	1.83	2.3	1.76	2.7	2.09	1.75	1.58	1.53	2.24	1.67	1.48	2	1.76	1.66	1.52	1.48	1.43
2	300	8	5.1	6	2.24	2.04	1.97	2.42	1.9	2.81	2.23	1.9	1.73	1.68	2.37	1.82	1.63	2.14	1.91	1.81	1.67	1.63	1.59
3	300	8	5	6	2.37	2.18	2.12	2.55	2.05	2.92	2.36	2.04	1.88	1.84	2.5	1.97	1.79	2.28	2.05	1.96	1.82	1.79	1.75
4	300	8	5.1	6	2.24	2.04	1.97	2.42	1.9	2.81	2.23	1.9	1.73	1.68	2.37	1.82	1.63	2.14	1.91	1.81	1.67	1.63	1.59
5	300	8	5.3	7	2.96	2.76	2.68	3.16	2.61	3.58	2.96	2.6	2.42	2.37	3.1	2.52	2.32	2.86	2.61	2.51	2.36	2.32	2.27
6	300	8	5.9	8	3.09	2.84	2.75	3.34	2.66	3.84	3.08	2.65	2.44	2.37	3.26	2.55	2.31	2.97	2.66	2.54	2.36	2.31	2.25
7	300	8	7.3	11	3.75	3.39	3.26	4.12	3.12	4.86	3.74	3.11	2.8	2.7	4.01	2.96	2.61	3.57	3.13	2.95	2.68	2.61	2.53
8	300	8	9.1	17	6.15	5.6	5.41	6.69	5.21	7.79	6.13	5.2	4.72	4.59	6.53	4.97	4.45	5.88	5.22	4.95	4.55	4.45	4.33
9	300	8	11.8	28	10.5	9.63	9.32	11.36	9	13.15	10.47	8.98	8.22	8.01	11.11	8.62	7.79	10.07	9.01	8.59	7.95	7.78	7.59
10	300	8	13	33	12.08	11.04	10.67	13.11	10.3	15.24	12.04	10.27	9.36	9.11	12.8	9.84	8.85	11.57	10.31	9.8	9.04	8.84	8.61
11	300	8	13.4	35	12.88	11.78	11.39	13.96	10.99	16.21	12.84	10.96	10.01	9.73	13.64	10.51	9.46	12.33	11	10.47	9.67	9.46	9.21
12	300	8	13.6	36	13.27	12.13	11.73	14.38	11.33	16.69	13.22	11.3	10.31	10.04	14.05	10.83	9.75	12.71	11.34	10.79	9.97	9.75	9.5
13	300	8	13.6	36	13.27	12.13	11.73	14.38	11.33	16.69	13.22	11.3	10.31	10.04	14.05	10.83	9.75	12.71	11.34	10.79	9.97	9.75	9.5
14	300	8	13	33	12.08	11.04	10.67	13.11	10.3	15.24	12.04	10.27	9.36	9.11	12.8	9.84	8.85	11.57	10.31	9.8	9.04	8.84	8.61
15	300	8	12.3	30	11.11	10.17	9.83	12.04	9.5	13.96	11.08	9.47	8.65	8.42	11.76	9.08	8.18	10.65	9.51	9.05	8.36	8.18	7.97
16	300	8	11.4	26	9.58	8.76	8.47	10.39	8.17	12.06	9.55	8.15	7.44	7.23	10.15	7.81	7.03	9.17	8.18	7.78	7.18	7.03	6.84
17	300	8	10.7	23	8.39	7.65	7.39	9.11	7.13	10.6	8.36	7.11	6.48	6.29	8.89	6.81	6.11	8.02	7.14	6.78	6.25	6.11	5.95
18	300	8	10.2	21	7.62	6.95	6.71	8.28	6.47	9.64	7.59	6.45	5.87	5.7	8.08	6.17	5.53	7.29	6.47	6.15	5.66	5.53	5.38
19	300	8	10	20	7.1	6.45	6.22	7.73	5.99	9.05	7.07	5.97	5.41	5.25	7.54	5.7	5.08	6.78	5.99	5.68	5.21	5.08	4.94
20	300	8	9.8	19	6.57	5.94	5.72	7.18	5.5	8.45	6.54	5.48	4.94	4.78	7	5.22	4.62	6.26	5.5	5.2	4.74	4.62	4.48
21	300	8	9.1	17	6.15	5.6	5.41	6.69	5.21	7.79	6.13	5.2	4.72	4.59	6.53	4.97	4.45	5.88	5.22	4.95	4.55	4.45	4.33
22	300	8	7.1	11	4.11	3.76	3.64	4.46	3.51	5.16	4.1	3.5	3.2	3.11	4.35	3.36	3.03	3.94	3.52	3.35	3.09	3.03	2.95
23	300	8	5.9	8	3.09	2.84	2.75	3.34	2.66	3.84	3.08	2.65	2.44	2.37	3.26	2.55	2.31	2.97	2.66	2.54	2.36	2.31	2.25
24	300	8	5.5	7	2.68	2.46	2.38	2.9	2.3	3.34	2.67	2.3	2.1	2.05	2.83	2.2	1.99	2.57	2.3	2.2	2.03	1.99	1.94

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	300	8	7.8	13	4.82	4.41	4.26	5.23	4.11	6.06	4.81	4.1	3.74	3.64	5.11	3.93	3.53	4.62	4.12	3.91	3.61	3.53	3.44
2	300	8	7.6	12	4.2	3.81	3.67	4.59	3.52	5.39	4.19	3.51	3.17	3.07	4.47	3.35	2.97	4	3.53	3.34	3.05	2.97	2.88
3	300	8	7.5	12	4.39	4	3.86	4.77	3.73	5.54	4.37	3.72	3.38	3.28	4.65	3.56	3.19	4.2	3.73	3.54	3.26	3.19	3.1
4	300	8	7.6	12	4.2	3.81	3.67	4.59	3.52	5.39	4.19	3.51	3.17	3.07	4.47	3.35	2.97	4	3.53	3.34	3.05	2.97	2.88
5	300	8	7.9	13	4.63	4.2	4.05	5.04	3.9	5.9	4.61	3.89	3.52	3.42	4.92	3.72	3.31	4.42	3.91	3.7	3.39	3.31	3.21
6	300	8	8.9	16	5.58	5.06	4.87	6.1	4.68	7.16	5.56	4.67	4.21	4.08	5.94	4.45	3.95	5.32	4.69	4.43	4.05	3.95	3.83
7	300	8	10.9	24	8.88	8.12	7.85	9.63	7.58	11.17	8.85	7.56	6.9	6.72	9.4	7.25	6.53	8.51	7.59	7.22	6.67	6.53	6.36
8	300	8	13.6	36	12.33	11.15	10.74	13.49	10.31	15.9	12.29	10.28	9.26	8.97	13.14	9.8	8.68	11.75	10.33	9.76	8.9	8.67	8.41
9	300	8	17.7	60	22.99	21.16	20.51	24.79	19.86	28.54	22.92	19.81	18.22	17.78	24.25	19.06	17.32	22.09	19.88	18.99	17.67	17.32	16.91
10	300	8	19.4	72	28.13	25.96	25.2	30.25	24.43	34.7	28.04	24.37	22.49	21.97	29.62	23.48	21.43	27.06	24.45	23.41	21.84	21.43	20.95
11	300	8	20.1	77	30.15	27.83	27.02	32.41	26.19	37.16	30.05	26.13	24.13	23.57	31.73	25.19	23	29.01	26.22	25.11	23.43	23	22.49
12	300	8	20.5	79	30.4	28	27.16	32.75	26.3	37.67	30.3	26.24	24.16	23.58	32.05	25.26	22.99	29.22	26.33	25.18	23.44	22.99	22.46
13	300	8	20.4	79	30.84	28.46	27.63	33.17	26.78	38.05	30.74	26.71	24.66	24.08	32.47	25.75	23.5	29.67	26.8	25.66	23.94	23.49	22.97
14	300	8	19.5	72	27.71	25.52	24.75	29.85	23.97	34.34	27.62	23.91	22.02	21.49	29.21	23.02	20.95	26.63	23.99	22.94	21.36	20.94	20.46
15	300	8	18.4	65	25.23	23.26	22.57	27.16	21.87	31.2	25.15	21.82	20.11	19.63	26.58	21.01	19.15	24.26	21.89	20.94	19.52	19.14	18.71
16	300	8	17	56	21.66	19.95	19.35	23.33	18.74	26.81	21.59	18.7	17.23	16.81	22.83	18.01	16.39	20.82	18.76	17.94	16.71	16.39	16.01
17	300	8	16	49	18.3	16.78	16.24	19.8	15.7	22.92	18.24	15.65	14.33	13.96	19.35	15.03	13.58	17.55	15.71	14.98	13.87	13.58	13.24
18	300	8	15.3	45	16.74	15.34	14.84	18.12	14.34	20.99	16.69	14.3	13.08	12.74	17.71	13.73	12.39	16.05	14.35	13.67	12.65	12.39	12.08
19	300	8	15	43	15.76	14.4	13.92	17.09	13.44	19.86	15.7	13.4	12.23	11.9	16.69	12.85	11.56	15.09	13.45	12.8	11.81	11.56	11.26
20	300	8	14.7	42	15.76	14.45	13.99	17.04	13.52	19.71	15.7	13.48	12.35	12.03	16.65	12.95	11.71	15.11	13.53	12.9	11.96	11.71	11.42
21	300	8	13.6	36	12.33	11.15	10.74	13.49	10.31	15.9	12.29	10.28	9.26	8.97	13.14	9.8	8.68	11.75	10.33	9.76	8.9	8.67	8.41
22	300	8	10.6	23	8.64	7.92	7.66	9.35	7.4	10.81	8.61	7.38	6.76	6.58	9.13	7.09	6.4	8.28	7.41	7.06	6.54	6.4	6.24
23	300	8	8.9	16	5.58	5.06	4.87	6.1	4.68	7.16	5.56	4.67	4.21	4.08	5.94	4.45	3.95	5.32	4.69	4.43	4.05	3.95	3.83
24	300	8	8.2	14	5.04	4.58	4.42	5.48	4.26	6.4	5.02	4.25	3.85	3.74	5.35	4.06	3.63	4.81	4.26	4.04	3.71	3.63	3.52

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	600	4	2.6	102	39.31	36.16	35.03	42.45	33.89	48.56	39.32	33.8	31.14	30.32	41.57	32.54	29.51	37.78	33.97	32.41	30.12	29.5	28.78
2	600	4	2.5	98	39.65	36.71	35.65	42.57	34.59	48.26	39.66	34.51	32.03	31.27	41.75	33.33	30.5	38.22	34.67	33.22	31.08	30.5	29.83
3	600	4	2.5	95	36.65	33.71	32.65	39.57	31.59	45.26	36.66	31.51	29.03	28.27	38.75	30.33	27.5	35.22	31.67	30.22	28.08	27.5	26.83
4	600	4	2.5	98	39.65	36.71	35.65	42.57	34.59	48.26	39.66	34.51	32.03	31.27	41.75	33.33	30.5	38.22	34.67	33.22	31.08	30.5	29.83
5	600	4	2.6	105	42.31	39.16	38.03	45.45	36.89	51.56	42.32	36.8	34.14	33.32	44.57	35.54	32.51	40.78	36.97	35.41	33.12	32.5	31.78
6	600	4	3	132	50.55	46.47	45	54.61	43.53	62.51	50.56	43.42	39.98	38.93	53.47	41.79	37.88	48.57	43.65	41.63	38.67	37.87	36.94
7	600	4	3.6	199	85.18	79.52	77.49	90.82	75.45	101.83	85.2	75.29	70.52	69.07	89.25	73.04	67.62	82.44	75.61	72.82	68.71	67.6	66.33
8	600	4	4.5	310	138.35	129.87	126.84	146.8	123.79	163.31	138.37	123.56	116.43	114.28	144.44	120.19	112.11	134.26	124.03	119.87	113.73	112.09	110.19
9	600	4	5.9	523	239.75	225.89	220.94	253.56	215.97	280.64	239.77	215.6	203.97	200.47	249.71	210.12	196.95	233.08	216.37	209.59	199.58	196.92	193.84
10	600	4	6.5	628	289	272.46	266.57	305.46	260.64	337.8	289.02	260.2	246.34	242.18	300.88	253.67	238	281.05	261.12	253.05	241.13	237.96	234.29
11	600	4	6.7	673	314.37	296.89	290.66	331.77	284.41	365.96	314.39	283.94	269.29	264.9	326.92	277.05	260.49	305.97	284.92	276.39	263.79	260.45	256.57
12	600	4	6.8	696	327.36	309.4	303.01	345.23	296.58	380.36	327.38	296.09	281.05	276.54	340.25	289.02	272.01	318.73	297.1	288.35	275.4	271.97	267.99
13	600	4	6.8	691	322.36	304.4	298.01	340.23	291.58	375.36	322.38	291.09	276.05	271.54	335.25	284.02	267.01	313.73	292.1	283.35	270.4	266.97	262.99
14	600	4	6.5	633	294	277.46	271.57	310.46	265.64	342.8	294.02	265.2	251.34	247.18	305.88	258.67	243	286.05	266.12	258.05	246.13	242.96	239.29
15	600	4	6.1	564	262.69	247.96	242.7	277.36	237.43	306.15	262.71	237.03	224.68	220.96	273.27	231.21	217.23	255.6	237.85	230.66	220.02	217.2	213.92
16	600	4	5.7	484	218.29	205.27	200.62	231.25	195.95	256.68	218.31	195.59	184.67	181.38	227.64	190.45	178.08	212.02	196.32	189.95	180.55	178.05	175.15
17	600	4	5.3	428	195.77	184.36	180.29	207.13	176.19	229.39	195.79	175.88	166.31	163.42	203.96	171.37	160.52	190.27	176.52	170.93	162.69	160.49	157.94
18	600	4	5.1	392	175.72	165.08	161.28	186.31	157.46	207.06	175.74	157.17	148.23	145.54	183.36	152.95	142.83	170.59	157.76	152.55	144.86	142.8	140.43
19	600	4	5	375	166.49	156.23	152.56	176.71	148.87	196.73	166.51	148.6	139.98	137.37	173.86	144.53	134.76	161.54	149.17	144.14	136.71	134.73	132.44
20	600	4	4.9	358	157.13	147.24	143.7	166.98	140.15	186.28	157.15	139.88	131.57	129.06	164.23	135.95	126.53	152.36	140.43	135.58	128.42	126.51	124.3
21	600	4	4.5	310	138.35	129.87	126.84	146.8	123.79	163.31	138.37	123.56	116.43	114.28	144.44	120.19	112.11	134.26	124.03	119.87	113.73	112.09	110.19
22	600	4	3.5	189	80.93	75.54	73.61	86.29	71.67	96.74	80.94	71.52	66.99	65.61	84.79	69.38	64.22	78.32	71.82	69.17	65.26	64.21	63
23	600	4	3	132	50.55	46.47	45	54.61	43.53	62.51	50.56	43.42	39.98	38.93	53.47	41.79	37.88	48.57	43.65	41.63	38.67	37.87	36.94
24	600	4	2.7	113	45.84	42.46	41.25	49.19	40.03	55.73	45.84	39.94	37.09	36.22	48.25	38.59	35.34	44.2	40.12	38.45	36	35.34	34.57

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	600	4	5.2	403	178.81	167.79	163.85	189.79	159.9	211.29	178.83	159.6	150.35	147.55	186.72	155.23	144.75	173.5	160.21	154.81	146.85	144.72	142.26
2	600	4	5.1	389	172.72	162.08	158.28	183.31	154.46	204.06	172.74	154.17	145.23	142.54	180.36	149.95	139.83	167.59	154.76	149.55	141.86	139.8	137.43
3	600	4	5	375	166.49	156.23	152.56	176.71	148.87	196.73	166.51	148.6	139.98	137.37	173.86	144.53	134.76	161.54	149.17	144.14	136.71	134.73	132.44
4	600	4	5.1	389	172.72	162.08	158.28	183.31	154.46	204.06	172.74	154.17	145.23	142.54	180.36	149.95	139.83	167.59	154.76	149.55	141.86	139.8	137.43
5	600	4	5.3	417	184.77	173.36	169.29	196.13	165.19	218.39	184.79	164.88	155.31	152.42	192.96	160.37	149.52	179.27	165.52	159.93	151.69	149.49	146.94
6	600	4	5.9	523	239.75	225.89	220.94	253.56	215.97	280.64	239.77	215.6	203.97	200.47	249.71	210.12	196.95	233.08	216.37	209.59	199.58	196.92	193.84
7	600	4	7.3	792	371.37	350.93	343.65	391.71	336.34	431.72	371.39	335.79	318.68	313.56	386.04	327.75	308.41	361.55	336.94	326.99	312.26	308.36	303.84
8	600	4	9.1	1236	601.54	570.96	560.1	631.97	549.18	691.98	601.56	548.36	522.81	515.2	623.5	536.38	507.55	586.89	550.09	535.25	513.28	507.48	500.76
9	600	4	11.8	2088	1055.66	1006.39	988.94	1104.67	971.41	1201.63	1055.66	970.09	929.03	916.86	1091.05	950.88	904.64	1032.13	972.9	949.1	913.79	904.53	893.79
10	600	4	13	2508	1269.45	1210.57	1189.74	1328.02	1168.81	1444.03	1269.44	1167.23	1118.2	1103.7	1311.75	1144.32	1089.14	1241.37	1170.59	1142.2	1100.05	1089.01	1076.22
11	600	4	13.4	2687	1375.73	1313.46	1291.44	1437.66	1269.32	1560.37	1375.71	1267.65	1215.82	1200.5	1420.46	1243.44	1185.12	1346.04	1271.21	1241.2	1196.65	1184.98	1171.47
12	600	4	13.6	2779	1430.62	1366.63	1344.01	1494.26	1321.27	1620.39	1430.6	1319.56	1266.3	1250.57	1476.59	1294.68	1234.76	1400.11	1323.22	1292.39	1246.61	1234.63	1220.74
13	600	4	13.6	2761	1412.62	1348.63	1326.01	1476.26	1303.27	1602.39	1412.6	1301.56	1248.3	1232.57	1458.59	1276.68	1216.76	1382.11	1305.22	1274.39	1228.61	1216.63	1202.74
14	600	4	13	2526	1287.45	1228.57	1207.74	1346.02	1186.81	1462.03	1287.44	1185.23	1136.2	1121.7	1329.75	1162.32	1107.14	1259.37	1188.59	1160.2	1118.05	1107.01	1094.22
15	600	4	12.3	2251	1139.42	1088.13	1070.47	1190.44	1052.72	1292.52	1140.05	1051.64	1008.25	995.66	1165.67	1033.46	983	1131.13	1061.66	1032.33	993.39	982.94	971.36
16	600	4	11.4	1930	962.39	916.15	899.77	1008.39	883.31	1099.36	962.4	882.07	843.52	832.08	995.61	864.03	820.6	940.3	884.7	862.35	829.2	820.5	810.41
17	600	4	10.7	1706	846.85	805.69	791.1	887.79	776.44	968.71	846.86	775.33	740.99	730.8	876.41	759.25	720.56	827.17	777.67	757.75	728.23	720.46	711.47
18	600	4	10.2	1564	778.54	740.84	727.47	816.05	714.04	890.11	778.55	713.02	681.56	672.21	805.62	698.28	662.81	760.51	715.16	696.91	669.85	662.73	654.48
19	600	4	10	1495	738.13	701.78	688.88	774.3	675.93	845.71	738.15	674.95	644.6	635.58	764.24	660.73	626.51	720.74	677.01	659.4	633.3	626.43	618.47
20	600	4	9.8	1428	699.22	664.19	651.76	734.08	639.27	802.87	699.24	638.33	609.08	600.38	724.38	624.62	591.64	682.46	640.32	623.34	598.19	591.56	583.88
21	600	4	9.1	1236	601.54	570.96	560.1	631.97	549.18	691.98	601.56	548.36	522.81	515.2	623.5	536.38	507.55	586.89	550.09	535.25	513.28	507.48	500.76
22	600	4	7.1	753	353.55	334.12	327.2	372.89	320.26	410.91	353.57	319.73	303.46	298.59	367.5	312.08	293.69	344.22	320.82	311.36	297.36	293.65	289.35
23	600	4	5.9	523	239.75	225.89	220.94	253.56	215.97	280.64	239.77	215.6	203.97	200.47	249.71	210.12	196.95	233.08	216.37	209.59	199.58	196.92	193.84
24	600	4	5.5	446	197.3	185.09	180.73	209.44	176.36	233.27	197.31	176.02	165.78	162.7	206.05	171.2	159.6	191.41	176.71	170.73	161.92	159.57	156.85

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	600	4	7.8	904	428.14	405.07	396.86	451.09	388.62	496.29	428.16	388	368.7	362.93	444.7	378.93	357.14	417.07	389.3	378.08	361.48	357.08	351.99
2	600	4	7.6	873	419.62	397.62	389.79	441.51	381.93	484.59	419.64	381.33	362.93	357.42	435.41	372.68	351.89	409.06	382.57	371.86	356.03	351.83	346.98
3	600	4	7.5	842	399.66	378.19	370.55	421.03	362.87	463.08	399.68	362.29	344.32	338.94	415.08	353.84	333.54	389.35	363.5	353.05	337.59	333.49	328.75
4	600	4	7.6	873	419.62	397.62	389.79	441.51	381.93	484.59	419.64	381.33	362.93	357.42	435.41	372.68	351.89	409.06	382.57	371.86	356.03	351.83	346.98
5	600	4	7.9	936	448.71	425.1	416.7	472.2	408.26	518.47	448.73	407.63	387.88	381.97	465.66	398.35	376.04	437.38	408.96	397.47	380.48	375.99	370.78
6	600	4	8.9	1175	566.34	536.98	526.55	595.56	516.07	653.17	566.36	515.28	490.75	483.43	587.43	503.77	476.08	552.28	516.94	502.69	481.59	476.02	469.56
7	600	4	10.9	1779	889.49	846.9	831.81	931.85	816.65	1015.58	889.5	815.5	779.99	769.44	920.07	798.87	758.85	869.13	817.92	797.33	766.79	758.76	749.46
8	600	4	13.6	2779	1430.62	1366.63	1344.01	1494.26	1321.27	1620.39	1430.6	1319.56	1266.3	1250.57	1476.59	1294.68	1234.76	1400.11	1323.22	1292.39	1246.61	1234.63	1220.74
9	600	4	17.7	4696	2477.89	2373.76	2337.06	2581.42	2300.17	2787.29	2477.79	2297.39	2210.95	2185.58	2552.71	2257.13	2160.08	2428.41	2303.39	2253.46	2179.2	2159.86	2137.46
10	600	4	19.4	5642	3002.64	2879.22	2835.77	3125.35	2792.08	3369.63	3002.5	2788.79	2686.43	2656.45	3091.33	2741.17	2626.32	2944.06	2795.92	2736.84	2648.92	2626.07	2599.59
11	600	4	20.1	6045	3221.9	3090.09	3043.71	3352.95	2997.07	3613.95	3221.74	2993.55	2884.28	2852.3	3316.63	2942.74	2820.16	3159.37	3001.18	2938.13	2844.26	2819.89	2791.65
12	600	4	20.5	6251	3320.22	3183.5	3135.4	3456.16	3087.04	3726.94	3320.05	3083.39	2970.06	2936.92	3418.49	3030.7	2903.61	3255.38	3091.31	3025.93	2928.59	2903.33	2874.05
13	600	4	20.4	6210	3306.33	3170.84	3123.17	3441.03	3075.25	3709.35	3306.16	3071.63	2959.32	2926.47	3403.7	3019.41	2893.45	3242.06	3079.47	3014.68	2918.22	2893.17	2864.16
14	600	4	19.5	5682	3016.75	2892.15	2848.29	3140.64	2804.19	3387.28	3016.61	2800.86	2697.53	2667.27	3106.3	2752.79	2636.86	2957.62	2808.07	2748.43	2659.66	2636.6	2609.87
15	600	4	18.4	5064	2676.72	2564.84	2525.42	2787.97	2485.8	3009.27	2676.61	2482.81	2389.96	2362.74	2757.12	2439.59	2335.38	2623.58	2489.26	2435.65	2355.9	2335.15	2311.1
16	600	4	17	4342	2287.04	2190.41	2156.34	2383.13	2122.09	2574.09	2286.96	2119.5	2039.25	2015.68	2356.48	2082.11	1991.98	2241.1	2125.07	2078.7	2009.75	1991.78	1970.96
17	600	4	16	3836	2003.67	1917.29	1886.81	2089.57	1856.17	2260.15	2003.61	1853.86	1782.08	1760.96	2065.74	1820.39	1739.74	1962.57	1858.82	1817.33	1755.65	1739.55	1720.91
18	600	4	15.3	3517	1833.18	1753.65	1725.57	1912.27	1697.35	2069.23	1833.13	1695.22	1629.11	1609.64	1890.32	1664.38	1590.07	1795.32	1699.79	1661.55	1604.74	1589.9	1572.71
19	600	4	15	3362	1739.97	1663.3	1636.23	1816.22	1609.02	1967.51	1739.93	1606.96	1543.21	1524.42	1795.06	1577.22	1505.55	1703.47	1611.36	1574.48	1519.7	1505.38	1488.8
20	600	4	14.7	3211	1649.65	1575.79	1549.7	1723.11	1523.48	1868.83	1649.62	1521.5	1460.07	1441.96	1702.72	1492.83	1423.77	1614.48	1525.74	1490.2	1437.41	1423.61	1407.62
21	600	4	13.6	2779	1430.62	1366.63	1344.01	1494.26	1321.27	1620.39	1430.6	1319.56	1266.3	1250.57	1476.59	1294.68	1234.76	1400.11	1323.22	1292.39	1246.61	1234.63	1220.74
22	600	4	10.6	1691	846.84	806.38	792.04	887.09	777.63	966.61	846.85	776.54	742.79	732.76	875.89	760.73	722.69	827.49	778.84	759.26	730.24	722.6	713.76
23	600	4	8.9	1175	566.34	536.98	526.55	595.56	516.07	653.17	566.36	515.28	490.75	483.43	587.43	503.77	476.08	552.28	516.94	502.69	481.59	476.02	469.56
24	600	4	8.2	1001	478.64	453.37	444.38	503.79	435.35	553.34	478.66	434.67	413.54	407.22	496.79	424.75	400.88	466.52	436.1	423.81	405.63	400.82	395.25

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	600	6	2.6	13	4.16	3.71	3.55	4.61	3.38	5.49	4.16	3.37	2.99	2.87	4.49	3.19	2.75	3.94	3.39	3.17	2.84	2.75	2.64
2	600	6	2.5	13	4.77	4.35	4.2	5.19	4.04	6.01	4.77	4.03	3.67	3.56	5.07	3.86	3.45	4.56	4.05	3.84	3.53	3.45	3.35
3	600	6	2.5	13	4.77	4.35	4.2	5.19	4.04	6.01	4.77	4.03	3.67	3.56	5.07	3.86	3.45	4.56	4.05	3.84	3.53	3.45	3.35
4	600	6	2.5	13	4.77	4.35	4.2	5.19	4.04	6.01	4.77	4.03	3.67	3.56	5.07	3.86	3.45	4.56	4.05	3.84	3.53	3.45	3.35
5	600	6	2.6	14	5.16	4.71	4.55	5.61	4.38	6.49	5.16	4.37	3.99	3.87	5.49	4.19	3.75	4.94	4.39	4.17	3.84	3.75	3.64
6	600	6	3	17	5.54	4.96	4.75	6.12	4.54	7.26	5.54	4.52	4.02	3.87	5.96	4.28	3.72	5.26	4.55	4.26	3.83	3.72	3.58
7	600	6	3.6	25	9.04	8.23	7.94	9.84	7.64	11.42	9.04	7.62	6.94	6.73	9.61	7.3	6.52	8.64	7.66	7.26	6.67	6.51	6.33
8	600	6	4.5	38	14.02	12.81	12.38	15.22	11.94	17.57	14.01	11.91	10.88	10.57	14.88	11.42	10.26	13.43	11.97	11.37	10.5	10.26	9.98
9	600	6	5.9	64	24.62	22.66	21.95	26.58	21.24	30.43	24.62	21.19	19.52	19.02	26.03	20.4	18.52	23.67	21.29	20.32	18.9	18.51	18.07
10	600	6	6.5	76	28.96	26.62	25.78	31.29	24.94	35.88	28.95	24.87	22.89	22.29	30.63	23.94	21.7	27.82	25	23.85	22.14	21.69	21.16
11	600	6	6.7	82	32.27	29.79	28.91	34.73	28.02	39.58	32.26	27.95	25.86	25.23	34.03	26.96	24.59	31.07	28.08	26.86	25.07	24.59	24.03
12	600	6	6.8	84	32.9	30.35	29.44	35.42	28.53	40.41	32.89	28.46	26.31	25.66	34.71	27.44	25.01	31.66	28.59	27.35	25.5	25.01	24.44
13	600	6	6.8	84	32.9	30.35	29.44	35.42	28.53	40.41	32.89	28.46	26.31	25.66	34.71	27.44	25.01	31.66	28.59	27.35	25.5	25.01	24.44
14	600	6	6.5	77	29.96	27.62	26.78	32.29	25.94	36.88	29.95	25.87	23.89	23.29	31.63	24.94	22.7	28.82	26	24.85	23.14	22.69	22.16
15	600	6	6.1	69	27.14	25.05	24.3	29.22	23.55	33.31	27.13	23.49	21.72	21.19	28.63	22.66	20.66	26.12	23.6	22.58	21.06	20.65	20.18
16	600	6	5.7	59	22.04	20.19	19.53	23.87	18.86	27.49	22.03	18.81	17.24	16.77	23.35	18.07	16.3	21.14	18.91	18	16.65	16.29	15.88
17	600	6	5.3	52	19.65	18.03	17.45	21.26	16.86	24.43	19.64	16.82	15.45	15.03	20.81	16.17	14.61	18.86	16.9	16.11	14.93	14.61	14.24
18	600	6	5.1	48	17.85	16.34	15.79	19.35	15.25	22.31	17.84	15.21	13.93	13.54	18.93	14.6	13.15	17.11	15.29	14.54	13.44	13.15	12.8
19	600	6	5	46	16.92	15.46	14.94	18.37	14.41	21.23	16.92	14.37	13.14	12.76	17.96	13.79	12.39	16.21	14.45	13.73	12.67	12.38	12.05
20	600	6	4.9	44	15.98	14.57	14.07	17.38	13.56	20.13	15.97	13.52	12.33	11.97	16.98	12.95	11.6	15.29	13.59	12.9	11.88	11.6	11.28
21	600	6	4.5	38	14.02	12.81	12.38	15.22	11.94	17.57	14.01	11.91	10.88	10.57	14.88	11.42	10.26	13.43	11.97	11.37	10.5	10.26	9.98
22	600	6	3.5	24	8.84	8.07	7.79	9.6	7.51	11.1	8.83	7.49	6.84	6.64	9.38	7.18	6.44	8.46	7.53	7.15	6.59	6.44	6.26
23	600	6	3	17	5.54	4.96	4.75	6.12	4.54	7.26	5.54	4.52	4.02	3.87	5.96	4.28	3.72	5.26	4.55	4.26	3.83	3.72	3.58
24	600	6	2.7	15	5.54	5.05	4.88	6.02	4.7	6.96	5.54	4.69	4.28	4.15	5.88	4.49	4.03	5.3	4.72	4.47	4.12	4.02	3.91

