Jacob Schwartz | MET330 | HW3.3 | 4-23-20

22) Describe each part of this centrifugal pump designation : $1\frac{1}{2} \times 3-6$

The $1\frac{1}{2} \times 3-6$ centrifugal pump is the pump with $1\frac{1}{2}$ in discharge connection, 3 in. suction connection and a casing that can accommodate an impeller with a diameter of 6 in. or smaller.

25) For the $2 \times 3-10$ centrifugal pump performance from graph.

- For an 8 in impeller operating against a system head of 200 ft corresponding capacity of the pump from the graph, $\boxed{Q = 230\,gal/min}$
- $\boxed{P = 22\,hp}$
- $\boxed{e = 54\%}$
- $\boxed{NPSH = 11\,ft}$

In the problems and in the lectures we learned how to design a pump and describe the pump with its designations. The first number is the discharge connection, the second is the suction connection, and the third is a casing that can accommodate an impeller with a diameter of the last digit. We have also seen how the specific diameter affects the specific speed and efficiency of a pump. There was alot to absorb on pumps and are very intricate it seems.

Known

80°F of water

125 ft from bank

55 ft ↑

1500 gal/min

From back of the Book density of water at 80°F is 62.2 lb/ft^3

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + Z_2$$

$$0 + 0 + 55\text{ ft} = \frac{P_2}{62.2 \cdot 32.2} + \frac{V_2^2}{2(32.2)} + 125\text{ ft}$$

gravity is 32.2

P_2 = atmospheric Pressure 14.7 psi

$$55 = \frac{14.7}{62.2 \cdot 32.2} + \frac{V_2^2}{2(32.2)} + 125$$

$$\frac{-V_2^2}{2(32.2)} = \frac{14.7}{(62.2)(32.2)} + 70$$

$$\frac{-V_2^2}{2(32.2)} = 70.00733958$$

$$\sqrt{-V_2^2} = \sqrt{4508.472669}$$

$$\boxed{V_2 = 67.15\text{ ft/s}}$$

diameter of pipe

$Q = AV$ 1500 gal/min = .114 m^3/s

$$.114\text{ m}^3/\text{s} = \frac{\pi}{4} d^2 (3\text{ m/s})$$

using critical velocity 3 m/s

$\boxed{d \doteq .22\text{ m}}$ or back of Book absolute V/D $\boxed{D \neq 10\text{ inch}}$

MET 330 Assignment 13

Problem 13.17

$$\frac{h_{a_1}}{h_{a_2}} = \left(\frac{N_1}{N_2}\right)^2$$

If final speed is cut into half

$$N_2 = \frac{N_1}{2}$$

Substituting $\frac{N_1}{2}$ for N_2

$$\frac{h_{a_1}}{h_{a_2}} = \left[\frac{N_1}{(N_1/2)}\right]^2$$

$$\therefore \frac{h_{a_1}}{h_{a_2}} = 4$$

$$\therefore h_{a_2} = \frac{h_{a_1}}{4}$$

Therefore, the final head developed is reduced by a factor of 4.

Problem 13.55

Given / Known

$\gamma = 9.53\ kN/m^3$
$\nu = 3.60 \times 10^{-7}\ m^2/s$

DN 50 (inner diameter)
$D_{50} = 52.2mm = 0.0525m$
$A_{50} = 2.168 \times 10^{-3} m^2$

$\varepsilon = 4.6 \times 10^{-5} m$

From table F.1
$D_{80} = 77.9mm = 0.0779m$
$A_{80} = 4.768 \times 10^{-3} m^2$

$$h_{sp} = \frac{P_{atm}}{\gamma} = \frac{101.8}{9.53} = 10.68m$$

$$V_{80} = \frac{Q}{A_{80}}$$
$$= \frac{300 \times 10^{-3}}{4.768 \times 10^{-3} \times 60}$$
$$= 1.048\ m/s$$

$$N_R = \frac{V \cdot D_{80}}{\nu}$$
$$= \frac{1.048 \times 0.0779}{3.6 \times 10^{-7}}$$
$$= 2.26 \times 10^5$$

$$\frac{D_{80}}{\varepsilon} = \frac{0.0779}{4.6 \times 10^{-5}}$$
$$= 1693.478$$

from moody's chart matching the values $f_{80} = 0.019$

$$V_{50} = \frac{300 \times 10^{-3}}{2.168 \times 10^{-3} \times 60} = 2.306 m/s$$

$$N_R = \frac{V \cdot D_{50}}{\nu} = \frac{2.306 \times 0.0525}{3.6 \times 10^{-7}} = 3.36 \times 10^5$$

$$\frac{D}{\varepsilon} = \frac{0.0525}{4.6 \times 10^{-5}}$$

$f_{10} = 0.025$

$$h_1 = \frac{0.019 \times 2}{0.0779} \times \frac{1.048^2}{2 \times 9.81}$$

$= 0.0273m$

13.55 Continuation

$$h_2 = K_1 \frac{v^2}{2 \cdot g}$$

$$h_2 = 75 \times 0.018 \times \frac{1.046^2}{2 \cdot 9.81}$$

$$= 0.075571 m$$

$$h_3 = 20 \times 0.018 \times \frac{1.646^2}{2 \cdot 9.81}$$

$$= 0.02018 m$$

$$h_4 = 0.025 \times \frac{1.5}{0.0525} \times \frac{2.306^2}{2 \times 9.81}$$

$$= 0.1935 m$$

$$\therefore h_L = h_1 + h_2 + h_3 + h_4$$

$$h_L = 0.0273 + 0.075571 + 0.02018 + 0.19$$

$$= 0.3238 m$$

$$NPSH = h_{sp} - h_s - h_L - h_{vp}$$

$$NPSH = 10.682 - 2 - 0.3238 - 4.967$$

$$= 3.39 m$$

$$\therefore NPSH = 3.391 m$$

13.65

Given:

$T = 45^{\circ}c$ (propoane) $sg = 0.48$

$h_s = -1.84m$, $h_f = 0.92m$

$P_{atm} = 98.4\ kPa$, $NPSHA \geq 1.5m$

Need to find; Pressure above the propane P_p

solution: $T = 45^{\circ}c \Rightarrow h_{vp} = 350\ m$ (fig

Using equation 13.13 we can write

$h_{sp} = NPSHA - h_s + h_f + h_{vp}$

$= 1.5 + 1.84 + 0.92 + 350$

$\boxed{h_{sp} = 354.26\,m}$

$P_{sp} = \rho g\, h_{sp} = 0.48 \times 9.81 \times 1000 \times 354.26$

$\boxed{P_{sp} = 1668.14\ kPa}$ absolute

$P_{sp} = 1668.14 - 98.4$

$\boxed{P_{sp} = 1569.74\ kPa}$ gage

13.9

Given: $D_2 = 0.75 D_1$ (D: Diameter)

Need to find: New capacity and change:

Solution:

For pump $\frac{Q_2}{Q_1} = \frac{D_2}{D_1}$

$$\Rightarrow Q_2 = Q\left(\frac{D_2}{D_1}\right)$$

$$Q_2 = Q_1\left(\frac{0.75D_1}{D_1}\right)$$

$$\boxed{Q_2 = 0.75Q_1}$$

$\Rightarrow$ The capcity also reduced by 25% percent.