Day-17

$$\frac{\Delta P}{\frac{1}{2}\rho v_{avg}^2} = \frac{64\mu}{\rho v_{avg} D}\frac{L}{D}$$

$$= \frac{64}{Re}\frac{L}{D} = \frac{fL}{D}$$

$$f = \frac{64}{Re} \rightarrow \text{friction factor}$$

$$\frac{\Delta P}{\frac{1}{2}\rho v_{avg}^2} = f\frac{L}{D}$$ is independent of Re

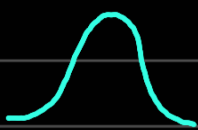
→ Test yourself:

water [$\rho = 1000\ kg\,m^{-3}$, $\mu_f = 10^{-3}\ kg\,m^{-1}s^{-1}$]

flowing through a pipe ($D = 10\ mm$, $\varepsilon = 10^{-3}\ mm$)
$v_{avg} = 1\ ms^{-1}$, $L = 1\ m$. Find ΔP.

Ans.) $Re = \frac{\rho v D}{\mu} = \frac{1000 \times 1 \times 0.01}{10^{-3}} = 10^4$

$\frac{\varepsilon}{D} = 10^{-4}$



$f \approx 0.032$ (from graph)

$\Delta P = \frac{1}{2} \times 1000 \times 1^2 \times 0.032 \times \frac{1}{10^{-2}}$
$= 1600\ Pa$

$Re \leq 2100$ (laminar)

$2100 < Re \leq 4000$ (transitional)

$Re > 4000$ (Turbulent)

For flow through circular cross section