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	600	6	5.2	49	17.76	16.19	15.63	19.32	15.07	22.38	17.75	15.02	13.7	13.29	18.88	14.39	12.89	17	15.11	14.33	13.19	12.89	12.53
2	600	6	5.1	48	17.85	16.34	15.79	19.35	15.25	22.31	17.84	15.21	13.93	13.54	18.93	14.6	13.15	17.11	15.29	14.54	13.44	13.15	12.8
3	600	6	5	46	16.92	15.46	14.94	18.37	14.41	21.23	16.92	14.37	13.14	12.76	17.96	13.79	12.39	16.21	14.45	13.73	12.67	12.38	12.05
4	600	6	5.1	48	17.85	16.34	15.79	19.35	15.25	22.31	17.84	15.21	13.93	13.54	18.93	14.6	13.15	17.11	15.29	14.54	13.44	13.15	12.8
5	600	6	5.3	51	18.65	17.03	16.45	20.26	15.86	23.43	18.64	15.82	14.45	14.03	19.81	15.17	13.61	17.86	15.9	15.11	13.93	13.61	13.24
6	600	6	5.9	64	24.62	22.66	21.95	26.58	21.24	30.43	24.62	21.19	19.52	19.02	26.03	20.4	18.52	23.67	21.29	20.32	18.9	18.51	18.07
7	600	6	7.3	96	63.65	62.03	61.45	65.26	60.86	68.43	63.64	60.82	59.45	59.03	64.81	60.17	58.61	62.86	60.9	60.11	58.93	58.61	58.24
8	600	6	9.1	149	61.59	57.28	55.74	65.87	54.19	74.35	61.57	54.07	50.44	49.35	64.66	52.36	48.26	59.5	54.3	52.2	49.08	48.25	47.29
9	600	6	11.8	251	109.63	102.71	100.25	116.5	97.77	130.15	109.59	97.58	91.75	90.02	114.56	94.84	88.28	106.29	97.95	94.58	89.59	88.27	86.74
10	600	6	13	301	131.79	123.53	120.6	139.99	117.65	156.29	131.74	117.42	110.47	108.41	137.68	114.16	106.34	127.81	117.86	113.85	107.9	106.32	104.5
11	600	6	13.4	322	142.99	134.26	131.16	151.66	128.04	168.89	142.94	127.81	120.46	118.29	149.21	124.36	116.1	138.78	128.27	124.03	117.74	116.08	114.16
12	600	6	13.6	333	148.99	140.02	136.84	157.9	133.64	175.61	148.94	133.4	125.85	123.62	155.39	129.85	121.37	144.67	133.87	129.52	123.06	121.35	119.37
13	600	6	13.6	331	146.99	138.02	134.84	155.9	131.64	173.61	146.94	131.4	123.85	121.62	153.39	127.85	119.37	142.67	131.87	127.52	121.06	119.35	117.37
14	600	6	13	303	133.79	125.53	122.6	141.99	119.65	158.29	133.74	119.42	112.47	110.41	139.68	116.16	108.34	129.81	119.86	115.85	109.9	108.32	106.5
15	600	6	12.3	270	117.32	109.85	107.2	124.73	104.53	139.46	117.27	104.33	98.04	96.18	122.64	101.37	94.3	113.71	104.72	101.09	95.71	94.28	92.63
16	600	6	11.4	232	99.38	92.88	90.57	105.84	88.25	118.65	99.35	88.07	82.59	80.97	104.02	85.49	79.33	96.25	88.42	85.25	80.56	79.32	77.88
17	600	6	10.7	205	87.07	81.28	79.22	92.82	77.15	104.23	87.04	76.99	72.11	70.66	91.2	74.69	69.2	84.27	77.3	74.47	70.29	69.18	67.9
18	600	6	10.2	188	80.07	74.76	72.87	85.34	70.97	95.79	80.04	70.82	66.35	65.02	83.85	68.71	63.68	77.5	71.1	68.52	64.68	63.66	62.48
19	600	6	10	180	75.95	70.83	69	81.03	67.17	91.11	75.92	67.03	62.71	61.43	79.6	65	60.14	73.47	67.3	64.8	61.1	60.12	58.98
20	600	6	9.8	172	71.76	66.83	65.07	76.66	63.3	86.38	71.74	63.17	59	57.77	75.28	61.21	56.52	69.38	63.43	61.02	57.45	56.51	55.41
21	600	6	9.1	149	61.59	57.28	55.74	65.87	54.19	74.35	61.57	54.07	50.44	49.35	64.66	52.36	48.26	59.5	54.3	52.2	49.08	48.25	47.29
22	600	6	7.1	91	35.67	32.92	31.94	38.41	30.95	43.8	35.66	30.88	28.55	27.86	37.63	29.78	27.16	34.34	31.02	29.67	27.68	27.15	26.53
23	600	6	5.9	64	24.62	22.66	21.95	26.58	21.24	30.43	24.62	21.19	19.52	19.02	26.03	20.4	18.52	23.67	21.29	20.32	18.9	18.51	18.07
24	600	6	5.5	55	20.38	18.65	18.02	22.1	17.4	25.49	20.37	17.35	15.88	15.44	21.61	16.66	15	19.54	17.44	16.59	15.33	14.99	14.6

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	600	6	7.8	109	43.22	39.96	38.79	46.46	37.62	52.86	43.2	37.54	34.78	33.96	45.54	36.23	33.13	41.64	37.71	36.11	33.75	33.12	32.39
2	600	6	7.6	106	43.29	40.18	39.07	46.38	37.95	52.49	43.28	37.87	35.24	34.45	45.51	36.63	33.66	41.78	38.03	36.51	34.26	33.65	32.96
3	600	6	7.5	102	40.8	37.77	36.68	43.82	35.59	49.78	40.79	35.51	32.94	32.17	42.97	34.3	31.4	39.33	35.67	34.18	31.98	31.39	30.71
4	600	6	7.6	106	43.29	40.18	39.07	46.38	37.95	52.49	43.28	37.87	35.24	34.45	45.51	36.63	33.66	41.78	38.03	36.51	34.26	33.65	32.96
5	600	6	7.9	113	45.66	42.32	41.13	48.97	39.93	55.52	45.64	39.84	37.02	36.18	48.04	38.51	35.33	44.04	40.02	38.38	35.97	35.32	34.58
6	600	6	8.9	142	58.1	53.96	52.48	62.22	51	70.36	58.08	50.89	47.39	46.35	61.06	49.24	45.3	56.1	51.1	49.08	46.08	45.29	44.36
7	600	6	10.9	214	91.96	85.97	83.84	97.9	81.69	109.71	91.92	81.53	76.48	74.98	96.23	79.15	73.47	89.06	81.85	78.93	74.6	73.46	72.13
8	600	6	13.6	333	148.99	140.02	136.84	157.9	133.64	175.61	148.94	133.4	125.85	123.62	155.39	129.85	121.37	144.67	133.87	129.52	123.06	121.35	119.37
9	600	6	17.7	562	261.37	246.84	241.7	275.78	236.52	304.57	261.27	236.13	223.93	220.34	271.72	230.41	216.73	254.39	236.91	229.89	219.44	216.7	213.52
10	600	6	19.4	675	318.16	300.97	294.9	335.22	288.77	369.31	318.04	288.31	273.88	269.65	330.42	281.55	265.39	309.91	289.23	280.93	268.59	265.35	261.6
11	600	6	20.1	723	341.69	323.35	316.86	359.89	310.33	396.29	341.56	309.84	294.44	289.93	354.77	302.63	285.39	332.89	310.82	301.97	288.8	285.35	281.35
12	600	6	20.5	748	352.37	333.34	326.62	371.24	319.85	408.99	352.22	319.34	303.37	298.7	365.92	311.87	293.99	343.23	320.36	311.18	297.53	293.95	289.81
13	600	6	20.4	743	350.97	332.12	325.46	369.67	318.74	407.08	350.83	318.24	302.42	297.78	364.41	310.83	293.12	341.92	319.25	310.15	296.62	293.08	288.97
14	600	6	19.5	680	319.72	302.36	296.23	336.93	290.05	371.35	319.59	289.58	275.01	270.74	332.08	282.76	266.44	311.38	290.51	282.13	269.67	266.41	262.62
15	600	6	18.4	606	282.78	267.18	261.66	298.26	256.1	329.17	282.67	255.69	242.59	238.74	293.9	249.55	234.87	275.28	256.52	248.98	237.78	234.83	231.42
16	600	6	17	520	241.18	227.69	222.92	254.57	218.1	281.29	241.09	217.74	206.4	203.07	250.8	212.43	199.71	234.7	218.46	211.94	202.23	199.68	196.73
17	600	6	16	460	210.99	198.92	194.64	222.97	190.33	246.86	210.91	190.01	179.86	176.87	219.6	185.25	173.86	205.18	190.65	184.81	176.12	173.84	171.19
18	600	6	15.3	421	191.91	180.78	176.84	202.95	172.87	224.95	191.83	172.57	163.22	160.46	199.84	168.18	157.68	186.55	173.16	167.77	159.77	157.66	155.21
19	600	6	15	403	182.2	171.47	167.67	192.85	163.84	214.06	182.13	163.55	154.53	151.87	189.85	159.32	149.19	177.04	164.12	158.92	151.2	149.17	146.81
20	600	6	14.7	385	172.35	162.01	158.35	182.61	154.65	203.05	172.29	154.38	145.68	143.11	179.72	150.29	140.53	167.37	154.93	149.91	142.47	140.51	138.23
21	600	6	13.6	333	148.99	140.02	136.84	157.9	133.64	175.61	148.94	133.4	125.85	123.62	155.39	129.85	121.37	144.67	133.87	129.52	123.06	121.35	119.37
22	600	6	10.6	203	87.1	81.41	79.38	92.76	77.35	103.97	87.07	77.19	72.39	70.97	91.16	74.93	69.53	84.35	77.49	74.72	70.61	69.52	68.25
23	600	6	8.9	142	58.1	53.96	52.48	62.22	51	70.36	58.08	50.89	47.39	46.35	61.06	49.24	45.3	56.1	51.1	49.08	46.08	45.29	44.36
24	600	6	8.2	121	48.87	45.3	44.03	52.42	42.74	59.43	48.85	42.65	39.63	38.73	51.41	41.22	37.82	47.14	42.83	41.09	38.5	37.81	37.02

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	600	8	2.6	4	1.79	1.67	1.63	1.9	1.59	2.12	1.79	1.59	1.49	1.46	1.87	1.54	1.43	1.73	1.59	1.54	1.45	1.43	1.4
2	600	8	2.5	4	1.94	1.83	1.79	2.04	1.75	2.25	1.94	1.75	1.66	1.63	2.01	1.71	1.6	1.89	1.76	1.7	1.62	1.6	1.58
3	600	8	2.5	4	1.94	1.83	1.79	2.04	1.75	2.25	1.94	1.75	1.66	1.63	2.01	1.71	1.6	1.89	1.76	1.7	1.62	1.6	1.58
4	600	8	2.5	4	1.94	1.83	1.79	2.04	1.75	2.25	1.94	1.75	1.66	1.63	2.01	1.71	1.6	1.89	1.76	1.7	1.62	1.6	1.58
5	600	8	2.6	4	1.79	1.67	1.63	1.9	1.59	2.12	1.79	1.59	1.49	1.46	1.87	1.54	1.43	1.73	1.59	1.54	1.45	1.43	1.4
6	600	8	3	5	2.13	1.99	1.93	2.28	1.88	2.57	2.13	1.88	1.75	1.71	2.24	1.82	1.67	2.06	1.88	1.81	1.7	1.67	1.64
7	600	8	3.6	6	2.01	1.81	1.74	2.22	1.66	2.62	2.01	1.66	1.48	1.43	2.16	1.57	1.38	1.91	1.67	1.57	1.42	1.38	1.33
8	600	8	4.5	9	3.02	2.72	2.61	3.33	2.5	3.92	3.02	2.49	2.23	2.15	3.24	2.37	2.07	2.88	2.51	2.36	2.13	2.07	2
9	600	8	5.9	14	4.22	3.72	3.54	4.71	3.36	5.68	4.21	3.35	2.93	2.8	4.57	3.15	2.67	3.97	3.38	3.13	2.77	2.67	2.56
10	600	8	6.5	17	5.32	4.73	4.52	5.91	4.31	7.07	5.32	4.29	3.79	3.64	5.74	4.06	3.49	5.04	4.32	4.03	3.61	3.49	3.36
11	600	8	6.7	18	5.68	5.07	4.85	6.29	4.63	7.5	5.68	4.62	4.09	3.93	6.07	4.38	3.78	5.3	4.52	4.36	3.9	3.78	3.63
12	600	8	6.8	19	6.32	5.68	5.45	6.95	5.22	8.21	6.31	5.2	4.66	4.5	6.77	4.95	4.33	6.01	5.24	4.92	4.46	4.33	4.19
13	600	8	6.8	19	6.32	5.68	5.45	6.95	5.22	8.21	6.31	5.2	4.66	4.5	6.77	4.95	4.33	6.01	5.24	4.92	4.46	4.33	4.19
14	600	8	6.5	17	5.32	4.73	4.52	5.91	4.31	7.07	5.32	4.29	3.79	3.64	5.74	4.06	3.49	5.04	4.32	4.03	3.61	3.49	3.36
15	600	8	6.1	15	4.6	4.08	3.89	5.12	3.7	6.15	4.6	3.68	3.24	3.1	4.97	3.47	2.97	4.34	3.71	3.45	3.07	2.97	2.85
16	600	8	5.7	13	3.81	3.35	3.18	4.27	3.01	5.19	3.81	3	2.6	2.48	4.14	2.81	2.36	3.58	3.02	2.79	2.45	2.36	2.26
17	600	8	5.3	12	3.95	3.54	3.4	4.36	3.25	5.16	3.95	3.24	2.89	2.79	4.24	3.07	2.68	3.75	3.26	3.06	2.76	2.68	2.59
18	600	8	5.1	11	3.5	3.12	2.98	3.88	2.84	4.62	3.49	2.83	2.51	2.41	3.77	2.68	2.31	3.31	2.85	2.66	2.38	2.31	2.22
19	600	8	5	11	3.76	3.4	3.26	4.13	3.13	4.85	3.76	3.12	2.81	2.71	4.02	2.97	2.62	3.58	3.14	2.96	2.69	2.62	2.53
20	600	8	4.9	10	3.02	2.67	2.54	3.38	2.41	4.07	3.02	2.4	2.1	2.01	3.28	2.26	1.92	2.85	2.42	2.25	1.99	1.92	1.84
21	600	8	4.5	9	3.02	2.72	2.61	3.33	2.5	3.92	3.02	2.49	2.23	2.15	3.24	2.37	2.07	2.88	2.51	2.36	2.13	2.07	2
22	600	8	3.5	6	2.21	2.02	1.95	2.41	1.88	2.78	2.21	1.87	1.71	1.66	2.35	1.79	1.61	2.12	1.88	1.79	1.64	1.6	1.56
23	600	8	3	5	2.13	1.99	1.93	2.28	1.88	2.57	2.13	1.88	1.75	1.71	2.24	1.82	1.67	2.06	1.88	1.81	1.7	1.67	1.64
24	600	8	2.7	4	1.63	1.51	1.46	1.75	1.42	1.99	1.63	1.42	1.31	1.28	1.72	1.37	1.25	1.57	1.42	1.36	1.27	1.25	1.22

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	600	8	5.2	11	3.23	2.83	2.69	3.62	2.55	4.39	3.22	2.54	2.2	2.1	3.51	2.38	2	3.03	2.56	2.36	2.07	2	1.91
2	600	8	5.1	11	3.5	3.12	2.98	3.88	2.84	4.62	3.49	2.83	2.51	2.41	3.77	2.68	2.31	3.31	2.85	2.66	2.38	2.31	2.22
3	600	8	5	11	3.76	3.4	3.26	4.13	3.13	4.85	3.76	3.12	2.81	2.71	4.02	2.97	2.62	3.58	3.14	2.96	2.69	2.62	2.53
4	600	8	5.1	11	3.5	3.12	2.98	3.88	2.84	4.62	3.49	2.83	2.51	2.41	3.77	2.68	2.31	3.31	2.85	2.66	2.38	2.31	2.22
5	600	8	5.3	12	3.95	3.54	3.4	4.36	3.25	5.16	3.95	3.24	2.89	2.79	4.24	3.07	2.68	3.75	3.26	3.06	2.76	2.68	2.59
6	600	8	5.9	14	4.22	3.72	3.54	4.71	3.36	5.68	4.21	3.35	2.93	2.8	4.57	3.15	2.67	3.97	3.38	3.13	2.77	2.67	2.56
7	600	8	7.3	21	6.56	5.84	5.58	7.28	5.32	8.71	6.56	5.3	4.68	4.49	7.08	5	4.31	6.21	5.33	4.98	4.45	4.31	4.14
8	600	8	9.1	32	10.38	9.3	8.92	11.45	8.53	13.59	10.37	8.5	7.58	7.31	11.15	8.06	7.03	9.86	8.55	8.02	7.24	7.03	6.78
9	600	8	11.8	53	18.15	16.42	15.8	19.87	15.18	23.29	18.13	15.14	13.67	13.23	19.38	14.44	12.79	17.31	15.22	14.38	13.12	12.79	12.4
10	600	8	13	63	21.34	19.28	18.54	23.39	17.8	27.47	21.32	17.75	16	15.48	22.8	16.92	14.96	20.34	17.85	16.84	15.35	14.95	14.49
11	600	8	13.4	68	23.95	21.77	20.99	26.11	20.21	30.43	23.92	20.15	18.3	17.75	25.49	19.28	17.2	22.89	20.26	19.2	17.62	17.2	16.71
12	600	8	13.6	70	24.73	22.49	21.69	26.94	20.89	31.39	24.7	20.83	18.93	18.37	26.31	19.93	17.8	23.64	20.94	19.85	18.22	17.8	17.3
13	600	8	13.6	70	24.73	22.49	21.69	26.94	20.89	31.39	24.7	20.83	18.93	18.37	26.31	19.93	17.8	23.64	20.94	19.85	18.22	17.8	17.3
14	600	8	13	64	22.34	20.28	19.54	24.39	18.8	28.47	22.32	18.75	17	16.48	23.8	17.92	15.96	21.34	18.85	17.84	16.35	15.95	15.49
15	600	8	12.3	57	19.38	17.52	16.85	21.23	16.18	24.93	19.36	16.13	14.55	14.08	20.7	15.38	13.61	18.47	16.22	15.31	13.96	13.6	13.19
16	600	8	11.4	49	16.29	14.67	14.09	17.91	13.51	21.12	16.28	13.46	12.08	11.67	17.45	12.81	11.26	15.5	13.54	12.75	11.57	11.26	10.89
17	600	8	10.7	44	14.89	13.44	12.93	16.33	12.41	19.19	14.88	12.37	11.14	10.77	15.92	11.79	10.4	14.19	12.44	11.73	10.68	10.4	10.08
18	600	8	10.2	40	13.34	12.02	11.54	14.66	11.06	17.29	13.33	11.03	9.9	9.56	14.29	10.49	9.23	12.7	11.09	10.44	9.48	9.22	8.92
19	600	8	10	38	12.3	11.01	10.56	13.57	10.1	16.1	12.28	10.06	8.97	8.65	13.2	9.55	8.32	11.67	10.13	9.5	8.57	8.32	8.03
20	600	8	9.8	37	12.23	11	10.56	13.46	10.11	15.9	12.22	10.08	9.03	8.72	13.11	9.58	8.4	11.63	10.14	9.53	8.64	8.4	8.12
21	600	8	9.1	32	10.38	9.3	8.92	11.45	8.53	13.59	10.37	8.5	7.58	7.31	11.15	8.06	7.03	9.86	8.55	8.02	7.24	7.03	6.78
22	600	8	7.1	20	6.28	5.59	5.34	6.96	5.09	8.32	6.27	5.07	4.49	4.31	6.77	4.79	4.13	5.94	5.11	4.77	4.27	4.13	3.97
23	600	8	5.9	14	4.22	3.72	3.54	4.71	3.36	5.68	4.21	3.35	2.93	2.8	4.57	3.15	2.67	3.97	3.38	3.13	2.77	2.67	2.56
24	600	8	5.5	12	3.39	2.95	2.8	3.82	2.64	4.68	3.39	2.63	2.26	2.14	3.7	2.45	2.03	3.18	2.65	2.43	2.12	2.03	1.93

Anexo 5. Carga en nodo [m] {EPANET}

Caso	L	d	q	h(20) tanque	h [m]																		
hrs	[m]	[pulg]	[l/s]	[m]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	600	8	7.8	24	7.7	6.89	6.59	8.51	6.3	10.13	7.7	6.28	5.58	5.37	8.28	5.95	5.16	7.3	6.32	5.91	5.32	5.16	4.98
2	600	8	7.6	23	7.46	6.68	6.4	8.23	6.12	9.77	7.45	6.1	5.43	5.23	8.01	5.78	5.03	7.08	6.14	5.75	5.18	5.03	4.86
3	600	8	7.5	22	6.83	6.07	5.8	7.59	5.52	9.09	6.82	5.5	4.85	4.66	7.37	5.19	4.46	6.46	5.54	5.16	4.61	4.46	4.29
4	600	8	7.6	23	7.46	6.68	6.4	8.23	6.12	9.77	7.45	6.1	5.43	5.23	8.01	5.78	5.03	7.08	6.14	5.75	5.18	5.03	4.86
5	600	8	7.9	25	8.32	7.48	7.18	9.15	6.88	10.8	8.31	6.86	6.15	5.93	8.91	6.52	5.72	7.91	6.9	6.49	5.88	5.72	5.53
6	600	8	8.9	30	9.25	8.21	7.84	10.28	7.46	12.32	9.24	7.44	6.55	6.29	9.98	7.02	6.02	8.74	7.49	6.98	6.22	6.02	5.79
7	600	8	10.9	45	14.88	13.39	12.85	16.37	12.31	19.33	14.87	12.27	11	10.62	15.95	11.67	10.24	14.16	12.35	11.61	10.53	10.24	9.9
8	600	8	13.6	70	22.85	20.52	19.69	25.17	18.85	29.8	22.84	18.82	16.84	16.26	24.52	17.88	15.67	21.74	18.93	17.8	16.11	15.66	15.15
9	600	8	17.7	117	43.31	39.69	38.4	46.89	37.11	54.09	43.26	37.01	33.95	33.05	45.87	35.57	32.14	41.55	37.19	35.44	32.82	32.13	31.33
10	600	8	19.4	141	53.65	49.37	47.85	57.89	46.32	66.4	53.59	46.21	42.59	41.53	56.68	44.51	40.46	51.58	46.42	44.35	41.26	40.45	39.51
11	600	8	20.1	151	57.71	53.14	51.53	62.23	49.9	71.32	57.65	49.77	45.91	44.78	60.94	47.96	43.64	55.5	50	47.79	44.5	43.63	42.63
12	600	8	20.5	156	59.23	54.5	52.83	63.92	51.13	73.35	59.17	51.01	47	45.83	62.58	49.13	44.65	56.94	51.24	48.95	45.54	44.64	43.6
13	600	8	20.4	155	59.11	54.42	52.76	63.75	51.08	73.1	59.04	50.96	46.98	45.83	62.43	49.09	44.66	56.84	51.19	48.92	45.54	44.65	43.61
14	600	8	19.5	142	53.81	49.49	47.96	58.09	46.42	66.69	53.75	46.3	42.65	41.58	56.87	44.58	40.5	51.72	46.52	44.43	41.31	40.49	39.54
15	600	8	18.4	127	47.81	43.93	42.55	51.66	41.16	59.39	47.76	41.06	37.77	36.81	50.56	39.51	35.83	45.93	41.25	39.37	36.56	35.83	34.97
16	600	8	17	109	40.61	37.25	36.06	43.94	34.85	50.63	40.57	34.76	31.91	31.08	42.99	33.42	30.24	38.98	34.93	33.3	30.87	30.23	29.49
17	600	8	16	96	34.87	31.86	30.79	37.85	29.71	43.83	34.83	29.63	27.08	26.33	37	28.43	25.57	33.41	29.78	28.32	26.14	25.57	24.9
18	600	8	15.3	88	31.72	28.95	27.96	34.47	26.97	39.98	31.69	26.89	24.54	23.85	33.69	25.79	23.15	30.38	27.03	25.68	23.68	23.15	22.53
19	600	8	15	85	30.75	28.07	27.12	33.4	26.16	38.71	30.71	26.09	23.82	23.15	32.64	25.02	22.48	29.45	26.22	24.92	22.98	22.47	21.88
20	600	8	14.7	81	28.73	26.15	25.24	31.29	24.31	36.41	28.7	24.24	22.05	21.41	30.56	23.21	20.76	27.48	24.37	23.12	21.25	20.76	20.18
21	600	8	13.6	70	22.85	20.52	19.69	25.17	18.85	29.8	22.84	18.82	16.84	16.26	24.52	17.88	15.67	21.74	18.93	17.8	16.11	15.66	15.15
22	600	8	10.6	43	14.39	12.97	12.46	15.8	11.95	18.62	14.38	11.91	10.7	10.34	15.4	11.34	9.98	13.7	11.98	11.28	10.25	9.97	9.65
23	600	8	8.9	30	9.25	8.21	7.84	10.28	7.46	12.32	9.24	7.44	6.55	6.29	9.98	7.02	6.02	8.74	7.49	6.98	6.22	6.02	5.79
24	600	8	8.2	26	8.14	7.24	6.92	9.03	6.6	10.79	8.13	6.58	5.82	5.59	8.77	6.22	5.36	7.7	6.62	6.18	5.53	5.36	5.16

