Two-Phase Pressure Drop of Gas and Liquid Flowing in a Pipe

Pipe relative roughness and diameter

$e := 0.0002$ $d := 95.0\,mm$

Cross-sectional area of pipe

$A := \frac{\pi \cdot d^2}{4} = 7.088 \times 10^3\,mm^2$

Colebrook equation

friction := (Rey, y) $fsolve\left(\frac{1}{\sqrt{f_{turb}}} = -2 \cdot \log10\left(\frac{e}{3.7} + \frac{2.51}{Rey \cdot \sqrt{f_{turb}}}\right)\right)$

Lockhart-Martinelli factor

$X_{tt} := \sqrt{\frac{dPdL_L}{dPdL_G}}$

	Liquid	Gas
Mass flowrate	$W_L := 17.0\,kg \cdot s^{-1}$	$W_G := 2.5\,kg \cdot s^{-1}$
Viscosity	$\mu_L := 0.003\,Pa \cdot s$	$\mu_G := 1.92 \times 10^{-5}\,Pa \cdot s$
Density	$\rho_L := 880\,kg \cdot m^{-3}$	$\rho_G := 3\,kg \cdot m^{-3}$
Liquid and gas mass fluxe	$G_L := \frac{W_L}{A} = 2.398 \times 10^3\,\frac{kg}{s \cdot m^2}$	$G_G := \frac{W_G}{A} = 352.698\,\frac{kg}{s \cdot m^2}$
Reynolds Number	$Rey_L := \frac{G_L \cdot d}{\mu_L} = 7.595 \times 10^4$	$Rey_G := \frac{G_G \cdot d}{\mu_G} = 1.745 \times 10^6$
Liquid and gas friction factor	$f_L := friction\left(Rey_L, e\right) = 0.020$	$f_G := friction\left(Rey_G, e\right) = 0.014$
Pressure gradient	$dPdL_L := \frac{f_L}{2} \cdot \frac{G_L^2}{\rho_L \cdot d} = 686.119\,\frac{Pa}{m}$	$dPdL_G := \frac{f_G}{2} \cdot \frac{G_G^2}{\rho_G \cdot d} = 3122.700\,\frac{Pa}{m}$
two-phase multiplier	$\phi_L := \left(1 + 18 \cdot X_{tt}^{-1} + X_{tt}^{-2}\right)^{0.5} = 6.630$	$\phi_G := \left(1 + 18 \cdot X_{tt} + X_{tt}^2\right)^{0.5} = 3.108$