DRILLING FLUID CLEANER COMPONENTS

LINEAR MOTION SCALPER SHAKER TABLE

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LINEAR MOTION SHAKER TABLE

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LINEAR MOTION SHAKER TABLE

EDUCATION

WDC offers multiple client education opportunities, including our multi-media Drilling Fluids Seminar. Each seminar is worth 0.1 CEU credits, and those completing a class will be presented with a framed Continuing Education Unit Certificate. At no expense to you, a WDC drilling professional will travel to your location and present one of our multi-media seminars during a WDC catered meal.

THE DRILLING FLUIDS SEMINAR FEATURES:

- Graphical illustrations of mud properties and functions.
- Photos and videos of the mud properties testing including viscosity, density, filter cake, and sand content.
- Videos of major mud rotary drilling components including drilling rigs and portable mud pits equipped with linear motion shaker tables.
- Estimates of drilling fluid containment and disposal costs.

TWO WAYS YOU CAN SIGN UP FOR THE SEMINAR:

1 Call the nearest WDC office listed on the back page of this publication.

2 Go to **www.wdcexploration.com** and check out the Client Education menu. Once at our website, you can sign up for all of the WDC Seminars using the online sign up form.

CONTACT

Arizona 800.584.6471

Northern California 800.873.3073

Southern California 800.974.2769

Minnesota 877.558.9430

Northern Nevada 775.753.4414

Southern Nevada 702.558.9800

New Mexico 800.914.7506

Texas 281.854.2026

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SOURCES

Handbook of Groundwater Development, Roscoe Moss Company, Published by John Wiley & Sons, Inc. 1990.
Groundwater and Wells, Second Edition, Published by Johnson Filtration Systems, Inc. 1986.
Drilling Fluid Properties & Functions, John H. Berry, PG – Foundation Division Manager – CETCO Drilling Products.

Drilling Fluid Properties and Effective Mud Cleaning

Mud rotary drilling is a method of drilling a borehole into the subsurface by rotating a string of drill pipe and bit against the formation. By circulating water based drilling fluid, the drilled material (cuttings) is carried to the surface. This drilling method is used in the environmental or water wells, mining, geotechnical and oil/gas drilling industries.

A complete drilling fluid system must be properly designed in order to efficiently construct a well. The two main parts of the fluid system consist of the actual drilling fluid, and the solids separation equipment designed to remove the cuttings from the mud at the surface.

WHAT DOES DRILLING MUD DO?

Removes material (cuttings) from the borehole
The drilling fluid carries the drilled material to the ground surface either by viscosity or velocity.

Cools and lubricates the bit
The drill bit becomes hot due to friction generated during the drilling process. As the drilling fluid passes through the bit and exits the jets/nozzles, the excess heat is removed and carried up the borehole.

Cleans the drill bit
When the drilling fluid exits the bit jets, the fluid's velocity removes material from the bit teeth and the cuttings from the bit formation interface. This prevents the cuttings from being re-cut or re-ground.

Controls fluid loss
As the fluid moves from the borehole into the formation, clay particles are deposited on the borehole wall. The clay particles form a barrier limiting the amount of drilling fluid penetrating the formation. This barrier, called a filter cake, is important for the stability of the borehole. Additionally, well development time is reduced if fluid loss to the formation is limited.

Stabilizes the borehole
The drilling fluid's weight in the borehole must overcome the formation pressure to prevent the borehole from collapsing. Also, the fluid prevents formation swelling by "coating" the formation with an impermeable barrier.

Lubricates the drill pipe
The drilling fluid reduces friction between the drill pipe and the rising cuttings, and also between the drill pipe and the formation.

Suspends cuttings
When the mud pump stops, the drilling fluid velocity stops. The fluid must have enough gel strength to keep the drilled material (cuttings) in suspension until the mud pump activates.

DRILLING FLUID PROPERTIES

Viscosity
Resistance to flow. Molasses has a higher viscosity than water. Viscosity is measured by the use of a Marsh funnel. The device measures the time required for a unit volume of fluid (one quart) to drain through the funnel. Fresh water at a temperature of 70° has a flow time of 26 seconds through the Marsh funnel.

Density
Mass per unit volume. Drilling fluid densities are measured in pounds per gallon (ppg). The density of water is approximately 8.3 ppg.