ANEXO 6. DIFERENCIA PORCENTUAL

TRANSFORMACIÓN DE ENERGÍA EN TUBO

Método Sánchez- Fuentes vs. EPANET

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	100	4	2.6	16.44%	2.73%	11.80%	3.57%	38.68%	29.60%	28.67%	12.77%	6.09%	-12.60%	33.20%	2.32%	-7.26%	12.23%	-26.59%	#¡DIV/0!	15.44%	-2.56%	4.51%	-14.81%	-9.68%	46.06%
2	100	4	2.5	21.38%	4.67%	16.72%	11.07%	42.96%	-37.45%	33.01%	16.53%	9.39%	-1.58%	38.37%	8.17%	-3.60%	15.67%	-29.15%	#¡DIV/0!	18.73%	1.57%	9.28%	-9.55%	-12.82%	51.53%
3	100	4	2.5	17.09%	0.96%	12.59%	7.14%	37.90%	-39.67%	28.30%	12.41%	5.51%	-5.07%	33.48%	4.34%	-7.01%	11.58%	-31.65%	#¡DIV/0!	14.53%	-2.02%	5.41%	-12.75%	-15.90%	46.16%
4	100	4	2.5	21.38%	4.67%	16.72%	11.07%	42.96%	-37.45%	33.01%	16.53%	9.39%	-1.58%	38.37%	8.17%	-3.60%	15.67%	-29.15%	#¡DIV/0!	18.73%	1.57%	9.28%	-9.55%	-12.82%	51.53%
5	100	4	2.6	20.56%	6.37%	15.75%	7.23%	43.59%	34.19%	33.22%	16.76%	9.85%	-9.51%	37.92%	5.94%	-3.97%	16.21%	-23.99%	#¡DIV/0!	19.52%	0.89%	8.21%	-11.79%	-6.48%	51.23%
6	100	4	3	16.81%	5.76%	13.31%	3.60%	37.76%	-15.73%	28.59%	13.09%	6.30%	-6.41%	33.32%	5.53%	-6.20%	12.13%	-4.54%	#¡DIV/0!	16.16%	0.62%	3.93%	-12.96%	-11.91%	46.15%
7	100	4	3.6	27.69%	13.08%	22.86%	16.58%	49.50%	-14.90%	39.78%	23.26%	15.56%	0.42%	44.88%	15.89%	6.57%	21.11%	-27.70%	#¡DIV/0!	26.33%	10.26%	13.08%	2.55%	-2.95%	58.34%
8	100	4	4.5	33.47%	17.80%	28.43%	20.29%	55.48%	-0.28%	45.44%	28.92%	20.85%	4.61%	50.48%	20.72%	11.01%	27.27%	-9.62%	#¡DIV/0!	31.97%	15.68%	17.24%	6.83%	1.09%	63.83%
9	100	4	5.9	37.43%	22.32%	32.85%	25.28%	59.34%	12.36%	49.13%	34.12%	23.51%	11.66%	54.37%	23.65%	14.47%	31.82%	-15.15%	#¡DIV/0!	35.99%	18.99%	22.55%	8.32%	6.37%	67.60%
10	100	4	6.5	38.38%	21.99%	34.18%	26.92%	60.24%	15.72%	50.16%	35.03%	24.66%	10.83%	55.25%	24.65%	15.93%	32.71%	-16.58%	#¡DIV/0!	37.12%	20.02%	23.66%	8.46%	7.53%	68.16%
11	100	4	6.7	40.35%	24.48%	35.88%	28.43%	62.15%	8.48%	51.99%	36.89%	26.48%	13.79%	57.11%	26.07%	17.49%	34.51%	-10.63%	-68.08%	38.80%	22.34%	25.20%	10.09%	9.97%	70.31%
12	100	4	6.8	41.38%	25.16%	36.78%	29.23%	63.28%	12.19%	53.12%	37.73%	26.96%	14.50%	58.31%	27.33%	19.89%	35.64%	-7.57%	-66.99%	39.31%	23.94%	25.45%	11.89%	10.38%	71.31%
13	100	4	6.8	40.44%	24.33%	35.87%	28.37%	62.20%	11.44%	52.10%	36.81%	26.11%	13.74%	57.26%	26.48%	19.09%	34.74%	-8.19%	-67.21%	38.38%	23.11%	24.61%	11.15%	9.65%	70.17%
14	100	4	6.5	39.35%	22.85%	35.12%	27.81%	61.37%	16.53%	51.22%	35.98%	25.54%	11.61%	56.35%	25.53%	16.75%	33.64%	-16.00%	#¡DIV/0!	38.09%	20.86%	24.53%	9.23%	8.28%	69.34%
15	100	4	6.1	39.41%	23.02%	35.11%	29.10%	61.76%	3.86%	51.47%	36.09%	25.43%	12.51%	56.85%	25.72%	17.47%	33.54%	-17.65%	-73.26%	38.00%	20.96%	24.26%	9.51%	8.57%	69.85%
16	100	4	5.7	35.00%	20.35%	31.32%	24.52%	57.10%	-10.96%	47.16%	31.61%	22.35%	8.97%	52.35%	23.02%	11.51%	29.29%	-21.55%	#¡DIV/0!	34.15%	17.15%	21.00%	4.81%	4.25%	65.18%
17	100	4	5.3	36.33%	20.21%	32.52%	25.74%	58.50%	10.15%	48.55%	32.95%	22.48%	10.62%	53.60%	21.96%	12.60%	31.20%	-10.88%	#¡DIV/0!	34.53%	18.93%	21.12%	7.63%	7.11%	67.08%
18	100	4	5.1	34.58%	18.80%	29.67%	22.25%	55.97%	0.97%	45.97%	30.64%	21.40%	5.92%	51.14%	20.62%	12.40%	28.71%	-4.68%	#¡DIV/0!	32.86%	16.46%	19.38%	4.30%	2.98%	64.49%
19	100	4	5	33.05%	19.17%	28.30%	20.53%	54.81%	-3.47%	44.89%	29.12%	19.81%	8.49%	50.00%	20.06%	9.90%	27.21%	-8.87%	#¡DIV/0!	31.19%	16.64%	17.67%	5.76%	0.91%	63.14%
20	100	4	4.9	31.56%	17.67%	27.73%	20.78%	53.28%	-7.80%	43.61%	28.08%	19.03%	6.15%	48.57%	17.90%	7.40%	26.38%	-12.97%	#¡DIV/0!	30.19%	14.12%	16.91%	4.16%	1.45%	61.74%
21	100	4	4.5	33.47%	17.80%	28.43%	20.29%	55.48%	-0.28%	45.44%	28.92%	20.85%	4.61%	50.48%	20.72%	11.01%	27.27%	-9.62%	#¡DIV/0!	31.97%	15.68%	17.24%	6.83%	1.09%	63.83%
22	100	4	3.5	27.98%	10.76%	23.28%	17.54%	50.35%	-19.10%	40.34%	23.19%	15.28%	4.14%	45.31%	15.97%	1.31%	22.60%	-31.27%	#¡DIV/0!	25.45%	9.48%	13.92%	-2.51%	1.48%	58.45%
23	100	4	3	16.81%	5.76%	13.31%	3.60%	37.76%	-15.73%	28.59%	13.09%	6.30%	-6.41%	33.32%	5.53%	-6.20%	12.13%	-4.54%	#¡DIV/0!	16.16%	0.62%	3.93%	-12.96%	-11.91%	46.15%
24	100	4	2.7	20.12%	2.99%	17.24%	14.76%	43.25%	-28.20%	32.96%	17.23%	8.34%	-3.16%	38.85%	8.65%	-4.09%	13.54%	-18.66%	#¡DIV/0!	20.49%	4.11%	5.03%	-5.60%	-7.62%	51.00%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	100	4	5.2	33.08%	18.30%	28.81%	21.84%	54.48%	3.68%	44.81%	29.49%	19.44%	6.39%	49.70%	19.16%	12.91%	27.40%	-16.11%	-80.93%	31.64%	15.64%	18.14%	4.12%	3.23%	62.93%
2	100	4	5.1	33.39%	17.75%	28.52%	21.17%	54.59%	0.08%	44.67%	29.48%	20.33%	4.98%	49.80%	19.55%	11.40%	27.57%	-5.53%	#¡DIV/0!	31.68%	15.42%	18.32%	3.37%	2.07%	63.03%
3	100	4	5	33.05%	19.17%	28.30%	20.53%	54.81%	-3.47%	44.89%	29.12%	19.81%	8.49%	50.00%	20.06%	9.90%	27.21%	-8.87%	#¡DIV/0!	31.19%	16.64%	17.67%	5.76%	0.91%	63.14%
4	100	4	5.1	33.39%	17.75%	28.52%	21.17%	54.59%	0.08%	44.67%	29.48%	20.33%	4.98%	49.80%	19.55%	11.40%	27.57%	-5.53%	#¡DIV/0!	31.68%	15.42%	18.32%	3.37%	2.07%	63.03%
5	100	4	5.3	32.87%	17.16%	29.16%	22.55%	54.48%	7.35%	44.78%	29.58%	19.37%	7.82%	49.70%	18.86%	9.75%	27.88%	-13.14%	#¡DIV/0!	31.12%	15.91%	18.05%	4.90%	4.39%	62.84%
6	100	4	5.9	37.43%	22.32%	32.85%	25.28%	59.34%	12.36%	49.13%	34.12%	23.51%	11.66%	54.37%	23.65%	14.47%	31.82%	-15.15%	#¡DIV/0!	35.99%	18.99%	22.55%	8.32%	6.37%	67.60%
7	100	4	7.3	41.15%	25.04%	36.91%	29.53%	62.87%	2.12%	52.72%	37.75%	27.15%	14.77%	57.93%	27.88%	18.96%	35.55%	-11.02%	#¡DIV/0!	39.44%	23.39%	25.94%	11.88%	9.49%	70.76%
8	100	4	9.1	47.17%	31.31%	42.76%	35.64%	69.05%	13.97%	58.70%	44.23%	32.59%	20.51%	63.99%	32.91%	24.89%	41.55%	-4.87%	-41.31%	45.71%	29.04%	31.36%	17.73%	16.03%	76.71%
9	100	4	11.8	54.10%	38.13%	49.80%	42.23%	76.14%	17.24%	65.57%	51.43%	38.89%	27.93%	70.86%	39.90%	32.43%	48.60%	1.82%	-50.41%	52.76%	36.16%	38.12%	23.41%	22.56%	83.29%
10	100	4	13	55.03%	38.63%	50.69%	43.05%	76.56%	20.00%	66.09%	52.44%	39.60%	28.52%	71.36%	40.42%	33.58%	49.42%	4.87%	-40.41%	53.63%	37.02%	38.82%	24.62%	23.17%	83.48%
11	100	4	13.4	56.82%	40.92%	52.75%	45.24%	78.75%	15.71%	68.17%	54.43%	41.49%	30.57%	73.47%	42.61%	35.32%	51.51%	6.28%	-36.16%	55.56%	38.99%	40.69%	26.13%	25.14%	85.65%
12	100	4	13.6	57.92%	41.54%	53.68%	46.00%	79.82%	19.67%	69.14%	55.51%	42.25%	31.88%	74.53%	43.28%	35.73%	52.42%	7.02%	32.05%	56.51%	39.88%	41.66%	27.25%	25.62%	86.69%
13	100	4	13.6	56.86%	40.60%	52.66%	45.03%	78.63%	18.87%	68.02%	54.48%	41.31%	31.00%	73.36%	42.32%	34.82%	51.41%	6.31%	31.17%	55.47%	38.95%	40.72%	26.40%	24.79%	85.45%
14	100	4	13	56.12%	39.60%	51.75%	44.05%	77.81%	20.85%	67.26%	53.51%	40.58%	29.43%	72.56%	41.40%	34.52%	50.47%	5.60%	-39.99%	54.71%	37.98%	39.80%	25.49%	24.03%	84.77%
15	100	4	12.3	54.02%	37.72%	49.72%	42.13%	75.80%	16.32%	65.26%	51.39%	38.81%	27.69%	70.59%	40.06%	32.43%	48.41%	2.94%	-46.52%	52.64%	36.33%	37.73%	23.69%	22.83%	82.79%
16	100	4	11.4	51.96%	35.55%	47.65%	40.30%	73.64%	13.32%	63.17%	49.22%	36.84%	25.87%	68.44%	37.60%	30.09%	46.41%	4.60%	-8.30%	50.51%	34.24%	35.89%	21.80%	19.83%	80.84%
17	100	4	10.7	50.75%	34.87%	46.60%	39.16%	72.64%	15.94%	62.22%	48.08%	35.83%	24.53%	67.47%	36.52%	29.06%	45.32%	-0.18%	-59.49%	49.34%	33.09%	34.78%	20.67%	19.63%	80.02%
18	100	4	10.2	51.20%	34.57%	46.55%	39.12%	73.00%	12.19%	62.50%	48.06%	36.07%	24.61%	67.78%	36.83%	28.86%	45.35%	-0.54%	-25.72%	49.70%	32.66%	35.12%	20.68%	18.93%	80.56%
19	100	4	10	49.63%	33.38%	45.42%	38.37%	71.64%	13.57%	61.19%	46.86%	34.81%	23.15%	66.45%	35.36%	27.25%	44.09%	-0.59%	-28.98%	48.25%	31.96%	33.74%	19.32%	18.72%	79.16%
20	100	4	9.8	48.36%	32.87%	44.11%	36.43%	70.23%	15.24%	59.85%	45.57%	33.60%	22.59%	65.07%	34.47%	25.67%	42.89%	-5.05%	-32.18%	47.04%	30.42%	32.70%	17.99%	17.72%	77.71%
21	100	4	9.1	47.17%	31.31%	42.76%	35.64%	69.05%	13.97%	58.70%	44.23%	32.59%	20.51%	63.99%	32.91%	24.89%	41.55%	-4.87%	-41.31%	45.71%	29.04%	31.36%	17.73%	16.03%	76.71%
22	100	4	7.1	41.01%	26.04%	36.98%	29.29%	62.77%	7.86%	52.80%	37.76%	27.04%	14.56%	57.99%	26.82%	18.60%	35.45%	-8.36%	-64.29%	39.46%	23.16%	26.15%	9.68%	11.21%	70.99%
23	100	4	5.9	37.43%	22.32%	32.85%	25.28%	59.34%	12.36%	49.13%	34.12%	23.51%	11.66%	54.37%	23.65%	14.47%	31.82%	-15.15%	#¡DIV/0!	35.99%	18.99%	22.55%	8.32%	6.37%	67.60%
24	100	4	5.5	33.34%	16.91%	28.73%	22.41%	54.72%	-4.26%	44.75%	29.58%	20.11%	6.33%	49.95%	19.89%	12.84%	27.39%	-7.04%	-78.87%	31.45%	16.60%	18.07%	3.84%	4.43%	62.67%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	100	4	7.8	42.91%	26.38%	38.51%	31.28%	64.43%	6.04%	54.28%	39.52%	28.59%	17.15%	59.42%	29.15%	20.47%	37.15%	-5.62%	-57.10%	41.28%	25.28%	27.37%	12.45%	12.12%	72.37%
2	100	4	7.6	44.51%	28.45%	40.25%	32.31%	66.48%	12.59%	56.18%	41.28%	30.08%	18.10%	61.49%	30.22%	21.28%	38.65%	-1.89%	#¡DIV/0!	42.94%	26.97%	28.75%	14.66%	13.44%	74.66%
3	100	4	7.5	42.79%	26.79%	38.30%	31.49%	64.73%	8.60%	54.42%	39.60%	28.57%	16.51%	59.63%	28.89%	20.89%	37.15%	-5.37%	-60.05%	41.29%	25.25%	26.96%	13.81%	12.13%	72.69%
4	100	4	7.6	44.51%	28.45%	40.25%	32.31%	66.48%	12.59%	56.18%	41.28%	30.08%	18.10%	61.49%	30.22%	21.28%	38.65%	-1.89%	#¡DIV/0!	42.94%	26.97%	28.75%	14.66%	13.44%	74.66%
5	100	4	7.9	44.68%	28.09%	39.78%	32.20%	66.46%	9.79%	56.11%	41.05%	30.16%	17.54%	61.35%	30.54%	22.22%	38.71%	-2.28%	-55.58%	42.99%	26.37%	28.75%	13.41%	13.48%	74.27%
6	100	4	8.9	45.44%	30.54%	41.52%	33.93%	67.49%	8.34%	57.22%	42.64%	31.14%	20.33%	62.42%	31.79%	23.55%	40.02%	-4.54%	-44.21%	44.44%	27.76%	29.98%	16.68%	14.28%	75.13%
7	100	4	10.9	52.08%	35.70%	47.74%	40.16%	74.04%	14.88%	63.50%	49.25%	37.06%	25.38%	68.87%	37.70%	30.05%	46.44%	4.11%	-15.49%	50.65%	34.02%	35.82%	22.16%	20.10%	81.33%
8	100	4	13.6	57.92%	41.54%	53.68%	46.00%	79.82%	19.67%	69.14%	55.51%	42.25%	31.88%	74.53%	43.28%	35.73%	52.42%	7.02%	32.05%	56.51%	39.88%	41.66%	27.25%	25.62%	86.69%
9	100	4	17.7	63.81%	47.38%	59.60%	51.99%	85.45%	23.82%	74.69%	61.81%	47.65%	38.02%	80.07%	49.08%	42.35%	58.45%	12.67%	-25.61%	62.47%	45.92%	47.23%	32.94%	31.79%	91.52%
10	100	4	19.4	65.98%	49.58%	61.79%	54.12%	87.52%	25.69%	76.73%	64.13%	49.59%	40.46%	82.12%	51.29%	44.91%	60.63%	14.70%	-32.96%	64.74%	48.13%	49.26%	35.16%	33.99%	93.29%
11	100	4	20.1	66.50%	50.23%	62.24%	54.50%	87.94%	28.04%	77.16%	64.71%	50.03%	41.26%	82.54%	51.69%	45.18%	61.17%	16.42%	-4.23%	65.22%	48.73%	49.69%	36.09%	34.13%	93.58%
12	100	4	20.5	65.99%	49.82%	61.76%	54.06%	87.31%	26.21%	76.58%	64.21%	49.63%	40.70%	81.94%	51.37%	45.03%	60.66%	15.83%	-0.96%	64.73%	48.39%	49.34%	35.52%	34.04%	92.82%
13	100	4	20.4	66.37%	50.12%	62.25%	54.51%	87.73%	25.37%	77.00%	64.60%	50.01%	41.06%	82.37%	51.77%	45.37%	61.06%	15.06%	-1.62%	65.14%	48.61%	49.67%	36.19%	34.21%	93.33%
14	100	4	19.5	65.59%	49.21%	61.37%	53.78%	87.00%	24.43%	76.27%	63.70%	49.21%	40.30%	81.62%	50.97%	44.22%	60.21%	13.92%	-9.99%	64.30%	47.84%	48.86%	35.07%	33.47%	92.76%
15	100	4	18.4	64.31%	48.18%	60.22%	52.44%	85.89%	23.45%	75.16%	62.41%	48.17%	38.81%	80.52%	49.82%	43.12%	59.00%	14.03%	-19.78%	63.14%	46.60%	47.61%	34.02%	32.17%	91.86%
16	100	4	17	63.16%	46.93%	59.00%	51.18%	84.95%	24.66%	74.20%	61.11%	47.12%	37.20%	79.59%	48.70%	41.92%	57.75%	11.48%	-31.22%	61.90%	45.43%	46.52%	32.55%	31.04%	91.17%
17	100	4	16	61.39%	44.95%	57.15%	49.47%	83.12%	23.91%	72.41%	59.22%	45.35%	35.63%	77.79%	46.83%	39.88%	55.95%	10.09%	-39.23%	60.05%	43.53%	44.73%	30.80%	29.54%	89.51%
18	100	4	15.3	60.79%	44.37%	56.43%	48.81%	82.54%	19.57%	71.83%	58.43%	44.84%	34.89%	77.20%	46.29%	38.78%	55.22%	9.51%	-16.43%	59.43%	42.78%	44.19%	29.86%	28.38%	89.09%
19	100	4	15	59.30%	43.47%	55.16%	47.40%	81.13%	20.67%	70.45%	57.14%	43.59%	33.59%	75.82%	45.00%	37.72%	53.89%	6.98%	-20.11%	58.08%	41.54%	43.05%	28.73%	27.47%	87.69%
20	100	4	14.7	58.12%	41.68%	53.83%	46.37%	79.60%	18.54%	69.07%	55.69%	42.39%	32.32%	74.35%	43.77%	36.28%	52.63%	6.81%	-23.70%	56.68%	40.36%	41.67%	27.65%	26.63%	86.24%
21	100	4	13.6	57.92%	41.54%	53.68%	46.00%	79.82%	19.67%	69.14%	55.51%	42.25%	31.88%	74.53%	43.28%	35.73%	52.42%	7.02%	32.05%	56.51%	39.88%	41.66%	27.25%	25.62%	86.69%
22	100	4	10.6	52.04%	35.93%	47.94%	40.20%	74.19%	14.96%	63.70%	49.23%	37.09%	25.73%	69.00%	38.20%	30.25%	46.57%	-1.03%	-19.66%	50.72%	33.95%	36.02%	22.43%	20.18%	81.67%
23	100	4	8.9	45.44%	30.54%	41.52%	33.93%	67.49%	8.34%	57.22%	42.64%	31.14%	20.33%	62.42%	31.79%	23.55%	40.02%	-4.54%	-44.21%	44.44%	27.76%	29.98%	16.68%	14.28%	75.13%
24	100	4	8.2	44.48%	28.06%	40.02%	33.26%	66.08%	7.70%	55.93%	41.16%	29.83%	18.46%	61.12%	30.38%	22.15%	38.53%	-8.50%	-52.46%	43.07%	26.13%	29.03%	13.97%	12.59%	73.95%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	100	6	2.6	-3.31%	-23.19%	0.33%	-15.39%	21.37%	#¡DIV/0!	12.52%	-5.75%	-10.99%	-27.54%	19.66%	2.24%	-20.18%	-6.18%	#¡DIV/0!	#¡DIV/0!	-7.00%	4.87%	-18.08%	-43.80%	29.75%	24.05%
2	100	6	2.5	6.66%	-25.86%	-3.16%	22.50%	32.77%	-85.62%	23.42%	-9.03%	0.24%	-30.06%	29.08%	-1.31%	-22.96%	-9.44%	#¡DIV/0!	#¡DIV/0!	12.21%	-24.08%	-5.11%	-45.75%	25.24%	27.92%
3	100	6	2.5	2.89%	-28.48%	-6.59%	18.16%	28.07%	-86.13%	19.05%	-12.25%	-3.31%	-32.53%	24.51%	-4.81%	-25.69%	-12.65%	#¡DIV/0!	#¡DIV/0!	8.24%	-26.77%	-8.47%	-47.67%	20.81%	23.39%
4	100	6	2.5	6.66%	-25.86%	-3.16%	22.50%	32.77%	-85.62%	23.42%	-9.03%	0.24%	-30.06%	29.08%	-1.31%	-22.96%	-9.44%	#¡DIV/0!	#¡DIV/0!	12.21%	-24.08%	-5.11%	-45.75%	25.24%	27.92%
5	100	6	2.6	0.11%	-20.47%	3.88%	-12.40%	25.67%	#¡DIV/0!	16.50%	-2.41%	-7.83%	-24.97%	23.89%	5.86%	-17.36%	-2.86%	#¡DIV/0!	#¡DIV/0!	-3.70%	8.59%	-15.18%	-41.81%	34.35%	28.44%
6	100	6	3	0.59%	-25.08%	1.47%	-17.48%	21.96%	#¡DIV/0!	14.31%	-6.27%	-9.97%	-37.18%	18.26%	-0.28%	3.79%	-8.50%	-77.23%	#¡DIV/0!	0.79%	-18.17%	-8.69%	-26.92%	-15.63%	24.47%
7	100	6	3.6	8.84%	13.48%	-1.19%	-16.67%	35.48%	#¡DIV/0!	23.14%	4.94%	-5.58%	-4.84%	31.72%	0.70%	4.82%	-2.16%	#¡DIV/0!	-98.98%	7.77%	3.29%	-11.98%	-26.19%	-14.80%	35.15%
8	100	6	4.5	13.37%	1.32%	8.08%	-2.35%	41.12%	-54.14%	29.22%	7.75%	6.55%	-25.66%	34.57%	4.90%	-1.74%	8.29%	#¡DIV/0!	#¡DIV/0!	14.50%	-3.16%	-5.45%	-13.51%	-20.13%	40.37%
9	100	6	5.9	18.34%	-0.11%	10.70%	10.02%	47.02%	-22.50%	34.24%	13.81%	4.55%	-5.77%	40.78%	6.37%	-7.74%	12.62%	-8.91%	#¡DIV/0!	15.18%	2.28%	2.27%	-16.47%	-3.58%	44.03%
10	100	6	6.5	17.92%	2.87%	12.54%	5.76%	48.23%	-6.88%	35.24%	14.30%	5.25%	-9.42%	42.09%	6.50%	-0.23%	12.28%	9.45%	#¡DIV/0!	16.25%	3.50%	2.40%	-12.18%	-9.89%	44.86%
11	100	6	6.7	20.46%	2.87%	14.70%	6.23%	48.56%	-0.23%	36.50%	15.56%	6.99%	-2.95%	43.62%	14.11%	-2.82%	13.08%	-41.37%	#¡DIV/0!	19.77%	0.32%	6.18%	-16.37%	-3.46%	46.86%
12	100	6	6.8	19.04%	6.39%	15.80%	9.86%	50.41%	3.18%	38.16%	16.24%	7.88%	-8.76%	44.44%	11.80%	10.55%	14.65%	-39.37%	-96.43%	21.52%	-0.96%	6.37%	-13.51%	-0.16%	47.71%
13	100	6	6.8	18.25%	5.68%	15.02%	9.13%	49.41%	2.49%	37.24%	15.46%	7.16%	-9.37%	43.48%	11.05%	9.81%	13.89%	-39.77%	-96.45%	20.71%	-1.62%	5.67%	-14.08%	-0.82%	46.72%
14	100	6	6.5	18.75%	3.60%	13.34%	6.50%	49.27%	-6.23%	36.19%	15.10%	5.99%	-8.79%	43.09%	7.25%	0.47%	13.07%	10.21%	#¡DIV/0!	17.07%	4.22%	3.12%	-11.57%	-9.26%	45.88%
15	100	6	6.1	20.53%	-0.57%	12.55%	9.52%	48.38%	-16.42%	36.03%	14.55%	5.92%	1.62%	43.29%	14.71%	-0.51%	12.77%	-50.89%	#¡DIV/0!	18.57%	-1.95%	6.05%	-9.93%	-9.02%	46.18%
16	100	6	5.7	16.25%	0.75%	8.95%	1.72%	43.81%	-28.35%	31.34%	11.18%	3.33%	-0.43%	38.40%	13.47%	-4.04%	9.75%	-57.89%	#¡DIV/0!	14.68%	-5.43%	2.78%	-9.91%	-22.00%	42.04%
17	100	6	5.3	17.39%	-2.08%	10.53%	7.86%	43.73%	-36.69%	32.82%	10.78%	5.91%	-12.02%	38.01%	8.62%	-3.10%	12.13%	-25.59%	#¡DIV/0!	16.24%	-4.50%	4.43%	-20.39%	-8.10%	43.55%
18	100	6	5.1	15.89%	-0.26%	5.22%	9.86%	43.53%	-41.96%	30.45%	11.00%	1.14%	-5.91%	36.25%	8.62%	-11.17%	9.64%	-31.79%	#¡DIV/0!	13.22%	2.13%	-4.26%	-12.43%	-15.76%	41.13%
19	100	6	5	10.80%	-4.64%	8.98%	5.03%	42.30%	#¡DIV/0!	29.34%	11.30%	0.89%	-10.04%	36.56%	3.85%	-15.07%	8.43%	-34.78%	#¡DIV/0!	11.73%	-2.36%	-3.65%	-16.28%	-3.35%	39.82%
20	100	6	4.9	14.64%	-8.93%	4.08%	12.85%	41.13%	-47.01%	28.28%	8.95%	0.74%	-14.09%	34.77%	9.10%	-5.37%	7.26%	-37.71%	#¡DIV/0!	10.27%	1.73%	-2.87%	-20.04%	-23.08%	38.57%
21	100	6	4.5	13.37%	1.32%	8.08%	-2.35%	41.12%	-54.14%	29.22%	7.75%	6.55%	-25.66%	34.57%	4.90%	-1.74%	8.29%	#¡DIV/0!	#¡DIV/0!	14.50%	-3.16%	-5.45%	-13.51%	-20.13%	40.37%
22	100	6	3.5	11.42%	-13.70%	1.16%	-4.94%	37.99%	#¡DIV/0!	25.42%	4.29%	-2.77%	-9.54%	33.04%	-4.27%	-25.27%	-1.18%	#¡DIV/0!	#¡DIV/0!	8.85%	-1.81%	-7.96%	-29.84%	-19.01%	35.05%
23	100	6	3	0.59%	-25.08%	1.47%	-17.48%	21.96%	#¡DIV/0!	14.31%	-6.27%	-9.97%	-37.18%	18.26%	-0.28%	3.79%	-8.50%	-77.23%	#¡DIV/0!	0.79%	-18.17%	-8.69%	-26.92%	-15.63%	24.47%
24	100	6	2.7	7.14%	-14.89%	-2.73%	-6.25%	27.01%	#¡DIV/0!	19.88%	-3.03%	-13.70%	-19.71%	25.95%	-15.03%	-11.56%	-6.44%	#¡DIV/0!	#¡DIV/0!	3.05%	-12.85%	-9.23%	-37.73%	-28.11%	28.22%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	100	6	5.2	14.60%	-7.82%	8.04%	1.53%	42.30%	#¡DIV/0!	30.84%	8.91%	-0.30%	-3.38%	37.79%	2.24%	-8.78%	5.55%	-29.96%	#¡DIV/0!	12.73%	-3.19%	-1.69%	-10.08%	-13.50%	39.69%
2	100	6	5.1	14.87%	-1.14%	4.28%	8.89%	42.25%	-42.48%	29.29%	10.01%	0.24%	-6.74%	35.04%	7.66%	-11.96%	8.67%	-32.39%	#¡DIV/0!	12.21%	1.23%	-5.11%	-13.20%	-16.51%	39.88%
3	100	6	5	10.80%	-4.64%	8.98%	5.03%	42.30%	#¡DIV/0!	29.34%	11.30%	0.89%	-10.04%	36.56%	3.85%	-15.07%	8.43%	-34.78%	#¡DIV/0!	11.73%	-2.36%	-3.65%	-16.28%	-3.35%	39.82%
4	100	6	5.1	14.87%	-1.14%	4.28%	8.89%	42.25%	-42.48%	29.29%	10.01%	0.24%	-6.74%	35.04%	7.66%	-11.96%	8.67%	-32.39%	#¡DIV/0!	12.21%	1.23%	-5.11%	-13.20%	-16.51%	39.88%
5	100	6	5.3	14.42%	-4.56%	7.72%	5.12%	40.09%	-38.29%	29.45%	7.97%	3.23%	-14.25%	34.51%	5.86%	-5.55%	9.28%	-27.48%	#¡DIV/0!	13.29%	-6.93%	1.79%	-22.41%	-10.44%	39.91%
6	100	6	5.9	18.34%	-0.11%	10.70%	10.02%	47.02%	-22.50%	34.24%	13.81%	4.55%	-5.77%	40.78%	6.37%	-7.74%	12.62%	-8.91%	#¡DIV/0!	15.18%	2.28%	2.27%	-16.47%	-3.58%	44.03%
7	100	6	7.3	117.68%	81.57%	104.94%	99.99%	166.52%	17.40%	146.27%	105.41%	96.39%	63.13%	155.91%	101.40%	79.68%	107.91%	37.98%	#¡DIV/0!	115.53%	77.07%	93.65%	47.61%	70.40%	166.18%
8	100	6	9.1	25.31%	9.12%	20.08%	15.74%	55.84%	-8.28%	42.52%	22.64%	12.81%	4.96%	49.68%	18.01%	3.44%	19.49%	-28.14%	#¡DIV/0!	25.83%	7.60%	10.03%	-1.15%	-0.16%	53.46%
9	100	6	11.8	33.01%	14.16%	25.96%	22.82%	62.61%	3.33%	48.93%	30.07%	17.86%	7.69%	56.12%	22.73%	14.53%	26.39%	-8.91%	#¡DIV/0!	32.54%	14.85%	14.91%	6.30%	-0.01%	60.19%
10	100	6	13	34.29%	15.22%	27.22%	22.03%	63.24%	-6.88%	49.95%	30.35%	18.91%	9.79%	57.01%	23.68%	14.02%	27.16%	-12.44%	#¡DIV/0!	32.86%	15.67%	17.03%	4.08%	1.37%	60.72%
11	100	6	13.4	35.42%	18.70%	29.73%	23.61%	64.97%	-0.23%	51.91%	32.33%	20.07%	10.91%	59.00%	24.48%	15.56%	28.50%	-6.19%	#¡DIV/0!	35.39%	17.05%	18.61%	3.82%	5.32%	62.75%
12	100	6	13.6	36.48%	18.21%	29.69%	25.55%	66.15%	3.18%	52.49%	33.62%	20.70%	11.52%	59.84%	26.82%	19.51%	29.22%	-19.15%	-85.71%	36.31%	17.78%	19.44%	3.79%	5.71%	63.75%
13	100	6	13.6	35.57%	17.42%	28.83%	24.72%	65.04%	2.49%	51.48%	32.74%	19.90%	10.77%	58.78%	25.97%	18.72%	28.36%	-19.69%	-85.81%	35.40%	16.99%	18.64%	3.10%	5.01%	62.66%
14	100	6	13	35.24%	16.03%	28.12%	22.89%	64.38%	-6.23%	51.00%	31.26%	19.75%	10.56%	58.11%	24.55%	14.82%	28.06%	-11.83%	#¡DIV/0!	33.80%	16.48%	17.85%	4.81%	2.08%	61.85%
15	100	6	12.3	33.51%	14.90%	26.06%	21.17%	62.44%	-16.42%	49.21%	29.07%	18.48%	8.39%	56.00%	25.13%	11.93%	26.30%	-21.42%	#¡DIV/0!	32.92%	13.86%	16.09%	0.88%	3.98%	59.89%
16	100	6	11.4	31.68%	13.66%	23.94%	19.09%	60.04%	-4.46%	47.05%	27.41%	16.37%	7.23%	53.99%	20.42%	9.67%	23.99%	-15.79%	#¡DIV/0!	30.59%	12.08%	13.92%	2.97%	-0.16%	57.91%
17	100	6	10.7	30.18%	11.91%	23.06%	19.84%	59.41%	-15.58%	46.22%	26.22%	16.39%	2.64%	53.35%	21.25%	13.05%	22.67%	-0.78%	#¡DIV/0!	29.58%	13.78%	12.90%	0.56%	-4.11%	56.88%
18	100	6	10.2	29.60%	12.21%	24.35%	19.85%	59.16%	-22.61%	46.10%	26.43%	16.98%	2.64%	53.35%	22.55%	8.14%	22.96%	-31.79%	#¡DIV/0!	29.39%	11.42%	14.31%	-2.70%	1.09%	57.20%
19	100	6	10	28.04%	10.74%	23.08%	18.16%	57.62%	10.98%	45.00%	25.02%	14.60%	2.81%	51.87%	20.25%	8.09%	22.12%	-34.78%	#¡DIV/0!	28.28%	9.00%	12.65%	-1.50%	1.73%	55.97%
20	100	6	9.8	27.97%	9.29%	20.38%	16.49%	56.98%	5.99%	43.96%	23.63%	13.66%	3.10%	50.45%	17.95%	8.15%	21.34%	-16.95%	#¡DIV/0!	27.23%	9.18%	11.00%	-0.05%	-2.84%	54.60%
21	100	6	9.1	25.31%	9.12%	20.08%	15.74%	55.84%	-8.28%	42.52%	22.64%	12.81%	4.96%	49.68%	18.01%	3.44%	19.49%	-28.14%	#¡DIV/0!	25.83%	7.60%	10.03%	-1.15%	-0.16%	53.46%
22	100	6	7.1	20.71%	7.88%	14.35%	5.62%	50.05%	11.60%	37.71%	16.17%	8.54%	-1.32%	44.31%	14.88%	-0.36%	14.99%	-34.42%	#¡DIV/0!	20.11%	2.46%	5.19%	-6.45%	-11.65%	47.58%
23	100	6	5.9	18.34%	-0.11%	10.70%	10.02%	47.02%	-22.50%	34.24%	13.81%	4.55%	-5.77%	40.78%	6.37%	-7.74%	12.62%	-8.91%	#¡DIV/0!	15.18%	2.28%	2.27%	-16.47%	-3.58%	44.03%
24	100	6	5.5	14.28%	-7.15%	7.33%	2.27%	42.89%	-33.96%	29.87%	8.61%	2.28%	-8.24%	36.17%	13.29%	1.07%	6.92%	-61.19%	#¡DIV/0!	14.50%	-7.04%	-0.98%	-0.36%	-17.84%	39.68%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	100	6	7.8	22.14%	9.16%	14.92%	8.78%	52.21%	34.09%	39.10%	18.57%	7.84%	0.33%	46.15%	10.42%	2.62%	15.14%	-21.20%	#¡DIV/0!	21.31%	4.87%	7.90%	-8.03%	-10.17%	49.10%
2	100	6	7.6	24.44%	5.36%	17.32%	16.05%	53.20%	-35.29%	40.44%	19.59%	10.47%	-3.16%	47.39%	15.85%	6.67%	16.43%	-23.94%	#¡DIV/0!	24.30%	5.12%	6.75%	-2.36%	-6.07%	51.01%
3	100	6	7.5	22.30%	7.28%	17.69%	6.34%	50.34%	24.85%	38.66%	18.01%	8.78%	1.20%	45.42%	11.75%	2.89%	15.99%	46.74%	#¡DIV/0!	21.77%	5.46%	5.61%	-5.81%	-9.39%	49.35%
4	100	6	7.6	24.44%	5.36%	17.32%	16.05%	53.20%	-35.29%	40.44%	19.59%	10.47%	-3.16%	47.39%	15.85%	6.67%	16.43%	-23.94%	#¡DIV/0!	24.30%	5.12%	6.75%	-2.36%	-6.07%	51.01%
5	100	6	7.9	24.28%	2.26%	18.99%	12.63%	52.59%	38.84%	40.18%	20.19%	9.56%	3.88%	47.12%	14.33%	-0.83%	17.44%	-18.41%	#¡DIV/0!	23.81%	4.71%	6.52%	-4.78%	-6.99%	50.83%
6	100	6	8.9	25.74%	7.88%	19.12%	14.25%	53.81%	-12.81%	41.30%	21.52%	12.19%	-0.23%	48.65%	15.80%	3.79%	17.64%	2.47%	#¡DIV/0!	25.11%	8.30%	8.54%	-6.03%	-5.09%	51.99%
