

6.69 For Prob. 6.62 suppose the only pump available can deliver only 80 hp to the fluid. What is the proper pipe size in inches to maintain the $3 \text{ ft}^3/\text{s}$ flow rate?

Water 20°C $\rho = 1.94 \text{ slug/ft}^3$ $\mu = 2.09 \times 10^{-5} \text{ slug/ft}\cdot\text{s}$
 Cast iron $\epsilon = .00085$ $\epsilon/D = ?$

$$h_p = \Delta z + f \frac{L}{D} \frac{V^2}{2g}$$

$$= 120 + f \frac{L}{D} \frac{(4Q/\pi D^2)^2}{2g} \quad Q = AV$$

$$h_p = \frac{P}{\rho g Q} = \frac{80 \times 550}{1.94 \times 3 \times 62.4} = 120 + 453 \frac{f}{D^5}$$

$$\frac{235}{(235-120)} D^5 = 453 \quad f = 3.94 f$$

guess $f = .02$ calculate D , ϵ/D & Re

$$.602 \text{ ft} \quad Re = \frac{4\rho Q}{\pi \mu D}$$

$$\epsilon/D = .00141$$

$$f_{\text{better}} = .0218$$

$$= 589,000$$

$$f_{\text{final}} = .0217$$

$$D = .612 \text{ ft}$$

$$\approx 7.3''$$