DFE (Asia) Pte Ltd.

DFE DEWATERING SYSTEM

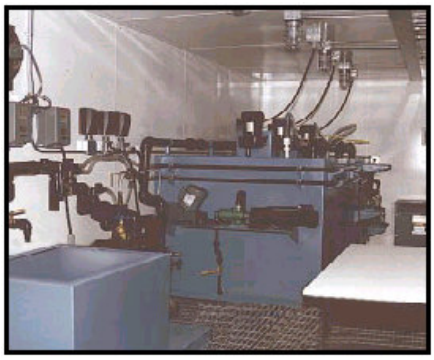
Even with an excellent solids control equipment system, fine solids that cannot be mechanically removed even by the high speed centrifuge, will continue to build up in the mud. A point will be reached where the concentration of these fine solids will begin affecting the mud rheology adversely. The only way to get rid of these ultra fines is by dilution with whole mud, as their particle size range is too small for mechanical removal. If the mud pits are full and more mud dilution is required, whole mud from the pits must be disposed of.

In a minimal discharge, environmentally sensitive area, this mud cannot simply be dumped in a sump and forgotten about. This is where mud dewatering becomes necessary. Also during cement displacements and at the end of the well, dewatering is used when the mud needs to be disposed of. The process of dewatering separates the mud into water and solids. The water can be either reused or discharged after going through a secondary water treatment / polishing system (can be supplied upon request), and the solids can be processed by the existing solids collection and treatment system.

System Components

Slurry Tank (optional) - This would be a metal tank with approximately 40 to 80 cubic meters capacity. It would be located immediately behind the active system centrifuges. This tank would be used for storage of fluid that is to be dewatered. When the mud engineer gives the order to lower the volume in the active system, effluent from the low gravity solids removal centrifuge can be directed by changing valves, to allow it to feed by gravity to this slurry tank. The effluent lines from the active system high speed centrifuge would be 6" PVC, with butterfly valves to allow the effluent to go either to the slurry tank for dewatering or back to the active system, depending on needs at that time.

The practice of passing centrifuge effluent to dewatering for lowering the active system volume should always be done. If the mud is un-weighted, it is more efficient because the fluid has passed first through a high speed centrifuge, removing as much of the low gravity solids as is mechanically possible before dewatering. If the mud is weighted, the barite has been recovered by the barite recovery centrifuge first, and again, as much of the low gravity solids have been removed by the high-speed centrifuges as is possible. Dewatering of whole mud would result in higher chemical costs and lower process rates, thus higher costs to the operator.



DFE-250 Containerized Dewatering System (Mixing/Metering and Chemical Unit) This is a self-contained unit that holds the static mixer, polymer tanks, polymer pumps, lights, lab, etc. There are two polymer tank sections inside the unit of about 10 barrels each. Each polymer tank section will be equipped with an electric paddle type agitator to aid in the mixing of the polymer, and a polymer mixing jet hopper system to insure maximum polymer mixing efficiency.

The polymer injection pump is equipped with a suction manifold to allow suction from either polymer tank. One tank will be in use while a new batch of polymer is being prepared in the other tank. This insures continuous operation without having to wait for polymer to yield. It also results in more efficient polymer use as the polymer in the second tank has sufficient time to yield to it's maximum potential. Processed water will be used to mix up new polymer to minimize new water use.

Static Mixer - The static mixer is a tubular mixing manifold, containing baffles inside to aid in

efficient mixing of the various dewatering components. It also contains connections for the inputs from the mud feed pump, dilution water pump, coagulant pump, and polymer pump, in that order. The slurry enters the mixing manifold and is next mixed with dilution water. Coagulant is added to the diluted mixture, then finally mixed with the polymer flocculant. The combined mixture travels through the baffles in the static mixer, effecting formation of flocs and separation of water. A valve at the end of the static mixer allows mixture samples to be taken and observed for proper floc formation and water clarity before the mixture enters the centrifuge.

Dewatering Centrifuge - The dewatering centrifuge system will consist of one DFE 600x960 Centrifuge.

The Centrifuge will be mounted on the dewatering unit, high enough to allow the effluent to gravity feed to the dilution/clean water tank, and to allow the solids discharges to fall into the collection area or centrifuge auger. This centrifuge will be located on a stand next to the pits and the active system centrifuge(s).

The 600-960 centrifuge can be adjusted from a range of 1000 RPM to 4000 RPM. Too low of a speed will not give adequate separation, and too high will break down the flocs. Intermediate speed generally gives a good balance between the two extremes. We have been able to process 500-1000+ barrels per day of mud with this arrangement.

The effluent from the dewatering centrifuge will gravity feed through 6" pipe either to the dilution/clean water tank or returned to the slurry tank for further treatment if necessary. A "Y" and butterfly valves will allow the effluent to be returned to the slurry tank to be reprocessed if it is not clear enough to continue the process. This is sometimes necessary when beginning dewatering, or after some parameter has changed, while searching for the optimum feed rates of the various components.

If the fluid is clean enough it will go to the dilution/clean water tank. From there the processed water is either used as dilution water in the dewatering process or flows to water treatment tank for storage of dewatered water. From the dewatered water storage tank the water can be pumped back to the premix pit to be used for new mud preparation, to the rig water storage tank for use in washing down equipment, or to the optional water treatment system for further treatment and eventual discharge.

