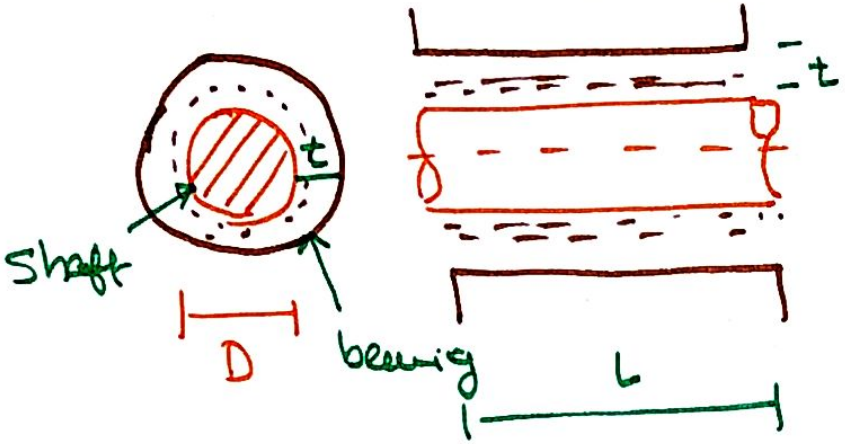
Power Absorbed in Viscous Flow - Journal Bearing



let

D = Diameter of shaft

L = length of bearing

t = thickness of oil film

N = speed of shaft rpm

Angular speed of shaft

$$\omega = \frac{2\pi N}{60}$$

Tangential speed

$$V = r \times \omega$$

$$V = \frac{2\pi N}{60} \times D/2$$

Shear stress in oil

$$\tau = \mu \frac{\partial u}{\partial y}$$

t is very small

linear Distribution of v

$$\frac{du}{dy} = \frac{V - 0}{t}$$

$$\frac{du}{dy} = \frac{V}{t}$$

$$\frac{du}{dy} = \frac{\pi D N}{60 \times t}$$

$$\tau = \mu \cdot \frac{\pi D N}{60 \times t}$$

Shear force $= \tau \times A$

$$F = \frac{\mu \pi D N}{60 \times t} \times \pi D L$$

$$F = \frac{\mu \pi^2 D^2 N L}{60 t}$$

Torque Required to Overcome Viscous Resistance

$$T = F_s \times D/2$$

$$T = \frac{\mu \pi^2 D^2 N L}{60 \times t} \times D/2$$

$$T = \frac{\mu \pi^2 D^3 N L}{120 \times t}$$

Power absorbed

$$P = \frac{2\pi N T}{60}$$

$$P = \frac{2\pi N}{60} \times \frac{\mu \pi^2 D^3 \times N \times L}{120 \times t}$$

$$\boxed{P = \frac{\mu \pi^3 D^3 N^2 L}{60 \times 60 \times t}}$$