

Question #81136

Oil, with 900 kg/m^3 and $0.00001 \text{ m}^2/\text{s}$, flows at $0.2 \text{ m}^3/\text{s}$ through 500 m of 200-mm diameter cast iron pipe. Determine the head loss.

Answer:

We can determine the velocity of the oil from the known flow rate $Q = 0.2 \text{ m}^3/\text{s}$ and the pipe diameter $d = 0.2 \text{ m}$ as follow:

$$u = \frac{4Q}{\pi d^2} = \frac{4 \cdot 0.2}{\pi \cdot 0.2^2} = 6.366 \text{ m/s}.$$

Then the Reynolds number is (given dynamic viscosity $\nu = 0.00001 \text{ m}^2/\text{s}$):

$$Re = \frac{ud}{\nu} = \frac{6.366 \cdot 0.2}{0.00001} = 127,324 = 1.27 \cdot 10^5.$$

The absolute roughness for the cast iron is $k = 0.25 - 0.8 \text{ mm}$ (see Engineering ToolBox at https://www.engineeringtoolbox.com/major-loss-ducts-tubes-d_459.html).

Assume $k = 0.25 \text{ mm}$. Then

$$\frac{k}{d} = \frac{0.25}{200} = 0.00125.$$

From Moody chart (see Engineering ToolBox at https://www.engineeringtoolbox.com/moody-diagram-d_618.html) for the known values of k/d and Re , we can read the friction factor $f = 0.025$. Then the head loss is:

$$\Delta h = f \frac{L}{d} \frac{u^2}{2g} = 0.025 \cdot \frac{500 \cdot 6.366^2}{0.2 \cdot 2 \cdot 9.81} = 129 \text{ m}.$$

Answer provided by www.AssignmentExpert.com