Key Solution

CHEN 490 – Fundamentals of Petroleum Engineering
HW # 5 – Due T. 26/11/2013

1. What will be the resulting density in lbm/gal if 87.5 lbs of clay is added to 10 bbls of water? Sp. Gravity of water = 1 and clay = 2.5.

2. How many bbls of water must be added to an existing system of 400 bbls of 11.5 lbm/gal mud to reduce the density to 10.5 lbm/gal.

3. Using a flow meter, the output flow rate for a 12" x 18" Single-acting, Single cylinder pump operating at 30 strokes/min was measured at 215 gal/min. Calculate the volumetric efficiency of the pump.

thh – AUB – 19/11/2013

1. Given: 87.5 lbs of clay is added to 10 bbl of water.

Find: the resulting density in lbm/gal ?

Where sp. gr. of water = 1.0

" " " clay = 2.5

Solution:

Using the eqn. $\rho_i V_i + \rho_a V_a = \rho_f V_f$

with ρ = lbm/gal and V = bbl

Assume, water = initial, and clay = added

then, $(\text{lbm/gal})_i V_i + (\text{lbm/gal})_a V_a = (\text{lbm/gal})_f V_f$

and

$\rho_i = (\text{sp.gr})(8.34) = (1)(8.34) = 8.34$ lbm/gal

$\rho_a = (\text{sp.gr})(8.34) = (2.5)(8.34) = 20.85$ lbm/gal

$\rho_f = ?$

$V_i = 10$ bbl

$V_a = \dfrac{W_a}{\rho_a} = \dfrac{W_a}{(\text{sp.gr.})(350 \text{ lbm/bbl})}$

$= \dfrac{87.5 \text{ lbm}}{(2.5)(350 \text{ lbm/bbl})} = 0.1$ bbl

$V_f = (V_i + V_a) = (10 + 0.1) = 10.1$ bbl

then.

$\rho_i V_i + \rho_a V_a = \rho_f V_f$

$(8.34)(10) + (20.85)(0.1) = \rho_f (10.1)$

$\rho_f = \dfrac{(83.4 + 2.085)}{(10.1)} = \underline{\underline{8.46}}$ lbm/gal

2. Given: mud system of 400 bbls of 11.5 lbm/gal

Find: How many bbls of water must be added to this mud system to have a density = 10.5 lbm/gal?

Solution:

$$\rho_i V_i + \rho_a V_a = \rho_f V_f$$

where ρ = lbm/gal and V = bbl

Assume 11.5 lbm/gal mud = initial and water = added

then,

$\rho_i = 11.5$ lbm/gal

$\rho_a = 8.34$ lbm/gal

$\rho_f = 10.5$ lbm/gal

$V_i = 400$ bbl

$V_a = ?$

$V_f = (V_i + V_a) = (400 + V_a)$

$$\rho_i V_i + \rho_a V_a = \rho_f (V_i + V_a)$$

$$(11.5)(400) + (8.34)(V_a) = (10.5)(400 + V_a)$$

$$(8.34 - 10.5)(V_a) = (10.5 - 11.5)(400)$$

$$V_a = (0.463)(400) = \underline{\underline{185}} \text{ bbls}$$

3. Given: A flow meter data:

Output flow rate 215 gal/min

A single-acting, single cylinder pump operate at 30 stroke/min = N

Calculate: the volumetric efficiency, e_v

Solution:

$$e_v = \frac{q_{out}}{PD}$$

$q_{out} = 215$ gal/min

$$PD = \frac{0.7854}{144}\left(\frac{12}{12}\right)^2 (18)(7.48)(30)$$

$$= 264 \text{ gal/min}$$

$$e_v = \frac{215}{264} = 0.814 = \underline{81.4\%}$$