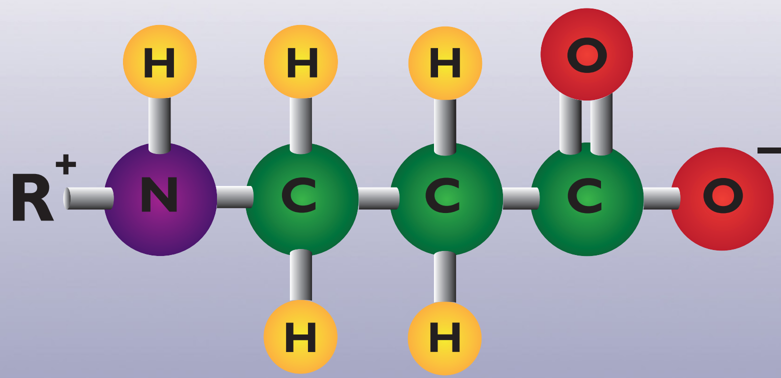
ELGIN SEPARATION SOLUTIONS

Industry Leading

Drilling Fluid Dewatering



Generic Amphoteric Molecular Structure

By Imparting "Sophistication Through Simplicity", Along with a Host of On-Board Monitoring Systems and Easy to Use Operator Controls, Elgin Drilling Fluid Dewatering Systems Maintain a Best-in-Class Status.

10050 Cash Road
Stafford, TX 77477 • 281-261-5778
www.elginseparationsolutions.com

Saving Money, Time, and the Environment Through Chemistry

A General Process Philosophy Description of Elgin's Drilling Fluid Dewatering Systems

The drilling industry is regulated by a myriad of environmental regulations that protect our air, water, and land resources. As these regulations continue to evolve, so too must the technologies utilized by the drilling industry. Though lowering compliance costs is always a worthy initiative, incorporating technology that also enhances the drilling process by improving down-hole conditions and lowering the consumption of chemicals and drilling fluid additives is the ultimate goal. Elgin's proprietary Drilling Fluid Dewatering ("DFD") Technology lowers the costs associated with drilling fluid make up, lowers the costs associated with used drilling fluid disposal, improves the properties of the drilling fluid while drilling therefore improving the rate of penetration ("ROP"), and ultimately reduces the impact to the environment. As such, Elgin's DFD Technology is the key element in 100% closed-loop waste management systems; therefore saving time, money and the environment.

ELGIN
SEPARATION SOLUTIONS

Since 1864, Elgin Separation Solutions (Elgin) has been providing sophisticated solids control and dewatering products to customers around the world. In doing so, Elgin has developed a unique set of core competencies that have made us a service leader in separation technology. By combining expertise in both dewatering polymers and solid/liquid separation technologies, Elgin has developed an organization capable of providing complex chemically-enhanced mechanical separation solutions.

Though the concept is relatively simple, the use of DFD Technology requires a considerable amount of planning, training, and operator skill. It is a process which varies greatly with location and mud type. Consequently, by combining Elgin's decades of dewatering experience, Elgin has developed a patent pending[1] DFD Technology that takes the complexity and guessing out of the process. Elgin's DFD Technology takes advantage of powerful organic polymers, an intelligent human-machine interface ("HMI") and a sophisticated programmable logic controller ("PLC") that simplifies the dewatering process making it a technology that can be used by any drilling operation.

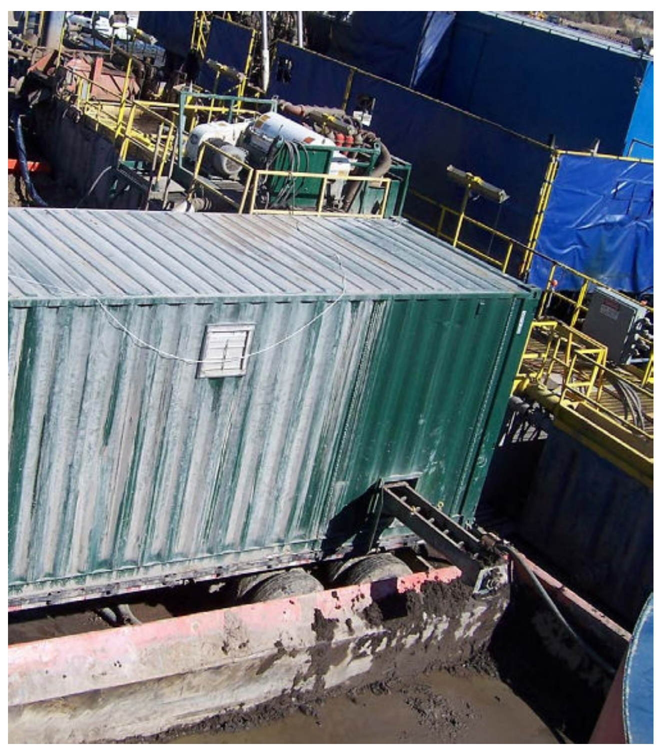


Figure 1 – Land-Based Drilling Fluid Management System Using Elgin's ESS-DW-40 Trailer-Mounted Dewatering System & ESS-1450 Solids Control Centrifuges

1 Patent Application US 2010/0059453 A1 Published March 11, 2010.

Tremendous Value Generated by Drilling Fluid Dewatering

The concept of dewatering drilling mud while drilling,was initially inspired from the need to reduce or eliminate liquid mud disposal. Today, DFD Technology is used also to reduce operating cost and improve drilling efficiency. In order to provide bit lubrication and cooling, cuttings removal, and well control, the properties of drilling fluid must be carefully controlled. As cuttings build up in drilling fluid, the weight and viscosity of the drilling fluid increases, which in turn increases drag forces on the drill bit slowing the ROP, increases the thickness of wall cake on the borehole wall, and makes control of the well pressure more difficult.

