Petro 311
Mud Properties & Additives

Viscosity – cuttings removal, lubricate drill sting, stabilize the wellbore.

Additives,
Bentonite, fresh water mud, prehydrated for salt water
Good water loss control
Attapuigite, salt water mud
Expensive, little water loss control
Polymers
Expensive, use in high temp wells

Tests
Marsh Funnel time in seconds for one quart of mud

Viscometers Fanning
Field ones have 2 speeds, 300 and 600 rpm
Calculate apparent and plastic viscosities, cp
Yield point and gel strength, #/100ft²

Mud Weight, #:gal – Hydrostatic control of formation pressures and hole stability. Lower the better for optimum drilling rates, too high can cause formation fractures and loss circulation in permeable low pressure zones.

Tests
Mud balance

Additives,
To add weight - Barium sulfate (barite), Iron oxides, salts, Calcium carbonate, Galena (FeS).
To lower – dilute
Need to control solids in the mud.

Loss circulation materials
Walnut shells, cotton seed hulls, ground up tires, fibrous materials, Anything that works!!
Mud Mixing Calculations

Use figure 2.15, page 54 to calculate the amount of bentonite to use viscosity.

For increase the weight of mud, volumes must balance.
If no excess storage capacity is available

\[ V_2 = V_1 + V_B = V_1 + \frac{m_B}{\rho_B} \]

Likewise the sum of total mass of mud and weight material most equal the desired density of the final mud.

\[ \rho_2 V_2 = \rho_1 V_1 + m_B \]

Solving gives

\[ V_1 = V_2 \left( \frac{\rho_B - \rho_2}{\rho_B - \rho_1} \right) \quad m_B = (V_2 - V_1) \rho_B \]

With no limit on pit capacity

\[ V_2 = V_1 \frac{\rho_m - \rho_1}{\rho_m - \rho_2} \]

The problem is that when adding this much solid material to the mud the viscosity is going to increase. We need to add more water to system, which will cause the density to drop. Need to add the minimum amount of water.

\[ V_2 = V_1 + V_B + V_w = V_1 + \frac{m_B}{\rho_B} + m_B V_{wB} \]

with the mass of water

\[ \rho_2 V_2 = \rho_1 V_1 + m_B + \rho_w m_B V_{wB} \]

Solve
\[ V_1 = V_2 \left\{ \frac{\rho_B \left(1 + \rho_w V_{wb} \right) - \rho_2}{1 + \rho_B V_{wb}} \right\} \]

and

\[ m_B = \frac{\rho_B}{1 + \rho_B V_{wb}} (V_2 - V_1) \]

Example

500 bbl system has a weight of 10 \# mud, raise the weight up to 12\#/gal. Adding water necessary to wet the barite.

\[ V_1 = 500 \left[ \frac{35 \left(1 + 8.33 \cdot 0.01\right)}{1 + 35 \cdot 0.01} \right] - 12 = 445bbls \]

Discarded mud is 55 bbls

\[ m_B = \frac{35}{1 + 35 \cdot 0.01} (500 - 445) = 59889\# \]

\[ V_w = 0.01 \cdot 59889 = 599gal = 14.26bbls \]

Check replacement volume

\[ V_R = V_B + V_w = \left( \frac{59889}{35 \cdot 42} \right) + 14.26 = 40.74 + 14.26 = 55bbls \]
Water Loss, cc/30 min – To control water lost into the formations while drilling. Important to protect possible productive formations, formation evaluation. Also helps while drilling formations with high clay content to prevent excess swelling of the formation.

The lower the water loss slower the drilling.
Good water loss is less than 10 cc’s
Spurt loss, the initial water loss when pressure is applied but before the mud cake forms

Factors
Pressure differential, cake permeability, filtrate viscosity (higher the vis the lower the water loss)

Tests
Filter press
Spurt loss in cc’s
Water loss in cc’s/30 minutes
Mud cake in 32’s of an inch

Additives
Bentonite, starch (requires high ph), polymers