7	100	6	10.9	30.61%	13.48%	24.50%	18.42%	60.44%	32.07%	47.11%	27.78%	16.28%	7.05%	54.43%	20.84%	8.85%	23.71%	-22.39%	#¡DIV/0!	30.86%	11.56%	14.66%	-0.36%	0.01%	58.17%
8	100	6	13.6	36.48%	18.21%	29.69%	25.55%	66.15%	3.18%	52.49%	33.62%	20.70%	11.52%	59.84%	26.82%	19.51%	29.22%	-19.15%	-85.71%	36.31%	17.78%	19.44%	3.79%	5.71%	63.75%
9	100	6	17.7	42.57%	24.00%	35.29%	30.58%	71.87%	-0.36%	58.09%	39.56%	25.73%	16.98%	65.52%	31.74%	24.55%	34.91%	-8.91%	-75.85%	41.82%	23.77%	23.71%	11.96%	10.44%	69.17%
10	100	6	19.4	44.56%	25.85%	37.64%	32.20%	73.74%	4.76%	60.15%	41.52%	27.92%	18.15%	67.39%	33.75%	26.47%	37.27%	-1.50%	#¡DIV/0!	44.12%	25.52%	25.68%	14.96%	10.59%	71.19%
11	100	6	20.1	44.78%	26.25%	38.31%	33.02%	74.16%	-0.23%	60.54%	42.00%	28.60%	19.65%	67.70%	34.93%	26.58%	37.90%	-4.06%	-68.91%	44.83%	25.57%	26.59%	12.90%	11.71%	71.62%
12	100	6	20.5	44.78%	25.99%	37.64%	32.94%	73.55%	3.18%	59.97%	41.95%	28.17%	18.85%	67.10%	33.69%	25.94%	37.77%	-0.78%	-67.85%	44.19%	25.70%	26.07%	13.00%	12.32%	71.05%
13	100	6	20.4	44.69%	26.26%	38.03%	33.17%	74.27%	2.49%	60.52%	42.06%	28.59%	18.06%	67.77%	34.68%	26.71%	37.57%	-1.44%	#¡DIV/0!	44.67%	26.49%	26.27%	14.08%	11.57%	71.46%
14	100	6	19.5	44.14%	24.32%	37.65%	33.13%	73.15%	-6.23%	59.66%	41.07%	27.88%	18.98%	66.82%	33.65%	25.59%	37.05%	-0.81%	-70.78%	43.55%	25.51%	25.42%	13.70%	11.36%	70.75%
15	100	6	18.4	43.05%	23.76%	36.36%	30.76%	72.17%	7.45%	58.67%	39.95%	26.33%	18.01%	65.86%	32.35%	23.98%	35.76%	-1.77%	#¡DIV/0!	42.71%	24.09%	24.07%	13.49%	9.18%	69.66%
16	100	6	17	41.87%	23.14%	34.50%	30.79%	71.41%	-7.87%	57.71%	38.47%	26.03%	16.16%	64.83%	31.45%	21.21%	34.86%	-5.26%	#¡DIV/0!	41.24%	22.68%	23.69%	10.57%	8.00%	68.67%
17	100	6	16	40.21%	20.73%	32.96%	29.43%	69.33%	-5.03%	55.69%	37.02%	24.12%	15.47%	62.82%	30.34%	19.71%	32.89%	-16.29%	#¡DIV/0!	40.03%	20.33%	22.07%	10.23%	7.88%	66.95%
18	100	6	15.3	39.07%	22.41%	32.37%	27.12%	69.01%	4.47%	55.31%	36.37%	23.42%	12.91%	62.66%	28.02%	21.66%	32.15%	2.32%	-81.92%	38.75%	21.21%	20.51%	9.46%	8.31%	66.35%
19	100	6	15	37.91%	20.69%	31.50%	25.11%	67.45%	-0.12%	54.06%	34.65%	22.85%	12.97%	61.10%	28.51%	18.90%	31.02%	-2.18%	#¡DIV/0!	37.93%	19.84%	19.38%	10.81%	3.55%	65.05%
20	100	6	14.7	36.81%	18.98%	29.95%	25.00%	65.95%	-4.61%	52.63%	33.41%	21.63%	13.15%	59.60%	27.52%	16.14%	29.95%	-6.57%	#¡DIV/0!	36.57%	18.49%	19.20%	5.83%	3.84%	63.71%
21	100	6	13.6	36.48%	18.21%	29.69%	25.55%	66.15%	3.18%	52.49%	33.62%	20.70%	11.52%	59.84%	26.82%	19.51%	29.22%	-19.15%	-85.71%	36.31%	17.78%	19.44%	3.79%	5.71%	63.75%
22	100	6	10.6	30.36%	14.22%	24.59%	18.82%	60.99%	25.55%	47.69%	27.47%	16.68%	6.19%	54.50%	20.22%	12.09%	24.83%	-1.63%	-91.31%	30.62%	12.82%	13.48%	-0.30%	-0.60%	58.28%
23	100	6	8.9	25.74%	7.88%	19.12%	14.25%	53.81%	-12.81%	41.30%	21.52%	12.19%	-0.23%	48.65%	15.80%	3.79%	17.64%	2.47%	#¡DIV/0!	25.11%	8.30%	8.54%	-6.03%	-5.09%	51.99%
24	100	6	8.2	22.44%	9.43%	18.70%	10.05%	52.41%	48.58%	40.26%	19.79%	9.01%	3.23%	47.22%	13.29%	6.13%	16.95%	-12.69%	-94.86%	22.03%	8.19%	6.56%	-6.59%	-0.47%	50.71%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	100	8	2.6	-16.93%	-53.07%	43.74%	-45.76%	-1.30%	#¡DIV/0!	-6.53%	-15.60%	-31.78%	#¡DIV/0!	8.05%	-29.48%	-65.75%	-41.83%	#¡DIV/0!	#¡DIV/0!	0.85%	-34.85%	2.93%	-76.63%	#¡DIV/0!	3.08%
2	100	8	2.5	-19.82%	#¡DIV/0!	-30.63%	-47.65%	19.09%	#¡DIV/0!	5.25%	-18.54%	-34.15%	#¡DIV/0!	4.29%	-31.94%	-66.94%	-15.78%	#¡DIV/0!	#¡DIV/0!	-2.66%	-37.12%	-0.65%	-77.45%	#¡DIV/0!	6.36%
3	100	8	2.5	-22.66%	#¡DIV/0!	-33.09%	-49.50%	14.87%	#¡DIV/0!	1.53%	-21.42%	-36.48%	#¡DIV/0!	0.60%	-34.35%	-68.11%	-18.76%	#¡DIV/0!	#¡DIV/0!	-6.10%	-39.34%	-4.16%	-78.24%	#¡DIV/0!	2.59%
4	100	8	2.5	-19.82%	#¡DIV/0!	-30.63%	-47.65%	19.09%	#¡DIV/0!	5.25%	-18.54%	-34.15%	#¡DIV/0!	4.29%	-31.94%	-66.94%	-15.78%	#¡DIV/0!	#¡DIV/0!	-2.66%	-37.12%	-0.65%	-77.45%	#¡DIV/0!	6.36%
5	100	8	2.6	-13.99%	-51.41%	48.83%	-43.84%	2.20%	#¡DIV/0!	-3.22%	-12.62%	-29.36%	#¡DIV/0!	11.87%	-26.99%	-64.53%	-39.77%	#¡DIV/0!	#¡DIV/0!	4.42%	-32.54%	6.58%	-75.81%	#¡DIV/0!	6.73%
6	100	8	3	8.02%	-38.98%	-37.69%	-29.47%	28.35%	#¡DIV/0!	6.35%	-17.69%	-11.28%	-61.46%	17.09%	-8.30%	-55.46%	-24.35%	#¡DIV/0!	#¡DIV/0!	-12.57%	-15.28%	-33.07%	-69.61%	#¡DIV/0!	1.35%
7	100	8	3.6	9.08%	-7.56%	-29.21%	-46.58%	21.52%	#¡DIV/0!	7.40%	-16.88%	-10.41%	-41.62%	18.24%	38.90%	-32.53%	-14.06%	#¡DIV/0!	#¡DIV/0!	-20.54%	28.33%	-32.41%	-53.97%	-47.01%	12.40%
8	100	8	4.5	-14.78%	-27.79%	-11.52%	66.93%	38.09%	-90.99%	18.46%	-13.41%	4.99%	-54.39%	27.90%	8.52%	5.43%	-10.48%	#¡DIV/0!	#¡DIV/0!	-11.31%	0.26%	-20.80%	-28.08%	-17.20%	15.71%
9	100	8	5.9	-3.98%	-18.64%	-6.54%	-5.96%	35.11%	#¡DIV/0!	21.55%	-5.93%	-11.28%	-22.92%	27.73%	-8.30%	-10.91%	-9.22%	#¡DIV/0!	#¡DIV/0!	4.92%	-15.28%	-23.51%	21.55%	-30.03%	19.58%
10	100	8	6.5	-5.61%	-2.24%	-10.16%	-15.26%	40.20%	#¡DIV/0!	23.92%	-6.91%	-14.72%	-7.39%	29.86%	-11.86%	-28.64%	-9.11%	#¡DIV/0!	#¡DIV/0!	5.05%	-18.56%	-19.58%	-26.98%	-15.93%	20.31%
11	100	8	6.7	11.25%	-21.44%	-12.50%	-9.21%	37.69%	-80.39%	21.70%	-5.81%	-8.63%	-0.77%	29.20%	18.05%	-23.54%	-2.62%	-75.79%	#¡DIV/0!	-3.52%	-12.75%	-13.84%	-21.76%	-9.93%	22.27%
12	100	8	6.8	-4.12%	8.32%	-0.46%	-6.10%	36.71%	-79.72%	22.46%	-2.59%	-5.51%	-31.59%	33.61%	-2.33%	-20.93%	-7.03%	#¡DIV/0!	#¡DIV/0!	-0.23%	-9.77%	-10.90%	-46.06%	-6.85%	22.94%
13	100	8	6.8	-4.76%	7.60%	-1.12%	-6.73%	35.80%	-79.86%	21.64%	-3.24%	-6.14%	-32.04%	32.73%	-2.98%	-21.45%	-7.65%	#¡DIV/0!	#¡DIV/0!	-0.89%	-10.37%	-11.49%	-46.42%	-7.47%	22.12%
14	100	8	6.5	-4.94%	-1.55%	-9.53%	-14.66%	41.19%	#¡DIV/0!	24.79%	-6.26%	-14.12%	-6.73%	30.78%	-11.24%	-28.14%	-8.47%	#¡DIV/0!	#¡DIV/0!	5.79%	-17.99%	-19.02%	-26.46%	-15.34%	21.16%
15	100	8	6.1	3.55%	-12.26%	-10.41%	1.41%	31.82%	-83.57%	18.39%	-5.32%	-4.33%	-16.88%	26.27%	-1.11%	-3.93%	-2.11%	#¡DIV/0!	#¡DIV/0!	-5.71%	-8.64%	-17.52%	31.08%	-49.70%	21.94%
16	100	8	5.7	-0.13%	-24.78%	-13.59%	-13.06%	31.85%	#¡DIV/0!	16.54%	-6.34%	-17.98%	-28.74%	23.72%	-15.22%	-17.63%	-6.75%	#¡DIV/0!	#¡DIV/0!	-3.00%	-21.67%	-17.50%	-43.81%	29.38%	18.21%
17	100	8	5.3	0.85%	-0.30%	-12.74%	-23.18%	31.07%	#¡DIV/0!	20.88%	-10.34%	-17.17%	25.94%	27.54%	-0.12%	-27.22%	-7.30%	#¡DIV/0!	#¡DIV/0!	-4.76%	-7.72%	-27.10%	-0.70%	-42.84%	19.11%
18	100	8	5.1	-7.55%	-8.60%	-6.68%	-29.58%	28.16%	#¡DIV/0!	15.85%	-10.34%	-11.41%	-42.28%	23.79%	-8.44%	33.43%	-15.02%	#¡DIV/0!	#¡DIV/0!	-1.78%	-15.40%	-19.81%	-8.98%	-47.60%	17.43%
19	100	8	5	3.12%	-12.62%	-10.78%	-32.67%	31.28%	#¡DIV/0!	16.03%	-5.71%	-15.31%	10.37%	25.75%	-12.46%	-36.22%	-7.15%	#¡DIV/0!	#¡DIV/0!	-6.10%	-19.12%	-23.33%	-12.98%	-49.91%	15.54%
20	100	8	4.9	-15.58%	-16.55%	-14.79%	-3.55%	35.03%	#¡DIV/0!	16.36%	-9.94%	-19.11%	5.41%	28.10%	-16.40%	-39.08%	-22.41%	#¡DIV/0!	#¡DIV/0!	2.49%	-22.76%	-26.78%	-16.89%	-4.31%	14.81%
21	100	8	4.5	-14.78%	-27.79%	-11.52%	66.93%	38.09%	-90.99%	18.46%	-13.41%	4.99%	-54.39%	27.90%	8.52%	5.43%	-10.48%	#¡DIV/0!	#¡DIV/0!	-11.31%	0.26%	-20.80%	-28.08%	-17.20%	15.71%
22	100	8	3.5	-22.23%	-12.13%	-10.28%	1.56%	32.02%	#¡DIV/0!	11.38%	-5.18%	-14.83%	-44.50%	26.45%	-33.98%	-35.86%	-18.30%	#¡DIV/0!	#¡DIV/0!	-5.57%	-39.00%	-3.62%	-56.24%	-49.62%	10.81%
23	100	8	3	8.02%	-38.98%	-37.69%	-29.47%	28.35%	#¡DIV/0!	6.35%	-17.69%	-11.28%	-61.46%	17.09%	-8.30%	-55.46%	-24.35%	#¡DIV/0!	#¡DIV/0!	-12.57%	-15.28%	-33.07%	-69.61%	#¡DIV/0!	1.35%
24	100	8	2.7	-7.96%	-48.01%	-20.37%	-39.91%	9.36%	#¡DIV/0!	3.57%	-29.86%	-24.41%	#¡DIV/0!	-0.23%	-21.87%	-62.05%	-3.31%	#¡DIV/0!	#¡DIV/0!	-25.50%	-27.81%	14.05%	-74.11%	#¡DIV/0!	7.29%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	100	8	5.2	-5.07%	-6.15%	-17.86%	-27.69%	31.60%	#¡DIV/0!	13.79%	-7.93%	-9.04%	-40.73%	20.05%	-5.98%	-31.49%	-0.28%	#¡DIV/0!	#¡DIV/0!	-10.35%	-13.13%	-17.65%	-53.27%	7.61%	16.20%
2	100	8	5.1	-8.37%	-9.41%	-7.51%	-30.20%	27.03%	#¡DIV/0!	14.82%	-11.13%	-12.20%	-42.79%	22.69%	-9.25%	32.25%	-15.78%	#¡DIV/0!	#¡DIV/0!	-2.66%	-16.16%	-20.52%	-9.78%	-48.07%	16.39%
3	100	8	5	3.12%	-12.62%	-10.78%	-32.67%	31.28%	#¡DIV/0!	16.03%	-5.71%	-15.31%	10.37%	25.75%	-12.46%	-36.22%	-7.15%	#¡DIV/0!	#¡DIV/0!	-6.10%	-19.12%	-23.33%	-12.98%	-49.91%	15.54%
4	100	8	5.1	-8.37%	-9.41%	-7.51%	-30.20%	27.03%	#¡DIV/0!	14.82%	-11.13%	-12.20%	-42.79%	22.69%	-9.25%	32.25%	-15.78%	#¡DIV/0!	#¡DIV/0!	-2.66%	-16.16%	-20.52%	-9.78%	-48.07%	16.39%
5	100	8	5.3	-1.71%	-2.83%	-14.96%	-25.13%	27.74%	#¡DIV/0!	17.82%	-12.62%	-19.27%	22.74%	24.30%	-2.65%	-29.07%	-9.65%	#¡DIV/0!	#¡DIV/0!	-7.18%	-10.06%	-28.95%	-3.22%	-44.29%	16.09%
6	100	8	5.9	-3.98%	-18.64%	-6.54%	-5.96%	35.11%	#¡DIV/0!	21.55%	-5.93%	-11.28%	-22.92%	27.73%	-8.30%	-10.91%	-9.22%	#¡DIV/0!	#¡DIV/0!	4.92%	-15.28%	-23.51%	21.55%	-30.03%	19.58%
7	100	8	7.3	0.69%	-7.56%	-5.62%	-14.53%	38.88%	#¡DIV/0!	22.74%	-0.25%	-10.41%	-22.16%	33.02%	-7.40%	-10.03%	-8.33%	#¡DIV/0!	#¡DIV/0!	5.95%	-14.44%	-18.90%	-7.94%	-29.34%	22.82%
8	100	8	9.1	7.65%	-17.47%	-1.69%	-4.61%	44.66%	#¡DIV/0!	27.86%	3.91%	-6.67%	-8.78%	35.74%	-3.54%	-15.66%	2.31%	#¡DIV/0!	#¡DIV/0!	7.97%	-10.88%	-15.52%	-4.11%	-17.20%	28.15%
9	100	8	11.8	15.22%	-11.24%	3.13%	2.59%	48.81%	-39.07%	33.46%	7.51%	1.39%	-11.91%	42.28%	12.86%	-10.91%	3.74%	-24.78%	#¡DIV/0!	13.43%	-3.18%	-6.88%	-18.97%	-6.71%	34.32%
10	100	8	13	15.37%	-9.76%	2.67%	4.30%	50.46%	-26.79%	34.07%	9.13%	0.33%	-7.39%	43.68%	10.18%	-4.85%	3.88%	-9.62%	#¡DIV/0!	14.60%	-4.19%	-4.69%	-16.55%	-15.93%	34.94%
11	100	8	13.4	17.10%	-3.32%	4.06%	3.76%	51.94%	-21.56%	35.85%	11.18%	1.52%	-11.80%	44.70%	11.10%	1.94%	6.24%	-51.58%	#¡DIV/0!	14.95%	-3.05%	-1.53%	-10.59%	-19.94%	36.73%
12	100	8	13.6	18.00%	-7.15%	4.78%	7.31%	53.60%	-18.88%	37.30%	11.33%	2.15%	-8.78%	46.71%	14.90%	5.43%	7.43%	-49.93%	#¡DIV/0!	16.40%	-5.02%	-1.68%	-7.53%	-17.20%	37.45%
13	100	8	13.6	17.21%	-7.77%	4.08%	6.60%	52.58%	-19.42%	36.39%	10.59%	1.47%	-9.39%	45.74%	14.14%	4.73%	6.71%	-50.26%	#¡DIV/0!	15.63%	-5.65%	-2.33%	-8.15%	-17.75%	36.53%
14	100	8	13	16.18%	-9.12%	3.39%	5.03%	51.52%	-26.28%	35.02%	9.90%	1.03%	-6.73%	44.69%	10.95%	-4.18%	4.61%	-8.98%	#¡DIV/0!	15.41%	-3.52%	-4.02%	-15.96%	-15.34%	35.89%
15	100	8	12.3	12.96%	-4.28%	4.04%	1.41%	49.64%	-34.29%	34.68%	7.19%	-1.24%	-5.00%	42.61%	5.48%	-3.93%	5.83%	-18.88%	#¡DIV/0!	13.14%	-8.64%	-3.77%	-12.62%	-24.55%	34.02%
16	100	8	11.4	10.20%	-9.73%	2.41%	4.33%	48.34%	-43.67%	32.49%	5.88%	-2.79%	-4.98%	40.44%	4.34%	-5.87%	4.91%	-30.45%	#¡DIV/0!	10.86%	-10.48%	-5.71%	-10.10%	-26.07%	32.19%
17	100	8	10.7	8.61%	-0.30%	1.80%	-7.81%	44.63%	#¡DIV/0!	30.84%	4.97%	-3.36%	-16.04%	39.13%	-0.12%	-2.96%	2.29%	#¡DIV/0!	#¡DIV/0!	10.60%	-7.72%	-7.92%	-20.56%	-23.79%	31.51%
18	100	8	10.2	7.86%	-8.60%	1.81%	5.64%	47.88%	-54.37%	32.40%	3.82%	-3.36%	-7.64%	40.30%	9.88%	-11.04%	0.71%	-43.67%	#¡DIV/0!	12.25%	-7.71%	-5.65%	-27.18%	-16.16%	31.37%
19	100	8	10	7.60%	-0.14%	1.97%	-10.23%	44.15%	#¡DIV/0!	29.96%	4.77%	-3.21%	-11.70%	38.75%	5.05%	-14.95%	-0.01%	-46.14%	#¡DIV/0!	11.29%	-11.77%	-9.80%	-12.98%	-19.85%	30.42%
20	100	8	9.8	7.44%	-4.62%	-2.62%	-3.55%	46.28%	-58.34%	29.29%	2.92%	-2.94%	-15.67%	37.25%	11.47%	-2.53%	-0.68%	-48.56%	#¡DIV/0!	10.37%	-7.31%	-8.47%	-16.89%	-23.45%	29.16%
21	100	8	9.1	7.65%	-17.47%	-1.69%	-4.61%	44.66%	#¡DIV/0!	27.86%	3.91%	-6.67%	-8.78%	35.74%	-3.54%	-15.66%	2.31%	#¡DIV/0!	#¡DIV/0!	7.97%	-10.88%	-15.52%	-4.11%	-17.20%	28.15%
22	100	8	7.1	3.70%	-12.13%	-10.28%	-18.75%	42.17%	#¡DIV/0!	25.66%	-5.18%	-7.09%	-26.00%	34.88%	5.64%	-14.48%	-6.63%	-72.92%	#¡DIV/0!	0.72%	-18.67%	-14.33%	-12.49%	-32.83%	22.74%
23	100	8	5.9	-3.98%	-18.64%	-6.54%	-5.96%	35.11%	#¡DIV/0!	21.55%	-5.93%	-11.28%	-22.92%	27.73%	-8.30%	-10.91%	-9.22%	#¡DIV/0!	#¡DIV/0!	4.92%	-15.28%	-23.51%	21.55%	-30.03%	19.58%
24	100	8	5.5	-7.96%	3.99%	-8.99%	-19.87%	28.66%	#¡DIV/0!	15.99%	-6.48%	-13.61%	-34.32%	26.02%	-21.87%	-24.09%	-14.06%	#¡DIV/0!	#¡DIV/0!	-0.67%	-27.81%	-23.96%	3.57%	-40.38%	16.09%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	100	8	7.8	6.80%	-15.53%	-7.60%	-2.38%	38.80%	-73.64%	22.68%	-0.92%	-5.54%	-33.32%	31.41%	5.77%	2.76%	-1.83%	-67.46%	#¡DIV/0!	0.85%	-16.24%	-7.36%	-29.90%	-19.29%	24.50%
2	100	8	7.6	3.09%	1.91%	-3.95%	-5.77%	38.29%	-74.56%	23.56%	-0.02%	-1.22%	-35.64%	34.08%	2.09%	-0.81%	-5.25%	#¡DIV/0!	#¡DIV/0!	3.07%	-5.67%	-10.58%	-32.34%	-22.10%	26.18%
3	100	8	7.5	7.09%	-21.36%	-7.35%	-9.11%	37.85%	#¡DIV/0!	24.60%	-3.56%	-4.72%	-17.22%	33.14%	-1.52%	-28.24%	-8.60%	#¡DIV/0!	#¡DIV/0!	5.64%	-9.01%	-13.75%	-34.73%	-24.86%	24.54%
4	100	8	7.6	3.09%	1.91%	-3.95%	-5.77%	38.29%	-74.56%	23.56%	-0.02%	-1.22%	-35.64%	34.08%	2.09%	-0.81%	-5.25%	#¡DIV/0!	#¡DIV/0!	3.07%	-5.67%	-10.58%	-32.34%	-22.10%	26.18%
5	100	8	7.9	3.21%	-12.54%	-4.33%	-15.77%	43.71%	#¡DIV/0!	27.02%	-1.69%	-9.18%	-7.94%	36.06%	9.52%	-20.20%	-4.34%	-66.31%	#¡DIV/0!	4.42%	-13.27%	-12.80%	-27.42%	-16.44%	25.64%
6	100	8	8.9	8.02%	-8.47%	-6.54%	-9.32%	44.40%	#¡DIV/0!	27.62%	2.18%	-6.06%	-30.63%	37.45%	3.16%	0.22%	-2.74%	-57.69%	#¡DIV/0!	7.30%	-15.28%	-13.95%	-8.84%	-21.29%	26.77%
7	100	8	10.9	9.08%	-7.56%	1.93%	6.84%	48.29%	-48.08%	31.81%	6.87%	-3.24%	-12.43%	40.85%	4.18%	1.21%	3.13%	-35.91%	#¡DIV/0!	11.75%	-11.15%	-3.96%	-17.15%	-20.51%	32.36%
8	100	8	13.6	12.24%	-13.34%	2.10%	7.31%	47.00%	-59.44%	31.33%	6.27%	-0.53%	-8.78%	39.86%	8.52%	-5.11%	2.86%	0.15%	#¡DIV/0!	11.75%	-5.02%	-8.02%	-7.53%	-17.20%	32.12%
9	100	8	17.7	21.52%	-0.15%	12.15%	10.39%	58.24%	-31.46%	42.46%	16.21%	6.46%	-0.90%	51.44%	17.90%	0.22%	11.92%	-43.58%	#¡DIV/0!	21.06%	1.66%	2.53%	-8.84%	-10.04%	42.61%
10	100	8	19.4	22.96%	1.52%	13.88%	12.99%	59.54%	-17.64%	43.76%	18.68%	8.10%	-1.94%	52.70%	16.66%	7.04%	14.15%	-32.21%	#¡DIV/0!	23.32%	1.80%	5.27%	-6.11%	-10.99%	44.61%
11	100	8	20.1	23.61%	4.74%	12.50%	12.71%	60.77%	-41.17%	44.44%	18.29%	9.64%	-5.99%	53.57%	21.42%	8.65%	13.09%	-27.37%	#¡DIV/0!	25.32%	3.32%	3.39%	-6.12%	-9.93%	45.02%
12	100	8	20.5	23.27%	0.85%	13.40%	12.68%	60.20%	-8.74%	44.10%	18.65%	7.65%	2.62%	53.05%	18.78%	6.75%	14.50%	-24.89%	#¡DIV/0!	23.25%	4.12%	3.48%	-2.91%	-11.75%	44.53%
13	100	8	20.4	23.92%	0.18%	14.09%	11.93%	59.97%	-9.35%	44.16%	18.75%	8.30%	1.94%	52.72%	17.99%	6.04%	14.94%	11.91%	#¡DIV/0!	23.64%	6.15%	2.79%	-3.55%	-7.47%	44.94%
14	100	8	19.5	23.82%	2.23%	11.54%	9.72%	59.74%	-17.06%	43.10%	18.53%	7.35%	-1.25%	52.25%	17.48%	7.80%	13.63%	2.39%	#¡DIV/0!	22.86%	5.44%	2.29%	-5.45%	-10.36%	44.23%
15	100	8	18.4	21.55%	3.00%	11.64%	9.52%	58.69%	-26.08%	42.38%	17.27%	7.63%	-6.49%	51.52%	18.67%	8.08%	12.95%	-39.16%	#¡DIV/0!	21.23%	2.78%	3.93%	-9.26%	-9.46%	43.14%
16	100	8	17	21.88%	-3.28%	11.10%	11.78%	57.06%	-36.63%	41.59%	15.36%	7.38%	-8.37%	50.86%	17.39%	5.90%	11.08%	-21.76%	#¡DIV/0!	21.25%	0.71%	1.25%	-8.06%	-10.43%	42.15%
17	100	8	16	19.88%	-0.30%	9.95%	3.71%	54.70%	11.99%	39.79%	13.92%	4.37%	-5.55%	48.64%	12.37%	0.77%	9.41%	38.26%	#¡DIV/0!	20.53%	-0.34%	-1.58%	-10.63%	-6.47%	40.63%
18	100	8	15.3	18.87%	-3.23%	9.55%	5.64%	54.48%	2.67%	39.02%	13.80%	3.99%	-5.54%	47.97%	12.37%	0.07%	9.26%	26.75%	#¡DIV/0!	19.86%	-0.69%	-2.47%	-8.98%	-14.26%	40.04%
19	100	8	15	18.48%	-1.70%	7.06%	6.93%	53.16%	-50.92%	37.93%	11.66%	3.94%	-0.66%	46.03%	18.18%	-4.32%	8.32%	-39.41%	#¡DIV/0!	18.61%	-0.74%	-1.43%	-12.98%	-9.83%	38.92%
20	100	8	14.7	18.18%	-6.11%	7.01%	8.51%	51.90%	-53.13%	36.89%	11.03%	4.00%	-13.75%	45.33%	12.87%	-0.32%	7.43%	15.73%	#¡DIV/0!	17.40%	-0.69%	-3.09%	-16.89%	-13.88%	37.68%
21	100	8	13.6	18.00%	-7.15%	4.78%	7.31%	53.60%	-18.88%	37.30%	11.33%	2.15%	-8.78%	46.71%	14.90%	5.43%	7.43%	-49.93%	#¡DIV/0!	16.40%	-5.02%	-1.68%	-7.53%	-17.20%	37.45%
22	100	8	10.6	7.69%	-1.14%	5.33%	1.56%	45.92%	-50.65%	31.27%	6.68%	-0.02%	-16.75%	40.07%	8.04%	-3.79%	1.42%	-39.07%	#¡DIV/0!	13.31%	-8.50%	-8.70%	-1.55%	-24.44%	32.65%
23	100	8	8.9	8.02%	-8.47%	-6.54%	-9.32%	44.40%	#¡DIV/0!	27.62%	2.18%	-6.06%	-30.63%	37.45%	3.16%	0.22%	-2.74%	-57.69%	#¡DIV/0!	7.30%	-15.28%	-13.95%	-8.84%	-21.29%	26.77%
24	100	8	8.2	3.55%	-22.01%	-4.44%	8.17%	40.61%	-70.80%	25.47%	-2.89%	-2.81%	-26.11%	31.40%	0.46%	-14.60%	-3.31%	#¡DIV/0!	#¡DIV/0!	5.87%	-7.19%	-14.46%	-22.33%	-10.57%	25.95%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	300	4	2.6	15.43%	3.72%	13.84%	5.83%	27.00%	-19.32%	22.04%	11.31%	5.32%	-7.67%	24.07%	-0.21%	-8.09%	11.96%	-26.65%	-84.26%	12.46%	0.78%	5.01%	-12.76%	-10.13%	46.12%
2	300	4	2.5	19.75%	7.66%	17.36%	7.83%	31.91%	-2.66%	26.42%	15.38%	8.91%	-6.19%	28.80%	2.74%	-4.28%	15.39%	-15.05%	#¡DIV/0!	17.09%	3.94%	7.93%	-7.08%	-8.16%	51.53%
3	300	4	2.5	15.52%	3.85%	13.21%	4.01%	27.24%	-6.11%	21.94%	11.29%	5.06%	-9.51%	24.24%	-0.89%	-7.67%	11.31%	-18.05%	#¡DIV/0!	12.94%	0.26%	4.11%	-10.37%	-11.41%	46.16%
4	300	4	2.5	19.75%	7.66%	17.36%	7.83%	31.91%	-2.66%	26.42%	15.38%	8.91%	-6.19%	28.80%	2.74%	-4.28%	15.39%	-15.05%	#¡DIV/0!	17.09%	3.94%	7.93%	-7.08%	-8.16%	51.53%
5	300	4	2.6	19.52%	7.39%	17.87%	9.58%	31.49%	-16.47%	26.36%	15.25%	9.04%	-4.41%	28.46%	3.33%	-4.83%	15.92%	-24.06%	-83.71%	16.44%	4.35%	8.73%	-9.67%	-6.95%	51.29%
6	300	4	3	15.69%	5.31%	14.50%	6.01%	27.44%	-12.57%	22.41%	12.22%	6.26%	-9.39%	24.59%	0.06%	-7.54%	12.32%	-28.47%	#¡DIV/0!	13.22%	1.21%	5.40%	-9.24%	-8.54%	46.15%
7	300	4	3.6	26.06%	14.17%	24.85%	15.37%	38.68%	13.51%	33.27%	22.50%	15.73%	-0.35%	35.52%	9.40%	1.69%	22.60%	-21.19%	#¡DIV/0!	23.64%	10.61%	14.92%	-0.01%	-1.96%	58.31%
8	300	4	4.5	31.77%	18.93%	30.05%	21.35%	44.37%	12.87%	38.71%	28.12%	20.88%	5.25%	41.17%	14.96%	7.40%	27.71%	-20.32%	-51.57%	29.30%	15.77%	20.29%	4.79%	3.72%	63.85%
9	300	4	5.9	35.91%	24.00%	34.55%	25.51%	48.65%	10.43%	43.06%	32.39%	25.35%	9.77%	45.50%	19.50%	11.37%	32.14%	-11.96%	-18.15%	33.71%	20.27%	24.39%	9.19%	8.57%	67.59%
10	300	4	6.5	37.01%	25.25%	35.57%	26.52%	49.51%	9.62%	43.95%	33.52%	26.22%	10.97%	46.37%	20.23%	12.69%	33.19%	-11.28%	-50.83%	34.68%	21.31%	25.59%	9.74%	9.89%	68.17%
11	300	4	6.7	38.78%	26.88%	37.41%	28.24%	51.56%	12.55%	45.89%	35.34%	27.96%	12.92%	48.33%	22.19%	14.18%	35.08%	-10.70%	-47.32%	36.53%	22.99%	27.35%	11.28%	11.67%	70.30%
12	300	4	6.8	39.72%	27.94%	38.30%	28.94%	52.55%	16.40%	46.86%	36.29%	28.71%	13.67%	49.35%	22.86%	15.47%	35.94%	-10.37%	-45.51%	37.31%	24.01%	28.27%	12.40%	12.02%	71.32%
13	300	4	6.8	38.79%	27.09%	37.38%	28.08%	51.53%	15.62%	45.88%	35.38%	27.85%	12.91%	48.36%	22.04%	14.71%	35.03%	-10.96%	-45.88%	36.40%	23.18%	27.41%	11.66%	11.28%	70.18%
14	300	4	6.5	37.97%	26.13%	36.52%	27.41%	50.57%	10.39%	44.96%	34.46%	27.11%	11.75%	47.40%	21.08%	13.48%	34.12%	-10.65%	-50.48%	35.63%	22.17%	26.47%	10.51%	10.66%	69.35%
15	300	4	6.1	38.06%	25.61%	36.59%	27.69%	50.82%	13.14%	45.14%	34.52%	26.99%	11.98%	47.65%	21.03%	13.04%	34.12%	-11.84%	-11.73%	35.63%	22.15%	26.38%	11.06%	9.98%	69.87%
16	300	4	5.7	33.91%	22.02%	32.45%	23.45%	46.45%	7.77%	40.87%	30.40%	23.20%	8.30%	43.33%	17.23%	9.84%	29.97%	-11.82%	-62.16%	31.61%	18.51%	22.52%	6.56%	6.57%	65.20%
17	300	4	5.3	35.26%	22.54%	33.48%	24.44%	47.74%	14.28%	42.15%	31.46%	24.06%	8.98%	44.60%	18.00%	10.44%	31.08%	-10.95%	-33.13%	32.78%	19.30%	23.36%	7.85%	7.40%	67.08%
18	300	4	5.1	32.80%	21.21%	31.12%	22.39%	45.42%	4.76%	39.78%	29.23%	21.99%	7.36%	42.31%	16.26%	7.94%	28.80%	-14.29%	-38.70%	30.41%	17.33%	21.24%	5.58%	5.90%	64.47%
19	300	4	5	31.63%	19.66%	30.01%	20.79%	44.21%	7.31%	38.59%	27.97%	21.17%	5.80%	41.07%	15.46%	7.13%	27.73%	-18.05%	-41.40%	29.08%	16.18%	20.25%	5.02%	4.77%	63.12%
20	300	4	4.9	30.26%	18.80%	28.95%	19.87%	42.76%	10.37%	37.27%	26.91%	19.55%	5.09%	39.64%	13.58%	6.38%	26.71%	-17.62%	-44.03%	28.00%	14.59%	19.32%	3.44%	3.67%	61.74%
21	300	4	4.5	31.77%	18.93%	30.05%	21.35%	44.37%	12.87%	38.71%	28.12%	20.88%	5.25%	41.17%	14.96%	7.40%	27.71%	-20.32%	-51.57%	29.30%	15.77%	20.29%	4.79%	3.72%	63.85%
22	300	4	3.5	26.49%	14.13%	24.89%	15.27%	38.76%	7.91%	33.30%	22.66%	15.75%	0.23%	35.81%	9.72%	2.27%	22.30%	-25.08%	-70.53%	23.65%	10.68%	15.38%	-1.36%	-0.69%	58.49%
23	300	4	3	15.69%	5.31%	14.50%	6.01%	27.44%	-12.57%	22.41%	12.22%	6.26%	-9.39%	24.59%	0.06%	-7.54%	12.32%	-28.47%	#¡DIV/0!	13.22%	1.21%	5.40%	-9.24%	-8.54%	46.15%
24	300	4	2.7	18.87%	7.38%	17.88%	9.58%	31.81%	-10.61%	26.33%	15.39%	9.40%	-4.84%	28.79%	4.07%	-5.10%	15.50%	-30.34%	#¡DIV/0!	16.71%	3.70%	8.79%	-6.26%	-8.09%	51.05%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	300	4	5.2	31.68%	20.04%	29.99%	21.25%	44.14%	0.85%	38.58%	28.00%	21.00%	6.28%	41.00%	15.60%	7.67%	27.86%	-16.18%	-37.06%	29.10%	16.46%	20.16%	5.35%	4.36%	62.92%
2	300	4	5.1	31.62%	20.13%	29.96%	21.30%	44.13%	3.83%	38.54%	28.09%	20.91%	6.41%	41.05%	15.23%	6.98%	27.65%	-15.05%	-39.25%	29.25%	16.29%	20.17%	4.65%	4.96%	63.01%
3	300	4	5	31.63%	19.66%	30.01%	20.79%	44.21%	7.31%	38.59%	27.97%	21.17%	5.80%	41.07%	15.46%	7.13%	27.73%	-18.05%	-41.40%	29.08%	16.18%	20.25%	5.02%	4.77%	63.12%
4	300	4	5.1	31.62%	20.13%	29.96%	21.30%	44.13%	3.83%	38.54%	28.09%	20.91%	6.41%	41.05%	15.23%	6.98%	27.65%	-15.05%	-39.25%	29.25%	16.29%	20.17%	4.65%	4.96%	63.01%
5	300	4	5.3	31.82%	19.44%	30.10%	21.28%	43.99%	11.38%	38.54%	28.13%	20.91%	6.22%	40.93%	15.01%	7.64%	27.75%	-13.21%	-34.83%	29.42%	16.28%	20.23%	5.11%	4.68%	62.84%
6	300	4	5.9	35.91%	24.00%	34.55%	25.51%	48.65%	10.43%	43.06%	32.39%	25.35%	9.77%	45.50%	19.50%	11.37%	32.14%	-11.96%	-18.15%	33.71%	20.27%	24.39%	9.19%	8.57%	67.59%
7	300	4	7.3	39.79%	27.62%	38.21%	29.16%	52.32%	13.51%	46.66%	36.29%	28.91%	13.67%	49.11%	23.04%	15.54%	36.00%	-8.75%	-58.67%	37.32%	24.13%	28.24%	12.23%	12.30%	70.77%
8	300	4	9.1	45.90%	33.55%	44.48%	35.28%	58.54%	18.24%	52.82%	42.51%	34.65%	19.97%	55.32%	28.90%	21.14%	42.05%	-3.25%	-35.42%	43.54%	30.08%	34.18%	18.11%	17.84%	76.71%
9	300	4	11.8	53.01%	40.58%	51.54%	42.14%	65.71%	25.27%	59.85%	49.76%	41.47%	26.80%	62.42%	35.87%	28.33%	49.20%	2.88%	-34.52%	50.61%	37.10%	41.08%	24.92%	24.42%	83.29%
10	300	4	13	53.78%	41.57%	52.35%	43.08%	66.37%	26.06%	60.54%	50.65%	42.35%	27.88%	63.08%	36.82%	29.23%	50.08%	3.79%	-34.44%	51.46%	38.01%	42.01%	25.75%	25.59%	83.48%
