$Z_1 := 1 \ \text{m}$ (Altura tanque)

$Z_2 := 0.71357 \ \text{m}$ (Altura cilindro)

$V_1 := 0 \ \frac{\text{m}}{\text{s}}$

$L_s := 2 \ \text{m}$ (Longitud de tuberia en tramo de succión)

$L_d := 2.759 \ \text{m}$ (Longitud de tuberia en tramo de descarga

$$f := \frac{0.027 + 0.025 + 0.023 + 0.022 + 0.021 + 0.019 + 0.018 + 0.017 + 0.016 + 0.015 + 0.014 + 0.013 + 0.012}{13} = 0.019$$

$$D_s := \frac{1}{4} \cdot 0.0254 = 6.35 \times 1\text{m}^{-3}$$

$P_1 := 101325 \ \text{Pa}$

$$P_2 := 15000 \cdot \left(\frac{6894.75729}{1} \right) + 101325 = 1.035 \times 10^8 \ \text{Pa}$$

$P_b := 2.305 \ \text{HP}$

$$Q := 0.17 \cdot 0.00006309 = 1.073 \times 10^{-5} \ \frac{\text{m}^3}{\text{s}}$$

$$\frac{P_1}{g\rho} + h_1 + \frac{{v_1}^2}{2g} - \sum H_{r_{1-2}} + \sum H_b - \sum H_t = \frac{P_2}{g\rho} + h_2 + \frac{{v_2}^2}{2g}$$

$$H_b := \frac{P_b \cdot 745.699872}{Q \cdot \zeta} = 1.634 \times 10^4 \ \text{m}$$

$$V_s := \frac{4 \cdot Q}{\pi \cdot {D_s}^2} = 0.339 \ \text{m}$$

$$V_d(D_d) := \frac{4 \cdot Q}{\pi \cdot {D_d}^2} \rightarrow \frac{0.000013655876089148040358}{{D_d}^2}$$

Caracteristicas agua

$\mu := 0.000891 \ \frac{\text{kg}}{\text{m} \cdot \text{s}}$ Viscosidad dinamica 25°C

$\rho := 1000 \ \frac{\text{kg}}{\text{m}^3}$ Densidad del agua

$ee := 4.6 \cdot 10^{-5} \ \text{m}$ Rugosidad tuberia (Mott [8])

$\zeta := \rho \cdot 9.81 = 9.81 \times 10^3 \ \frac{\text{N}}{\text{m}^3}$ Peso especifico

Accesorios	**K**	
Entrada a ras de filo agudo:	0.5	(Rocha [13])
Valvula check	400*ft	(Crane [12])
Tee directa	20*ft	(Crane [12])
Tee desviada	60·ft	(Crane [12])
Conector	2·ft	(Pope [19])
Curva 90°	35·ft	(Pope [19])
Electro Valvulas (Aguja)	340*ft	(Crane [12])

$$h_f(D_d) := \left[\left[\frac{f \cdot L_s}{D_s} + (0.5 + 150 \cdot f + 2 \cdot 2 \cdot f)\right] \cdot \frac{V_s^{\,2}}{2 \cdot 9.81} + \left[\frac{f \cdot L_d}{D_d} + (400 \cdot f + 11 \cdot 35 \cdot f + 2 \cdot 20 \cdot f + 2 \cdot 60 \cdot f + 18 \cdot 2 \cdot f + 2 \cdot 340 \cdot f)\right] \cdot \frac{V_d(D_d)^2}{2 \cdot 9.81}\right] \text{simplificar} \rightarrow \frac{0.053956205830435200079 \cdot D_d^{\,5} + 2.9388794893838099921\text{e-}10 \cdot D_d + 4.8816186099999589213\text{e-}13}{D_d^{\,5}}$$

$$a(D_d) := \frac{P_1}{\zeta} + Z_1 - h_f(D_d) + H_b - \frac{P_2}{\zeta} - \frac{V_d(D_d)^2}{2 \cdot 9.81} - Z_2 \left|\begin{matrix}\text{simplificar}\\ \text{recopilar}\end{matrix}\right. \rightarrow -\frac{1.0\text{e-}32 \cdot \left(3.0339268654093783802\text{e}22 \cdot D_d - 5.7941970348195462804\text{e}35 \cdot D_d^{\,5} + 4.8816186099999589213\text{e}19\right)}{D_d^{\,5}}$$

$$a(D_d)\ \text{resolver}, D_d \rightarrow \begin{pmatrix} 0.00065266194535069755733 \\ 0.00015393704524225725373 - 0.00060881666846992688753i \\ 0.00015393704524225725373 + 0.00060881666846992688753i \\ -0.00048026801791760603239 - 0.00031093416438223751428i \\ -0.00048026801791760603239 + 0.00031093416438223751428i \end{pmatrix}$$

$D_d := 0.0006526619 \quad m$

EL PROCEDIMIENTO ANTERIOR SE REPITE CAMBIANDO LAS VARIABLES DE CAUDAL Y DIÁMETRO DE SUCCIÓN.