Studies have shown that the lower the colloidal content in a water-based drilling fluid, the faster the drill bit rate of penetration (ROP). Minimizing colloidal solids lowers the plastic viscosity of drilling fluid, contributing to greater horsepower at the bit. However, removing colloidal solids becomes cost prohibitive, if they are allowed to accumulate and further degrade when continuously recirculated in the drilling fluid.

For both environmental and economic concerns, it is better to reclaim the water phase of used mud and dispose of only dry solids than to haul off and dispose of whole liquid mud. Dewatering systems also enable water to be reclaimed from used drilling fluid and subsequently combined with unused or recirculated drilling fluid being pumped down the drill pipe and returned to the surface. Using reclaimed water to maintain volume prior to being recirculated down-hole reduces the costs associated with transporting clean water to the well site for such purposes. After water is separated from used drilling fluid, the remaining solids for disposal are smaller in volume and lighter in weight, as compared to that of the used drilling fluid prior to dewatering, and can be transported from the well site and disposed at significantly less expense. In most installations, DFD Technology can also provide the additional benefit of eliminating the need for reserve pits, saving valuable room and further reducing operating costs.

Model Number:	ESS-DW-40	ESS-DW-20	XP Polisher with Select Floc ™
Product Image:			
Description:	40' HMI Containerized Dewatering Unit	20' HMI Containerized Dewatering Unit	Trailer-Mounted Dewatering Unit
Length:	40' (12.1 m)	20' (6.1 m)	31' (9.5 m)
Width:	8' (2.4 m)	8' (2.4 m)	8' (2.4 m)
Height:	9.5' (2.9 m)	9.5' (2.9 m)	10.5' (3.2 m)
Centrifuge (rpm / G's):	ESS-1967HD2 (3,100 / 2,600)	KT-1450HD2 (3,250 / 2,100)	KT-1450HD2 (3,250 / 2,100)
Coagulant Tank:	2 x 160 gallon (606 liter)	2 x 160 gallon (606 liter)	330 gallon tote (1,250 liter)
Flocculant Tank:	2 x 330 gallon (1,250 liter)	2 x 330 gallon (1,250 liter)	330 gallon tote (1,250 liter)
Acid / Aux. Tank:	100 gallon (26.4 liter)	N/A	N/A
Dissolution / Transfer Tank:	1,500 gallon (5,678 liter)	460 gallon (1,750 liter)	460 gallon (1,750 liter)
Tank Agitators:	4 x 1 HP	4 x 1 HP	N/A
Air Conditioning:	Heater and AC	Heater and AC	N/A
Control Room / Laboratory:	8' x 8' (2.4m x 2.4m)	N/A	N/A
Electrical:	380V / 50Hz or 460V / 60Hz – 3 Phase	380V / 50Hz or 460V / 60Hz – 3 Phase	380V / 50Hz or 460V / 60Hz – 3 Phase

Table 1 – Standard Elgin Dewatering Systems.

Understanding the Dewatering Process

Dewatering is the process of extracting the liquid phase from drilling fluids through the use of chemically enhanced mechanical separation. In Elgin's patent pending1 process, organic polymers are added to the drilling fluid via a conditioning manifold prior to entering a centrifuge. The solid particles found in drilling fluid carry an electrical charge that causes them to repel one another, thereby enabling the solids to be suspended in the water. Due to these repulsive forces and the concentration of colloidal / ultra-fine solids, the drilling fluid would require such a significant amount of time as to make this natural process an impractical means of dewatering.

Table 2 – Typical DFD Reclaimed Water Results	
pH^	7 to 10
Chlorides (mg/L)+	200 to 2,500
Total Suspended Solids (mg/L)	10 to 100
Total Hardness (mg/L)	5 to 200

Table 2 – Typical DFD Reclaimed Water Results

^Since Elgin's DFD Technology does not require the use of acids to achieve coagulation, the effluent pH is not affected. This eliminates downstream drilling fluid and equipment impact typically experienced with low pH effluent.

+Chlorides are dissolved ions or salts and cannot be removed through DFD technology.

To accelerate the dewatering process, the drilling fluid is first treated with an organic coagulant to destabilize the suspended solids of the mixture. Colloidal solids may be removed from the drilling fluid after particle charge destabilization with a high cationic charged, low molecular weight organic polymer and then aggregated together to form a "hard floc" with the addition of an anionic charged, high molecular weight polymer. As used herein, destabilization refers to the process of neutralizing the electrical charge of solids suspended in the colloidal mixture, or drilling fluid, so as to reduce or breakdown their repulsive forces.

Elgin's proprietary DFD Technology:

- *Lowers the costs associated with drilling fluid make up,*
- *Lowers the costs associated with used drilling fluid disposal,*
- *Improves the properties of the drilling fluid while drilling therefore improving the rate of penetration ("ROP"), and*
- *Reduces the impact to the environment.*

Elgin's DFD process integrates and controls the process of polymer hydration, polymer injection, drilling fluid conditioning, polymer/drilling fluid mixing, and solid/liquid separation via centrifuge technology. This is accomplished within a single, packaged system fully controlled through a graphical human/machine interface that can help manage historical treatment data. Elgin's systems are designed to function as stand-alone systems or as a system upgrade that can be seamlessly incorporated into an operation's existing drilling fluid management systems.

When properly applied, customers can achieve amazing results leaving them with a manageable solid (for affordable disposal or reuse) and water (for affordable disposal or reuse). Typical DFD reclaimed water can achieve impressive results (See Table 2).