11	300	4	13.4	55.83%	43.43%	54.38%	45.04%	68.48%	27.11%	62.61%	52.66%	44.25%	29.82%	65.18%	38.74%	31.09%	52.04%	5.24%	-39.79%	53.49%	39.91%	43.89%	27.61%	27.43%	85.64%
12	300	4	13.6	56.80%	44.41%	55.35%	45.94%	69.49%	28.44%	63.60%	53.63%	45.17%	30.65%	66.17%	39.64%	31.97%	53.05%	6.00%	-37.73%	54.43%	40.85%	44.81%	28.46%	28.39%	86.69%
13	300	4	13.6	55.76%	43.45%	54.32%	44.97%	68.36%	27.58%	62.51%	52.61%	44.20%	29.78%	65.06%	38.71%	31.09%	52.03%	5.30%	-38.14%	53.41%	39.92%	43.85%	27.61%	27.54%	85.45%
14	300	4	13	54.86%	42.56%	53.42%	44.09%	67.54%	26.94%	61.67%	51.71%	43.35%	28.78%	64.22%	37.78%	30.14%	51.13%	4.52%	-33.97%	52.53%	38.98%	43.01%	26.64%	26.47%	84.77%
15	300	4	12.3	52.87%	40.52%	51.39%	42.18%	65.46%	25.71%	59.63%	49.68%	41.41%	26.70%	62.17%	35.70%	28.31%	49.12%	3.94%	-41.16%	50.51%	37.05%	40.98%	24.78%	24.72%	82.80%
16	300	4	11.4	50.77%	38.35%	49.30%	39.98%	63.29%	25.16%	57.51%	47.52%	39.33%	24.64%	60.04%	33.69%	26.29%	46.95%	0.78%	-39.46%	48.40%	34.90%	38.94%	22.89%	22.51%	80.84%
17	300	4	10.7	49.62%	37.46%	48.20%	38.75%	62.27%	22.44%	56.48%	46.35%	38.33%	23.57%	59.02%	32.71%	24.86%	45.86%	-0.27%	-33.13%	47.22%	33.89%	37.86%	21.67%	21.39%	80.02%
18	300	4	10.2	49.81%	37.28%	48.30%	39.05%	62.51%	23.24%	56.68%	46.47%	38.29%	23.49%	59.23%	32.51%	24.93%	45.96%	-0.62%	-38.70%	47.37%	33.72%	37.95%	21.51%	21.47%	80.55%
19	300	4	10	48.47%	36.33%	47.02%	37.62%	61.15%	22.64%	55.36%	45.19%	37.18%	22.26%	57.90%	31.41%	23.92%	44.67%	-0.67%	-41.40%	46.14%	32.62%	36.70%	20.55%	20.18%	79.16%
20	300	4	9.8	47.18%	35.01%	45.73%	36.45%	59.77%	19.56%	54.02%	43.87%	35.94%	21.07%	56.55%	30.18%	22.69%	43.36%	-2.17%	-44.03%	44.77%	31.43%	35.50%	19.28%	19.24%	77.72%
21	300	4	9.1	45.90%	33.55%	44.48%	35.28%	58.54%	18.24%	52.82%	42.51%	34.65%	19.97%	55.32%	28.90%	21.14%	42.05%	-3.25%	-35.42%	43.54%	30.08%	34.18%	18.11%	17.84%	76.71%
22	300	4	7.1	39.83%	27.61%	38.30%	29.10%	52.33%	11.91%	46.72%	36.24%	28.77%	14.31%	49.16%	22.98%	15.21%	35.93%	-8.44%	-60.71%	37.41%	23.96%	28.30%	11.82%	12.19%	70.98%
23	300	4	5.9	35.91%	24.00%	34.55%	25.51%	48.65%	10.43%	43.06%	32.39%	25.35%	9.77%	45.50%	19.50%	11.37%	32.14%	-11.96%	-18.15%	33.71%	20.27%	24.39%	9.19%	8.57%	67.59%
24	300	4	5.5	31.65%	19.64%	30.29%	21.53%	44.07%	11.74%	38.62%	28.21%	20.95%	6.29%	41.04%	15.07%	7.76%	27.78%	-15.20%	-30.26%	29.32%	16.53%	20.55%	4.86%	4.66%	62.68%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	300	4	7.8	41.38%	29.46%	40.00%	30.82%	54.01%	13.45%	48.36%	37.97%	30.44%	15.41%	50.80%	24.69%	16.95%	37.70%	-7.89%	-29.19%	39.01%	25.67%	29.85%	14.21%	13.74%	72.37%
2	300	4	7.6	43.12%	31.01%	41.67%	32.33%	55.88%	16.81%	50.17%	39.65%	31.95%	17.09%	52.68%	26.09%	18.18%	39.26%	-6.76%	-54.44%	40.71%	27.17%	31.46%	14.94%	15.18%	74.65%
3	300	4	7.5	41.38%	29.34%	39.97%	30.96%	54.15%	12.67%	48.44%	37.95%	30.49%	15.47%	50.94%	24.75%	16.52%	37.56%	-7.81%	-34.07%	39.07%	25.71%	29.90%	13.56%	13.90%	72.68%
4	300	4	7.6	43.12%	31.01%	41.67%	32.33%	55.88%	16.81%	50.17%	39.65%	31.95%	17.09%	52.68%	26.09%	18.18%	39.26%	-6.76%	-54.44%	40.71%	27.17%	31.46%	14.94%	15.18%	74.65%
5	300	4	7.9	43.06%	30.85%	41.63%	32.27%	55.75%	17.47%	50.03%	39.64%	31.96%	16.66%	52.55%	26.09%	18.64%	39.26%	-6.80%	-51.12%	40.61%	27.18%	31.46%	15.11%	15.07%	74.27%
6	300	4	8.9	44.42%	32.29%	42.98%	33.97%	57.06%	18.03%	51.35%	41.11%	33.33%	18.42%	53.85%	27.56%	19.85%	40.63%	-4.62%	-38.61%	42.13%	28.68%	32.83%	16.69%	16.86%	75.13%
7	300	4	10.9	50.88%	38.45%	49.40%	39.98%	63.52%	25.46%	57.71%	47.59%	39.41%	24.71%	60.26%	33.68%	26.05%	47.06%	1.32%	-44.21%	48.43%	35.05%	38.93%	22.81%	22.55%	81.33%
8	300	4	13.6	56.80%	44.41%	55.35%	45.94%	69.49%	28.44%	63.60%	53.63%	45.17%	30.65%	66.17%	39.64%	31.97%	53.05%	6.00%	-37.73%	54.43%	40.85%	44.81%	28.46%	28.39%	86.69%
9	300	4	17.7	62.85%	50.41%	61.38%	51.91%	75.34%	33.93%	69.41%	59.85%	51.03%	36.89%	71.99%	45.64%	38.26%	59.11%	11.97%	-33.03%	60.50%	46.97%	50.84%	34.46%	34.39%	91.52%
10	300	4	19.4	65.07%	52.61%	63.61%	54.17%	77.50%	35.87%	71.57%	62.13%	53.21%	39.23%	74.16%	47.90%	40.57%	61.33%	14.07%	-26.24%	62.75%	49.24%	53.06%	36.79%	36.52%	93.29%
11	300	4	20.1	65.56%	53.24%	64.15%	54.70%	77.96%	36.58%	72.04%	62.70%	53.72%	39.80%	74.63%	48.44%	41.24%	61.88%	14.81%	-27.05%	63.27%	49.83%	53.58%	37.46%	37.11%	93.58%
12	300	4	20.5	65.08%	52.83%	63.66%	54.28%	77.39%	35.90%	71.50%	62.24%	53.31%	39.50%	74.07%	48.04%	40.81%	61.43%	15.24%	-24.56%	62.79%	49.47%	53.14%	37.12%	36.80%	92.82%
13	300	4	20.4	65.47%	53.14%	64.06%	54.65%	77.82%	36.47%	71.92%	62.62%	53.67%	39.76%	74.50%	48.37%	41.23%	61.80%	15.45%	-25.06%	63.19%	49.80%	53.52%	37.40%	37.10%	93.33%
14	300	4	19.5	64.64%	52.29%	63.19%	53.72%	77.04%	36.01%	71.11%	61.74%	52.82%	38.91%	73.71%	47.49%	40.25%	60.94%	14.35%	-31.44%	62.32%	48.88%	52.66%	36.45%	36.25%	92.76%
15	300	4	18.4	63.40%	51.04%	62.00%	52.58%	75.86%	33.98%	69.95%	60.47%	51.65%	37.50%	72.53%	46.30%	38.97%	59.71%	12.78%	-27.78%	61.11%	47.59%	51.43%	35.26%	34.98%	91.86%
16	300	4	17	62.23%	49.81%	60.77%	51.27%	74.79%	33.28%	68.85%	59.20%	50.46%	36.15%	71.44%	45.03%	37.53%	58.49%	11.39%	-31.89%	59.89%	46.34%	50.20%	33.81%	33.61%	91.17%
17	300	4	16	60.35%	47.97%	58.93%	49.42%	72.92%	32.99%	67.02%	57.32%	48.60%	34.39%	69.60%	43.09%	35.58%	56.62%	10.00%	-24.78%	58.02%	44.47%	48.36%	32.14%	31.91%	89.51%
18	300	4	15.3	59.69%	47.20%	58.20%	48.83%	72.31%	30.95%	66.38%	56.59%	47.95%	33.48%	68.97%	42.44%	34.95%	55.89%	8.65%	-31.04%	57.35%	43.69%	47.67%	31.38%	31.12%	89.09%
19	300	4	15	58.37%	46.02%	56.87%	47.48%	70.93%	30.01%	65.04%	55.26%	46.72%	32.25%	67.60%	41.21%	33.66%	54.59%	7.67%	-24.65%	56.01%	42.50%	46.44%	30.14%	29.86%	87.69%
20	300	4	14.7	56.99%	44.68%	55.56%	46.18%	69.48%	29.13%	63.65%	53.90%	45.41%	31.07%	66.20%	39.94%	32.56%	53.26%	6.72%	-37.03%	54.63%	41.22%	45.11%	28.96%	28.81%	86.24%
21	300	4	13.6	56.80%	44.41%	55.35%	45.94%	69.49%	28.44%	63.60%	53.63%	45.17%	30.65%	66.17%	39.64%	31.97%	53.05%	6.00%	-37.73%	54.43%	40.85%	44.81%	28.46%	28.39%	86.69%
22	300	4	10.6	50.97%	38.57%	49.49%	40.04%	63.71%	23.61%	57.87%	47.63%	39.47%	24.73%	60.42%	33.71%	26.01%	47.12%	1.60%	-46.96%	48.53%	35.05%	39.02%	22.53%	22.80%	81.67%
23	300	4	8.9	44.42%	32.29%	42.98%	33.97%	57.06%	18.03%	51.35%	41.11%	33.33%	18.42%	53.85%	27.56%	19.85%	40.63%	-4.62%	-38.61%	42.13%	28.68%	32.83%	16.69%	16.86%	75.13%
24	300	4	8.2	42.99%	30.72%	41.57%	32.50%	55.62%	14.93%	49.92%	39.57%	31.89%	17.29%	52.41%	26.12%	18.18%	39.20%	-4.60%	-21.54%	40.64%	27.26%	31.33%	15.52%	15.22%	73.95%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	300	6	2.6	-4.45%	-12.23%	-7.58%	-9.26%	12.53%	-52.52%	5.78%	-8.43%	-9.31%	-26.81%	8.24%	-12.51%	-24.34%	-6.55%	-47.55%	#¡DIV/0!	-6.84%	-14.74%	-15.01%	-16.65%	-35.65%	23.72%
2	300	6	2.5	1.01%	-3.18%	-2.30%	-12.42%	13.79%	-54.17%	8.59%	-4.45%	-7.60%	-15.23%	11.01%	-5.00%	-26.97%	-2.58%	-49.38%	#¡DIV/0!	-3.16%	-9.48%	-12.84%	-19.55%	-25.46%	28.29%
3	300	6	2.5	-2.57%	-6.61%	-5.76%	-15.52%	9.76%	-55.79%	4.74%	-7.83%	-10.87%	-18.23%	7.08%	-8.36%	-29.55%	-6.03%	-51.17%	#¡DIV/0!	-6.59%	-12.68%	-15.93%	-22.40%	-28.10%	23.74%
4	300	6	2.5	1.01%	-3.18%	-2.30%	-12.42%	13.79%	-54.17%	8.59%	-4.45%	-7.60%	-15.23%	11.01%	-5.00%	-26.97%	-2.58%	-49.38%	#¡DIV/0!	-3.16%	-9.48%	-12.84%	-19.55%	-25.46%	28.29%
5	300	6	2.6	-1.07%	-9.13%	-4.31%	-6.05%	16.52%	-50.84%	9.53%	-5.19%	-6.10%	-24.22%	12.07%	-9.42%	-21.66%	-3.24%	-45.70%	#¡DIV/0!	-3.54%	-11.72%	-12.01%	-13.70%	-33.37%	28.10%
6	300	6	3	-4.74%	-8.69%	-4.68%	-14.19%	11.02%	-38.26%	4.73%	-6.61%	-10.37%	-28.62%	7.14%	-14.68%	-15.66%	-6.25%	-31.80%	#¡DIV/0!	-3.08%	-18.69%	-10.53%	-27.74%	-28.27%	24.21%
7	300	6	3.6	5.58%	-7.79%	4.68%	2.13%	20.41%	-6.47%	14.43%	3.07%	-5.72%	-13.50%	16.93%	-8.77%	-10.57%	3.55%	-48.35%	-96.42%	2.77%	-7.63%	-5.13%	-17.91%	-15.49%	34.95%
8	300	6	4.5	10.88%	-1.77%	9.04%	1.55%	25.95%	-26.93%	19.20%	7.37%	1.99%	-9.90%	22.24%	0.98%	-12.67%	7.86%	-46.19%	#¡DIV/0!	8.50%	-3.78%	1.06%	-14.49%	-15.11%	40.23%
9	300	6	5.9	14.31%	4.35%	13.99%	4.88%	30.08%	-17.68%	23.71%	11.42%	5.44%	-8.63%	27.06%	2.39%	-5.54%	11.23%	-31.80%	#¡DIV/0!	13.07%	-0.44%	4.38%	-8.73%	-8.71%	44.11%
10	300	6	6.5	16.40%	4.48%	13.55%	5.51%	31.13%	-1.08%	24.78%	12.22%	6.63%	-8.52%	27.79%	2.52%	-5.42%	11.85%	-18.05%	#¡DIV/0!	14.01%	2.84%	5.00%	-9.40%	-10.62%	44.93%
11	300	6	6.7	17.72%	6.86%	15.73%	8.02%	32.63%	-20.52%	26.22%	14.08%	7.83%	-5.14%	29.25%	5.45%	-5.00%	14.16%	-29.76%	#¡DIV/0!	15.68%	2.95%	6.31%	-6.98%	-7.66%	46.86%
12	300	6	6.8	18.90%	5.71%	15.91%	9.28%	33.95%	9.60%	27.15%	15.30%	8.48%	-4.97%	30.48%	4.86%	-4.73%	14.21%	-27.36%	#¡DIV/0!	16.55%	4.76%	7.58%	-7.65%	-7.80%	47.77%
13	300	6	6.8	18.10%	5.00%	15.14%	8.55%	33.05%	8.87%	26.31%	14.53%	7.76%	-5.60%	29.61%	4.16%	-5.36%	13.45%	-27.84%	#¡DIV/0!	15.77%	4.06%	6.87%	-8.26%	-8.41%	46.79%
14	300	6	6.5	17.22%	5.22%	14.35%	6.25%	32.05%	-0.39%	25.66%	13.01%	7.37%	-7.87%	28.68%	3.24%	-4.76%	12.63%	-17.48%	#¡DIV/0!	14.81%	3.56%	5.74%	-8.77%	-9.99%	45.95%
15	300	6	6.1	17.40%	3.65%	14.65%	7.15%	32.26%	-11.22%	25.81%	12.89%	7.39%	-8.77%	29.03%	2.71%	-2.06%	12.33%	-26.45%	-89.81%	15.22%	1.17%	6.64%	-10.94%	-5.83%	46.18%
16	300	6	5.7	12.43%	2.32%	11.12%	2.67%	28.02%	14.17%	21.30%	10.09%	3.58%	-12.01%	24.64%	-0.35%	-5.08%	9.32%	-36.95%	#¡DIV/0!	11.02%	-1.95%	3.70%	-10.92%	-15.60%	42.04%
17	300	6	5.3	13.88%	2.88%	11.52%	6.36%	29.08%	-32.75%	22.43%	10.39%	4.60%	-11.14%	25.44%	1.39%	-3.54%	10.54%	-25.71%	-92.28%	11.97%	-0.37%	2.32%	-11.45%	-8.85%	43.45%
18	300	6	5.1	12.64%	1.30%	8.95%	0.99%	27.74%	-7.52%	21.09%	8.09%	3.26%	-14.47%	24.30%	-1.06%	-6.92%	8.01%	-31.90%	#¡DIV/0!	10.45%	-3.86%	2.33%	-13.42%	-11.53%	41.02%
19	300	6	5	12.11%	-3.15%	8.45%	3.98%	26.30%	-11.59%	19.98%	7.41%	0.27%	-9.14%	23.11%	-2.26%	-11.02%	6.79%	-34.89%	#¡DIV/0!	9.16%	-2.98%	-0.36%	-11.31%	-15.41%	39.82%
20	300	6	4.9	10.09%	-0.10%	8.01%	-0.70%	24.91%	-15.56%	18.35%	6.79%	0.47%	-13.23%	21.96%	-3.43%	-10.29%	5.59%	-6.73%	#¡DIV/0!	7.89%	-1.89%	-1.18%	-15.30%	-14.17%	38.57%
21	300	6	4.5	10.88%	-1.77%	9.04%	1.55%	25.95%	-26.93%	19.20%	7.37%	1.99%	-9.90%	22.24%	0.98%	-12.67%	7.86%	-46.19%	#¡DIV/0!	8.50%	-3.78%	1.06%	-14.49%	-15.11%	40.23%
22	300	6	3.5	5.52%	-6.09%	4.75%	-2.91%	20.42%	-11.09%	14.41%	2.37%	-2.23%	-17.77%	17.47%	-7.85%	-14.99%	2.72%	-1.79%	#¡DIV/0!	3.93%	-7.57%	-6.71%	-10.81%	-19.66%	35.05%
23	300	6	3	-4.74%	-8.69%	-4.68%	-14.19%	11.02%	-38.26%	4.73%	-6.61%	-10.37%	-28.62%	7.14%	-14.68%	-15.66%	-6.25%	-31.80%	#¡DIV/0!	-3.08%	-18.69%	-10.53%	-27.74%	-28.27%	24.21%
24	300	6	2.7	-2.60%	-2.75%	-1.86%	-10.63%	14.30%	-47.39%	7.58%	-3.37%	-9.09%	-18.91%	11.21%	-12.76%	-28.14%	-3.59%	-41.89%	#¡DIV/0!	-3.65%	-13.40%	-11.06%	-26.12%	-14.44%	28.22%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	300	6	5.2	11.27%	-3.15%	9.01%	3.70%	26.15%	-5.04%	19.62%	7.73%	1.36%	-12.18%	22.67%	-1.58%	-9.20%	7.37%	-30.07%	#¡DIV/0!	8.69%	-1.28%	-0.36%	-11.09%	-14.20%	39.80%
2	300	6	5.1	11.64%	0.40%	7.99%	0.09%	26.60%	-8.34%	20.02%	7.13%	2.35%	-15.23%	23.20%	-1.94%	-7.75%	7.05%	-32.50%	#¡DIV/0!	9.47%	-4.71%	1.42%	-14.19%	-12.31%	39.77%
3	300	6	5	12.11%	-3.15%	8.45%	3.98%	26.30%	-11.59%	19.98%	7.41%	0.27%	-9.14%	23.11%	-2.26%	-11.02%	6.79%	-34.89%	#¡DIV/0!	9.16%	-2.98%	-0.36%	-11.31%	-15.41%	39.82%
4	300	6	5.1	11.64%	0.40%	7.99%	0.09%	26.60%	-8.34%	20.02%	7.13%	2.35%	-15.23%	23.20%	-1.94%	-7.75%	7.05%	-32.50%	#¡DIV/0!	9.47%	-4.71%	1.42%	-14.19%	-12.31%	39.77%
5	300	6	5.3	10.99%	0.27%	8.69%	3.67%	25.81%	-34.45%	19.32%	7.59%	1.95%	-13.40%	22.26%	-1.18%	-5.99%	7.73%	-27.60%	-92.47%	9.13%	-2.89%	-0.27%	-13.70%	-11.16%	39.81%
6	300	6	5.9	14.31%	4.35%	13.99%	4.88%	30.08%	-17.68%	23.71%	11.42%	5.44%	-8.63%	27.06%	2.39%	-5.54%	11.23%	-31.80%	#¡DIV/0!	13.07%	-0.44%	4.38%	-8.73%	-8.71%	44.11%
7	300	6	7.3	111.16%	90.77%	106.78%	97.22%	139.35%	24.70%	127.01%	104.69%	93.95%	64.76%	132.60%	88.00%	78.85%	104.96%	37.75%	-85.68%	107.62%	84.74%	89.73%	64.19%	69.02%	165.99%
8	300	6	9.1	24.11%	12.26%	21.72%	14.57%	39.50%	-2.58%	32.81%	20.57%	14.05%	0.12%	35.93%	10.16%	1.62%	19.94%	-19.29%	#¡DIV/0!	22.58%	8.93%	12.58%	0.11%	-2.99%	53.46%
9	300	6	11.8	30.64%	18.77%	28.57%	20.82%	46.34%	-1.21%	39.38%	27.44%	19.90%	6.24%	42.68%	17.02%	8.57%	26.81%	-16.06%	-62.19%	28.92%	15.47%	18.82%	3.54%	4.33%	60.16%
10	300	6	13	31.75%	19.41%	29.30%	21.79%	47.02%	-1.08%	40.18%	28.25%	21.00%	6.58%	43.46%	17.87%	10.19%	27.44%	-18.05%	-54.57%	29.91%	16.07%	20.00%	5.51%	4.92%	60.74%
11	300	6	13.4	33.78%	20.56%	31.19%	23.06%	48.85%	5.98%	41.99%	30.12%	22.75%	7.91%	45.39%	19.15%	11.56%	29.23%	-12.20%	-51.33%	31.58%	17.94%	21.69%	6.31%	6.62%	62.77%
12	300	6	13.6	34.68%	21.56%	32.02%	24.12%	49.74%	9.60%	42.89%	31.09%	23.02%	10.58%	46.19%	19.84%	11.29%	30.16%	-14.54%	-49.66%	32.59%	18.63%	22.39%	7.39%	6.96%	63.75%
13	300	6	13.6	33.78%	20.75%	31.15%	23.29%	48.74%	8.87%	41.94%	30.22%	22.20%	9.85%	45.22%	19.04%	10.55%	29.29%	-15.11%	-50.00%	31.70%	17.84%	21.57%	6.67%	6.24%	62.66%
14	300	6	13	32.68%	20.25%	30.21%	22.65%	48.05%	-0.39%	41.16%	29.15%	21.85%	7.33%	44.47%	18.70%	10.96%	28.33%	-17.48%	-54.25%	30.82%	16.89%	20.84%	6.25%	5.66%	61.87%
15	300	6	12.3	30.79%	18.45%	28.56%	20.65%	45.99%	6.53%	39.25%	27.42%	20.07%	5.95%	42.54%	16.23%	8.36%	26.66%	-15.95%	-59.23%	28.92%	14.99%	19.18%	3.90%	4.38%	59.91%
16	300	6	11.4	28.88%	16.44%	26.60%	18.34%	44.10%	1.48%	37.30%	25.37%	18.38%	4.29%	40.65%	14.74%	6.50%	24.46%	-15.93%	-65.04%	27.04%	13.47%	17.27%	1.80%	3.16%	57.88%
17	300	6	10.7	27.92%	14.76%	25.46%	17.51%	43.13%	15.29%	36.28%	24.52%	16.68%	3.67%	39.63%	13.42%	5.71%	23.60%	-18.96%	-69.11%	25.61%	13.06%	15.84%	1.20%	2.55%	56.91%
18	300	6	10.2	27.77%	16.39%	25.46%	17.82%	43.14%	-7.52%	36.34%	24.34%	17.24%	3.67%	39.64%	13.60%	5.58%	23.64%	-18.28%	-71.69%	25.84%	12.41%	16.04%	1.86%	1.97%	57.20%
19	300	6	10	26.89%	13.69%	24.18%	17.54%	41.85%	1.04%	35.01%	23.45%	15.62%	2.21%	38.21%	11.71%	5.67%	22.44%	-13.19%	-72.93%	24.95%	11.77%	14.48%	1.36%	0.91%	55.93%
20	300	6	9.8	25.57%	13.52%	22.94%	16.04%	40.61%	-3.50%	33.91%	22.04%	15.09%	0.77%	37.07%	12.02%	4.18%	21.28%	-25.38%	-74.15%	23.71%	10.28%	14.20%	-1.18%	-0.12%	54.60%
21	300	6	9.1	24.11%	12.26%	21.72%	14.57%	39.50%	-2.58%	32.81%	20.57%	14.05%	0.12%	35.93%	10.16%	1.62%	19.94%	-19.29%	#¡DIV/0!	22.58%	8.93%	12.58%	0.11%	-2.99%	53.46%
22	300	6	7.1	19.28%	5.18%	16.22%	10.96%	33.41%	-11.09%	27.00%	15.28%	8.46%	-6.02%	30.03%	5.31%	-2.84%	14.54%	-34.53%	#¡DIV/0!	17.00%	3.31%	8.22%	-7.51%	-6.71%	47.64%
23	300	6	5.9	14.31%	4.35%	13.99%	4.88%	30.08%	-17.68%	23.71%	11.42%	5.44%	-8.63%	27.06%	2.39%	-5.54%	11.23%	-31.80%	#¡DIV/0!	13.07%	-0.44%	4.38%	-8.73%	-8.71%	44.11%
24	300	6	5.5	11.95%	-2.75%	9.55%	3.78%	25.40%	5.22%	19.44%	8.23%	1.82%	-15.38%	22.33%	-3.06%	-8.54%	7.53%	-22.52%	#¡DIV/0!	9.07%	-1.03%	0.05%	-13.08%	-14.44%	39.78%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	300	6	7.8	20.60%	7.11%	18.09%	10.73%	35.04%	6.83%	28.60%	16.90%	9.98%	-3.61%	31.79%	5.77%	-2.72%	15.86%	-21.33%	#¡DIV/0!	18.57%	5.51%	8.36%	-3.21%	-6.08%	49.15%
2	300	6	7.6	21.59%	10.90%	19.13%	10.63%	36.99%	3.11%	30.17%	18.29%	10.88%	-2.19%	33.58%	6.87%	1.12%	17.22%	-24.07%	-84.21%	19.90%	5.81%	10.09%	-3.46%	-4.17%	51.01%
3	300	6	7.5	20.36%	6.97%	17.96%	10.59%	35.15%	-0.54%	28.55%	16.70%	10.22%	-3.17%	31.79%	6.42%	-2.46%	16.17%	-26.76%	-84.77%	18.15%	4.78%	9.07%	-6.88%	-4.84%	49.29%
4	300	6	7.6	21.59%	10.90%	19.13%	10.63%	36.99%	3.11%	30.17%	18.29%	10.88%	-2.19%	33.58%	6.87%	1.12%	17.22%	-24.07%	-84.21%	19.90%	5.81%	10.09%	-3.46%	-4.17%	51.01%
5	300	6	7.9	21.17%	10.90%	19.33%	10.89%	36.92%	10.61%	30.27%	18.10%	10.73%	-2.57%	33.27%	6.34%	0.72%	17.56%	-18.55%	-83.07%	19.74%	6.58%	10.35%	-5.85%	-2.76%	50.83%
6	300	6	8.9	23.06%	11.05%	20.77%	13.27%	37.98%	-7.39%	31.46%	19.41%	12.66%	-1.17%	34.60%	9.70%	2.18%	19.08%	-23.27%	-78.73%	21.15%	7.61%	11.24%	-2.45%	-1.76%	51.99%
7	300	6	10.9	29.01%	16.33%	26.46%	19.16%	44.14%	5.22%	37.47%	25.36%	17.94%	3.80%	40.61%	14.42%	7.31%	24.61%	-15.47%	-67.78%	27.05%	13.88%	16.96%	1.91%	2.17%	58.14%
8	300	6	13.6	34.68%	21.56%	32.02%	24.12%	49.74%	9.60%	42.89%	31.09%	23.02%	10.58%	46.19%	19.84%	11.29%	30.16%	-14.54%	-49.66%	32.59%	18.63%	22.39%	7.39%	6.96%	63.75%
9	300	6	17.7	40.35%	27.40%	37.64%	29.70%	55.78%	11.14%	48.65%	36.96%	28.65%	15.49%	52.11%	25.37%	17.42%	35.77%	-5.57%	-14.93%	38.30%	24.73%	27.62%	13.93%	12.27%	69.18%
10	300	6	19.4	42.25%	29.49%	40.01%	32.14%	57.89%	11.28%	50.78%	39.12%	30.80%	17.07%	54.18%	27.64%	19.89%	38.07%	-4.84%	-48.89%	40.41%	26.81%	29.82%	15.05%	14.91%	71.19%
11	300	6	20.1	42.87%	29.80%	40.47%	32.57%	58.39%	14.46%	51.25%	39.71%	31.28%	17.62%	54.67%	27.90%	20.53%	38.62%	-4.22%	-45.24%	41.00%	27.02%	30.54%	15.48%	15.20%	71.62%
12	300	6	20.5	42.53%	29.47%	40.20%	32.29%	57.94%	13.82%	50.87%	39.37%	30.81%	17.97%	54.29%	27.80%	19.89%	38.19%	-6.61%	-43.37%	40.64%	26.80%	30.13%	15.44%	15.14%	71.04%
13	300	6	20.4	42.77%	30.15%	40.45%	32.18%	58.35%	17.58%	51.20%	39.72%	31.05%	18.20%	54.65%	27.95%	20.11%	38.49%	-4.50%	12.51%	40.93%	27.34%	30.39%	15.96%	14.93%	71.47%
14	300	6	19.5	41.94%	29.13%	39.69%	31.79%	57.48%	12.06%	50.42%	38.78%	30.31%	17.33%	53.81%	27.07%	19.61%	37.70%	-4.17%	-48.53%	40.06%	26.49%	29.49%	15.16%	14.51%	70.74%
15	300	6	18.4	40.79%	27.97%	38.47%	30.41%	56.23%	14.14%	49.21%	37.59%	29.06%	16.07%	52.54%	25.79%	18.14%	36.53%	-5.44%	-8.26%	38.92%	25.26%	28.41%	13.73%	13.33%	69.67%
16	300	6	17	39.67%	26.63%	37.12%	29.29%	55.19%	8.16%	48.05%	36.32%	28.14%	14.50%	51.51%	24.83%	16.96%	35.16%	-5.42%	-21.35%	37.69%	24.14%	27.10%	12.74%	12.16%	68.68%
17	300	6	16	37.78%	24.90%	35.49%	27.93%	53.33%	6.81%	46.36%	34.44%	26.48%	12.71%	49.73%	23.41%	15.75%	33.47%	-8.83%	-30.50%	35.92%	22.42%	25.58%	10.88%	10.20%	66.94%
18	300	6	15.3	37.09%	24.32%	34.76%	27.24%	52.68%	10.97%	45.65%	33.90%	25.59%	12.37%	49.10%	22.14%	14.50%	32.83%	-8.07%	-36.29%	35.09%	21.78%	24.76%	10.27%	10.05%	66.36%
19	300	6	15	36.15%	23.22%	33.42%	25.41%	51.43%	13.67%	44.41%	32.72%	24.47%	11.50%	47.79%	21.06%	13.56%	31.74%	-12.11%	-39.09%	33.90%	20.44%	23.85%	9.56%	8.75%	65.05%
20	300	6	14.7	34.77%	22.16%	32.39%	24.93%	49.96%	8.57%	43.14%	31.45%	23.40%	10.69%	46.41%	20.02%	11.79%	30.49%	-11.64%	-41.83%	32.97%	19.14%	22.68%	7.81%	8.42%	63.69%
21	300	6	13.6	34.68%	21.56%	32.02%	24.12%	49.74%	9.60%	42.89%	31.09%	23.02%	10.58%	46.19%	19.84%	11.29%	30.16%	-14.54%	-49.66%	32.59%	18.63%	22.39%	7.39%	6.96%	63.75%
22	300	6	10.6	28.60%	17.16%	26.59%	18.77%	44.37%	0.02%	37.45%	25.47%	18.05%	4.23%	40.75%	14.39%	6.26%	24.71%	-11.61%	#¡DIV/0!	27.06%	13.71%	16.50%	4.05%	1.67%	58.31%
23	300	6	8.9	23.06%	11.05%	20.77%	13.27%	37.98%	-7.39%	31.46%	19.41%	12.66%	-1.17%	34.60%	9.70%	2.18%	19.08%	-23.27%	-78.73%	21.15%	7.61%	11.24%	-2.45%	-1.76%	51.99%
24	300	6	8.2	21.08%	9.40%	19.76%	13.11%	36.78%	-5.30%	30.16%	18.21%	11.58%	-2.69%	33.29%	7.56%	-1.58%	17.58%	-25.29%	#¡DIV/0!	19.88%	6.28%	9.98%	-2.21%	-3.74%	50.66%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	300	8	2.6	-23.38%	-27.96%	-27.17%	-24.22%	-1.03%	#¡DIV/0!	-9.70%	-24.44%	-27.37%	-54.87%	-6.97%	-15.20%	-5.06%	-25.64%	-89.19%	#¡DIV/0!	-21.77%	-35.46%	-25.15%	-31.08%	-20.25%	1.98%
2	300	8	2.5	-26.05%	-30.46%	-15.64%	-26.85%	-4.47%	#¡DIV/0!	-12.84%	-18.97%	-29.89%	-12.89%	-10.21%	-18.15%	-8.36%	-16.26%	#¡DIV/0!	#¡DIV/0!	-24.50%	-6.56%	-27.76%	-33.48%	-61.51%	6.36%
3	300	8	2.5	-28.67%	-32.92%	-18.63%	-29.44%	-7.85%	#¡DIV/0!	-15.92%	-21.84%	-32.37%	-15.97%	-13.39%	-21.05%	-11.61%	-19.22%	#¡DIV/0!	#¡DIV/0!	-27.17%	-9.87%	-30.31%	-35.83%	-62.87%	2.59%
4	300	8	2.5	-26.05%	-30.46%	-15.64%	-26.85%	-4.47%	#¡DIV/0!	-12.84%	-18.97%	-29.89%	-12.89%	-10.21%	-18.15%	-8.36%	-16.26%	#¡DIV/0!	#¡DIV/0!	-24.50%	-6.56%	-27.76%	-33.48%	-61.51%	6.36%
5	300	8	2.6	-20.67%	-25.41%	-24.59%	-21.53%	2.48%	#¡DIV/0!	-6.50%	-21.77%	-24.80%	-53.28%	-3.68%	-12.20%	-1.70%	-23.00%	-88.81%	#¡DIV/0!	-19.01%	-33.18%	-22.50%	-28.64%	-17.43%	5.59%
6	300	8	3	-14.60%	-37.54%	-28.97%	-34.30%	1.13%	#¡DIV/0!	-9.26%	-24.42%	-21.29%	-41.32%	-7.49%	-26.49%	-38.27%	-15.38%	#¡DIV/0!	#¡DIV/0!	-20.88%	-37.06%	-35.11%	-10.38%	-48.15%	2.18%
7	300	8	3.6	-9.45%	-29.04%	-13.92%	-25.36%	2.12%	#¡DIV/0!	-2.45%	-17.31%	-20.51%	-40.74%	-0.74%	-16.48%	-6.49%	-14.55%	-78.70%	#¡DIV/0!	-17.03%	-23.72%	-15.75%	-32.12%	-47.64%	11.74%
8	300	8	4.5	-5.68%	-26.09%	-10.33%	-6.70%	8.09%	-70.37%	2.72%	-13.87%	-14.02%	-30.56%	6.35%	-13.00%	-26.95%	-10.99%	-66.72%	#¡DIV/0!	-11.30%	-25.51%	-16.23%	-29.29%	-18.18%	16.16%
9	300	8	5.9	-4.35%	-16.72%	-9.08%	-12.40%	13.26%	-49.93%	5.07%	-8.60%	-10.04%	-32.94%	8.46%	-11.78%	-17.70%	-6.63%	-43.76%	#¡DIV/0!	-8.12%	-16.07%	-13.48%	-28.30%	-30.86%	19.87%
10	300	8	6.5	-4.23%	-9.95%	-5.82%	-13.88%	13.41%	-39.84%	6.61%	-7.41%	-12.70%	-19.42%	11.15%	-11.67%	-25.83%	-9.63%	-32.42%	#¡DIV/0!	-4.93%	-13.56%	-14.95%	-28.21%	-28.80%	20.55%
11	300	8	6.7	-3.81%	-12.29%	-5.60%	-7.73%	15.72%	-35.54%	8.21%	-6.31%	-9.93%	-24.46%	10.93%	-12.64%	-20.53%	-5.79%	-27.60%	#¡DIV/0!	-3.51%	-13.57%	-12.84%	-23.08%	-33.25%	22.27%
12	300	8	6.8	-3.53%	-9.29%	-2.38%	-12.53%	14.24%	-33.34%	8.48%	-6.56%	-10.18%	-21.87%	11.67%	-9.65%	-17.82%	-5.13%	-25.12%	#¡DIV/0!	-2.77%	-16.20%	-13.61%	-20.45%	-21.10%	23.17%
13	300	8	6.8	-4.17%	-9.89%	-3.03%	-13.11%	13.48%	-33.78%	7.76%	-7.19%	-10.78%	-22.39%	10.92%	-10.26%	-18.36%	-5.77%	-25.62%	#¡DIV/0!	-3.41%	-16.76%	-14.19%	-20.98%	-21.63%	22.35%
14	300	8	6.5	-3.56%	-9.31%	-5.16%	-13.28%	14.21%	-39.41%	7.36%	-6.76%	-12.09%	-18.85%	11.94%	-11.05%	-25.31%	-8.99%	-31.95%	#¡DIV/0!	-4.27%	-12.96%	-14.35%	-27.70%	-28.30%	21.40%
15	300	8	6.1	-0.82%	-19.18%	-5.72%	-5.53%	13.09%	-46.00%	6.31%	-5.82%	-11.43%	-27.68%	11.21%	-13.51%	-23.92%	-8.75%	-39.35%	#¡DIV/0!	-4.01%	-16.46%	-16.03%	-22.68%	-25.44%	21.66%