Fluid Loss Control
Water loss and wall building (filter cake) tests are performed to API standards by measuring the amount of liquid forced from the mud, though a filter paper to a set pressure and time (normally 100 psi at 30 minutes). The filtrate or water passing through the filter paper and the thickness of the filter cake is measured. Please note that the filter cake does not structurally prevent the borehole wall from collapsing. The filter cake only minimizes the amount of drilling fluid that penetrates into the formation.

Sand Content
Sand content is measured as a percent of total fluid volume of particles retained on a 200-mesh sieve.

Gel Strength
A measure of a fluid's ability to hold particles in suspension. Gel strength is measured on a concentric cylinder viscometer.

Field personnel on a periodic basis, normally measure density, sand content, and fluid loss, during drilling operations. The testing equipment is inexpensive and easy to use with minimal training. A typical range of fluid properties for drilling in unconsolidated formation are as shown below:

DENSITY	Less than 9 pounds Per gallon (ppg)
FILTER CAKE	Approximately 2/32"
SAND CONTENT	Less than 1%
VISCOSITY	32–48 seconds

The above parameters should be modified on a site-specific basis. However, the sand content should remain below 1% in order to maintain the proper mud weight and viscosity.

DRILLING FLUID CLEANING EQUIPMENT

9000 GALLON CAPACITY CHEMTRON PORTABLE MUD PIT

SPEEDSTAR 50K ROTARY RIG AND PORTABLE MUD CLEANER EQUIPPED WITH LINEAR MOTION SHAKER TABLES

DRILLING FLUID CLEANING PROCESS

The purpose of a drilling fluid cleaning system is to remove the suspending solids (drill cuttings) entrained in the mud. High solids or sand content increases the fluid density, which leads to the
following problems:

1 High fluid density causes pressure in the formation of the borehole. This pressure drives the drilling fluid through the filter cake into the formation, leads to excessive drilling fluid loss to the formation, and extends well development time required to remove the mud from the formation.

2 As the fluid density increases, the pressure required to move the fluid up the borehole also increases, leading to high mud pump pressure requirements.

3 High solids or sand content also leads to significant abrasion in the drill tooling as the fine particles are recirculating through the mud pump and drill string. Washed out drill strings and mud pump valves/seats, along with leaking swivel packing, are caused by the recirculation of sand through the system.

4 If the gravel pack is emplaced in the annulus through drilling fluid with a high sand content, the fines will be entrained in the gravel pack leading to increased well development costs and reduced well yields.

Drilling fluid in a typical direct mud rotary drilling operation is directed through the following path:

1 Clean fluid is pumped from the mud pump into a flow line to the drill rig.

2 The drill mud travels down the inside of the drill pipe to the bit.

3 As the fluid exits the bit nozzles, heat and drill cuttings caused by friction, are carried away from the bit face.

4 The cutting's laden fluid travels up the annulus between the drill pipe and the borehole wall.

5 The fluid is typically contained at the ground's surface within an above ground pit at the drill rig.

6 A transfer pump moves the fluid to the cleaning unit.

7 The fluid enters the fluid cleaning system at the "possum belly" and flows across the first linear motion shaker called the scalping shaker. (Figure 1, back page) This "first cut" removes the large cuttings from the mud.

8 The fluid falls through the scalping shaker into a pit where some settling occurs.

9 Another pump drives the partially cleaned fluid through a set of hydro cyclones, which removes sand and silt particles. (Figure 2 & 3, back page)

10 The hydro cyclone discharge is directed onto a second linear motions shaker with small mesh size screens (140-200), where the sand size particles are removed from the drilling fluid. (Figure 2 & 3, back page)

11 The cleaned mud is then returned to the mud pump and the cycle is repeated.

12 The solids from the linear motion shale shakers are discharged into small transfer hoppers or roll off containers for disposal. Linear motion shale shakers employ the latest in technology by allowing a finer screen on the shaker. This results in more solids removed from the mud and a drier solids discharge from the unit.

Fluid cleaning systems are portable; they are skid or trailer mounted, and can range in tank capacity from less than 500 gallons to over 10,000 gallons. The cleaning rate of the unit should be designed at 150% of the mud pump's maximum flow rate.

The use of WDC modern linear motion solid separation equipment will increase well yields, reduce disposal costs, and provide the cleanest possible mud separated from cuttings from the drilling fluid in a virtually dry manner.