Dewatering Equipment and System

Conventional solids control systems deliver used drilling fluid through a linear motion shaker, a hydrocyclone package, and a decanter centrifuge. The used drilling fluid initially passes through the linear motion shaker, which is capable of handling 100% of the mud pump flow while removing coarse

Figure 2 - Elgin's Solids Management Equipment

sized solid particles between 320 to 75 microns, depending upon the screen mesh size being used. The drilling fluid may then optionally pass through a desander and/or desilter hydrocylclone package for further removal of fine and silt sized drill solid particles, ranging in size between 74 to 20 microns. Finally, the fluids are processed by a high speed solids control decanter centrifuge to remove ultra-fine particles greater than 5 micron at an average process rate of approximately 20% of the mud pump flow rate. Figure 2 outlines a sample of Elgin manufactured technologies that would be used within a complete drilling fluid management system.

As highlighted in the previous sections, these conventional solids control systems are incapable of managing ultra-fine or colloidal solids with a particle size less than 5 microns. To achieve the benefits noted, a dewatering system is required.

Keeping within the essence of Elgin's philosophy of "Sophistication Through Simplicity", Elgin's DFD systems are designed as modular systems to be incorporated into existing drilling operations with minimal changes. The goal is to mitigate the expense incurred by incorporating the technology, therefore ensuring positive economic returns once the system is fully operational. A comprehensive DFD system can be easily accommodated if given the following:

- Approximately 1,000 square feet (100 square meters) of space adjacent to mud tanks.
- Space near or adjacent to the primary drilling fluid cleaning system.
- A "clean" 3-phase electrical power source capable of providing 220 to 350 KVA.
- Fresh water source for polymer make down.
- Collection bins for dry cuttings and storage tanks for reclaimed water.

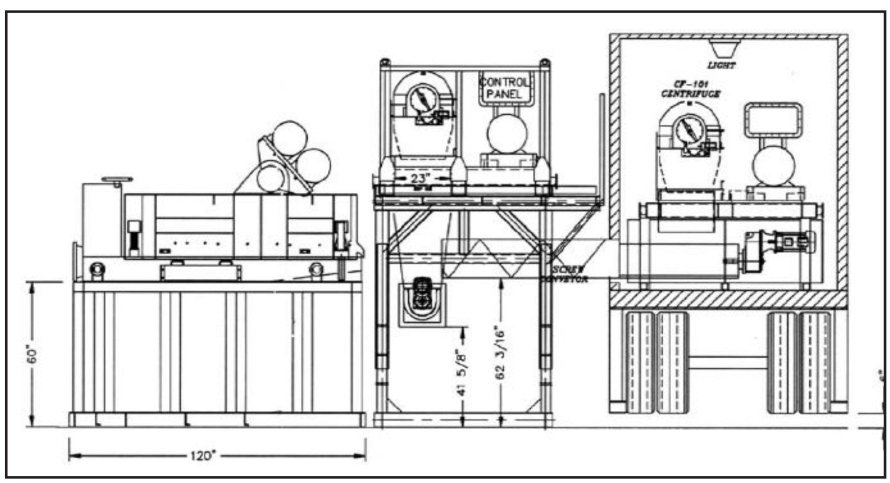


Figure 3 – Cross-Section of Elgin's DFD System Using a Trailer-Mounted Dewatering Package.

The most common way to aid dewatering during a drilling operation is with a reserve pit. Consequently, the "reserve pit" utilized for DFD systems is considerably different than what drilling operators are typically accustomed to. A reserve pit utilized when employing DFD technology should be limited to receive only dry solids discharged from the solids control and dewatering equipment. All used drilling fluid should be pumped to an agitated holding tank, which in turn is used as the feed system to the dewatering unit. The dewatering unit would then reclaim the water from the used drilling fluid and recycle it back to the operation to maintain mud properties, surface volume, and/or other needs on location. Properly managed DFD systems can result in no liquid wastes to be hauled away at the completion of a well, and the relatively small reserve pit can be simply back-filled.

Figure 4 – Elgin's DFD System Can Eliminate the Need for Reserve Pits

To achieve the absolutely lowest impact to the environment and to minimize costs associated with a drilling fluid management system, a DFD system should be deployed without the use of a traditional reserve pit. By eliminating the reserve pit, dewatered solids are discharged directly to collection tanks (i.e. open top frac tanks). When eliminating the reserve pit, no liquids are discharged to bins. Instead, all liquids are processed through the primary mud cleaning system and/or DFD system.

Dewatering While Drilling

A closed-loop dewatering system should never compromise drilling operations. Elgin's DFD Technology is actually designed to enhance drilling operations. As previously discussed, Elgin's DFD systems are installed on location to receive all used drilling fluid and spent rig water. This eliminates the need for reserve pits as "dry" solids from the drilling fluid management (solids control system) and the dewatering system should be discharged to collection bins or a liquid-free reserve pit as highlighted in Figure 5. This eliminates the need for the use of reserve pits. As "dried" solids are discarded from the DFD system, they are collected in containers for disposal or land application, where applicable; the reclaimed water is then recycled back into the mud system for future use. The combination of these two activities creates a true closed-loop system. When using a DFD system as a barite recovery operation, the drilling rig can significantly reduce the need for preparing new drilling fluid.

Figure 5 – Elgin's DFD System Using a Dry Reserve Pit.