16	300	8	5.7	-7.89%	-13.38%	-8.63%	-8.89%	11.40%	-53.71%	3.98%	-9.16%	-12.67%	-27.66%	7.70%	-18.44%	-23.91%	-10.59%	-48.00%	#¡DIV/0!	-5.95%	-22.41%	-15.31%	-17.14%	-36.08%	17.91%
17	300	8	5.3	-2.33%	-23.47%	-7.15%	-7.99%	10.15%	-59.09%	5.22%	-10.81%	-14.26%	-23.30%	7.06%	-9.91%	-19.32%	-7.83%	-54.06%	#¡DIV/0!	-6.92%	-17.73%	-15.19%	-26.78%	-32.22%	19.11%
18	300	8	5.1	-10.47%	-19.82%	-5.43%	-15.65%	8.74%	#¡DIV/0!	3.10%	-10.81%	-16.78%	-29.69%	7.07%	-17.42%	-26.04%	-11.84%	-57.88%	#¡DIV/0!	-7.26%	-24.58%	-16.70%	-32.88%	-22.34%	17.06%
19	300	8	5	-9.90%	-10.57%	-9.58%	-19.36%	9.58%	-64.15%	2.09%	-12.07%	-15.47%	-15.97%	7.24%	-9.77%	-29.29%	-11.88%	-59.73%	#¡DIV/0!	-11.33%	-19.88%	-20.36%	-14.44%	-25.75%	15.92%
20	300	8	4.9	-9.16%	-14.58%	-13.65%	-22.98%	7.57%	#¡DIV/0!	-0.72%	-10.42%	-19.27%	-19.75%	2.42%	-24.60%	-32.46%	-11.83%	#¡DIV/0!	#¡DIV/0!	-11.47%	-13.92%	-23.94%	-18.29%	-29.09%	15.19%
21	300	8	4.5	-5.68%	-26.09%	-10.33%	-6.70%	8.09%	-70.37%	2.72%	-13.87%	-14.02%	-30.56%	6.35%	-13.00%	-26.95%	-10.99%	-66.72%	#¡DIV/0!	-11.30%	-25.51%	-16.23%	-29.29%	-18.18%	16.16%
22	300	8	3.5	-13.92%	-10.06%	-18.17%	-29.04%	7.30%	#¡DIV/0!	-0.87%	-16.77%	-24.44%	-15.50%	2.94%	-20.60%	-40.74%	-18.77%	-79.75%	#¡DIV/0!	-14.55%	-27.49%	-19.91%	-35.47%	-25.33%	11.50%
23	300	8	3	-14.60%	-37.54%	-28.97%	-34.30%	1.13%	#¡DIV/0!	-9.26%	-24.42%	-21.29%	-41.32%	-7.49%	-26.49%	-38.27%	-15.38%	#¡DIV/0!	#¡DIV/0!	-20.88%	-37.06%	-35.11%	-10.38%	-48.15%	2.18%
24	300	8	2.7	-15.11%	-20.17%	-19.30%	-16.03%	-7.20%	-89.33%	-10.48%	-23.89%	-19.52%	-50.00%	-10.67%	-6.04%	5.19%	-17.60%	#¡DIV/0!	#¡DIV/0!	-13.32%	-28.49%	-33.65%	-23.63%	-55.82%	6.22%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	300	8	5.2	-8.06%	-17.67%	-12.60%	-13.39%	8.87%	-61.49%	0.66%	-11.11%	-14.55%	-27.80%	5.16%	-15.20%	-24.05%	-13.24%	-56.75%	#¡DIV/0!	-8.74%	-22.55%	-14.46%	-31.08%	-36.20%	16.20%
2	300	8	5.1	-11.26%	-20.53%	-6.27%	-16.40%	7.78%	#¡DIV/0!	2.19%	-11.60%	-17.52%	-30.31%	6.12%	-18.15%	-26.69%	-12.62%	-58.26%	#¡DIV/0!	-8.08%	-25.25%	-17.44%	-33.48%	-23.03%	16.03%
3	300	8	5	-9.90%	-10.57%	-9.58%	-19.36%	9.58%	-64.15%	2.09%	-12.07%	-15.47%	-15.97%	7.24%	-9.77%	-29.29%	-11.88%	-59.73%	#¡DIV/0!	-11.33%	-19.88%	-20.36%	-14.44%	-25.75%	15.92%
4	300	8	5.1	-11.26%	-20.53%	-6.27%	-16.40%	7.78%	#¡DIV/0!	2.19%	-11.60%	-17.52%	-30.31%	6.12%	-18.15%	-26.69%	-12.62%	-58.26%	#¡DIV/0!	-8.08%	-25.25%	-17.44%	-33.48%	-23.03%	16.03%
5	300	8	5.3	-4.81%	-25.41%	-9.51%	-10.32%	7.36%	-60.13%	2.55%	-13.08%	-16.44%	-25.24%	4.35%	-12.20%	-21.36%	-10.17%	-55.22%	#¡DIV/0!	-9.29%	-19.81%	-17.34%	-28.64%	-33.94%	16.09%
6	300	8	5.9	-4.35%	-16.72%	-9.08%	-12.40%	13.26%	-49.93%	5.07%	-8.60%	-10.04%	-32.94%	8.46%	-11.78%	-17.70%	-6.63%	-43.76%	#¡DIV/0!	-8.12%	-16.07%	-13.48%	-28.30%	-30.86%	19.87%
7	300	8	7.3	0.61%	-12.67%	-6.94%	-14.70%	15.92%	-24.15%	8.00%	-5.50%	-7.69%	-28.89%	12.11%	-10.91%	-16.88%	-6.78%	-14.81%	#¡DIV/0!	-1.94%	-15.25%	-12.63%	-22.42%	-21.45%	23.02%
8	300	8	9.1	2.90%	-6.64%	-0.37%	-6.70%	21.85%	18.51%	13.85%	0.02%	-6.85%	-14.53%	18.17%	-9.22%	-16.51%	-1.40%	-33.44%	#¡DIV/0!	2.14%	-11.71%	-7.85%	-15.15%	-18.18%	28.15%
9	300	8	11.8	9.94%	-3.29%	5.73%	-1.45%	26.55%	0.14%	19.18%	5.51%	-0.58%	-10.58%	23.34%	-1.98%	-10.21%	4.14%	-25.01%	-92.53%	7.48%	-4.08%	-2.67%	-15.65%	-12.67%	34.32%
10	300	8	13	10.50%	-2.64%	6.07%	2.41%	27.78%	-19.78%	19.93%	6.72%	-0.23%	-9.75%	23.91%	-1.40%	-8.71%	5.80%	-32.42%	-91.03%	8.65%	-5.09%	-1.52%	-13.85%	-13.32%	34.94%
11	300	8	13.4	11.94%	-1.04%	8.38%	1.49%	29.61%	-14.05%	22.01%	7.65%	2.40%	-13.67%	26.04%	0.95%	-5.82%	6.43%	-27.60%	#¡DIV/0!	10.28%	-2.15%	0.24%	-12.09%	-14.56%	36.65%
12	300	8	13.6	11.70%	-0.22%	9.06%	4.96%	30.56%	-11.11%	22.55%	9.01%	1.62%	-7.41%	26.89%	-0.04%	-9.32%	7.61%	-25.12%	#¡DIV/0!	10.72%	-2.49%	1.14%	-13.22%	-11.64%	37.52%
13	300	8	13.6	10.96%	-0.88%	8.33%	4.27%	29.69%	-11.71%	21.73%	8.28%	0.94%	-8.02%	26.05%	-0.71%	-9.92%	6.89%	-25.62%	#¡DIV/0!	9.98%	-3.13%	0.46%	-13.80%	-12.22%	36.61%
14	300	8	13	11.28%	-1.96%	6.81%	3.13%	28.68%	-19.22%	20.78%	7.47%	0.47%	-9.11%	24.78%	-0.70%	-8.07%	6.55%	-31.95%	-90.96%	9.41%	-4.42%	-0.83%	-13.24%	-12.71%	35.89%
15	300	8	12.3	9.73%	-4.91%	5.43%	3.06%	27.23%	-28.00%	19.60%	5.30%	-0.63%	-11.96%	23.34%	-2.43%	-11.24%	5.22%	-19.13%	#¡DIV/0!	7.78%	-5.56%	-2.64%	-14.09%	-14.79%	34.10%
16	300	8	11.4	7.84%	-4.42%	3.78%	-2.81%	25.41%	-7.41%	17.65%	3.82%	-1.60%	-17.33%	21.80%	-4.04%	-8.69%	2.18%	-30.67%	#¡DIV/0!	6.40%	-6.89%	-4.01%	-11.61%	-19.26%	32.29%
17	300	8	10.7	5.59%	-5.80%	3.17%	-0.91%	24.20%	-18.19%	16.49%	2.74%	-2.02%	-19.26%	20.21%	-3.91%	-10.35%	1.70%	-38.74%	#¡DIV/0!	5.77%	-8.58%	-3.98%	-16.32%	-15.28%	31.41%
18	300	8	10.2	6.91%	-6.45%	3.17%	-1.60%	24.74%	-25.00%	16.68%	3.27%	-2.43%	-17.28%	20.79%	-5.62%	-12.98%	2.67%	-15.76%	#¡DIV/0!	4.05%	-5.72%	-4.80%	-17.39%	-17.16%	31.49%
19	300	8	10	5.35%	-6.68%	3.33%	-1.83%	22.87%	-28.30%	15.50%	2.32%	-3.39%	-15.97%	19.31%	-6.43%	-16.81%	2.03%	-19.47%	#¡DIV/0!	3.26%	-6.96%	-5.11%	-21.02%	-15.14%	30.42%
20	300	8	9.8	3.81%	-6.82%	1.92%	-1.98%	21.97%	-31.52%	14.35%	1.41%	-4.32%	-19.75%	18.66%	-7.19%	-15.58%	0.08%	-23.09%	#¡DIV/0!	2.51%	-8.18%	-7.40%	-18.29%	-18.96%	29.28%
21	300	8	9.1	2.90%	-6.64%	-0.37%	-6.70%	21.85%	18.51%	13.85%	0.02%	-6.85%	-14.53%	18.17%	-9.22%	-16.51%	-1.40%	-33.44%	#¡DIV/0!	2.14%	-11.71%	-7.85%	-15.15%	-18.18%	28.15%
22	300	8	7.1	-1.62%	-10.06%	-6.48%	-12.67%	16.50%	-27.90%	8.48%	-5.68%	-9.32%	-24.89%	11.83%	-9.26%	-11.11%	-4.90%	-19.01%	#¡DIV/0!	-2.34%	-14.69%	-13.75%	-13.96%	-25.33%	22.95%
23	300	8	5.9	-4.35%	-16.72%	-9.08%	-12.40%	13.26%	-49.93%	5.07%	-8.60%	-10.04%	-32.94%	8.46%	-11.78%	-17.70%	-6.63%	-43.76%	#¡DIV/0!	-8.12%	-16.07%	-13.48%	-28.30%	-30.86%	19.87%
24	300	8	5.5	-7.39%	-20.17%	-11.96%	-16.03%	9.67%	#¡DIV/0!	1.55%	-9.49%	-19.52%	-20.00%	5.10%	-24.83%	-29.87%	-11.26%	#¡DIV/0!	#¡DIV/0!	-10.11%	-14.19%	-21.95%	-23.63%	-29.31%	16.09%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	300	8	7.8	0.91%	-13.55%	-4.07%	-9.06%	18.05%	-13.36%	10.53%	-4.22%	-9.21%	-18.77%	14.57%	-10.21%	-22.32%	-4.39%	-51.35%	#¡DIV/0!	-1.44%	-17.02%	-10.18%	-22.46%	-20.25%	24.32%
2	300	8	7.6	2.39%	-10.60%	-2.66%	-12.22%	18.22%	-16.38%	11.13%	-3.48%	-7.21%	-21.60%	14.19%	-7.92%	-17.53%	-3.79%	-6.08%	#¡DIV/0!	1.21%	-11.48%	-10.32%	-25.16%	-23.03%	25.99%
3	300	8	7.5	-1.23%	-13.76%	-3.64%	-2.30%	18.48%	-19.34%	9.95%	-2.60%	-10.49%	-24.37%	13.86%	-11.18%	-11.61%	-3.07%	-54.70%	#¡DIV/0!	-2.37%	-14.61%	-10.40%	-17.50%	-25.75%	24.35%
4	300	8	7.6	2.39%	-10.60%	-2.66%	-12.22%	18.22%	-16.38%	11.13%	-3.48%	-7.21%	-21.60%	14.19%	-7.92%	-17.53%	-3.79%	-6.08%	#¡DIV/0!	1.21%	-11.48%	-10.32%	-25.16%	-23.03%	25.99%
5	300	8	7.9	-0.38%	-10.49%	-0.68%	-5.84%	17.97%	-10.30%	10.89%	-2.21%	-8.53%	-15.90%	14.99%	-7.04%	-19.57%	-2.98%	-49.62%	#¡DIV/0!	0.05%	-14.08%	-10.00%	-19.72%	-25.69%	25.82%
6	300	8	8.9	3.46%	-11.25%	-1.65%	-6.64%	20.21%	12.66%	12.29%	-0.64%	-7.60%	-18.75%	16.01%	-9.78%	-14.53%	-1.74%	-36.73%	#¡DIV/0!	1.72%	-12.85%	-7.79%	-19.34%	-22.22%	26.92%
7	300	8	10.9	7.23%	-5.39%	3.30%	-0.48%	25.33%	-14.67%	17.31%	3.84%	-2.45%	-11.11%	21.13%	-3.01%	-11.42%	3.69%	-36.11%	#¡DIV/0!	5.52%	-7.23%	-3.50%	-12.72%	-16.83%	32.47%
8	300	8	13.6	7.91%	-2.65%	4.36%	-2.36%	25.14%	-11.11%	17.80%	4.13%	-1.37%	-13.79%	21.38%	-2.13%	-9.32%	3.74%	-25.12%	-90.06%	6.82%	-5.91%	-3.57%	-16.99%	-15.03%	32.12%
9	300	8	17.7	17.60%	3.77%	13.65%	9.16%	35.91%	-9.87%	27.88%	13.73%	6.93%	-3.98%	31.97%	5.86%	-3.38%	12.82%	-27.69%	#¡DIV/0!	15.99%	1.84%	6.18%	-7.82%	-8.94%	42.65%
10	300	8	19.4	19.16%	6.64%	15.95%	10.72%	37.62%	-9.75%	29.66%	15.80%	8.66%	-2.37%	33.91%	7.19%	-1.11%	14.38%	-13.12%	#¡DIV/0!	18.01%	4.72%	7.26%	-5.44%	-6.54%	44.57%
11	300	8	20.1	19.41%	7.20%	16.53%	10.05%	38.13%	-3.31%	30.12%	16.16%	9.44%	-2.87%	34.22%	8.73%	0.38%	15.34%	-18.55%	#¡DIV/0!	18.28%	5.12%	7.40%	-3.40%	-5.76%	45.02%
12	300	8	20.5	19.38%	6.91%	15.90%	9.85%	37.92%	0.00%	29.82%	15.99%	8.82%	-3.02%	34.12%	7.86%	0.29%	14.64%	-15.76%	#¡DIV/0!	18.09%	4.93%	7.24%	-4.54%	-6.22%	44.57%
13	300	8	20.4	19.58%	7.48%	16.12%	10.40%	38.12%	-14.86%	30.02%	16.08%	9.68%	-3.66%	34.18%	9.38%	1.34%	15.10%	-25.62%	-77.78%	18.12%	5.15%	7.77%	-5.18%	-5.05%	44.94%
14	300	8	19.5	18.90%	6.00%	15.67%	10.07%	37.35%	-9.12%	29.40%	15.36%	8.85%	-3.54%	33.54%	7.94%	-0.41%	14.29%	-23.44%	-79.67%	17.49%	4.45%	7.33%	-7.05%	-5.89%	44.19%
15	300	8	18.4	17.80%	5.42%	14.31%	9.31%	36.05%	-2.80%	28.10%	14.55%	7.22%	-5.08%	32.15%	5.70%	-0.15%	13.27%	-22.02%	-81.88%	16.64%	2.89%	6.44%	-8.44%	-6.37%	43.19%
16	300	8	17	16.35%	3.94%	13.26%	7.54%	35.41%	4.16%	27.29%	13.16%	6.93%	-6.99%	31.52%	6.39%	-2.16%	12.09%	-33.15%	#¡DIV/0!	15.05%	2.20%	5.35%	-6.78%	-9.17%	42.15%
17	300	8	16	15.66%	2.05%	11.42%	7.34%	33.45%	-26.37%	25.45%	11.57%	5.22%	-6.71%	29.56%	4.62%	-4.45%	10.60%	-17.30%	#¡DIV/0!	13.81%	1.43%	3.15%	-9.11%	-10.30%	40.58%
18	300	8	15.3	15.12%	1.03%	11.02%	6.28%	32.99%	-15.63%	25.16%	10.83%	4.36%	-6.94%	29.26%	4.31%	-4.90%	9.94%	-36.82%	#¡DIV/0!	12.93%	-0.18%	2.90%	-7.07%	-9.81%	39.98%
19	300	8	15	13.29%	0.61%	10.13%	5.84%	31.74%	-19.34%	23.69%	10.11%	4.04%	-8.33%	27.87%	3.36%	-6.41%	9.05%	-27.52%	#¡DIV/0!	11.91%	-0.16%	1.36%	-7.60%	-10.90%	38.86%
20	300	8	14.7	12.33%	0.27%	9.29%	3.23%	30.53%	-22.96%	22.55%	8.95%	2.88%	-9.72%	26.52%	2.44%	-5.03%	8.21%	-30.78%	#¡DIV/0!	10.94%	-1.62%	1.96%	-11.75%	-11.97%	37.68%
21	300	8	13.6	7.91%	-2.65%	4.36%	-2.36%	25.14%	-11.11%	17.80%	4.13%	-1.37%	-13.79%	21.38%	-2.13%	-9.32%	3.74%	-25.12%	-90.06%	6.82%	-5.91%	-3.57%	-16.99%	-15.03%	32.12%
22	300	8	10.6	7.60%	-6.60%	3.73%	-1.75%	25.67%	-18.88%	17.60%	3.53%	-1.28%	-15.50%	21.32%	-1.44%	-11.11%	3.21%	-39.26%	#¡DIV/0!	6.07%	-6.77%	-2.97%	-17.03%	-16.00%	32.54%
23	300	8	8.9	3.46%	-11.25%	-1.65%	-6.64%	20.21%	12.66%	12.29%	-0.64%	-7.60%	-18.75%	16.01%	-9.78%	-14.53%	-1.74%	-36.73%	#¡DIV/0!	1.72%	-12.85%	-7.79%	-19.34%	-22.22%	26.92%
24	300	8	8.2	-0.34%	-10.20%	-0.96%	-5.53%	18.01%	-4.00%	10.93%	-2.15%	-9.46%	-18.18%	14.86%	-10.99%	-13.93%	-3.87%	-46.09%	#¡DIV/0!	-0.72%	-12.24%	-9.53%	-14.09%	-27.70%	25.79%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	600	4	2.6	14.80%	4.89%	14.00%	5.03%	24.15%	-9.52%	20.18%	11.24%	5.50%	-9.79%	21.67%	-1.30%	-7.74%	11.60%	-32.31%	-67.78%	12.14%	0.68%	5.14%	-10.10%	-10.25%	46.12%
2	600	4	2.5	18.72%	7.93%	18.33%	9.03%	28.68%	-1.75%	24.64%	15.09%	9.22%	-6.05%	26.09%	1.73%	-6.32%	15.65%	-22.78%	#¡DIV/0!	16.17%	4.55%	8.60%	-7.25%	-6.91%	51.53%
3	600	4	2.5	14.52%	4.11%	14.14%	5.17%	24.12%	-5.23%	20.22%	11.02%	5.36%	-9.37%	21.63%	-1.87%	-9.64%	11.56%	-25.52%	#¡DIV/0!	12.06%	0.85%	4.75%	-10.53%	-10.20%	46.16%
4	600	4	2.5	18.72%	7.93%	18.33%	9.03%	28.68%	-1.75%	24.64%	15.09%	9.22%	-6.05%	26.09%	1.73%	-6.32%	15.65%	-22.78%	#¡DIV/0!	16.17%	4.55%	8.60%	-7.25%	-6.91%	51.53%
5	600	4	2.6	18.86%	8.60%	18.04%	8.75%	28.55%	-6.32%	24.44%	15.18%	9.24%	-6.59%	25.97%	2.19%	-4.47%	15.55%	-29.91%	-66.64%	16.11%	4.24%	8.86%	-6.92%	-7.07%	51.29%
6	600	4	3	15.26%	4.85%	14.66%	5.92%	24.86%	-3.73%	20.84%	11.84%	6.09%	-8.38%	22.34%	-0.78%	-7.45%	12.25%	-28.48%	-58.10%	12.93%	1.11%	5.77%	-9.40%	-9.64%	46.13%
7	600	4	3.6	25.86%	15.01%	25.03%	15.62%	35.72%	0.25%	31.54%	22.06%	15.89%	0.50%	33.17%	8.88%	1.52%	22.34%	-21.21%	-68.26%	23.23%	10.89%	15.39%	-1.09%	0.23%	58.30%
8	600	4	4.5	31.25%	20.40%	30.39%	20.83%	41.41%	8.97%	37.05%	27.62%	21.15%	5.90%	38.72%	13.58%	6.00%	27.88%	-15.36%	-50.41%	28.55%	16.21%	20.69%	4.60%	4.68%	63.84%
9	600	4	5.9	35.72%	24.55%	34.83%	25.31%	45.71%	14.48%	41.33%	32.15%	25.52%	9.94%	43.02%	18.05%	10.43%	32.29%	-13.63%	-44.13%	33.00%	20.50%	25.11%	8.99%	9.13%	67.59%
10	600	4	6.5	36.65%	25.77%	35.93%	26.19%	46.60%	15.67%	42.28%	33.17%	26.55%	11.14%	43.97%	19.03%	11.74%	33.30%	-11.29%	-49.65%	33.99%	21.64%	26.24%	9.89%	10.05%	68.17%
11	600	4	6.7	38.53%	27.40%	37.76%	28.28%	48.57%	16.02%	44.20%	35.04%	28.28%	12.84%	45.87%	20.87%	13.47%	35.19%	-10.72%	-46.06%	35.92%	23.30%	27.96%	11.74%	11.52%	70.30%
12	600	4	6.8	39.44%	28.45%	38.73%	28.95%	49.54%	15.09%	45.16%	35.91%	29.22%	13.59%	46.83%	21.82%	14.24%	36.11%	-9.04%	-44.21%	36.80%	24.31%	28.75%	12.53%	12.44%	71.32%
13	600	4	6.8	38.51%	27.60%	37.80%	28.10%	48.54%	14.32%	44.19%	35.00%	28.36%	12.84%	45.86%	21.01%	13.48%	35.20%	-9.65%	-44.58%	35.89%	23.48%	27.90%	11.78%	11.69%	70.18%
14	600	4	6.5	37.61%	26.65%	36.88%	27.08%	47.63%	16.48%	43.28%	34.10%	27.44%	11.92%	44.98%	19.87%	12.52%	34.24%	-10.67%	-49.30%	34.93%	22.50%	27.13%	10.66%	10.82%	69.35%
15	600	4	6.1	37.71%	26.40%	36.88%	27.44%	47.80%	14.19%	43.40%	34.13%	27.47%	11.55%	45.09%	19.86%	12.38%	34.27%	-10.25%	-39.75%	35.03%	22.54%	26.93%	10.87%	10.51%	69.87%
16	600	4	5.7	33.57%	22.58%	32.84%	23.30%	43.45%	8.78%	39.19%	29.98%	23.59%	8.13%	40.84%	16.36%	8.91%	30.22%	-15.36%	-48.35%	30.88%	18.58%	23.18%	7.22%	7.16%	65.20%
17	600	4	5.3	34.68%	23.75%	33.91%	24.10%	44.81%	11.62%	40.44%	31.06%	24.61%	8.77%	42.11%	17.18%	9.50%	31.28%	-15.01%	-54.36%	32.04%	19.40%	24.16%	7.66%	7.68%	67.07%
18	600	4	5.1	32.39%	21.50%	31.68%	22.10%	42.41%	9.38%	38.12%	28.81%	22.28%	7.13%	39.78%	14.80%	7.42%	29.02%	-14.30%	-58.16%	29.73%	17.43%	21.96%	5.40%	6.21%	64.47%
19	600	4	5	31.26%	20.28%	30.45%	20.84%	41.11%	12.32%	36.85%	27.69%	21.25%	5.56%	38.49%	13.80%	6.63%	27.85%	-15.97%	-60.00%	28.64%	16.29%	20.68%	4.83%	5.09%	63.13%
20	600	4	4.9	30.06%	19.09%	29.26%	19.96%	39.80%	7.27%	35.59%	26.47%	20.12%	4.83%	37.18%	12.56%	5.06%	26.74%	-15.41%	-42.69%	27.39%	15.19%	19.61%	3.79%	4.00%	61.74%
21	600	4	4.5	31.25%	20.40%	30.39%	20.83%	41.41%	8.97%	37.05%	27.62%	21.15%	5.90%	38.72%	13.58%	6.00%	27.88%	-15.36%	-50.41%	28.55%	16.21%	20.69%	4.60%	4.68%	63.84%
22	600	4	3.5	25.63%	15.00%	25.06%	15.57%	35.93%	1.66%	31.61%	22.07%	16.01%	0.38%	33.27%	8.82%	0.68%	22.41%	-21.53%	-39.66%	23.09%	10.99%	15.31%	-0.60%	0.00%	58.49%
23	600	4	3	15.26%	4.85%	14.66%	5.92%	24.86%	-3.73%	20.84%	11.84%	6.09%	-8.38%	22.34%	-0.78%	-7.45%	12.25%	-28.48%	-58.10%	12.93%	1.11%	5.77%	-9.40%	-9.64%	46.13%
24	600	4	2.7	18.55%	8.54%	18.40%	8.74%	28.52%	0.25%	24.41%	15.32%	9.11%	-5.78%	25.98%	2.07%	-5.90%	15.71%	-30.35%	#¡DIV/0!	16.03%	4.21%	8.89%	-6.43%	-7.01%	51.08%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	600	4	5.2	31.26%	20.33%	30.41%	21.25%	41.13%	8.57%	36.84%	27.73%	21.36%	5.68%	38.45%	13.83%	6.76%	27.97%	-16.19%	-57.04%	28.60%	16.34%	20.99%	4.67%	5.07%	62.92%
2	600	4	5.1	31.22%	20.42%	30.51%	21.01%	41.14%	8.41%	36.89%	27.67%	21.20%	6.18%	38.54%	13.78%	6.47%	27.87%	-15.06%	-58.53%	28.57%	16.39%	20.88%	4.46%	5.27%	63.01%
3	600	4	5	31.26%	20.28%	30.45%	20.84%	41.11%	12.32%	36.85%	27.69%	21.25%	5.56%	38.49%	13.80%	6.63%	27.85%	-15.97%	-60.00%	28.64%	16.29%	20.68%	4.83%	5.09%	63.13%
4	600	4	5.1	31.22%	20.42%	30.51%	21.01%	41.14%	8.41%	36.89%	27.67%	21.20%	6.18%	38.54%	13.78%	6.47%	27.87%	-15.06%	-58.53%	28.57%	16.39%	20.88%	4.46%	5.27%	63.01%
5	600	4	5.3	31.26%	20.61%	30.51%	20.95%	41.13%	8.79%	36.88%	27.74%	21.45%	6.01%	38.51%	14.20%	6.73%	27.95%	-17.17%	-55.52%	28.69%	16.37%	21.01%	4.92%	4.95%	62.83%
6	600	4	5.9	35.72%	24.55%	34.83%	25.31%	45.71%	14.48%	41.33%	32.15%	25.52%	9.94%	43.02%	18.05%	10.43%	32.29%	-13.63%	-44.13%	33.00%	20.50%	25.11%	8.99%	9.13%	67.59%
7	600	4	7.3	39.40%	28.28%	38.67%	29.06%	49.39%	16.66%	45.03%	35.91%	29.24%	13.84%	46.69%	21.88%	14.34%	36.08%	-8.77%	-49.22%	36.80%	24.38%	28.79%	12.61%	12.65%	70.77%
8	600	4	9.1	45.59%	34.37%	44.83%	34.99%	55.62%	22.26%	51.20%	42.11%	35.23%	19.68%	52.89%	27.80%	20.27%	42.23%	-4.12%	-43.33%	42.94%	30.30%	34.92%	18.31%	18.39%	76.71%
9	600	4	11.8	52.71%	41.32%	51.97%	42.11%	62.78%	28.35%	58.29%	49.31%	42.21%	26.47%	60.02%	34.70%	27.24%	49.36%	2.86%	-39.05%	50.09%	37.31%	41.87%	25.23%	25.19%	83.30%
10	600	4	13	53.54%	42.25%	52.80%	43.02%	63.47%	28.84%	59.01%	50.20%	43.09%	27.54%	60.73%	35.71%	28.31%	50.24%	3.77%	-38.03%	50.91%	38.31%	42.80%	26.21%	26.31%	83.48%
11	600	4	13.4	55.55%	44.17%	54.83%	44.99%	65.58%	30.61%	61.08%	52.21%	45.03%	29.34%	62.81%	37.59%	30.15%	52.23%	5.23%	-38.35%	52.94%	40.18%	44.76%	27.93%	28.11%	85.65%
12	600	4	13.6	56.54%	45.15%	55.82%	45.85%	66.60%	31.91%	62.08%	53.19%	45.96%	30.27%	63.82%	38.46%	30.94%	53.19%	6.45%	-31.34%	53.93%	41.12%	45.68%	28.88%	28.87%	86.69%
13	600	4	13.6	55.50%	44.18%	54.78%	44.88%	65.49%	31.03%	61.00%	52.17%	44.99%	29.41%	62.73%	37.54%	30.06%	52.17%	5.74%	-31.80%	52.90%	40.18%	44.72%	28.02%	28.01%	85.45%
14	600	4	13	54.62%	43.25%	53.87%	44.02%	64.62%	29.75%	60.13%	51.25%	44.10%	28.44%	61.86%	36.66%	29.22%	51.29%	4.50%	-37.60%	51.97%	39.28%	43.81%	27.10%	27.20%	84.77%
15	600	4	12.3	58.20%	50.59%	57.43%	51.35%	66.74%	69.18%	63.42%	55.84%	45.12%	31.84%	50.43%	53.49%	32.45%	174.75%	74.73%	20.50%	38.00%	20.15%	38.73%	19.67%	25.21%	82.80%
16	600	4	11.4	50.44%	39.19%	49.70%	39.93%	60.41%	26.33%	55.97%	47.05%	40.04%	24.39%	57.68%	32.61%	25.22%	47.10%	0.76%	-38.02%	47.83%	35.18%	39.72%	23.24%	23.20%	80.84%
17	600	4	10.7	49.34%	38.08%	48.62%	38.82%	59.34%	24.69%	54.91%	45.92%	38.91%	23.40%	56.61%	31.46%	24.05%	46.00%	-0.28%	-45.23%	46.72%	34.02%	38.63%	21.93%	22.18%	80.02%
18	600	4	10.2	49.46%	38.13%	48.70%	38.92%	59.60%	24.39%	55.10%	46.01%	39.00%	23.28%	56.84%	31.47%	23.88%	46.09%	0.09%	-37.24%	46.80%	34.10%	38.64%	21.97%	22.05%	80.55%
19	600	4	10	48.20%	36.87%	47.43%	37.73%	58.24%	23.78%	53.80%	44.74%	37.75%	22.17%	55.50%	30.28%	22.74%	44.84%	-1.43%	-40.00%	45.55%	32.86%	37.42%	20.86%	20.93%	79.15%
20	600	4	9.8	46.87%	35.66%	46.10%	36.39%	56.89%	23.25%	52.46%	43.43%	36.50%	20.98%	54.16%	29.06%	21.65%	43.55%	-2.19%	-42.69%	44.25%	31.60%	36.20%	19.60%	19.71%	77.72%
21	600	4	9.1	45.59%	34.37%	44.83%	34.99%	55.62%	22.26%	51.20%	42.11%	35.23%	19.68%	52.89%	27.80%	20.27%	42.23%	-4.12%	-43.33%	42.94%	30.30%	34.92%	18.31%	18.39%	76.71%
22	600	4	7.1	39.41%	28.29%	38.64%	29.23%	49.44%	15.08%	45.06%	35.92%	29.20%	13.78%	46.74%	21.77%	14.24%	36.08%	-8.45%	-39.66%	36.77%	24.36%	28.82%	12.53%	12.56%	70.97%
23	600	4	5.9	35.72%	24.55%	34.83%	25.31%	45.71%	14.48%	41.33%	32.15%	25.52%	9.94%	43.02%	18.05%	10.43%	32.29%	-13.63%	-44.13%	33.00%	20.50%	25.11%	8.99%	9.13%	67.59%
24	600	4	5.5	31.27%	20.49%	30.69%	21.44%	41.08%	6.15%	36.87%	27.84%	21.47%	6.45%	38.47%	14.36%	6.84%	28.04%	-17.02%	-52.40%	28.82%	16.41%	21.13%	5.12%	5.29%	62.69%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	600	4	7.8	41.08%	29.93%	40.38%	30.78%	51.04%	18.20%	46.70%	37.61%	30.87%	15.39%	48.36%	23.40%	16.16%	37.77%	-6.82%	-51.67%	38.47%	25.99%	30.54%	14.00%	14.26%	72.37%
2	600	4	7.6	42.79%	31.50%	42.06%	32.33%	52.96%	17.90%	48.53%	39.24%	32.49%	16.63%	50.22%	24.90%	17.39%	39.44%	-6.77%	-53.35%	40.11%	27.39%	32.13%	15.28%	15.74%	74.64%
3	600	4	7.5	41.14%	30.00%	40.37%	30.64%	51.16%	17.65%	46.77%	37.62%	30.86%	15.22%	48.46%	23.33%	15.96%	37.74%	-6.66%	-46.00%	38.50%	25.94%	30.50%	13.91%	14.24%	72.68%
4	600	4	7.6	42.79%	31.50%	42.06%	32.33%	52.96%	17.90%	48.53%	39.24%	32.49%	16.63%	50.22%	24.90%	17.39%	39.44%	-6.77%	-53.35%	40.11%	27.39%	32.13%	15.28%	15.74%	74.64%
5	600	4	7.9	42.73%	31.49%	42.01%	32.20%	52.77%	20.45%	48.38%	39.23%	32.41%	16.64%	50.06%	24.88%	17.43%	39.37%	-6.82%	-39.95%	40.09%	27.38%	32.05%	15.67%	15.58%	74.27%
6	600	4	8.9	44.15%	33.00%	43.38%	33.71%	54.10%	20.64%	49.71%	40.70%	33.90%	18.28%	51.40%	26.46%	19.00%	40.83%	-4.64%	-37.15%	41.50%	29.00%	33.55%	17.11%	17.07%	75.13%
7	600	4	10.9	50.53%	39.25%	49.82%	40.02%	60.61%	25.53%	56.15%	47.11%	40.11%	24.31%	57.86%	32.58%	25.11%	47.20%	1.31%	-36.53%	47.92%	35.23%	39.77%	23.05%	23.18%	81.33%
8	600	4	13.6	56.54%	45.15%	55.82%	45.85%	66.60%	31.91%	62.08%	53.19%	45.96%	30.27%	63.82%	38.46%	30.94%	53.19%	6.45%	-31.34%	53.93%	41.12%	45.68%	28.88%	28.87%	86.69%
9	600	4	17.7	62.58%	51.19%	61.87%	51.94%	72.50%	37.13%	67.97%	59.35%	51.99%	36.51%	69.72%	44.61%	37.19%	59.29%	12.25%	-31.43%	59.99%	47.26%	51.78%	34.91%	35.05%	91.52%
10	600	4	19.4	64.81%	53.44%	64.09%	54.15%	74.67%	39.22%	70.14%	61.63%	54.22%	38.80%	71.89%	46.90%	39.52%	61.55%	14.32%	-27.50%	62.24%	49.54%	54.04%	37.21%	37.27%	93.29%
11	600	4	20.1	65.34%	54.01%	64.62%	54.72%	75.16%	39.42%	70.64%	62.18%	54.78%	39.41%	72.38%	47.51%	40.13%	62.09%	15.04%	-28.08%	62.78%	50.13%	54.58%	37.83%	37.90%	93.58%
12	600	4	20.5	64.85%	53.58%	64.13%	54.31%	74.60%	39.05%	70.10%	61.72%	54.34%	39.13%	71.84%	47.11%	39.83%	61.62%	14.98%	-28.27%	62.31%	49.73%	54.16%	37.52%	37.55%	92.82%
13	600	4	20.4	65.24%	53.93%	64.53%	54.69%	75.03%	39.27%	70.52%	62.10%	54.70%	39.42%	72.26%	47.45%	40.12%	62.00%	15.18%	-28.75%	62.70%	50.09%	54.53%	37.75%	37.91%	93.33%
14	600	4	19.5	64.40%	53.07%	63.67%	53.79%	74.22%	38.52%	69.70%	61.22%	53.85%	38.48%	71.45%	46.55%	39.20%	61.14%	14.33%	-29.80%	61.84%	49.18%	53.64%	36.91%	36.94%	92.76%
15	600	4	18.4	63.18%	51.79%	62.45%	52.57%	73.05%	37.49%	68.53%	59.96%	52.59%	37.20%	70.27%	45.27%	37.89%	59.90%	12.76%	-29.27%	60.59%	47.91%	52.41%	35.61%	35.65%	91.86%
16	600	4	17	61.98%	50.57%	61.24%	51.31%	71.93%	36.08%	67.40%	58.71%	51.36%	35.85%	69.15%	43.96%	36.48%	58.66%	11.70%	-30.27%	59.38%	46.60%	51.14%	34.25%	34.34%	91.17%
17	600	4	16	60.11%	48.72%	59.38%	49.45%	70.07%	34.82%	65.55%	56.83%	49.52%	33.96%	67.30%	42.10%	34.69%	56.78%	9.98%	-35.14%	57.50%	44.78%	49.29%	32.40%	32.58%	89.51%
18	600	4	15.3	59.41%	47.98%	58.68%	48.75%	69.43%	34.03%	64.90%	56.11%	48.83%	33.21%	66.65%	41.38%	33.88%	56.09%	9.02%	-33.55%	56.80%	44.00%	48.58%	31.67%	31.79%	89.09%
19	600	4	15	58.09%	46.76%	57.36%	47.49%	68.06%	32.49%	63.55%	54.79%	47.55%	31.96%	65.30%	40.16%	32.74%	54.78%	7.65%	-36.47%	55.48%	42.74%	47.32%	30.46%	30.63%	87.69%
20	600	4	14.7	56.73%	45.43%	55.99%	46.18%	66.64%	31.65%	62.17%	53.43%	46.24%	30.76%	63.89%	38.86%	31.52%	53.44%	7.11%	-35.53%	54.13%	41.47%	46.00%	29.29%	29.37%	86.24%
