

HDD Training



Drilling Fluid

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Drilling Fluids



Bentonite is a naturally occurring sodium montmorillonite clay.



HDD drilling fluids are the elixir between the soil formation and the deployed downhole tools. Drilling fluid is a mixture of bentonite clay and water. Sometimes other additives are mixed in. It's function is to:

1. Maintain an open hole.
2. Suspend cuttings.
3. Remove cuttings.

Drilling Fluids



Mud balance scale. Used to calculate the drilling fluid unit weight.

The unit weight needs to be within a range between 9 and 10 pounds per gallon. Water is 8.34 pounds per gallon.

To prevent the flow of formation fluids into the hole, the drilling mud must exert a greater pressure than that of the fluids in the porous soil/rock that are penetrated by the bit.

The pressure exerted by the drilling mud at any depth is related directly to its density.



Viscosity is measured in the Marsh Funnel.

Viscosity is the measure of a fluid's resistance to deformation by shear stress. Informally it corresponds to the concept of "thickness".

Water is 26 seconds.

Drilling fluid usually ranges between 30 and 60 seconds.

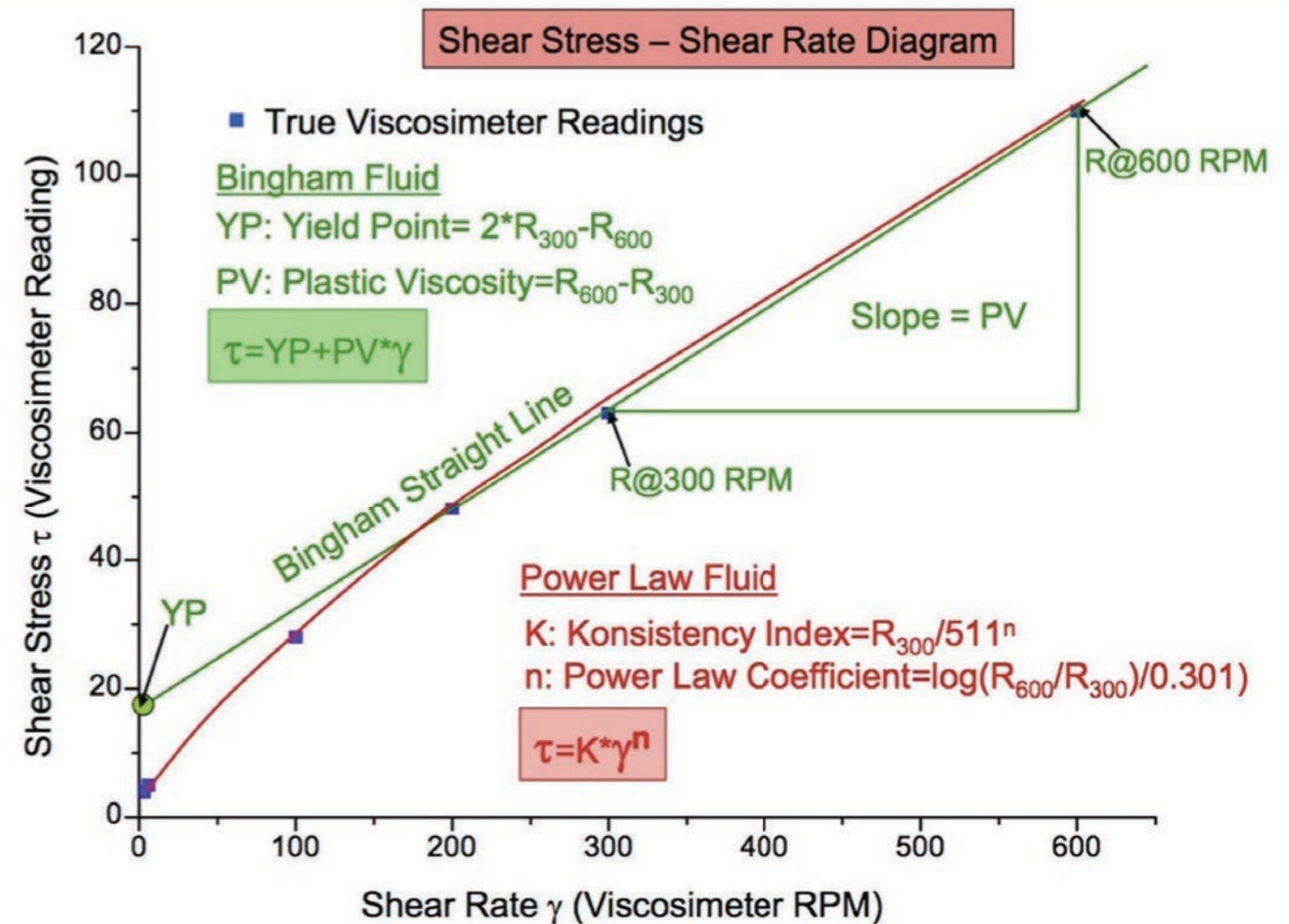
Drilling Fluids



The rotational viscometer gives a more detailed measure of the condition of the drilling fluid. The resistance is calculated at 300 and 600 rpm and these values are used to calculate the PV and YP of the drilling fluid.