When drilling with a weighted drilling fluid in formations that contain highly reactive clay fractions, the only effective form of solids control is running a centrifuge to recover barite. This is the only way, short of dumping and diluting the mud, to effectively control low gravity solids and bentonite content. Normally, when operating the centrifuge to recover barite, the liquid effluent is a waste product. This is not the case when dewatering while drilling. Transferring the liquid effluent to the dewatering unit, removing the colloidal solids and returning the water to the mud allows for truly significant reductions in suspended clays, cationic exchange capacity, and percent low-gravity solids. To be most effective, this process should take place slowly and accurately whenever drilling and circulating. The slower the fluid is fed to a centrifuge, the more cost efficient barite recovery will be.

Typically, during normal rig operations mud is intermittently transferred to an agitated storage system along with used drilling fluid or new barite and wash water. In an un-weighted mud system, drilling mud is usually pumped from the rig pit located on the active mud system to the agitated holding tanks. In a weighted mud system, drilling mud can also be transferred in this manner, but is commonly transferred via centrate from a centrifuge operating in a barite recovery mode on the active mud system. Without such a system, operators would be left with the continuous accumulation of colloidal and ultra-fine drilled solids in the circulating system. Ultimately, this can lead to excessive mud densities, rheology, pipe torque/drag, mud loss, pore throat damage, disposal fees, drilling days, and higher well cost.

Additional features and benefits achieved by the installation of the DFD system include:

- The DFD agitated storage system provides additional flexibility in determining how and when to transfer mud from each of the active rig systems to the dewatering system for processing.
- The DFD storage system can act as a contained reserve pit or redundant collection system, therefore allowing the mud engineer to make dilution for viscosity control or to reduce the volume in the active system prior to increasing mud weight.
- When running casing, the DFD storage system can eliminate the need for hauling off or dumping excess mud.
- A properly run DFD system will significantly reduce disposal costs and dramatically reduce operating risk associated with environmental problems inherent with open reserve pits.
- Dewatering can be used on rig wastewater, as well as on drilling fluid. Since clear water is returned to the active system, the volume of fresh water required on a rig is greatly reduced.
- The entire drilling fluid system can be dewatering while nippling up the Blow-Out Preventer ("BOP") stack after the casing has been set. When the DFD feed storage system is properly sized, additional

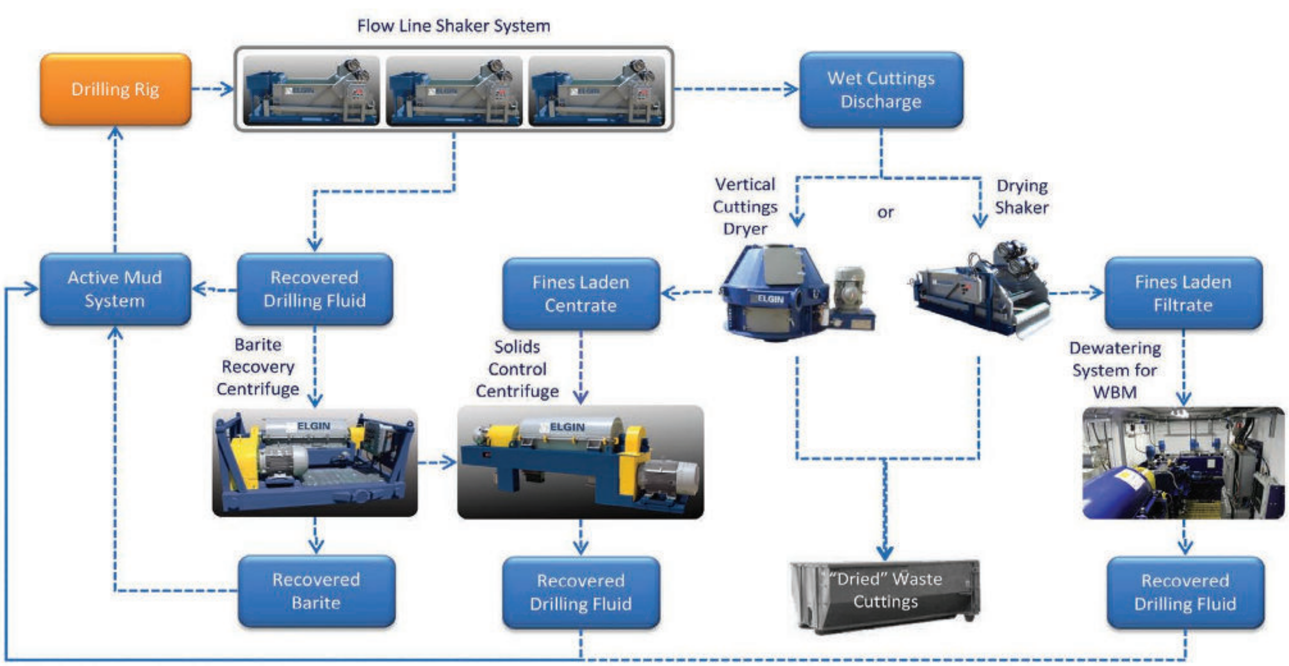


Figure 6 – Elgin's DFD System Combined with a Primary and Secondary Solids Control System

The entire drilling fluid system can be dewatering while nippling up the Blow-Out Preventer ("BOP") stack after the casing has been set. When the DFD feed storage system is properly sized, additional storages tanks, vacuum tracks and unnecessary tank cleaning charges associated with a change over from water-based to oil-based drilling fluid can be avoided.

