



Designing a Drilling Fluid for Successful Well Completions

A few weeks ago, a driller from the Midwest called me for help on a drilling project he was on, and his first question was, "Do you have any drilling additives that will keep our borehole walls from caving in?" Assuming that he already was using bentonite drilling mud that needed some enhancement, I immediately began discussing various additives that he could use for borehole stability. After several minutes of back-and-forth discussion, I finally asked him what type of fluid he was using. "Oh, we are just using water," was his response.

The water he was using was mixing with the soils in the formation to form a type of drilling fluid, although not a very good drilling fluid because it was not keeping the borehole open. Water is unlikely to perform as well as bentonite drilling fluid, bentonite/polymer fluid or even drill foam in air-drilling operations, especially in unconsolidated formations. The water by itself also can wash out the borehole, making it larger than desired. The water is going to mix with whatever soil is downhole, and become a type of "drilling mud." The problem with this type of "drilling mud" is that, in many cases, it will not control the borehole during drilling. Instead, the borehole overpowers the fluid, and the results are not good.

There are several questions to be asked when deciding what should be used for any particular drilling application.

- What do you want the fluid to do?
- What are the soil conditions that will be encountered?
- Will the fluid match those soil conditions?
- Will it stabilize the borehole?
- Will the fluid suspend, transport and drop the cuttings out at the surface?
- Will it protect the drill bit and drill string by lubricating and cooling?
- Will the drill fluid control fluid loss to the formation?

The questions above contain the functions of a good drilling fluid. I would suggest to you that water mixed with native soils most likely will *not* meet the criteria in the ques-

tions listed above. Neither will it yield the consistency of a bentonite/polymer fluid or, in the case of air drilling, a foam/additive mix. It also will not be as efficient.

Bentonite drilling fluids, polymers and foams do provide consistency. They will help stabilize the borehole, provide gel strength for cuttings removal, and help to keep the drilling fluid in the borehole. These fluids also will help protect the drilling equipment by lubricating and cooling them. The most important things to consider in choosing the right fluid are knowing the soil conditions and matching the fluid to those conditions. Using the wrong fluid additive can be just as disastrous as using water, as the abovementioned contractor was doing.

Once the soil conditions have been matched to the fluid, it is time to plan the formulation of a successful drilling fluid. The first step is to ensure that the make-up water for the fluid is of good quality. It should be clean, and come from a reliable source free of salt or other contaminants that would harm the drill fluid. A good choice is water from a municipal well.

The water first should be checked for the pH level. Bentonite, polymers and foams work well in a pH range of 8.5 to 9.5. Many water sources range from 5.5 to 7.5. This is too low for good drill fluid mixing and proper yield. Soda ash can be added to the water at rates of ¼ pound to ½ pound per 100 gallons to raise the pH and precipitate out any calcium that would be causing hard water. Make-up water for drill fluid is much like water we use to shampoo our hair. If the water is too hard, it will take more product, and the yield of the product will be considerably less. Treating make-up water is essential to good, efficient drilling fluid.

The next step is to assess the quantities that will be required to control drilling conditions. Planning ahead will ensure successful borehole completion. Product manufacturers normally list dosage recommendations on the containers or on their technical literature. This literature can be obtained from the web, from



Powdered bentonite.

the distributor or directly from the manufacturer.

After adequate mixing of the basic fluid that has been selected for the project, additives can be considered to enhance the basic fluid, depending on conditions. This selection of additives is an important part of the planning process mentioned above. One important point to remember is that these additives should be used to keep the driller out of trouble in the borehole. It is not good planning to use additives after the driller already is in trouble.

Some important additives to consider:

1. PAC polymers are essential to use in unconsolidated formations such as sand, gravel or cobble.

2. Clay and shale inhibitors are important additives when encountering swelling clays.

3. Drilling detergents work well to make fluid "wetter," and to help pre-

vent bit balling and sticky conditions.

4. Gel-strength enhancers are available for adding to fluids when cuttings are hard to lift out of the borehole.

5. Products are available that will go beyond what clay and shale inhibitors can do, and these help to break down the clay, preventing or minimizing swelling. This enables the driller to pump the clay out of the borehole.

If you have questions or comments on this article, please contact me through *National Driller*. If you desire more technical information on the use of any of the products mentioned above, please contact your supplier, manufacturer or their respective websites to obtain the information. Some websites even include calculators to determine amounts of product needed for specific drilling applications. **ND**

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