Gasoline flowing in a tube

Tube Properties

$kJ \equiv 1000J$

$u_m := 19.2 \frac{m}{s}$

$D := 3mm$

Gasoline Properties

$\rho := 719 \frac{kg}{m^3}$

$k := .15 \frac{W}{m \cdot K}$

$\nu := 4.6 \cdot 10^{-7} \cdot \frac{m^2}{s}$

$c_p := 2.22 \frac{kJ}{kg \cdot K}$

$\mu := \nu \cdot \rho = 3.307 \times 10^{-4} Pa \cdot s$

$\alpha := \frac{k}{\rho \cdot c_p} = 9.397 \times 10^{-8} \frac{m^2}{s}$

$Pr := \frac{\nu}{\alpha} = 4.895$

Calculate the Reynold's number

$Re_D := \frac{\rho \cdot u_m \cdot D}{\mu} = 1.252 \times 10^5$

Calculate friction factor

$f := \left(.790 \cdot \ln\left(Re_D\right) - 1.64\right)^{-2} = 0.017$

Calculate Nusselt number

$$Nu_D := \frac{\left(\frac{f}{8}\right) \cdot \left(Re_D - 1000\right) \cdot Pr}{1 + 12.7 \cdot \left(\frac{f}{8}\right)^{0.5} \cdot \left(Pr^{\frac{2}{3}} - 1\right)} = 618.966$$

Calculate Convective Coefficient

$$h_1 := \frac{Nu_D \cdot k}{D} = 3.095 \times 10^4 \frac{W}{m^2 \cdot K}$$

Direct calculation

$$h_2 := \frac{Nu_D \cdot \rho \cdot u_m \cdot c_p}{Re_D \cdot Pr} = 3.095 \times 10^4 \frac{W}{m^2 \cdot K}$$

Momentum and heat transfer analogy