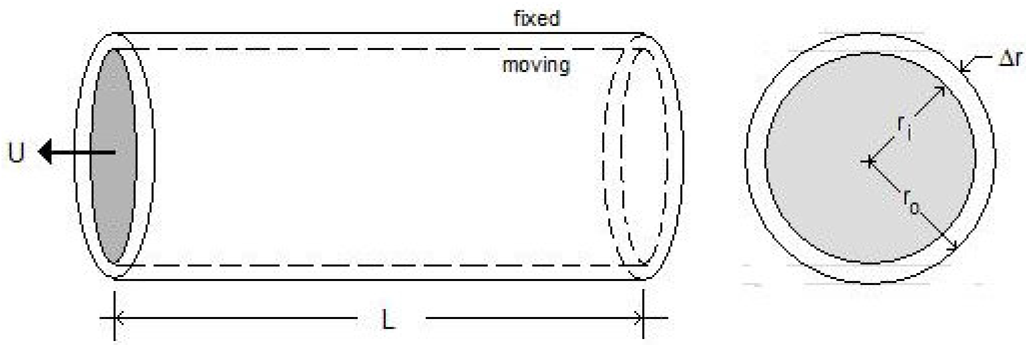
[1]. The piston in a mechanism consists of a moving inner cylinder of radius ri = 2.00 cm encased in a fixed outer cylinder of radius ro = 2.05 cm. The lenght of the moving cylinder is L = 10.00 cm. The gap between the cylinders is filled with an oil of specific gravity S = 0.86 and kinematic viscosity ν = 1.25x10^(-5) m^2/s. If the inner cylinder moves with a velocity U = 4.00 cm/s, determine the force (in N or kN) required to maintain the motion.



$ri := \frac{2}{100}$ i.e., $ri = 0.02$ m $\quad ro := \frac{2.05}{100}$ i.e., $ro = 0.0205$m

$\Delta r := ro - ri$ i.e. $\Delta r = 5\cdot 10^{-4}$ m $\quad L := \frac{10}{100}$ i.e., $L = 0.1$

$S := 0.86 \quad \rho w := 1000 \frac{kg}{m^3} \quad \rho := S\cdot \rho w \quad \rho = 860 \frac{kg}{m^3}$

$\nu := 1.25\cdot 10^{-5} \frac{m^2}{s} \quad \mu := \rho\cdot \nu \quad \mu = 0.0107 \frac{kg}{m\cdot s}$ or $\frac{N\cdot s}{m^2}$

$U := \frac{4}{100}$ i.e. $U = 0.04 \frac{m}{s} \quad \tau := \mu\cdot \frac{U}{\Delta r} \quad \tau = 0.86 \frac{N}{m^2}$

$A := \pi\cdot ri^2\cdot L$ i.e., $A = 1.2566\cdot 10^{-4}$ m^2

$Fs := \tau\cdot A$ i.e., $Fs = 1.0807\cdot 10^{-4}$ N