key Solution

CHEN 490 – Fundamental s of Petroleum Engineering
HW 5 (continued) – Due 28/11/2013

1. If the bore hole is 8 ¾" and using 4 ½" OD drill pipe, what is the required flow rate if the minimum upward velocity is 195 ft/min?
2. Calculate the pressure drop in psi in 1500 ft of 4" ID pipe carrying oil (sp. gr. = 0.825 and viscosity = 12 cp) at a rate of 1550 gal/min.
3. What is the total weight of 20 bbl. Of material whose sp.gr. is 4.3?
4. Calculate the density in all common units (lb_m/ft^3, lb_m/bbl, gm/cm^3) of a fluid weighs 500 lbs?

thh – AUB - 25/2013

1. Given : A drill pipe of $4\frac{1}{2}$" OD in
A bore hole of $8\frac{3}{4}" = 8.75"$

Find : Flow rate of mud if $v = 195$ ft/min. ?

Solution :

$$q = Av$$

Where $q = ft^3/sec$

$A = ft^2$

$v = ft/sec$

then, $$A = \frac{\pi}{4}\frac{(8.75)^2}{12} - \frac{\pi}{4}\frac{(4.5)^2}{12} = 0.307 \text{ ft}^2$$

$$v = \frac{195 \text{ ft/min}}{60 \text{ sec/min}} = 3.25 \text{ ft/sec}$$

and $$q = (0.307)(3.25) = 1 \text{ ft}^3/\text{sec} = \underline{\underline{449}} \text{ gal/min}$$

or

$$q = 2.45 (d^2_{hole} - d^2_{OD\,pipe})\, v$$

$$= 2.45 (8.75^2 - 4.5^2)\left(\frac{195}{60}\right) = \underline{\underline{448}} \text{ gal/min}$$

2. Given: 1500' of 4" ID pipe of oil flowing (sp. gr. = 0.825 & μ = 12cp) @ a rate = 1550 gal/min

Find: ΔP_f in psi ?

Solution:

$$N_R = \frac{928 d \rho v}{\mu}, \quad d = 4"$$

$$\rho = (0.825)(8.34) = 6.88 \text{ lbm/gal}$$

$$v = \frac{q}{(2.45)(d)^2} = \frac{1550}{(2.45)(4)^2} = 39.5 \text{ ft/sec}$$

$$\mu = 12 \text{ cp}$$

then, $$N_R = \frac{(928)(6.88)(4)(39.5)}{12} = 84064 > 2000 \rightarrow$$ turbulent flow

then, $$\Delta P_f = \frac{f \rho L v^2}{25.8(d)}, \quad f \cong 0.0055 \text{ (from curve II)}$$

$$\Delta P_f = \frac{(0.0055)(6.88)(1500)(39.5)^2}{(25.8)(4)}$$

$$= 858 \text{ psi}$$

USE FOR ANSWER

3. Given: 20 bbl of material (sp. gr. = 4.3)

Find: total weight

Solution:

$$T.Wt. = (\rho)(Vol)$$

$$lbm = \frac{lbm}{bbl}(bbl) = (4.3)\left(350 \frac{lbm}{bbl}\right)(20\ bbl)$$

$$= 30100\ lbm$$

4. Given: @ Volume of fluid = $3 ft^3$, Weighs = 500 lbs

Find: ρ ? in lbm/ft^3, lbm/bbl, gm/cm^3 ?

Solution:

$$\rho = \frac{500\ lbm}{3 ft^3} = 166.7\ lbm/ft^3$$

$$\rho = \frac{166.7\ lbm/ft^3}{7.48\ gal/ft^3} = 22.3\ lbm/gal$$

$$\rho = (166.7\ lbm/ft^3)(5.615\ ft^3/bbl) = 963.0 \frac{bbm}{bbl}$$

$$\rho = \frac{(166.7\ lbm/ft^3)(454\ gm/lbm)}{(28320\ cm^3/ft^3)}$$

$$= 2.67\ gm/cm^3$$