Critical Features of a Best-in-Class Dewatering System

Though there are dozens of critical facets to managing and maintaining a successful DFD system. Consequently, there are six that separate those systems that achieve dewatering only by name, from those that truly achieve a significant reduction in drilling and waste disposal costs:

1. Maintaining a Homogeneous Feed to the DFD System
2. Ensuring Complete Polymer "Hydration" (i.e. Activation) and Drilling Fluid Conditioning
3. Control of all Process Variables to Maximize Dewatering Capabilities
4. Control of the Polymer Injection System
5. Equipment Redundancy to Ensure 100% Productive Operation
6. On-Board System Monitoring and Accurate Performance Feedback Systems

Each of the above are discussed in more detail:

Section 1 - Homogenous Feed

Fluids to be dewatered must be collected in a fully agitated collection system. Mixing of the feed stream during the dewatering process ensures mixture homogeneity of the feed stream therefore improving the results and minimizing chemical consumption. Once collected, the drilling fluid must be carefully fed to the dewatering system to ensure flow homogeneity.

As previously suggested, the ability to properly receive, hold and agitate a significant amount of the fluid to be dewatered greatly increases the probability of a homogeneous feed stream. The more homogeneous the fluid the less likely will be the tendency for "upsets" to occur. The large storage capacity for a continuously mixed feed-stream allows mud to be taken simultaneously, if necessary from dilution, desilter underflow, a barite recovery centrifuge, excess volume at casing points, cellar water and/or pit washing fluids. Any or all of these operations are enhanced or eased on a closed loop location by the use of the Elgin's DFD system.

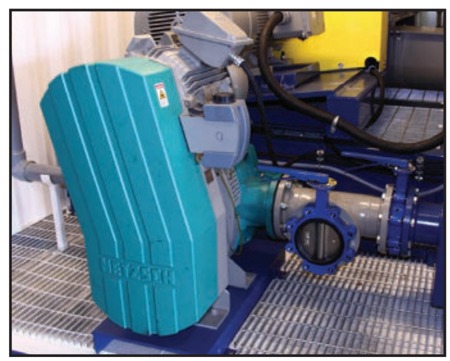


Figure 8 – 20' DFD Systems Fed Via Progressive Cavity or Rotor Lobe Pumps

The type of pump used to control the feed stream from the storage tank to the dewatering system is very important. This importance is magnified when the fluid becomes more difficult to process and at other times when very fine control of chemical usage is necessary. A variable speed, progressive cavity or rotar lube pump is preferred and is used with great success on Elgin's DFD system. Rheological properties of the feed stream are significantly affected by chemical injections, thus effecting manifold pressures. A progressive cavity pump output is unaffected by such changes and allows the feed rate to remain constant. This is not always true with centrifugal feed pumps lacking this continuity, and chemical additions must be constantly adjusted. Further, with high solids drilling fluids, the viscosity in the flocculation manifold can become so high that a centrifugal pump will not move the fluid. The progressive cavity pump employed in the Elgin DFD system provides a smooth and continuous flow of fluid, regardless of viscosity changes.

Section 2 -Polymer "Hydration" (Activation)

The method used by Elgin's DFD system has operated for years under the harshest conditions, utilized both dry and liquid polymers with full hydration and no "fish eyes" (clumping of polymers). The system is set up to reuse processed water as make-up water for polymer when appropriate. This can help prevent excessive fluid from accumulating on the location.

Prior to adding coagulant and flocculant to the used drilling fluid, each polymer must be fully hydrated or activated, a process commonly referred to as "make-down." Making-down each polymer involves mixing into water, or hydrating, a concentrated or neat form of the polymer and then allowing sufficient residence time for the polymer to uncoil or activate. Improper make-down of the polymers results in reduced dewatering efficiency and higher use of the neat polymer materials. In the worst case, an improperly activated coagulant may fail to destabilize solids in the drilling fluid. Similarly, an improperly activated flocculant may fail to aggregate the destabilized solids. Either way, the dewatering process fails to reclaim usable water from the used drilling fluid and affect the discharge quality of the dry "cake solids."

Figure 9a and 9b – Elgin's DFD Polymer Injection and Conditioning Manifolds

Polymers typically applied to the dewatering of used drilling fluid have long, fragile carbon chains and are sensitive to high mechanical shear forces and high temperatures. Adequate water pressure and warm temperatures improve hydration, or activation, of the polymers and reduces the time required for maximum uncoiling of the carbon chain. The water often used for make-down of polymers in conventional dewatering systems is limited by the source of that water, without regard to pressure or temperature.

For instance, gravity-fed water may be provided from a storage tank to make-down the polymers. In such cases, the water pressure is too low for proper make-down, leading to reduced dewatering efficiency and excess use of the neat polymer materials. To increase the water pressure, the water may be passed through a booster pump and then delivered from the pump by hose for make-down.

Moreover, the water source is exposed to environmental conditions. During Winter or at well sites located in cold environments, the water temperature is often low. Consequently, the polymers will not activate quickly during make-down. Water temperatures that are too low may also result in decreased dewatering efficiency.

It is because of each of the above concerns, that Elgin's Drilling Fluid Dewatering systems have been designed. This unit, carefully controls polymer activation by managing dosing, flow rates, water pressure, water temperature, mixing, and residence time.

Elgin has also developed a patent pending portable liquid or emulsion polymer hydration system, the Select Floc™. This system incorporates make-up inline heaters, static mixers, graphical user interface, and a water booster pump to ensure proper mixing pressure and flow. Elgin's Select Floc™ can be used in dewatering used drilling fluids and other oilfield water and wastewater treatment applications.

