A word of explanation about lubricants used in underground construction. *(The following is meant as a guide in understanding lubricant products and their use. For clarity – Baroid product names have been used. Other manufacturers have similar products under different names)*

Anyone who has driven down a muddy road or tried to walk down a muddy creek or river bank can testify to the lubrication qualities of clay and that's what bentonite is – a very special, high quality clay. In the case of the muddy road, you couldn't get traction. You couldn't create friction between your tire and the road. The same thing happened on the muddy creek or riverbank. Your feet got lubricated right out from under you. This is the same phenomenon that we want to create in the borehole: reduced traction and friction.

When bentonite is properly mixed, the bentonite is sheared apart into very small, flat, thin, platelets. These bentonite platelets act like small shingles and shingle or plaster off the inside of the burrow by forming a filter cake or wall cake.

In sand, the bentonite platelets plug up the pore spaces between the sand grains. This allows the bentonite platelets to form a grout-like layer, plugging the porosity and permeability of the sand. In clay or shale, the objective is to prevent the existing ground from becoming water wet. This reduces the tendency to swell and become sticky that usually characterizes native clay and shale. In coarse stone and gravel, it is necessary to add a product to the mix to eliminate the loss of fluid into the formation by creating a lattice network of fibers. The product of choice for this situation is a "fibrous loss of circulation material". (N-Seal).

Bentonite

Primary benefits

1.) Lubricity
2.) Hole Stability
3.) Suspension of solids

Secondary benefits

1.) Clay stabilization – it inhibits swelling in the existing soil through the building of a filter cake.
2.) Viscosity – this is not very important and can be negative if the mix is too thick.

Different types of polymers can be added to the bentonite fluid. Easy mud can be used to inhibit the swelling of clay. Quick Trol can be added in sandy situations to enhance the filter cake building of the bentonite. Surfactant such as ConDet or Penetrol can be added to reduce the sticking tendencies of clay.

Polymer

Linear polymers– 'Easy Mud' product

Primary benefits

1.) Clay stabilization – the poly chain wraps around the clay particles to inhibit water absorption and therefore the swelling caused by water absorption.

Secondary benefits

1.) Lubricity

Branch polymers –'Quick Trol' and the 'No Sag' products

Quick Trol

Primary benefit –enhances the filter cake building with bentonite

Secondary benefit – lubricity

No Sag

Primary benefit – enhances the suspension capability of bentonite

Secondary benefit – lubricity

Surfactant – All commonly used soap and detergent products are classified as surfactants. The liquid surfactants used in this industry are formulated so that they will not create a lot of foam in the mix. Surfactant should not be used alone in sandy soils. In clay soils surfactants reduce the stickiness of the existing clays.

Fibrous loss of circulation material

N-Seal – works in conjunction with bentonite and polymers.

Primary benefit – control of fluid loss into the formation.

Secondary - Enhanced bore hole stabilization through establishment of the filter cake more quickly.

Water Quality

Low pH and/or calcium content (hardness) are not friendly to drilling fluid products. When calcium is present, the platelets tend to stay in little stacks like decks of cards and not shear apart.

This is why free water surfaces on top of our tanks when we turn off our mixing equipment for a period of time. These larger particles want to settle out, indicating that the bentonite wasn't properly mixed in the first place. The clumps of larger particles also stick to pump seats and valves, not letting the pump work freely. This is where the "clanging" in the pump can come from. These larger particles can also cut out pump packings.

Calcium in the water can prevent the polymer from fully yielding or hydrating, keeping it from "blossoming" to work effectively.

What can be done about this? The first thing to do is check the pH. On the pH scale, 7 is neutral. Both bentonite and polymers like an elevated pH range of around 9. To raise the pH, we use a product called soda ash or sodium carbonate. As it raises the pH, it simultaneously treats out (precipitates) the calcium in the water. All drilling fluid products work best in water with a moderate alkaline Ph of 8.5 to 9.5 where 7 is neutral.

Soda Ash – when using soda ash to raise Ph, the calcium content is also reduced. The reduction of calcium in the water is actually more important than elevating the Ph of the water.

Sodium Bicarbonate – This material is used to lower the Ph as well as the calcium. The goal is a Ph of 8.5 to 9.5. This material is appropriate to use when the Ph is greater than 9.5. Water with a high ph number is very rarely seen and may indicate the presence of contaminants in the water source.

Mixing – order of addition

All of the polymers inhibit the swelling of clay. And since bentonite is a type of clay it is very important to mix the bentonite before adding polymers to the mix. If the polymer is added first the bentonite will not hydrate.

The order in which the lubricant materials are added to the water are important.

- The ph of the water must first be tested and the addition of soda ash or sodium bicarbonate must be used to bring the ph into the range of 8.5 to 9.5 where 7 is neutral.
- Bentonite can be added as soon as the ph is in the proper range.
- If N-Seal is used – it can be mixed either before or after the bentonite is added.
- When the bentonite is thoroughly mixed, Polymer can be added – bentonite cannot be added to water that has polymer in it.
- Finally, a wetting agent or surfactant can be added.