Bingham Fluid is a viscoplastic material that behaves as a rigid body at low stresses, but flows as a viscous fluid at high stress.

Named after Eugene Bingham (1878-1945) proposed the mathematical form in 1914.



PV is an indication of the size and number of solids in the drilling fluid.

Typical value is 12 centipoise. Range 10-20.

YP is an indication of the shear stress required to turn the gel into a liquefied state.

Typical value is 26 pounds per 100 square feet.

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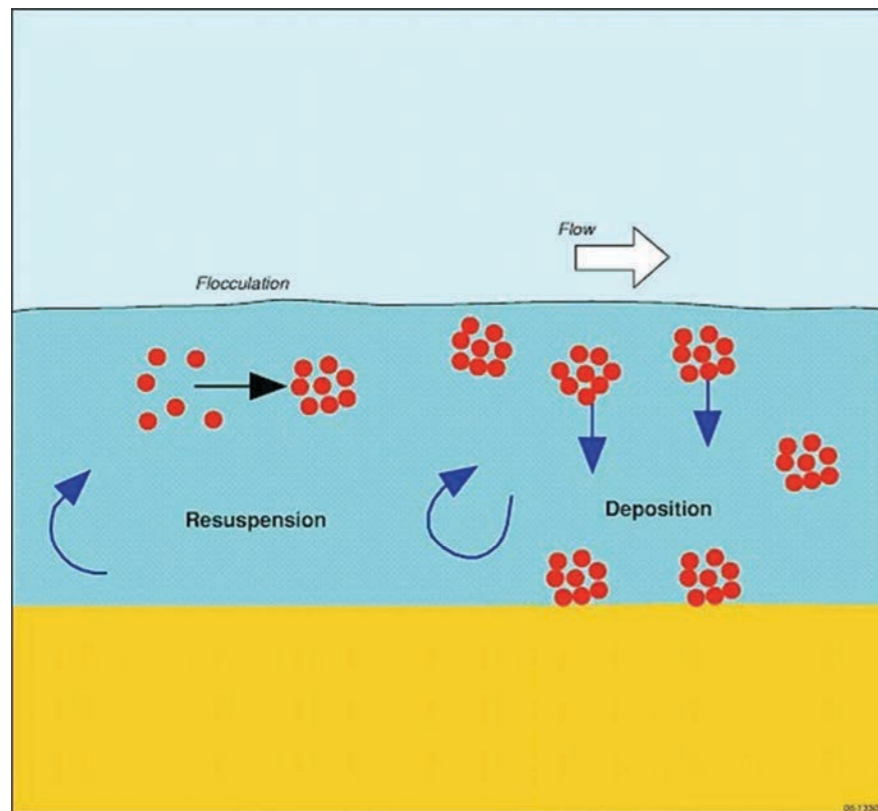
Polyanionic Cellulose (PAC) Polymer is naturally occurring polymer that is used to control water loss. Used in combination with bentonite. It also improves lubricity and helps to prevent bit balling. Used in more coarse grained soils.



Partially Hydraulized PolyAcrylamide (PHPA)

PHPA is a clay and shale inhibitors. These polymer chains readily attach themselves to clay or shale, sealing off the formation so that the makeup water cannot filter into the formation and cause it to swell. Adding PHPA polymer to the makeup water produces a noticeable increase in viscosity and lubricity.

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ADDITIVES-

Surfactants are used to lubricate downhole tooling, reduce torque on the drill string and inhibit reactive clays and shales. **Xanthan Gum** small amounts are used to boost the drilling fluid viscosity, without substantially increasing the fluid density. It can reduce the total amount of bentonite required to achieve similar rheological fluid properties. Xanthan Gum is used in many food products and is non-toxic.

Detergents make the clay particles slide against each other.

Flocculating agents are used to help the clay particles cling together so they are transported in larger sand and gravel sized particles.

Soda Ash is another name for sodium carbonate. It is used to increase the pH of the drilling fluid makeup water to aid in the hydration of the bentonite.

Foam is used primarily in drilling through rock when small, uniform, rock flakes have to be transported to the entry pit.

In the concentrations used in drilling fluids, these additives can be considered non-toxic.