21	600	4	13.6	56.54%	45.15%	55.82%	45.85%	66.60%	31.91%	62.08%	53.19%	45.96%	30.27%	63.82%	38.46%	30.94%	53.19%	6.45%	-31.34%	53.93%	41.12%	45.68%	28.88%	28.87%	86.69%
22	600	4	10.6	50.63%	39.30%	49.89%	40.03%	60.77%	25.90%	56.27%	47.19%	40.14%	24.30%	57.99%	32.57%	25.07%	47.27%	0.89%	-39.66%	48.01%	35.19%	39.82%	22.95%	23.19%	81.67%
23	600	4	8.9	44.15%	33.00%	43.38%	33.71%	54.10%	20.64%	49.71%	40.70%	33.90%	18.28%	51.40%	26.46%	19.00%	40.83%	-4.64%	-37.15%	41.50%	29.00%	33.55%	17.11%	17.07%	75.13%
24	600	4	8.2	42.71%	31.47%	41.94%	32.23%	52.67%	19.42%	48.29%	39.21%	32.45%	16.73%	49.97%	25.02%	17.55%	39.34%	-6.64%	-46.44%	40.07%	27.44%	32.07%	15.55%	15.69%	73.95%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	600	6	2.6	-3.71%	-11.88%	-5.31%	-15.66%	5.50%	-3.57%	1.50%	-7.35%	-11.24%	-26.63%	3.91%	-16.21%	-25.38%	-8.34%	-47.57%	#¡DIV/0!	-6.79%	-14.88%	-12.89%	-26.13%	-29.95%	23.88%
2	600	6	2.5	-0.42%	-9.28%	-2.07%	-13.51%	9.28%	-6.93%	5.08%	-4.53%	-9.57%	-22.74%	6.69%	-14.37%	-21.43%	-4.59%	-49.39%	#¡DIV/0!	-2.97%	-13.93%	-10.50%	-19.78%	-25.62%	28.47%
3	600	6	2.5	-3.94%	-12.49%	-5.54%	-16.57%	5.41%	-10.22%	1.36%	-7.91%	-12.77%	-25.47%	2.92%	-17.40%	-24.21%	-7.97%	-51.19%	#¡DIV/0!	-6.41%	-16.98%	-13.66%	-22.62%	-28.26%	23.92%
4	600	6	2.5	-0.42%	-9.28%	-2.07%	-13.51%	9.28%	-6.93%	5.08%	-4.53%	-9.57%	-22.74%	6.69%	-14.37%	-21.43%	-4.59%	-49.39%	#¡DIV/0!	-2.97%	-13.93%	-10.50%	-19.78%	-25.62%	28.47%
5	600	6	2.6	-0.30%	-8.76%	-1.96%	-12.68%	9.23%	-0.16%	5.09%	-4.08%	-8.10%	-24.03%	7.58%	-13.25%	-22.74%	-5.10%	-45.71%	#¡DIV/0!	-3.49%	-11.87%	-9.81%	-23.51%	-27.47%	28.27%
6	600	6	3	-2.85%	-12.69%	-4.46%	-11.22%	5.90%	-37.30%	2.06%	-6.69%	-12.28%	-23.67%	3.94%	-18.28%	-22.38%	-6.35%	-31.82%	#¡DIV/0!	-6.10%	-16.03%	-13.07%	-21.40%	-28.42%	24.21%
7	600	6	3.6	5.38%	-4.23%	4.92%	-5.86%	15.74%	-5.03%	11.73%	1.53%	-2.30%	-17.41%	13.08%	-7.16%	-16.01%	2.38%	-48.36%	-92.55%	3.05%	-7.78%	-4.03%	-18.15%	-15.67%	34.95%
8	600	6	4.5	10.22%	0.92%	9.29%	0.29%	21.59%	-1.07%	16.71%	7.27%	0.79%	-12.58%	18.89%	-5.27%	-11.10%	7.01%	-35.45%	#¡DIV/0!	8.08%	-3.94%	1.70%	-14.74%	-15.30%	40.16%
9	600	6	5.9	15.00%	3.29%	13.09%	5.04%	25.43%	0.32%	20.86%	10.99%	5.05%	-8.40%	22.84%	-0.70%	-6.85%	11.11%	-31.82%	-80.34%	12.04%	0.42%	5.30%	-11.33%	-8.90%	44.16%
10	600	6	6.5	15.74%	4.90%	14.30%	6.68%	26.41%	-13.90%	21.75%	12.12%	6.46%	-8.28%	23.70%	1.36%	-5.15%	12.13%	-27.18%	-76.37%	13.62%	1.77%	5.07%	-7.66%	-9.13%	44.93%
11	600	6	6.7	17.00%	7.29%	15.99%	7.87%	28.18%	-7.76%	23.49%	13.71%	8.06%	-6.41%	25.37%	2.01%	-6.32%	14.05%	-29.78%	#¡DIV/0!	14.81%	2.78%	7.54%	-7.25%	-7.86%	46.86%
12	600	6	6.8	17.68%	7.30%	17.10%	9.11%	28.84%	-4.60%	24.31%	14.41%	8.64%	-6.19%	26.24%	2.40%	-4.60%	14.47%	-19.31%	#¡DIV/0!	15.64%	4.58%	7.61%	-6.04%	-6.38%	47.81%
13	600	6	6.8	16.90%	6.58%	16.32%	8.38%	27.98%	-5.24%	23.49%	13.65%	7.92%	-6.82%	25.40%	1.71%	-5.24%	13.70%	-19.85%	#¡DIV/0!	14.87%	3.89%	6.89%	-6.66%	-7.00%	46.82%
14	600	6	6.5	16.55%	5.64%	15.10%	7.43%	27.30%	-13.30%	22.60%	12.91%	7.21%	-7.64%	24.57%	2.07%	-4.48%	12.92%	-26.67%	-76.21%	14.42%	2.49%	5.80%	-7.01%	-8.49%	45.95%
15	600	6	6.1	16.30%	5.45%	14.92%	7.23%	27.33%	-9.85%	22.53%	12.79%	6.89%	-6.81%	24.54%	1.93%	-5.23%	12.67%	-26.48%	-78.80%	14.12%	2.98%	6.08%	-9.04%	-8.03%	46.22%
16	600	6	5.7	12.64%	2.73%	11.98%	2.91%	23.33%	-7.25%	18.90%	9.31%	3.31%	-9.91%	20.70%	-1.99%	-8.38%	9.70%	-27.96%	-81.82%	10.56%	-1.04%	2.40%	-11.18%	-9.61%	41.99%
17	600	6	5.3	13.66%	3.30%	12.47%	3.26%	24.45%	2.44%	19.76%	10.29%	4.62%	-10.92%	21.97%	-1.40%	-9.41%	9.86%	-25.74%	#¡DIV/0!	11.15%	0.73%	3.52%	-11.71%	-11.50%	43.40%
18	600	6	5.1	11.79%	-0.14%	10.66%	3.43%	22.18%	-6.09%	17.64%	8.41%	2.64%	-12.05%	19.75%	-3.69%	-10.57%	7.90%	-31.92%	#¡DIV/0!	9.73%	-2.74%	1.80%	-10.69%	-14.24%	41.07%
19	600	6	5	10.53%	0.98%	9.44%	0.75%	20.89%	-10.22%	16.64%	6.89%	2.12%	-13.71%	18.34%	-3.16%	-9.88%	7.29%	-34.91%	-85.92%	8.48%	-3.14%	1.00%	-14.62%	-13.04%	39.88%
20	600	6	4.9	9.31%	0.30%	8.26%	-0.01%	20.08%	-14.25%	15.42%	6.26%	0.81%	-13.01%	17.33%	-5.89%	-13.93%	6.10%	-25.41%	#¡DIV/0!	7.26%	-3.47%	0.24%	-15.54%	-14.35%	38.63%
21	600	6	4.5	10.22%	0.92%	9.29%	0.29%	21.59%	-1.07%	16.71%	7.27%	0.79%	-12.58%	18.89%	-5.27%	-11.10%	7.01%	-35.45%	#¡DIV/0!	8.08%	-3.94%	1.70%	-14.74%	-15.30%	40.16%
22	600	6	3.5	5.38%	-5.71%	4.99%	-4.11%	15.90%	-9.72%	11.36%	2.28%	-2.83%	-17.56%	13.12%	-8.90%	-16.17%	2.61%	-34.55%	#¡DIV/0!	3.22%	-7.72%	-3.88%	-17.00%	-19.84%	35.05%
23	600	6	3	-2.85%	-12.69%	-4.46%	-11.22%	5.90%	-37.30%	2.06%	-6.69%	-12.28%	-23.67%	3.94%	-18.28%	-22.38%	-6.35%	-31.82%	#¡DIV/0!	-6.10%	-16.03%	-13.07%	-21.40%	-28.42%	24.21%
24	600	6	2.7	-2.01%	-8.10%	-1.64%	-11.74%	9.43%	6.85%	5.33%	-4.59%	-8.85%	-24.95%	6.60%	-16.44%	-17.32%	-3.69%	-41.91%	-95.81%	-2.06%	-17.00%	-9.00%	-26.33%	-22.38%	28.22%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	600	6	5.2	10.40%	0.71%	9.26%	2.41%	21.36%	-22.86%	16.62%	7.24%	2.21%	-14.10%	18.75%	-4.24%	-10.46%	7.26%	-30.09%	#¡DIV/0!	8.50%	-3.97%	0.86%	-11.35%	-14.38%	39.80%
2	600	6	5.1	10.79%	-1.03%	9.68%	2.51%	21.09%	-6.93%	16.60%	7.44%	1.73%	-12.83%	18.69%	-4.54%	-11.36%	6.94%	-32.53%	#¡DIV/0!	8.75%	-3.60%	0.89%	-11.49%	-15.00%	39.82%
3	600	6	5	10.53%	0.98%	9.44%	0.75%	20.89%	-10.22%	16.64%	6.89%	2.12%	-13.71%	18.34%	-3.16%	-9.88%	7.29%	-34.91%	-85.92%	8.48%	-3.14%	1.00%	-14.62%	-13.04%	39.88%
4	600	6	5.1	10.79%	-1.03%	9.68%	2.51%	21.09%	-6.93%	16.60%	7.44%	1.73%	-12.83%	18.69%	-4.54%	-11.36%	6.94%	-32.53%	#¡DIV/0!	8.75%	-3.60%	0.89%	-11.49%	-15.00%	39.82%
5	600	6	5.3	10.78%	0.68%	9.61%	0.64%	21.29%	-0.16%	16.72%	7.49%	1.96%	-13.18%	18.88%	-3.90%	-11.71%	7.07%	-27.62%	#¡DIV/0!	8.33%	-1.83%	0.89%	-13.95%	-13.75%	39.76%
6	600	6	5.9	15.00%	3.29%	13.09%	5.04%	25.43%	0.32%	20.86%	10.99%	5.05%	-8.40%	22.84%	-0.70%	-6.85%	11.11%	-31.82%	-80.34%	12.04%	0.42%	5.30%	-11.33%	-8.90%	44.16%
7	600	6	7.3	110.76%	91.54%	108.54%	91.47%	130.75%	89.95%	122.06%	104.50%	93.98%	65.18%	126.16%	82.82%	67.98%	103.70%	37.70%	#¡DIV/0!	106.09%	86.77%	91.95%	63.71%	64.10%	165.89%
8	600	6	9.1	23.78%	12.71%	22.57%	13.88%	34.78%	-1.07%	30.04%	20.14%	14.39%	-0.55%	32.02%	8.58%	1.13%	20.28%	-19.31%	-53.46%	21.38%	9.78%	13.43%	-1.38%	-1.18%	53.44%
9	600	6	11.8	30.29%	19.25%	29.05%	20.29%	41.51%	5.60%	36.61%	26.80%	20.37%	5.90%	38.67%	14.52%	7.07%	26.83%	-16.09%	-21.35%	27.90%	15.61%	19.86%	4.80%	4.79%	60.18%
10	600	6	13	31.15%	20.30%	29.91%	21.50%	42.39%	4.81%	37.47%	27.78%	21.32%	6.86%	39.58%	15.66%	8.14%	27.69%	-15.44%	-52.75%	28.81%	16.75%	20.78%	5.20%	5.85%	60.73%
11	600	6	13.4	32.95%	21.82%	31.64%	23.09%	44.32%	12.30%	39.34%	29.57%	22.91%	8.68%	41.42%	17.09%	9.51%	29.47%	-14.89%	-49.38%	30.65%	18.30%	22.41%	7.28%	7.50%	62.76%
12	600	6	13.6	33.82%	22.82%	32.48%	24.11%	45.21%	11.30%	40.21%	30.46%	23.75%	9.37%	42.35%	17.68%	10.23%	30.27%	-11.98%	-47.64%	31.49%	19.25%	23.26%	7.70%	7.81%	63.74%
13	600	6	13.6	32.93%	22.00%	31.60%	23.29%	44.24%	10.56%	39.28%	29.60%	22.92%	8.65%	41.40%	16.90%	9.50%	29.40%	-12.57%	-47.99%	30.62%	18.45%	22.44%	6.98%	7.09%	62.65%
14	600	6	13	32.07%	21.14%	30.83%	22.36%	43.39%	5.55%	38.43%	28.67%	22.18%	7.61%	40.57%	16.47%	8.90%	28.59%	-14.84%	-52.42%	29.71%	17.57%	21.63%	5.94%	6.59%	61.86%
15	600	6	12.3	30.16%	19.38%	29.03%	20.49%	41.41%	8.18%	36.50%	26.91%	20.31%	6.22%	38.61%	14.32%	6.86%	26.67%	-15.97%	-57.59%	27.95%	15.75%	19.89%	4.32%	4.79%	59.91%
16	600	6	11.4	28.24%	17.41%	26.89%	18.88%	39.41%	3.05%	34.55%	24.82%	18.40%	4.55%	36.62%	12.45%	5.03%	24.81%	-15.95%	-27.28%	25.95%	13.64%	17.90%	3.14%	2.94%	57.89%
17	600	6	10.7	27.21%	16.33%	25.96%	17.73%	38.30%	2.44%	33.48%	23.79%	17.48%	3.22%	35.55%	11.46%	4.24%	23.65%	-18.98%	-67.87%	25.02%	12.47%	16.89%	1.81%	2.33%	56.93%
18	600	6	10.2	27.15%	16.24%	25.99%	17.58%	38.43%	0.17%	33.55%	23.69%	17.57%	3.15%	35.60%	11.37%	4.12%	23.70%	-14.01%	-70.55%	24.81%	13.09%	16.64%	1.56%	1.75%	57.21%
19	600	6	10	26.08%	14.77%	24.96%	16.71%	37.20%	2.61%	32.39%	22.64%	16.31%	2.47%	34.48%	10.67%	3.40%	22.51%	-21.90%	-71.84%	23.78%	11.58%	15.74%	1.06%	0.69%	55.92%
20	600	6	9.8	25.05%	13.97%	23.73%	15.25%	35.89%	5.53%	31.19%	21.51%	15.08%	1.85%	33.18%	9.48%	1.91%	21.57%	-21.48%	-46.22%	22.59%	10.55%	14.56%	0.63%	-0.33%	54.60%
21	600	6	9.1	23.78%	12.71%	22.57%	13.88%	34.78%	-1.07%	30.04%	20.14%	14.39%	-0.55%	32.02%	8.58%	1.13%	20.28%	-19.31%	-53.46%	21.38%	9.78%	13.43%	-1.38%	-1.18%	53.44%
22	600	6	7.1	18.03%	7.76%	16.49%	8.48%	29.01%	3.18%	24.22%	14.69%	8.43%	-4.42%	26.14%	2.70%	-4.19%	14.78%	-28.60%	-71.69%	15.66%	3.90%	8.20%	-6.04%	-6.91%	47.64%
23	600	6	5.9	15.00%	3.29%	13.09%	5.04%	25.43%	0.32%	20.86%	10.99%	5.05%	-8.40%	22.84%	-0.70%	-6.85%	11.11%	-31.82%	-80.34%	12.04%	0.42%	5.30%	-11.33%	-8.90%	44.16%
24	600	6	5.5	11.01%	-0.81%	9.80%	2.49%	21.38%	-14.52%	16.86%	7.41%	1.69%	-11.31%	18.69%	-3.12%	-9.81%	7.94%	-33.61%	-83.25%	8.20%	-2.36%	1.12%	-13.33%	-12.43%	39.73%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	600	6	7.8	19.63%	8.45%	18.37%	10.29%	30.55%	8.48%	25.77%	16.38%	9.98%	-3.36%	27.75%	3.61%	-2.91%	16.34%	-21.36%	-65.98%	17.40%	5.33%	9.62%	-5.02%	-5.00%	49.15%
2	600	6	7.6	21.04%	10.34%	19.79%	11.20%	31.99%	4.71%	27.33%	17.52%	11.40%	-3.18%	29.32%	5.66%	-1.54%	17.41%	-24.09%	-67.16%	18.76%	7.02%	10.98%	-5.32%	-2.99%	51.04%
3	600	6	7.5	19.84%	8.39%	18.23%	10.22%	30.52%	1.00%	25.82%	16.15%	9.97%	-4.18%	27.85%	4.44%	-2.56%	16.05%	-26.78%	-68.32%	17.37%	5.31%	9.49%	-5.57%	-5.04%	49.29%
4	600	6	7.6	21.04%	10.34%	19.79%	11.20%	31.99%	4.71%	27.33%	17.52%	11.40%	-3.18%	29.32%	5.66%	-1.54%	17.41%	-24.09%	-67.16%	18.76%	7.02%	10.98%	-5.32%	-2.99%	51.04%
5	600	6	7.9	20.90%	10.41%	19.96%	11.34%	32.08%	-0.16%	27.32%	17.59%	11.45%	-2.32%	29.45%	5.67%	-1.84%	17.44%	-24.84%	-64.78%	18.84%	6.40%	11.15%	-4.69%	-2.96%	50.83%
6	600	6	8.9	22.50%	11.49%	21.05%	13.38%	33.48%	2.60%	28.66%	19.14%	12.78%	-0.91%	30.76%	6.98%	-0.20%	18.96%	-23.30%	-55.76%	20.00%	8.50%	12.14%	-1.50%	-3.03%	51.99%
7	600	6	10.9	28.25%	17.35%	27.18%	18.22%	39.36%	6.85%	34.52%	24.88%	18.41%	4.07%	36.65%	12.34%	5.12%	24.65%	-15.50%	-32.99%	26.06%	13.69%	17.70%	3.39%	2.71%	58.15%
8	600	6	13.6	33.82%	22.82%	32.48%	24.11%	45.21%	11.30%	40.21%	30.46%	23.75%	9.37%	42.35%	17.68%	10.23%	30.27%	-11.98%	-47.64%	31.49%	19.25%	23.26%	7.70%	7.81%	63.74%
9	600	6	17.7	39.61%	28.41%	38.43%	29.58%	50.96%	15.75%	45.95%	36.29%	29.42%	14.82%	48.08%	23.43%	16.11%	36.18%	-5.60%	-41.01%	37.30%	24.88%	28.78%	13.59%	13.44%	69.19%
10	600	6	19.4	41.79%	30.65%	40.50%	31.56%	53.18%	17.92%	48.10%	38.48%	31.48%	17.09%	50.29%	25.49%	18.23%	38.26%	-4.87%	-46.84%	39.44%	26.91%	31.03%	15.42%	15.59%	71.19%
11	600	6	20.1	42.39%	30.92%	41.10%	32.32%	53.71%	18.60%	48.65%	39.06%	31.99%	17.66%	50.82%	26.06%	18.86%	38.86%	-4.25%	-43.05%	39.99%	27.52%	31.54%	16.14%	16.10%	71.62%
12	600	6	20.5	41.92%	30.77%	40.74%	32.00%	53.28%	17.84%	48.20%	38.74%	31.63%	17.51%	50.36%	25.84%	18.49%	38.48%	-5.28%	-41.10%	39.71%	27.14%	31.26%	15.75%	16.01%	71.05%
13	600	6	20.4	42.32%	31.07%	41.08%	32.09%	53.64%	19.40%	48.58%	39.04%	32.00%	17.49%	50.76%	26.01%	18.96%	38.78%	-4.53%	-41.49%	40.01%	27.40%	31.54%	16.28%	16.08%	71.47%
14	600	6	19.5	41.39%	30.28%	40.25%	31.42%	52.78%	16.22%	47.73%	38.15%	31.13%	16.81%	49.88%	25.27%	17.95%	37.96%	-5.72%	-28.63%	39.15%	26.58%	30.68%	15.52%	15.17%	70.75%
15	600	6	18.4	40.23%	28.95%	38.97%	30.18%	51.63%	18.74%	46.56%	36.95%	29.98%	15.46%	48.73%	24.01%	16.80%	36.69%	-7.13%	-52.29%	37.96%	25.38%	29.57%	13.78%	14.08%	69.67%
16	600	6	17	39.03%	27.93%	37.74%	28.75%	50.38%	15.94%	45.34%	35.67%	28.73%	14.44%	47.50%	22.93%	15.34%	35.53%	-7.38%	-45.46%	36.63%	24.31%	28.13%	12.85%	13.06%	68.69%
17	600	6	16	37.30%	25.98%	36.03%	27.22%	48.62%	15.25%	43.61%	33.93%	27.08%	12.62%	45.78%	21.17%	13.77%	33.71%	-8.86%	-27.72%	34.94%	22.63%	26.51%	11.52%	11.21%	66.94%
18	600	6	15.3	36.49%	25.46%	35.32%	26.61%	47.94%	12.69%	42.89%	33.23%	26.47%	11.84%	45.08%	20.44%	12.92%	32.99%	-10.34%	-33.74%	34.23%	21.80%	25.97%	10.47%	10.27%	66.37%
19	600	6	15	35.36%	24.36%	34.11%	25.47%	46.71%	11.45%	41.70%	32.03%	25.33%	10.95%	43.86%	19.51%	11.98%	31.91%	-12.13%	-36.65%	33.00%	20.70%	24.81%	9.78%	9.44%	65.05%
20	600	6	14.7	34.15%	23.32%	32.95%	24.05%	45.39%	14.33%	40.48%	30.82%	24.10%	9.67%	42.57%	18.04%	11.10%	30.67%	-11.67%	-39.50%	31.92%	19.41%	23.68%	8.59%	8.19%	63.68%
21	600	6	13.6	33.82%	22.82%	32.48%	24.11%	45.21%	11.30%	40.21%	30.46%	23.75%	9.37%	42.35%	17.68%	10.23%	30.27%	-11.98%	-47.64%	31.49%	19.25%	23.26%	7.70%	7.81%	63.74%
22	600	6	10.6	28.35%	17.05%	26.88%	19.03%	39.57%	1.57%	34.62%	24.85%	18.42%	4.50%	36.70%	12.47%	4.79%	24.76%	-15.85%	-36.29%	25.95%	13.93%	17.87%	2.80%	2.26%	58.33%
23	600	6	8.9	22.50%	11.49%	21.05%	13.38%	33.48%	2.60%	28.66%	19.14%	12.78%	-0.91%	30.76%	6.98%	-0.20%	18.96%	-23.30%	-55.76%	20.00%	8.50%	12.14%	-1.50%	-3.03%	51.99%
24	600	6	8.2	21.04%	10.71%	19.70%	10.84%	32.07%	6.85%	27.24%	17.72%	11.37%	-2.44%	29.20%	5.17%	-1.88%	17.74%	-19.56%	-62.30%	18.62%	7.32%	10.68%	-3.91%	-2.73%	50.69%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	600	8	2.6	-25.01%	-27.52%	-20.27%	-25.64%	-9.93%	#¡DIV/0!	-13.44%	-24.55%	-29.68%	-39.60%	-11.48%	-36.37%	-38.03%	-25.75%	#¡DIV/0!	#¡DIV/0!	-23.82%	-22.75%	-34.00%	-31.39%	-47.01%	1.98%
2	600	8	2.5	-21.04%	-30.04%	-15.34%	-28.22%	-8.92%	#¡DIV/0!	-11.06%	-23.34%	-24.59%	-41.70%	-11.00%	-23.23%	-40.19%	-16.39%	-79.14%	#¡DIV/0!	-20.82%	-37.86%	-28.33%	-33.77%	-23.27%	5.75%
3	600	8	2.5	-23.84%	-32.51%	-18.34%	-30.76%	-12.15%	#¡DIV/0!	-14.21%	-26.05%	-27.26%	-43.76%	-14.15%	-25.95%	-42.30%	-19.35%	-79.88%	#¡DIV/0!	-23.62%	-40.06%	-30.86%	-36.12%	-25.99%	2.01%
4	600	8	2.5	-21.04%	-30.04%	-15.34%	-28.22%	-8.92%	#¡DIV/0!	-11.06%	-23.34%	-24.59%	-41.70%	-11.00%	-23.23%	-40.19%	-16.39%	-79.14%	#¡DIV/0!	-20.82%	-37.86%	-28.33%	-33.77%	-23.27%	5.75%
5	600	8	2.6	-22.36%	-24.95%	-17.45%	-23.00%	-6.74%	#¡DIV/0!	-10.38%	-21.88%	-27.20%	-37.46%	-8.35%	-34.12%	-35.84%	-23.12%	#¡DIV/0!	#¡DIV/0!	-21.13%	-20.02%	-31.66%	-28.96%	-45.13%	5.59%
6	600	8	3	-16.42%	-37.16%	-23.97%	-22.64%	-11.15%	#¡DIV/0!	-15.58%	-21.51%	-29.66%	-41.09%	-12.79%	-31.05%	-39.56%	-24.90%	-71.89%	#¡DIV/0!	-22.95%	-28.25%	-29.77%	-40.52%	-31.09%	2.60%
7	600	8	3.6	-11.37%	-18.41%	-17.73%	-26.76%	-2.42%	#¡DIV/0!	-7.76%	-15.07%	-23.05%	-28.61%	-5.23%	-30.37%	-26.76%	-18.09%	#¡DIV/0!	#¡DIV/0!	-12.47%	-23.91%	-21.99%	-32.42%	-37.37%	11.74%
8	600	8	4.5	-7.68%	-18.88%	-12.92%	-16.77%	3.37%	-39.34%	-2.31%	-12.37%	-16.76%	-30.28%	0.17%	-18.40%	-28.47%	-11.13%	-33.48%	#¡DIV/0!	-11.28%	-20.74%	-20.50%	-29.61%	-30.10%	16.16%
9	600	8	5.9	-6.39%	-16.22%	-6.90%	-14.04%	6.26%	2.52%	1.08%	-8.73%	-12.92%	-27.50%	3.71%	-17.26%	-25.61%	-9.88%	-43.79%	#¡DIV/0!	-5.98%	-19.63%	-14.17%	-28.62%	-24.82%	19.87%
10	600	8	6.5	-4.68%	-13.71%	-7.09%	-11.47%	6.76%	-38.41%	2.02%	-8.43%	-12.11%	-24.50%	4.00%	-13.55%	-22.54%	-7.19%	-54.97%	#¡DIV/0!	-7.42%	-16.76%	-11.60%	-28.53%	-23.57%	20.67%
11	600	8	6.7	-1.22%	-11.75%	-3.72%	-9.46%	9.66%	31.98%	5.10%	-4.67%	-11.16%	-24.16%	3.63%	-11.23%	-17.01%	-9.60%	-27.64%	#¡DIV/0!	-8.44%	61.65%	-13.52%	-23.42%	-29.03%	22.27%
12	600	8	6.8	-2.63%	-12.70%	-3.59%	-10.44%	8.91%	-31.76%	4.11%	-5.85%	-9.82%	-21.57%	6.43%	-11.87%	-24.27%	-5.28%	-50.11%	#¡DIV/0!	-4.08%	-16.41%	-10.57%	-26.90%	-21.36%	23.05%
13	600	8	6.8	-3.28%	-13.28%	-4.23%	-11.03%	8.18%	-32.21%	3.42%	-6.48%	-10.42%	-22.09%	5.72%	-12.46%	-24.77%	-5.91%	-50.44%	#¡DIV/0!	-4.72%	-16.97%	-11.16%	-27.38%	-21.88%	22.24%
14	600	8	6.5	-4.01%	-13.10%	-6.44%	-10.85%	7.51%	-37.98%	2.73%	-7.79%	-11.49%	-23.97%	4.73%	-12.94%	-21.99%	-6.54%	-54.66%	#¡DIV/0!	-6.77%	-16.17%	-10.98%	-28.02%	-23.03%	21.52%
15	600	8	6.1	-2.93%	-14.40%	-5.39%	-12.18%	7.91%	-44.72%	3.37%	-7.99%	-10.36%	-27.40%	5.20%	-15.02%	-19.78%	-7.45%	-39.38%	#¡DIV/0!	-5.04%	-16.67%	-12.31%	-23.02%	-25.68%	21.52%
16	600	8	5.7	-5.93%	-17.98%	-8.31%	-15.85%	3.58%	-5.22%	-0.46%	-10.40%	-15.46%	-27.38%	1.36%	-19.47%	-25.49%	-10.73%	-48.03%	#¡DIV/0!	-8.41%	-19.24%	-15.97%	-26.67%	-23.54%	18.06%
17	600	8	5.3	-6.74%	-12.00%	-9.10%	-15.73%	5.25%	-16.25%	0.32%	-9.68%	-14.63%	-23.00%	2.22%	-20.47%	-28.18%	-9.85%	-8.16%	#¡DIV/0!	-7.51%	-17.93%	-15.86%	-27.11%	-24.94%	19.11%
18	600	8	5.1	-7.76%	-19.33%	-10.09%	-17.23%	4.31%	-23.22%	-1.53%	-10.93%	-14.40%	-29.41%	1.42%	-17.38%	-27.58%	-11.97%	-57.90%	#¡DIV/0!	-9.69%	-20.81%	-17.35%	-23.63%	-31.19%	17.06%
19	600	8	5	-6.91%	-22.87%	-11.72%	-14.78%	2.49%	-26.60%	-2.40%	-12.19%	-15.53%	-32.52%	-0.70%	-21.01%	-23.07%	-12.02%	-19.51%	#¡DIV/0!	-9.73%	-20.08%	-18.06%	-26.99%	-34.21%	16.10%
20	600	8	4.9	-8.56%	-20.67%	-13.35%	-18.61%	2.14%	-29.90%	-3.24%	-13.43%	-16.63%	-28.39%	-0.36%	-19.17%	-26.53%	-14.02%	-23.13%	#¡DIV/0!	-11.78%	-19.19%	-18.73%	-30.27%	-29.32%	15.00%
21	600	8	4.5	-7.68%	-18.88%	-12.92%	-16.77%	3.37%	-39.34%	-2.31%	-12.37%	-16.76%	-30.28%	0.17%	-18.40%	-28.47%	-11.13%	-33.48%	#¡DIV/0!	-11.28%	-20.74%	-20.50%	-29.61%	-30.10%	16.16%
22	600	8	3.5	-11.32%	-22.44%	-17.88%	-20.43%	0.28%	-63.09%	-6.16%	-16.89%	-17.71%	-32.14%	-3.63%	-25.53%	-30.37%	-15.37%	#¡DIV/0!	-98.57%	-16.79%	-19.63%	-25.84%	-35.76%	-25.57%	11.50%
23	600	8	3	-16.42%	-37.16%	-23.97%	-22.64%	-11.15%	#¡DIV/0!	-15.58%	-21.51%	-29.66%	-41.09%	-12.79%	-31.05%	-39.56%	-24.90%	-71.89%	#¡DIV/0!	-22.95%	-28.25%	-29.77%	-40.52%	-31.09%	2.60%
24	600	8	2.7	-16.91%	-35.75%	-19.02%	-17.60%	-8.52%	#¡DIV/0!	-12.08%	-20.38%	-29.17%	-33.07%	-9.18%	-29.50%	-31.34%	-23.21%	-76.05%	#¡DIV/0!	-21.22%	-28.67%	-26.86%	-23.97%	-41.28%	5.69%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	600	8	5.2	-10.02%	-17.16%	-10.05%	-15.01%	2.94%	-21.16%	-2.34%	-11.23%	-17.28%	-27.52%	0.59%	-20.46%	-25.64%	-13.38%	-56.77%	#¡DIV/0!	-9.24%	-22.75%	-18.06%	-21.58%	-29.34%	16.02%
2	600	8	5.1	-8.58%	-20.04%	-10.89%	-17.97%	3.38%	-23.91%	-2.40%	-11.72%	-15.16%	-30.04%	0.52%	-18.11%	-28.22%	-12.75%	-58.28%	#¡DIV/0!	-10.49%	-21.51%	-18.09%	-24.31%	-31.80%	16.03%
3	600	8	5	-6.91%	-22.87%	-11.72%	-14.78%	2.49%	-26.60%	-2.40%	-12.19%	-15.53%	-32.52%	-0.70%	-21.01%	-23.07%	-12.02%	-19.51%	#¡DIV/0!	-9.73%	-20.08%	-18.06%	-26.99%	-34.21%	16.10%
4	600	8	5.1	-8.58%	-20.04%	-10.89%	-17.97%	3.38%	-23.91%	-2.40%	-11.72%	-15.16%	-30.04%	0.52%	-18.11%	-28.22%	-12.75%	-58.28%	#¡DIV/0!	-10.49%	-21.51%	-18.09%	-24.31%	-31.80%	16.03%
5	600	8	5.3	-9.10%	-14.23%	-11.40%	-17.87%	2.58%	-18.37%	-2.23%	-11.97%	-16.79%	-24.95%	-0.38%	-22.49%	-30.00%	-12.14%	-10.49%	#¡DIV/0!	-9.86%	-20.02%	-17.99%	-28.96%	-26.84%	16.09%
6	600	8	5.9	-6.39%	-16.22%	-6.90%	-14.04%	6.26%	2.52%	1.08%	-8.73%	-12.92%	-27.50%	3.71%	-17.26%	-25.61%	-9.88%	-43.79%	#¡DIV/0!	-5.98%	-19.63%	-14.17%	-28.62%	-24.82%	19.87%
7	600	8	7.3	-1.53%	-12.14%	-4.02%	-9.85%	9.18%	-22.35%	4.68%	-5.63%	-10.64%	-24.85%	6.98%	-16.44%	-18.62%	-5.86%	-14.85%	#¡DIV/0!	-4.51%	-13.05%	-11.69%	-22.77%	-26.31%	22.92%
8	600	8	9.1	2.58%	-6.07%	0.91%	-6.10%	14.00%	-19.12%	9.21%	-0.65%	-5.90%	-17.37%	11.66%	-10.98%	-18.26%	-0.79%	-33.48%	#¡DIV/0!	0.23%	-10.28%	-6.24%	-19.55%	-21.71%	28.22%
9	600	8	11.8	8.22%	-2.70%	6.10%	-0.18%	20.55%	2.52%	15.18%	5.01%	-0.47%	-14.31%	17.76%	-5.44%	-12.09%	4.48%	-25.05%	#¡DIV/0!	6.17%	-4.33%	-1.91%	-13.48%	-15.18%	34.27%
10	600	8	13	9.20%	-2.05%	6.96%	0.49%	21.42%	-1.45%	16.12%	5.67%	0.45%	-12.88%	18.47%	-4.17%	-10.62%	5.64%	-32.46%	-80.93%	7.08%	-4.39%	-0.33%	-14.23%	-13.60%	34.91%
11	600	8	13.4	10.56%	-0.44%	8.76%	2.15%	22.86%	-12.01%	17.53%	7.21%	1.81%	-11.75%	19.99%	-2.05%	-9.46%	7.09%	-27.64%	#¡DIV/0!	8.62%	-2.40%	0.71%	-12.48%	-13.09%	36.69%
12	600	8	13.6	11.28%	0.39%	9.93%	3.00%	23.35%	-9.01%	18.28%	8.01%	2.52%	-10.37%	20.67%	-2.08%	-9.65%	7.85%	-25.16%	#¡DIV/0!	9.42%	-1.84%	0.95%	-9.49%	-11.92%	37.56%
13	600	8	13.6	10.54%	-0.28%	9.20%	2.31%	22.53%	-9.61%	17.49%	7.30%	1.83%	-10.96%	19.87%	-2.73%	-10.25%	7.13%	-25.66%	#¡DIV/0!	8.69%	-2.49%	0.28%	-10.09%	-12.51%	36.64%
14	600	8	13	9.97%	-1.36%	7.71%	1.20%	22.27%	-0.76%	16.93%	6.42%	1.16%	-12.27%	19.30%	-3.50%	-9.99%	6.38%	-31.99%	-80.80%	7.83%	-3.72%	0.37%	-13.63%	-12.99%	35.85%
15	600	8	12.3	8.55%	-2.91%	6.37%	-0.38%	20.16%	-11.55%	15.07%	4.83%	-0.14%	-13.49%	17.39%	-4.82%	-11.25%	4.59%	-30.72%	-82.88%	6.35%	-4.76%	-1.27%	-14.47%	-13.00%	34.14%
16	600	8	11.4	6.85%	-3.84%	4.15%	-1.34%	18.75%	-24.17%	13.53%	2.94%	-1.98%	-14.98%	16.00%	-5.84%	-12.77%	2.55%	-30.71%	#¡DIV/0!	4.67%	-5.95%	-3.16%	-14.84%	-17.34%	32.29%
17	600	8	10.7	5.48%	-3.37%	3.53%	-2.77%	17.76%	-16.25%	12.65%	2.19%	-2.83%	-16.76%	15.03%	-6.76%	-14.59%	2.13%	-38.77%	#¡DIV/0!	3.59%	-7.53%	-3.84%	-16.70%	-15.55%	31.35%
18	600	8	10.2	6.22%	-5.88%	3.53%	-3.44%	17.40%	2.37%	12.40%	2.23%	-3.04%	-16.96%	14.94%	-8.20%	-12.22%	1.87%	-32.65%	-88.11%	3.21%	-7.41%	-3.58%	-17.76%	-17.43%	31.55%
19	600	8	10	3.91%	-4.02%	2.88%	-3.67%	16.67%	-26.60%	11.39%	1.26%	-3.90%	-15.64%	13.68%	-7.07%	-16.08%	1.21%	-35.61%	#¡DIV/0!	3.16%	-8.67%	-4.84%	-18.23%	-18.33%	30.42%
20	600	8	9.8	4.08%	-6.25%	1.45%	-5.95%	15.54%	-6.53%	10.43%	0.33%	-4.72%	-16.84%	12.85%	-9.47%	-17.34%	-0.07%	-38.50%	#¡DIV/0!	1.83%	-9.91%	-5.04%	-18.65%	-19.22%	29.28%
21	600	8	9.1	2.58%	-6.07%	0.91%	-6.10%	14.00%	-19.12%	9.21%	-0.65%	-5.90%	-17.37%	11.66%	-10.98%	-18.26%	-0.79%	-33.48%	#¡DIV/0!	0.23%	-10.28%	-6.24%	-19.55%	-21.71%	28.22%
22	600	8	7.1	-2.32%	-13.13%	-3.39%	-10.88%	9.13%	-26.19%	4.37%	-5.81%	-9.19%	-24.60%	6.94%	-14.89%	-22.64%	-6.19%	-19.06%	#¡DIV/0!	-3.76%	-14.91%	-11.01%	-26.58%	-25.57%	22.95%
23	600	8	5.9	-6.39%	-16.22%	-6.90%	-14.04%	6.26%	2.52%	1.08%	-8.73%	-12.92%	-27.50%	3.71%	-17.26%	-25.61%	-9.88%	-43.79%	#¡DIV/0!	-5.98%	-19.63%	-14.17%	-28.62%	-24.82%	19.87%
24	600	8	5.5	-9.36%	-14.33%	-9.60%	-17.60%	2.12%	-12.65%	-1.86%	-12.00%	-15.77%	-33.07%	0.09%	-21.66%	-25.09%	-11.40%	-52.10%	#¡DIV/0!	-10.82%	-22.19%	-15.07%	-32.42%	-29.54%	16.09%

