

A Uniquely Engineered Fluid and Cuttings Separator System

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Abstract

Incorporating a uniquely engineered fluid and cuttings separator system reduced costs on a 12,500 foot well section by nearly \$107,000 in waste reduction and saved an additional \$46,000 in recovered drilling fluids.

The situation

The operator requested a solution to reduce the exorbitant and steady rising cost of managing the high volume of oil-base mud (OBM) covered cuttings generated in the North American Woodford Shale. Previously, the operator used a cuttings processing package that included a mobile cuttings dryer and a centrifuge (**Fig. 1**) to dry their cuttings for transportation at a cost of \$8.50 per drilled foot from a 12,500 foot OBM section.



Fig. 1—Example of the mobile vertical cuttings dryer.

The solution

The service company recommended the operator employ a uniquely engineered fluid and cuttings separator system in conjunction with proprietary high-capacity, long-life composite shaker screens, which have demonstrated capacity to dry cuttings that meets or exceeds the EPA 9095B Paint Filter Liquids Test, recovers more OBM, and reduces the overall waste volume disposal and related expenses. The system was specially configured (**Fig. 2**) to meet the space constraints of any location with a small 27 inch x 30 inch footprint.

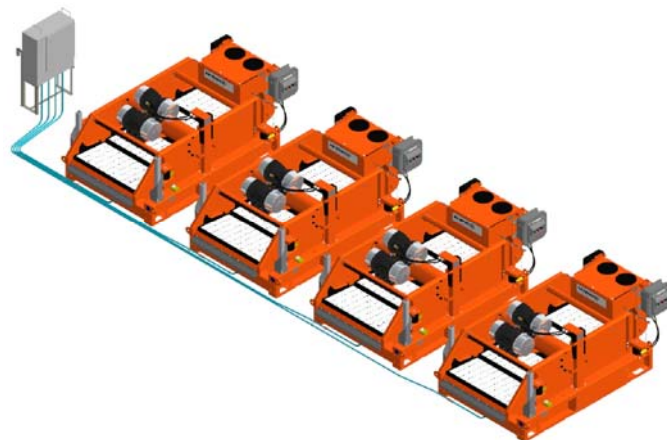


Fig. 2—The fluid and cuttings separator system setup on four dynamic dual-motion shale shakers.

The results

The fluid and cuttings separator system proved to be the ideal solution by reducing the operator's cumulative drilling waste management costs by \$106,250 in the OBM interval. An additional savings of \$45,600 was generated by the recovery of 285 barrels of OBM in the 20 day, 12,500 foot interval, which was reused in the active drilling fluid system.



Fig. 3—Dry cuttings in the bin below three shakers running the fluid and cuttings separator system.

Introduction

The fluid and cuttings separator system is a retro-fitted, fully pneumatic-operated system that uses pulsating suction below the last screen at the discharge end of the shale shaker, thus separating the drilling fluid from the cuttings. Application of this technology generates significantly drier drill cuttings and reduces waste treatment, transportation, and disposal fees by optimizing fluid recovery. The fluid and cuttings separator system transforms waste into a valuable commodity.

A detailed look at the fluid and cuttings separator

In order to comply with increasingly stringent global health, safety, and environmental (HSE) standards, the costs associated with drill cuttings waste disposal, and expensive drilling fluids, operators need to pay closer attention to the amount of drilling fluid being lost over the shale shakers. The fluid and cuttings separator system solves this problem by utilizing a lightweight carbon fiber, drop-in pan under the last shaker screen on the discharge end of the shakers. The 34-pound pan assembly neither impairs shaker performance, nor does it affect the life of the screens from the air suction applied to the screen's surface. The pan is connected to a fully pneumatic pulse control panel (**Fig. 4**) that uses compressed air to create an adjustable, pulsing, indirect vacuum (or suction) under the last shaker screen. This breaks the surface tension on the screen face (**Fig. 5**), which allows the fluid to be pulled through the screen along with any residual drilling fluid on the cutting's surface and provide a much drier cutting.

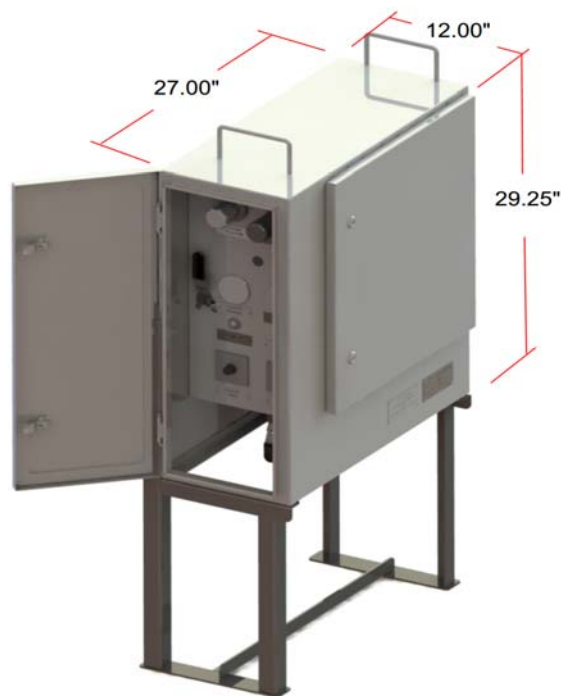


Fig. 4—The fluid and cuttings separator system control panel operates up to four shakers simultaneously and is 100% pneumatic.