Figure 10 – Elgin's Patent-Pending, Portable, DFD Polymer Injection and Conditioning System, the Select Floc™ LP3.0

Section 3 - Controlled Physical Variables and Drilling Fluid Conditioning

Though hydration is the cornerstone of ensuring optimal polymer performance, both shear and temperature must be closely managed. To stabilize the water pressure and ensure the proper system temperature, Elgin DFD systems are equipped with a "booster pump" and water make-up immersion heaters. This allows the system to be used in the most extreme weather environments and ensures that each DFD system operates per the design criteria.

The use of inline mixers and sufficient residence time after adding coagulant and flocculant optimize chemical usage in the flocculation manifold (See Figure 9). Thorough mixing of each addition is critical to minimizing chemical usage. The use of inline mixers and the unique design of the flocculation manifold facilitate this operation. The manifold has been sized appropriately to provide optimization between residence (or reaction) time and floc shear. A sample port is located after each injection port so that samples may be withdrawn to monitor the progress of the system and treatment levels adjusted, if necessary.

Figure 11 – Elgin's DFD Systems Incorporate InLine Static Mixers and Sampling Port.

Section 4 - Controlled Polymer Injection

Adding both coagulant and flocculant independently to the feed stream must be carefully planned in order to optimize the operation. Coagulant is added with a precise progressive cavity metering pump capable of a wide range of output rates. The ability to make extremely fine incremental adjustments of coagulant is extremely important to the efficiency of the dewatering process while drilling. Pre-mixed viscous flocculant is added by a progressive cavity metering pump of a type which allows a controlled rate, consistent output, and low shear mechanics. The controlled rate and output is needed to meter the polymer at a minimum level to promote flocculation and dewatering without leading to wasteful over treatment. Each of Elgin's packaged dewatering systems incorporate precise controls for polymer injection. Elgin's Select Floc™ systems can be incorporated into existing drilling fluid management operations utilizing centrifuges with minimal effort and capital expense.

Section 5 - Equipment Redundancy

The use of redundant pumps on Elgin's DFD systems allow operators to shift from one pump to another in the event of a breakdown. Additionally, the ability to reroute fluids to handle a wide variety of expected and unexpected uses makes Elgin's DFD systems capable of handling any situation that arises. These redundancies, coupled with the fact that Elgin employs dual polymer tanks and dual mix tanks, ensures that the DFD system can operate on a continuous basis.

Elgin packaged dewatering systems have been designed to meet the demanding environment of the oil field. It may be possible to get by in some situations with a less sophisticated system; However, the unexpected can make what was adequate now inadequate, therefore easily destroying the entire economics of the project.

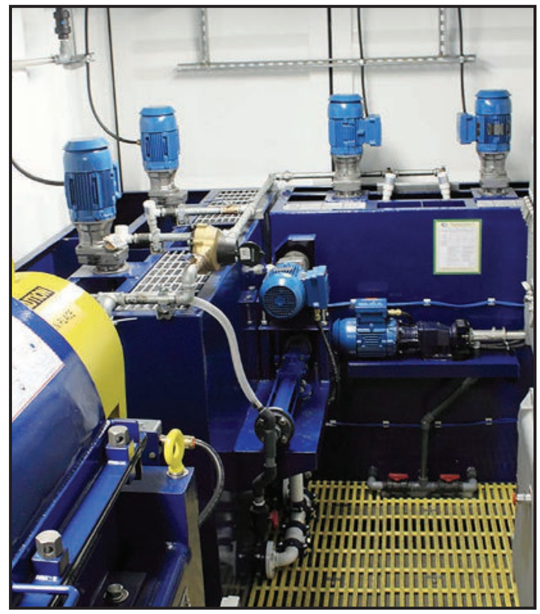


Figure 12 – Elgin's DFD Systems Incorporates Dual Polymer Feed Tanks and Dual Mixing Tanks

Section 6 - System Monitoring

To ensure that all the key process variables are properly monitored, a suite of sophisticated monitoring devices have been incorporated into Elgin's DFD systems. This is achieved through a host of local pressure gauges, thermometers, flow meters, and visual feedback systems, all of which are supported by the data logging capabilities of Elgin's proprietary HMI and dewatering PLC.

a. **Data Management** - The amounts of coagulant and flocculant added to the feed stream are carefully measured and controlled. Incoming mud weight, pH of mud, water hardness, viscosity, clay content, sand content and other water quality evaluations are also made on regular basis and logged. Elgin's HMI controlled DFD system provides the operator with all the tools necessary for accurate control of all process variables and provides immediate feedback regarding system performance. By inputting basic information regarding the polymers being used into the HMI and making adjustments based on the process data collected, the system takes advantage of factory-calibrated metering pumps to precisely control injection rates and polymer hydration based on the volumetric loading (i.e. via a feed pump). Local flow meters automatically maintain daily records relative to polymer consumption therefore allowing the operator to compare resulting fluid and dewatering properties in an effort to fine-tune the system's performance. Regularly reviewing the DFD system performance against records is a key factor in minimizing chemical usage, keeping costs down and making the reclaimed water more compatible with the active mud system.

b. Used Drilling Fluid Feed Control - The fluid to be dewatered is pumped by a Elgin progressive cavity pump with variable speed control (See Figure 8). The advantages of this type of pump are two-fold. First, when the mud has been batch treated it is sensitive to shear. A progressive cavity pump imparts much less shear than a centrifugal pump. Second, the need for a consistent flow rate and repeatable settings make this type of pump a necessity. Further control is gained by having the fluid processed in a compartment within sight of the operator, which gives a better feel for the volume being processed and a simple way to gauge total volume.

