Removing Cuttings from the Borehole

As a well hole is bored into the earth, the drill bit breaks off small pieces of rock, called cuttings. The cuttings must be removed from the hole so that the bit can continue drilling. In modern well drilling, the cuttings are brought up out of the hole by circulating drilling fluid, a slurry of water, clay, and other materials. This drilling fluid is often called drilling mud.

The mud is pumped under pressure down through the center of the drill pipe. It comes out the bottom of the hole through openings in the drill bit. It then flows up the hole outside of the drill pipe back to the surface, bringing up the cuttings at the same time. The cuttings are removed from the mud, and the mud is then recirculated.

A liquid's resistance to flowing is called viscosity. The viscosity of the mud helps to suspend the cuttings, preventing them from sinking to the bottom of the well hole. As the mud returns to the surface, it brings up the suspended cuttings as well.

If you have Internet access, you can see an animation of this process. Point your browser to: http://www.seed.slb.com/en/scictr/watch/mud/cycle.htm and click on the link at the bottom of the diagram.

In this activity, you will simulate the circulation of drilling mud and investigate the importance of viscosity in bringing cuttings to the surface.

Tools & Materials

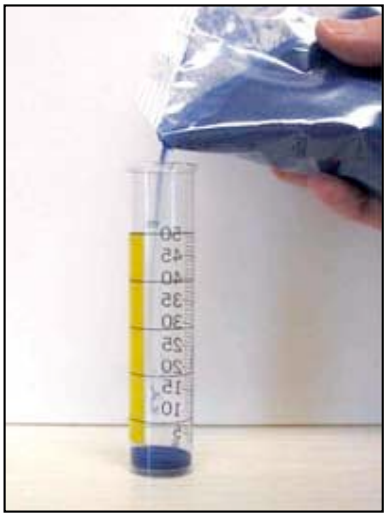
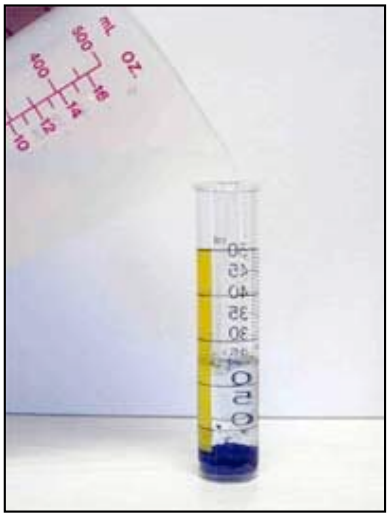
- Wooden dowel about 30 cm (about 12 inches) long and about 1.3 cm (1 / 2 inch) diameter
- Clear plastic tubing about 15 cm (about 6 inches) long and about 1.3 cm (1 / 2 inch) inside diameter
- Sand
- Clear plastic graduated cylinder about 2.5 cm (about 1 inch) inside diameter
- Water
- Clear shampoo
- Transparent tape
- Sandpaper
- Paper towels
- Goggles

Note: Do not worry if the materials in your SEEDPACK do not look exactly like those in the photographs. They will work just as well.

What To Do

1. Insert the dowel into the clear tubing and push it all the way to the other end.
   The dowel should move easily through the tubing when pushed, while making contact all around with the wall of the tubing. If the dowel does not fit the tubing closely, wrap one or two turns of cellophane tape around the end. If the dowel is too tight in the tube, then rub the outside of the dowel with sandpaper to make it a bit smaller in diameter.


2. Slowly and carefully, pour sand into the graduated cylinder to form a layer about 3 mm (1 / 8 inch) deep at the bottom.

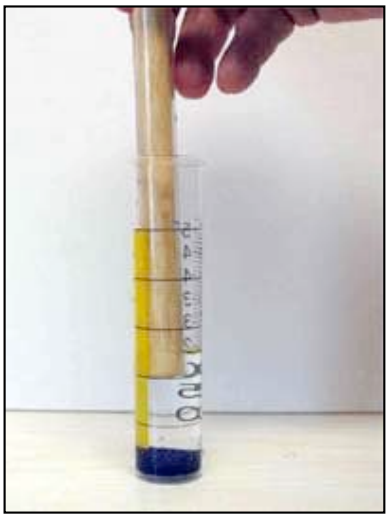



3. Slowly pour water into the cylinder until it is about 1 / 3 full.

   The cylinder represents a hole being drilled into the earth, and the sand represents the cuttings that need to be removed from the hole. The water represents a type of drilling mud with a very low viscosity.

4. Pause a few moments to allow the water to seep into the sand and wet all of the granules. If you have sand that does not accept water readily, stir the water or shake the cylinder gently to mix the sand and the water.

   Wet sand is darker in color than dry sand. In the photograph on the left below, you can see the dry sand as a lighter colored layer beneath the darker wet sand. In the photograph on the right, all of the sand is wet with water.

5. Insert the end of the tubing with the dowel into the graduated cylinder so that it is just below the level of the water.

   Slowly push the tubing farther down into the water, while holding the dowel so that its end remains about even with the water level. As the tubing moves downward past the end of the dowel, it fills with water. Keep pushing on the tubing until it comes to rest on the sand at the bottom of the cylinder, and the bottom of the dowel is about even with the water level, so that the tubing below the dowel is filled with water.

   The tubing represents the drill assembly, and the dowel represents the pump that will circulate the low viscosity mud (water). The water in the tubing represents the drilling mud that will be circulated next.

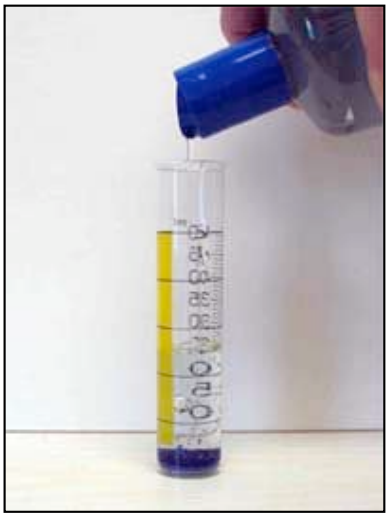
6. With the end of the tubing still resting on the bottom of the cylinder, push down on the dowel steadily, driving the water out the bottom of the tubing. Observe what happens to the sand as the water is flowing.

   After the dowel has been pushed all the way to the bottom of the tubing, wait a moment and observe what happens to the sand when the water flow stops.

After you have finished making your observations, it is time to prepare for the next part of the activity. Remove the dowel from the tubing. Dispose of the sand and water by pouring it into wadded up paper towels. Place the paper towels in the trash. Do not flush sand down a drain.

Wash and dry all the parts. Push through a piece of paper towel with the dowel to dry the inside of the tubing and graduated cylinder.

For the next part of the activity, repeat the above steps using clear shampoo to represent a high viscosity drilling mud. How do you think the shampoo will compare with water? (Be sure to pour in the sand before adding the shampoo.)



After you've completed the experiment and made your observations, take a look at our results.

Our Results

When we used water, we saw the sand disturbed by the outflow from the tubing. However, the sand sank back to the bottom once the outflow stopped, as shown in these two photographs taken a few moments apart.

When we used shampoo, we saw the sand raised up by the outflow from the tubing. As the outflow stopped, the sand remained suspended in the shampoo, as shown in these photographs taken several minutes apart.

Like the water, a drilling mud with low viscosity has difficulty bringing cuttings to the surface from the bottom of a well hole. It would take a strong continuous current to do so. However, as we have seen with the shampoo, a high-viscosity drilling mud can bring cuttings to the surface even with a slow rate of flow.