

CH. 15 4.9, 15

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4) FIND MANOMETER DEFLECTION for 1" & 7" ORIFICE DIAMETER.

GIVEN: $Q = \frac{25 \text{ gal}}{\text{min}} \mid 449 \text{ gals} \rightarrow 0.0557 \text{ ft}^3/\text{s}$

$g = 32.17 \text{ ft/s}^2$, $\mu_a = 2.5 \times 10^{-4} \text{ lb.s/ft}^2$
 $S_{ga} = .83 \rightarrow P_a = \frac{1.61 \text{ lb.s/ft}^2}{2.5 \times 10^{-4} \text{ lb.s/ft}^2} = 1.61 \text{ lb.s/ft}^2$

$A_1 = \pi/4 (10/12)^2 = 0.545 \text{ ft}^2$

$A_{2a} = \pi/4 (1/12)^2 = 0.00545 \text{ ft}^2$

$A_{2b} = \pi/4 (7/12)^2 = 0.267 \text{ ft}^2$

* $\Delta P = \rho h \Rightarrow h = \frac{(V_1/c)^2 (A_1/A_2)^2 - 1}{2g}$ *

$V_1 = Q/A_1 = \frac{0.0557 \text{ ft}^3/\text{s}}{0.545 \text{ ft}^2} = 0.102 \text{ ft/s}$

* ASSUME 40° F * $N_L = \frac{\rho V_1 D_1}{\mu} = \frac{1.61 \text{ lb.s/ft}^2 \mid 0.102 \text{ ft/s} \mid .833 \text{ ft}^3 \cdot \text{ft}^3}{\text{ft}^4 \mid \text{s} \mid 2.5 \times 10^{-4} \text{ lb.s}^2}$

$\Rightarrow N_L = 5.5 \times 10^4 \Rightarrow @ d_1, C = .595 @ d_7, C = .618$

* USING EXCEL FOR COMPUTATION *

@ $d = 1"$ $h = 4.55 \text{ ft} (12") = \boxed{54.6"} *$

@ $d = 7"$ $h = -.01578 (12") = \boxed{-.165"} *$

* THESE NUMBERS SEEM RIDICULOUS? *

NOT SURE WHERE I WENT
ASTRAY?

9) FIND DIAMETER of Flow NOZZLE?

GIVEN:

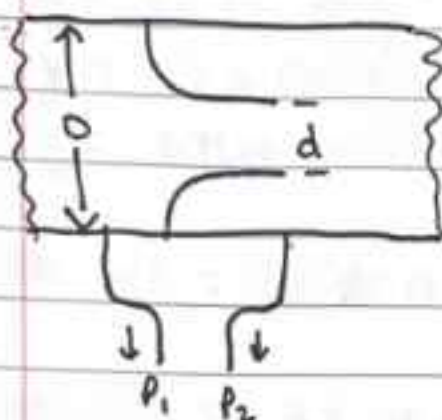
5" TYPE K COPPER TUBING $\rightarrow$.4004 Ft DIAMETER, 4.805"

$$\Rightarrow A_1 = .12592 \text{ ft}^2$$

LINSEED OIL @ 77°F $\rightarrow \gamma_o = 58 \text{ lb/ft}^3$, $\rho = 1.8 \text{ lb.s}^2/\text{ft}^4$
 $\nu = 3.84 \times 10^{-4} \text{ ft}^2/\text{s}$

Q $\rightarrow$ 700 TO 1000 gal/min

MANOMETER $\rightarrow$ 0 TO .8 IN.Hg



$$V_1 = C \sqrt{\frac{2gh[(\gamma_m/\gamma_o)-1]}{(A_1/A_2)^2 - 1}}$$

$$\Rightarrow A_2 = \frac{A_1}{\sqrt{\frac{2gh(\gamma_m/\gamma_o - 1)}{(V_1/C)^2} + 1}}$$

$$C = .9975 - 6.53 \sqrt{\beta / \text{Nr}}, \quad \beta = d/D$$

• ASSUME .98 FOR C.

$$\gamma_m = 844.9 \text{ lb/ft}^3$$

FROM EXCEL COMPUTATION: $A_2 = 16.701 \text{ in}^2$

$$\Rightarrow A_2 = (\pi/4) d^2$$

$$\Rightarrow \sqrt{A_2 / (\pi/4)} = d \Rightarrow d = \underline{4.61 \text{ in}}$$

$$\Rightarrow \beta = 4.61 / 4.805 = 0.96$$

$$\Rightarrow \text{Nr} = VD_1/\nu = 18443.29 = 1.8443 \times 10^4$$

$\Rightarrow$ FROM CHART, $C = 0.96$ & CALC, $C = 0.95$

$\Rightarrow$ USING $C = 0.95$ & SAME Nr

$$A_2 = 16.778 \text{ in}^2$$

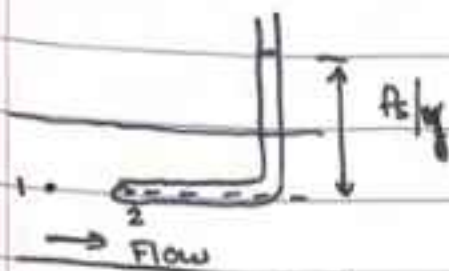
$$\underline{d = 4.62 \text{ in}}$$

Very close using
ANAL 1%.

15) Find velocity of flow?

GIVEN: PITOT. AIR @ STD ATM. PRESS/TEMP

MANOMETER READS .24 IN H₂O



$$v_1 = \sqrt{\frac{2g(P_1 - P_2)}{\rho_1 - \rho_2}}$$
$$v_1 = \sqrt{2gh(\rho_1 - \rho_2)/\rho_2}$$

$$h = .24'' = .02 \text{ ft}$$

* ASSUME 60°F *

$$g = 32.17 \text{ ft/s}^2$$

$$\rho_1 = 62.4 \text{ lb/ft}^3$$

$$\rho_2 = .0764 \text{ lb/ft}^3$$

$$\Rightarrow v_1 = \sqrt{2(32.17 \text{ ft/s}^2)(.02 \text{ ft})(62.4 \text{ lb/ft}^3 - .0764 \text{ lb/ft}^3) / .0764 \text{ lb/ft}^3}$$

$$\Rightarrow \boxed{v_1 = 32.4 \text{ ft/s}}$$