**Ex.8: 500** bbls of drilling mud prepared from water and bentonite. Bentonite weight percentage to water is (**8**%). Oil diesel (ρ = **6.87** ppg) added and density of the fluid became (**8.45** ppg). Calculate:

1- Amount of bentonite in tons (weight).
2- Amount of $H_2o$ in bbls
3- Amount of diesel in bbls.

**Solution:**

1) $\frac{w_{Bn}}{w_{H2O}} = 8\%$

$W_{Bn} = 0.08\ W_{H2O}$

$$\rho_{m1} = \frac{\sum w}{\sum v} = \frac{w_{H2O} + w_{Bn}}{v_{H20} + v_{Bn}}$$

$$\rho_{m1} = \frac{w_{H2o} + 0.08 * w_{H2O}}{\frac{w_{H2O}}{8.33} + \frac{0.08 * w_{H2O}}{20.8}}$$

$$\rho_{m1} = \frac{w_{H2O}(1 + 0.08)}{w_{H2O}\left(\frac{1}{8.33} + \frac{0.08}{20.8}\right)} = 8.7 \text{ ppg for water and Bentonite}$$

$$v_{Bn} = \frac{v_{m2}(\rho_{m2} - \rho_{m1})}{\rho_s - \rho_{m1}}$$

$$v_{Bn} = \frac{500 * (8.7 - 8.33)}{20.8 - 8.33} = 14.8 \text{ bbl}$$

$$w_{Bn} = 14.8 \text{ bbl} * 20.8 \frac{\text{Ib}}{\text{gal}} * 42 \frac{\text{gal}}{\text{bbl}} = 12929 \text{ Ib}$$

$$w_{Bn} = \frac{12929}{2000} = 6.46 \text{ tons}$$

2) $w_{m1}$ = 8.7 * 500 * 42 = 182700 Ib total weight of mixture

$W_{H2O}$ = 182700 – 12929 = 16977 Ib

$$v_{H2O} = \frac{16977}{8.33*42} = 485 \text{ bbl}$$

$$v_o = \frac{v_{m1}(\rho_{m1}-\rho_{m2})}{\rho_{m2}-\rho_o}$$

$$v_o = \frac{500*(8.7-8.45)}{8.45-6.87} = 79.11 \text{ bbl}$$

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## Mixing Fluids of Different Densities

$\boldsymbol{\rho_{mF} V_F = \rho_{m1} V_{m1} + \rho_{m2} V_{m2}}$ ------------------------------------------------------- **(18)**

**Ex.9:** A limit is placed on the desired volume: Determine the volume of **11** ppg mud and **14** ppg mud required to build **300** bbl of **11.5** ppg mud:

**Solution:**

Let $V_1$ = bbl of 11 ppg mud

$V_2$ = bbl of 14 ppg mud

Then

a) $V_1 + V_2$ = 300bbl

b) (11) $V_1$ + (14) $V_2$ = (11.5) (300)

Multiply Equation **a** by the density of the lowest mud weight ($\rho_1$ = 11 ppg) and subtract the result from Equation **b**:

b) $(11)(V_1) + (14)(V_2) = 3450$

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a) $(11)(V_1) + (11)(V_2) = 3300$

$(3)(V_2) = 150$

$3V_2 = 150$

$V_2 = 150/3$

$V_2 = 50$

Therefore: $V_2$ = 50bbl of 14ppg mud

$V_1 + V_2 = 300$ bbl

V1 = 300 - 50

$V_1$ = 250 bbl of 11ppg mud

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- **Oil-Based Mud Calculations**
- **Density of oil/water mixture being used**

$$\rho_o V_o + \rho_w V_w = \rho_{m2} V_{m2} \text{ ---------------------------------------------------------------- } (19)$$

**Ex.13:** If the oil/water (o/w) ratio is **75/25** (**75**% oil, $V_1$, and **25**% water, $V_2$), the following material balance is set up:

**Solution:**

**NOTE:** The weight of diesel oil, $\rho_o$= 7 ppg

The weight of water, $\rho_{m2}$ = 8.33ppg

$(0.75)(7) + (0.25)(8.33) = (0.75 + 0.25)\ \rho_{m2}$

$5.25 + 2.0825 = 1\ \rho_{m2}$

$7.33 = \rho_{m2}$

Therefore: The density of the oil/water mixture = 7.33ppg

- **Oil/Water Ratio From Retort Data**

Obtain the percent-by-volume oil and percent-by-volume water from retort analysis or mud still analysis. Using the data obtained, the oil/water ratio is calculated as follows:

$$\%\ \textbf{oil in liquid phase} = \frac{\%\ \textbf{by vol. oil}}{\%\ \textbf{by vol. oil} + \%\ \textbf{by vol. water}} \times \mathbf{100}$$

$$\%\ \textbf{water in liquid phase} = \frac{\%\ \textbf{by vol. water}}{\%\ \textbf{by vol. oil} + \%\ \textbf{by vol. water}} \times \mathbf{100}$$

Result: The oil/water ratio is reported as the percent oil and the percent water.

**Ex.14:** Retort analysis: % by volume oil = **51** % by volume water = **17 %** by volume solids = **32**

**Solution:**

$$\%\ \textbf{oil in liquid phase} = \frac{\mathbf{51}}{\mathbf{51 + 17}} \times \mathbf{100 = 0.75 = 75\%}$$

$$\%\ \textbf{water in liquid phase} = \frac{\mathbf{17}}{\mathbf{51 + 17}} \times \mathbf{100 = 0.25 = 25\%}$$

c) Result: Therefore, the oil/water ratio is reported as 75/25: 75%) oil and 25%) water.