At the end of the water base mud sections, all of the remaining water base mud will have to be dewatered. This will take several days depending on the actual volume. As the rig mud pits are emptied they can be cleaned.

Dewatering Chemicals

It is recommended that DFE obtain a sample of each type of fluid to be dewatered carry out pilot testing. This way we can test a full range of flocculants and coagulants in the lab and make sure we have the polymers on location what work the best when the well starts.

DFE has access to a line of "Polymers" and flocculants and coagulants.
Based on past experience with normal water base mud, and depending on the results of the pilot tests mentioned above, we recommend the following chemicals for dewatering and water treatment.

It is advisable to have both a nonionic and anionic flocculant on location. Depending on current conditions, the one that give the best results can be used.

a. A high molecular weight nonionic polymer of acrylamide and comes as a free flowing white powder.

b. A high molecular weight anionic polyelectrolyte supplied in powder form. With a medium anionic charge density and is completely soluble in water.

Coagulants can lower treating costs but also can cause problems with water compatibility for making up new mud. We recommend having the following available on location:

a. An organic coagulant supplied in solution form. With a very high cationic charge density and a medium molecular weight. Water treated with this can be used for mud makeup if overtreatment does not occur. It is recommended to test all water according to the "Dewatered Water compatibility test" outlined in the quality control.

b. Aluminum Sulfate – Inorganic coagulant also used in water treatment. Can also be used as a coagulant in dewatering process. Works especially well in clearing up the processed water if mud has lignite or other "black powder" like Gilsonite. IT IS NOT RECOMMENDED TO USE PROCESSED WATER FOR MUD MAKEUP. The water can severely flocculate the mud. This coagulant can be used when it is certain that the water will not be used to prepare new mud and will result in better water clarity at a significantly lower price. Comes as a white powder or granular material.

c. A Blend of polymer and Aluminium Chloride. Also good for clearing up water coloured with lignite or other black powder.

Acetic Acid – This acid functions as a coagulant when pH values of the mud are high. It is still strong enough to work well in this capacity, but not strong enough to be as dangerous to handle as Hydrochloric, or Sulphuric Acid.

Quality Control of Dewatered Water for new mud makeup

In an environmentally sensitive area, it is important to minimize any discharge of fluid to the environment. Water processed through the Dewatering System can be reused to prepare new mud if certain conditions are met:

Processed water from the dewatering system can be used if the water was processed utilizing a treatment that does not involve Aluminum Sulfate or similar product. Mud can be processed more cheaply by the dewatering system using Aluminum Sulfate as a coagulant, then treating with the more expensive polymer flocculants. This pre-treatment with the relatively cheap coagulant greatly reduces the amount of the polymer flocculant required to effect clarification, thus reducing the cost of treatment. However, as stated above, this will normally render the processed water unsuitable for new mud preparation due to the presence of excess coagulant in the water, which in turn can flocculate the mud.

In this case all of the water treated in the dewatering system would have to be sent to discharge. The treatment can be effected without Aluminum Sulfate, only using the polymer. This will result in water that is compatible with new mud preparation, but the treatment cost will be more expensive. DFE will have both options available for this project. The actual treatment that is used will be an economic versus environmental question that will be decided by the OPERATOR representative on location based on the current conditions.

For the above mentioned water source, the following procedures are recommended to guarantee that the water to be used for new mud preparation will not have harmful effects on the mud due to polymer carryover.

I. PROPERTY ADJUSTMENT - Physical properties must be adjusted in the Water Storage tank to meet the following parameters, if they do not already meet them.
   a. pH.....7-9
   b. Density, ppg.....<=8.5
   c. Ca++, mg/L.....<=280
   pH adjustment would be done with lime and caustic soda. Calcium can be treated out with Soda Ash. Density is a function of solids content.

II. MUD COMPATIBILITY TEST PROCEDURES
   a. Obtain three barrels equivalent (1050 cc) of mud
   b. After mixing, evaluate the performance of rheology on the three different samples:
      i. Mud from the active system
      ii. Mud plus 21 mls (6%) of rig water
      iii. Mud plus 21 mls (6%) dewatered water

III. Record the Plastic Viscosity, Yield Point, 10 second and 10 minute gels for each sample

IV. Evaluate the results obtained:

   a. Best Case - the properties of the mud plus dewatered water are virtually the same as mud plus river water.

b. Acceptable Case - properties of mud plus dewatered water are higher than mud plus rig water but not as high as the whole mud properties.
c. Unacceptable Case - the mud plus dewatered water properties are higher than the whole mud properties.

Basically, if there is no significant difference in the rheology between the rig water/mud sample and the dewatered water/mud sample, the water is deemed acceptable for use in preparing new mud.

This test should be discussed with the mud company representative, and the pertinent OPERATOR representatives well before any drilling begins to establish an objective criteria for evaluating the water for use in preparing new mud.

Bacteria can be a significant problem to the mud, especially if treated water is pumped to the DFE water treatment system. **All** water used to prepare mud should be treated with Sodium Hypochlorite as a preventative measure against contaminating the mud. Excess Sodium Hypochlorite can be oxidized by aeration of the water using the aeration/mixing system on the treatment tank if necessary

Basic Flow Diagram