Figure 13 – Dry Solids Discharge from a Elgin DFD System

c. Centrifuge Control – The standard dewatering system is built around Elgin's ESS-1450 MVD dewatering centrifuge. The dewatering centrifuge is a double scroll, high rpm decanter for the separation of flocked solids and clear water. The drilling fluid is processed in this centrifuge at approximately 3,000 rpm with a processing capacity adjustable from 20 to 115 gpm. Greater processing speeds can be achieved by increasing the size of the centrifuge bowl diameter. The conveying speed can be controlled through an optional variable frequency drive or manually by changing the ratio of the scroll speed to the bowl speed for various processing needs. To achieve desirable results, the G-force is maintained between 1,500 and 2,000 times the force of gravity. This range produces a dry discharge. Solids should have a dry appearance with a minimum amount of free water (See Figure13). Individual disposal requirements should be examined in setting parameters for the solids dryness. The operator may wish to add Moisture Balance to closely monitor "cake" dryness to fine-tune the flocculant dosage and centrifuge dewatering performance. In comparison, barite recovery is typically conducted at slower rpm's (lower G-force). A barite recovery centrifuge is typically not run over 2,000 rpm.

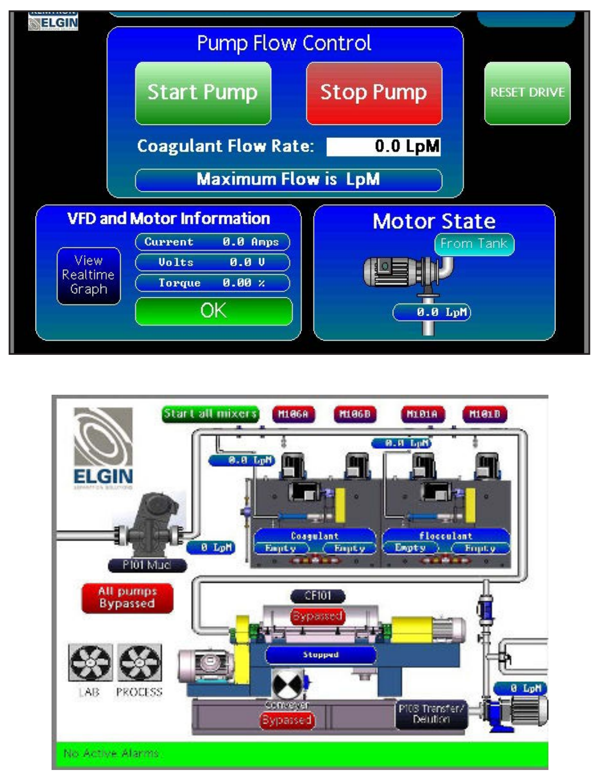


Figure 14 – Elgin's DFD Systems Incorporate full HMI touch screen operation for coaguland and flocculant polymer tanks.

d. Polymer Feed Control and Carryover - A set of progressive cavity pumps are used to draw from the designated containers (See Figure12) of coagulant and flocculant. The amount of neat coagulant and flocculant is displayed. When used in concert, these instruments provide all the necessary information to the operator to ensure the optimal level of polymer consumption and hydration. Sampling ports are located at various points on the flocculation manifold. These ports allow visual inspection of the flocculation process after each addition. Monitoring the polymer content of the discharged solids can be done on location or in a lab. When carefully monitored and controlled, polymer carryover can be kept to 0.01% above filtrate levels. Working closely with the mud engineer, the operator makes sure that the reclaimed water is not having an adverse effect on the mud, but continues to help reduce viscosity without harming fluid loss or other flow properties. It is important to test the processed clear water to confirm that it is ready for immediate return to the active drilling fluid system.

e. **Water Clarity** - A dewatering unit is operated on the premise that the finer the solids are, the more harmful they are to the mud system. For this reason, the final product is as solids-free as possible. An optional turbidity meter is used to provide further feedback to the operator regarding the fine-tuning adjustments (i.e. feed rates, centrifuge pond depth, chemical injection rates, etc.) that can be made to the system to improve water clarity.

Figure 15 – Select Floc™ Dual Polymer PC Feed Pumps

Though each standard DFD system is capable of meeting the needs demanded by most applications, Elgin's DFD systems are well adapted for customized control schemes and instrumentation. Elgin's seasoned staff of dewatering experts and engineers are available to collaborate with your team to select the most appropriate combination of instrumentation and controls. DFD systems generate the best results, when couple with qualified and well trained operators.

Operating a Drilling Fluid Treatment System Successfully

As highlighted in the previous section, Elgin's DFD systems incorporate a sophisticated set of tools and equipment. The combination of these devices ensures that, when operated per the design parameters, Elgin's DFD systems will generate great economic, rig performance, and environmental value. Consequently, this value can only be achieved by well-trained and qualified operators. Elgin's DFD System Operator Certification Program will provide your personnel the needed skills to not only operate Elgin's DFD systems successfully, but also maintain them to ensure years of service.