Anexo 6. Diferencia porcentual, transformación en tubo {M S-F vs. EPANET}

Caso	L	d	q	Tubo																					
hrs	[m]	[pulg]	[l/s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	600	8	7.8	-0.02%	-13.02%	-2.55%	-7.69%	10.08%	-11.31%	5.79%	-4.36%	-9.59%	-22.34%	7.66%	-13.23%	-20.32%	-4.54%	-51.37%	#¡DIV/0!	-2.06%	-15.21%	-9.38%	-22.81%	-20.51%	24.41%
2	600	8	7.6	0.22%	-10.05%	-1.05%	-7.71%	11.77%	-14.39%	6.96%	-2.90%	-8.83%	-21.29%	9.23%	-13.63%	-19.25%	-2.90%	-37.42%	#¡DIV/0!	-1.44%	-13.96%	-9.47%	-20.53%	-18.76%	25.89%
3	600	8	7.5	-0.79%	-10.02%	-3.30%	-10.98%	10.69%	-17.42%	5.44%	-4.20%	-9.35%	-20.08%	7.81%	-14.00%	-22.11%	-4.28%	-39.63%	#¡DIV/0!	-2.86%	-14.83%	-9.49%	-23.34%	-21.64%	24.45%
4	600	8	7.6	0.22%	-10.05%	-1.05%	-7.71%	11.77%	-14.39%	6.96%	-2.90%	-8.83%	-21.29%	9.23%	-13.63%	-19.25%	-2.90%	-37.42%	#¡DIV/0!	-1.44%	-13.96%	-9.47%	-20.53%	-18.76%	25.89%
5	600	8	7.9	-0.18%	-9.94%	-1.53%	-7.60%	11.91%	-8.17%	6.90%	-3.02%	-7.71%	-23.25%	9.11%	-12.80%	-17.50%	-3.13%	-32.87%	#¡DIV/0!	-1.60%	-12.21%	-9.25%	-20.08%	-22.03%	25.82%
6	600	8	8.9	1.26%	-8.29%	-0.34%	-8.39%	13.68%	15.33%	8.54%	-1.88%	-7.53%	-18.43%	10.69%	-11.35%	-19.41%	-1.89%	-36.76%	#¡DIV/0!	-0.15%	-11.36%	-8.52%	-19.70%	-19.10%	26.92%
7	600	8	10.9	7.06%	-4.81%	4.36%	-2.34%	18.68%	-12.65%	13.54%	2.90%	-1.84%	-15.46%	16.08%	-5.99%	-13.27%	2.95%	-36.14%	#¡DIV/0!	4.46%	-7.46%	-2.49%	-16.11%	-17.10%	32.41%
8	600	8	13.6	6.98%	-3.24%	4.72%	-1.91%	18.55%	81.99%	13.69%	3.98%	-1.63%	-13.46%	16.10%	-6.24%	-12.71%	3.58%	-25.16%	-78.87%	5.13%	-5.31%	-2.63%	-15.53%	-13.65%	32.12%
9	600	8	17.7	16.37%	5.22%	14.69%	7.95%	28.84%	-7.73%	23.47%	13.03%	7.58%	-5.74%	26.04%	3.43%	-4.36%	12.65%	-22.17%	-64.29%	14.51%	3.33%	6.14%	-6.90%	-6.97%	42.67%
10	600	8	19.4	18.26%	7.29%	16.35%	9.36%	30.98%	0.79%	25.43%	15.02%	9.26%	-3.84%	28.07%	5.27%	-2.27%	14.65%	-24.02%	-57.09%	16.26%	4.96%	8.14%	-4.70%	-4.86%	44.57%
11	600	8	20.1	18.66%	8.53%	16.94%	9.98%	31.37%	-8.63%	25.93%	15.41%	9.79%	-3.36%	28.49%	5.93%	-1.72%	15.16%	-23.38%	-54.03%	16.86%	5.33%	8.82%	-4.94%	-4.19%	45.02%
12	600	8	20.5	18.57%	8.21%	16.55%	9.06%	30.97%	2.37%	25.55%	15.26%	9.29%	-3.47%	28.07%	5.47%	-1.80%	14.87%	-25.16%	-52.46%	16.61%	5.13%	8.58%	-4.97%	-4.72%	44.58%
13	600	8	20.4	18.79%	8.13%	17.03%	9.62%	31.21%	1.69%	25.78%	15.63%	9.38%	-2.45%	28.41%	5.33%	-1.62%	15.13%	-21.29%	-52.77%	16.86%	5.35%	8.81%	-4.54%	-5.36%	44.94%
14	600	8	19.5	17.99%	7.34%	16.08%	9.41%	30.52%	-6.96%	25.04%	14.74%	9.13%	-4.07%	27.66%	4.78%	-2.49%	14.33%	-18.38%	-56.79%	16.18%	4.69%	7.85%	-5.20%	-5.20%	44.21%
15	600	8	18.4	17.08%	6.07%	15.01%	8.04%	29.41%	-0.50%	24.00%	13.71%	7.90%	-4.71%	26.53%	3.62%	-4.23%	13.34%	-22.06%	#¡DIV/0!	15.04%	3.72%	6.73%	-5.10%	-6.67%	43.16%
16	600	8	17	15.91%	5.45%	14.00%	6.40%	28.20%	-5.22%	22.90%	12.42%	6.79%	-5.51%	25.37%	2.76%	-4.21%	12.20%	-22.05%	-66.98%	13.98%	2.56%	5.81%	-7.19%	-7.01%	42.17%
17	600	8	16	14.33%	3.63%	12.56%	5.33%	26.73%	-5.78%	21.38%	10.99%	5.46%	-7.60%	23.92%	1.40%	-6.45%	10.74%	-24.86%	#¡DIV/0!	12.36%	1.18%	4.22%	-7.93%	-9.25%	40.55%
18	600	8	15.3	13.89%	2.67%	11.81%	5.34%	26.08%	-13.63%	20.80%	10.22%	4.90%	-7.93%	23.35%	1.40%	-6.89%	10.10%	-31.12%	#¡DIV/0!	11.61%	0.31%	4.13%	-9.23%	-10.10%	39.98%
19	600	8	15	12.54%	2.29%	10.93%	3.86%	25.08%	-5.63%	19.68%	9.48%	3.83%	-9.35%	22.20%	-0.34%	-7.00%	9.22%	-27.56%	-74.43%	10.67%	-0.41%	2.64%	-9.81%	-9.68%	38.83%
20	600	8	14.7	11.65%	1.99%	9.67%	2.39%	23.89%	-9.87%	18.60%	8.31%	2.78%	-9.36%	21.10%	-1.12%	-8.44%	8.04%	-23.13%	#¡DIV/0!	9.77%	-1.08%	1.69%	-10.35%	-12.25%	37.64%
21	600	8	13.6	6.98%	-3.24%	4.72%	-1.91%	18.55%	81.99%	13.69%	3.98%	-1.63%	-13.46%	16.10%	-6.24%	-12.71%	3.58%	-25.16%	-78.87%	5.13%	-5.31%	-2.63%	-15.53%	-13.65%	32.12%
22	600	8	10.6	6.80%	-4.19%	4.83%	-1.70%	18.42%	-16.96%	13.54%	2.96%	-2.06%	-15.17%	15.83%	-5.93%	-12.97%	3.05%	-39.29%	-87.14%	4.50%	-7.01%	-2.80%	-17.40%	-16.27%	32.54%
23	600	8	8.9	1.26%	-8.29%	-0.34%	-8.39%	13.68%	15.33%	8.54%	-1.88%	-7.53%	-18.43%	10.69%	-11.35%	-19.41%	-1.89%	-36.76%	#¡DIV/0!	-0.15%	-11.36%	-8.52%	-19.70%	-19.10%	26.92%
24	600	8	8.2	-0.30%	-9.65%	-1.73%	-7.30%	12.27%	-1.73%	7.09%	-2.91%	-7.74%	-21.43%	9.25%	-11.87%	-19.39%	-3.12%	-46.12%	#¡DIV/0!	-1.53%	-12.46%	-8.86%	-19.50%	-20.73%	25.70%