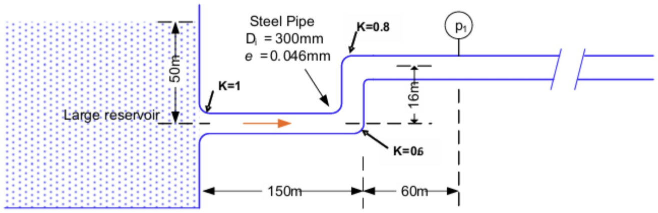
//QUESTION 3



{ What will the absolute pressure be at point 1 for a water flow rate of 0.2m3/s through the pipe system shown below? The large reservoir is open to atmosphere at 85kPa and assume for water:}

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P_atm=85[kPa]*convert(kPa;Pa)
rho=1000[kg/m^3]
mu=1,005E-3 [N-s/m^2]
g=9,81[m/s^2]

V_dot=0,2[m^3/s]

D_i=300[mm]*convert(mm;m)
e=0,046[mm]*convert(mm;m)

V=V_dot/(pi*D_i^2/4)  // Velocity along the pipe

k_tot=1[dim]+0,6[dim]+0,8[dim]
L_tot=150[m]+16[m]+60[m]


//Let Point E be the Reservoir  Exit

H_E=50[m] //[The Distance from top of the water exposed to atm to outlet of resovoir
z_E=0[m] //Making the outlet a REF poin

z_1=16[m] //The point 1 is 16 m above point E

P_atm+rho*g*H_E=P_E

Re=(rho*D_i*V)/mu //Calc and find it greater than 40000

1/sqrt(f)=-2*log10(e/D_i/3,7+2,51/(Re*sqrt(f)))

//Head Loss Calculation

h_minor=k_tot*(V^2/2/g)
h_major=f*(L_tot/D_i)*(V^2/2/g)
h_friction=h_minor+h_major

P_E/rho/g+z_E+v^2/2/g=P_1/rho/g+z_1+v^2/2/g+h_friction
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$P_{atm} = 85 \text{ [kPa]} \cdot \left| 1000 \cdot \frac{Pa}{kPa} \right|$

$\rho = 1000 \text{ [kg/m}^3\text{]}$

$\mu = 0{,}001005 \text{ [N-s/m}^2\text{]}$

$g = 9{,}81$ [m/s^2]

$\dot{V} = 0{,}2$ [m^3/s]

$D_i = 300$ [mm] $\cdot \left| 0{,}001 \cdot \dfrac{m}{mm} \right|$

$e = 0{,}046$ [mm] $\cdot \left| 0{,}001 \cdot \dfrac{m}{mm} \right|$

$$V = \frac{\dot{V}}{\pi \cdot \dfrac{D_i^{\;2}}{4}}$$

$k_{tot} = 1$ [dim] $+ 0{,}6$ [dim] $+ 0{,}8$ [dim]

$L_{tot} = 150$ [m] $+ 16$ [m] $+ 60$ [m]

$H_E = 50$ [m]

$z_E = 0$ [m]

$z_1 = 16$ [m]

$$P_{atm} + \rho \cdot g \cdot H_E = P_E$$

$$Re = \frac{\rho \cdot D_i \cdot V}{\mu}$$

$$\frac{1}{\sqrt{f}} = -2 \cdot \mathbf{log}\left[\frac{e}{D_i \cdot 3{,}7} + \frac{2{,}51}{Re \cdot \sqrt{f}}\right]$$

$$h_{minor} = k_{tot} \cdot \frac{V^2}{2 \cdot g}$$

$$h_{major} = f \cdot \frac{L_{tot}}{D_i} \cdot \frac{V^2}{2 \cdot g}$$

$$h_{friction} = h_{minor} + h_{major}$$

$$\frac{P_E}{\rho \cdot g} + z_E + \frac{V^2}{2 \cdot g} = \frac{P_1}{\rho \cdot g} + z_1 + \frac{V^2}{2 \cdot g} + h_{friction}$$

SOLUTION

Unit Settings: SI C kPa kJ mass deg

$D_i = 0{,}3$ [m]	$e = 0{,}000046$ [m]	$f = 0{,}01432$ [dim]
$g = 9{,}81$ [m/s^2]	$H_E = 50$ [m]	$h_{friction} = 5{,}38$ [m]
$h_{major} = 4{,}401$ [m]	$h_{minor} = 0{,}9793$ [m]	$k_{tot} = 2{,}4$ [dim]

L_{tot} = 226 [m]
P_{atm} = 85000 [Pa]
ρ = 1000 [kg/m^3]
z_1 = 16 [m]
μ = 0,001005 [N-s/m^2]
P_E = 575500 [Pa]
V = 2,829 [m/s]
z_E = 0 [m]
P_1 = 365759 [Pa]
Re = 844603 [dim]
$\dot{V}$ = 0,2 [m^3/s]

No unit problems were detected.