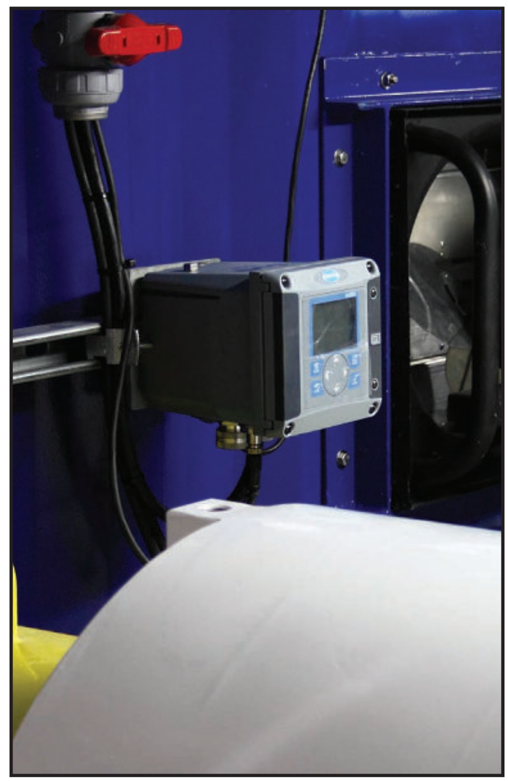


Figure 16– Elgin's DFD Systems Incorporating a HACH Turbidity Meter

Qualified DFD System Operators are trained to monitor all the key dewatering functions needed to ensure system effectiveness. A strong mud engineering background will help the operator understand that the goal is not just to create clear water and dry solids, they must also recognize that the chemicals and processes used must be compatible with the active drilling fluid system. Some of the key processes DFD System Operators must master prior to engaging a DFD system include:

- How much coagulant and flocculant is being added?
- What is the clarity of the reclaimed water?
- Is the reclaimed water suitable for polymer make-up or return to the active drilling fluid treatment system?
- Are the processing rates being maintained and if not, why not?
- Is the DFD system feed storage volume adequate to maintain a homogeneous feed and does it allow for temporary shut-down without upsetting the active drilling fluid system?
- Is the centrifuge operating properly and is the proper G-force being applied to achieve the desired results?
- What is the moisture content of the solids being generated from the DFD system and do these meet operator specified requirements?
- What are the fluid properties at each stage of the dewatering process?
- Is proper polymer hydration occurring and is the appropriate level of mixing being applied?

Figure 16– Qualified DFD System Operators are trained to monitor all the key dewatering functions

When operated correctly, Elgin's DFD systems can achieve excellent results. Assuming daily dewatering operations may receive 250 barrels (40 cubic meters) of drilling fluid from the active system, the DFD system will return approximately 200 barrels (32 cubic meters) of reclaimed water for use as polymer make-up, drilling fluid make-up, or general rig purposes. As such, Elgin's DFD Technology is the key element in 100% closed-loop waste management systems; therefore saving time, money and the environment.

Water-Based Drilling Fluid Dewatering Polymers

Elgin Separation Solutions has a wide range of polymers to meet your water and wastewater needs.

	COLOR-KATCH 7	COLOR-KATCH 7AF*	KAN-FLOC 2000DW	KAN-FLOC E50
Part Number	COLOR-KATCH-7	COLOR-KATCH-7AF	KAN-FLOC 2000 DW	KAN-FLOC E50
Description:	**Quaternary Polyamine** *Water Soluble Cationic Polymer Coagulant*		**Anionic Polyacrylamide** *Water Soluble Anionic Polymer Flocculant*	
Form:	Liquid	Liquid	Powder	Emulsion
Molecular Weight:	Low	Low	High	High
Charge Density:	High	High	Medium	Low
Specific Gravity:	1.10 to 1.15	1.10 to 1.15	0.80	0.80
pH:	5.0 to 7.0	5.0 to 7.0	5.0 to 8.0 (0.5% sol.)	5.0 to 8.0 (0.5% sol.)
Product Viscosity (Cp):	150 to 700	100 to 600	N/A	1,100 to 1,200
Solution Viscosity (Cp):	<100	<100	1,100 to 1,300	400 to 600
Shelf Life (Months):	24	24	24	12
Dissolution (Minutes):	1	1	60	10
Freeze Point (^{0}C):	-3	-29*	-3	-3
Function:	• COLOR-KATCH is a high cationic structured liquid polymer used for primary colloidal particle neutralization and also creates molecular bridging to enmesh the destabilized particles. • COLOR-KATCH is the building block when developing a "Hard Floc" before the addition of KEMTRON's KAN-FLOC flocculants for dewatering sludges with high suspended solids and drilling mud.		• Specially formulated flocculant applied after COLOR-KATCH coagulant dosing to enmesh destabilized colloidal solids and encapsulate with a polymeric film to withstand high G-forces generated by a decanter centrifuge dewatering. • The phenomenon of the "Hard Floc" produced by the dosing of COLOR-KATCH coagulants and KEMTRON's KAN-FLOC products, stems from the configuration of the polymer chains on the surface of the colloidal particles.	
Benefits:	• Works across a broad pH range. • Does not alter pH of treated water or add soluble metals to treated water. • Increases the rate of solid-liquid separation. • Non-Hazardous and unregulated by DOT.		• Works across a broad pH range. • Maintains "Hard Floc" in water with high salinity and hardness values when exposed to decanter centrifuge separation. • Reduces hydraulic head losses through lowered "flow friction".	
Dosage:	• Low Solids/Density Freshwater Drilling Muds (<8.9 lb./gal.): 1,000 to 3,000 mg/l. • High Solids/Density Freshwater Drilling Muds (<10.0 lb./gal.): 3,000 to 7,000 mg/l.		• Low Solids/Density Freshwater Drilling Muds (<8.9 lb./gal.): 100 to 300 mg/l. • High Solids/Density Freshwater Drilling Muds (<10.0 lb./gal.): 300 to 600 mg/l.	
Packaging:	• 5 gallon pail (45 lb.) / 18.9 liter (20.4 kgs) • 55 gallon drum (500 lb.) / 208 liter (94.3 kgs) • 275 gallon tote (2,500 lb.) / 1,041 liter (1,134 kgs)		• 50 pound (22.7kg) bag	• 55 gallon drum (450 lb. net wt.) / 208 liter (94.3 kgs) • 275 gallon tote (2,300 lb. net wt.) / 1,041 liter (1,134 kgs)