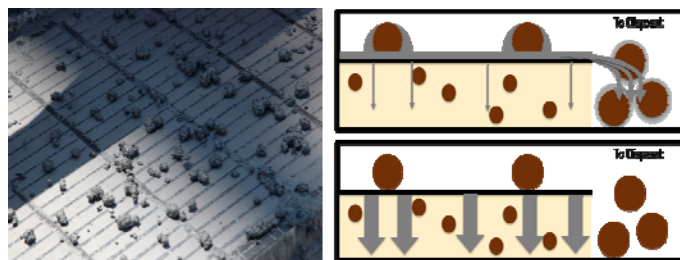


Fig. 5—Illustration of the fluid and cuttings separator system breaking the surface tension and removing residual fluids from the cuttings when turned off and on.

The reusable drilling fluid flows back to the circulating system after being discharged through the carbon pan under the shakers along with the rest of the underflow; this removes the need for ancillary holding tanks or pumps and therefore eliminates potential non-productive time (NPT) due to equipment failure. The unmanned unit requires neither welding nor adjusting of the shakers for installation. The footprint is significantly smaller than dryer shakers or a vertical type dryer; it requires only a 27 in x 30 in footprint of space. The pulse control panel to operate the system is placed in front of or near the shakers to facilitate adjusting the pulse-on—pulse-off ratio and provides the operator the ability to watch cuttings convey off the end of the shakers. Despite the ease of installation and operation, the results are unmistakable: a reduction of whole mud on cuttings by 30-40%; an average reduction of oil on cuttings of 11% by weight when used on the rig's primary shakers; and a reduction of oil on cuttings of 25% when used on the dryer or secondary shakers.

These reductions result in an increase in the amount of expensive fluid returning to the circulating system, an increase in savings from the reduction of lost mud, a decrease in expenses associated with mix-off material (such as agricultural lime, saw dust, or potash) to dry the cuttings, a decrease in the number of trips to transport wet cuttings (either by trucks or ship to shore boats), and a decrease in disposal costs at a landfill or processing facility.

The pulsed vacuum ensures cuttings are conveyed off the screen during the pulse-off period and allows excess drilling fluids to be actively pulled through the shaker screen during the pulse-on period without altering the drilling fluid's properties. While using the fluid and cuttings separator system, the operator should use the finest screens to inhibit drill solids from entering the circulating system, thus decreasing the cost of dilution, chemical treatment, and associated solids control required to combat increasing low gravity solids. The fluid and cuttings separator system is a safe and simple technology that reduces drilling costs associated with lost drilling fluid and cuttings disposal. Disposed cuttings meet the U.S. EPA's most stringent standards, Method 9095B Paint Filter Liquids Test (**Fig. 6**).



Fig. 6—Cuttings from the Paint Filter Liquids Test, with and without the fluid and cuttings separator system.

Markets and types of drilling fluids compatible with the fluid and cuttings separator

The fluid and cuttings separator system has been in wide use since April 2015 and now operates in North America, Colombia, Ecuador, Argentina, Saudi Arabia, Oman, Thailand, Indonesia, Romania, and the Komi Republic in Russia on several types of drilling fluids (diesel, synthetic, brine, water, and highly inhibitive water-base drilling fluids). The two main value drivers for operating a fluid and cuttings separator system are the recovery of valuable drilling fluids and the reduction of drilling waste. A South American operator performs most drilling with a low-cost, water-base drilling fluid, and there is little to no value in recovering the fluid, but heavily fluid laden drill cuttings are manually loaded into dump trucks and transported to a waste treatment facility. The sole value of using the fluid and cuttings separator system is to reduce the excess volume to the drilling waste by reducing the number of truckloads per well. For the operator, this resulted in a minimization of truckloads from 88 to 57, a 35% reduction.

The effects of ultra-fines on effluent from vertical dryers vs the fluid and cuttings separator system

When circulating wet drilled cuttings through a vertical dryer using a .010, .020, or .030 inch screen, the large cuttings are broken down to create smaller cuttings called ultra-fines [2 to 44 microns (μm)], which then build up the solids concentration in the drilling fluid. This causes problems for operators, drilling contractors, and fluids providers. When these solids, or ultra-fines, are reintroduced to the fluids system, they cannot be removed at the shaker screen level; eventually this causes deficiencies in the drilling rate of penetration (ROP), higher torque and drag on the drillstring, premature wear on pumps, and higher viscosity and gel strengths, to name a few. Implementing the fluid and cuttings separator system eliminates ultra-fines due to the uniquely

engineered high-flow/low-pressure vacuum design, which pulses on and off. A common concern is whether or not the vacuum below the screen will break the cuttings down into such a small size they would be able to pass through the selected screen mesh size, and, in turn, create more solids in the returning drilling fluids. It is possible to see drilling fluids clinging to the screen's surface (surface tension) and wet drill cuttings travel over the end of the shaker into the cuttings bins when inspecting the last screen on the discharge end of the shale shaker (where the fluid and cuttings separator system carbon pan is located during the drilling operations). This means the fluid and cuttings separator system and the light, non-aggressive vacuum under the screen surface only pulls the residual drilling fluid off the cutting's surface (not pulling the fluid out of the cutting), thereby keeping the cuttings together. This also breaks the surface tension and pulls the drilling fluid in through the screen and returns the recovered drilling fluid back to the active system underneath the shale shaker. The fluid and cuttings separator system does not introduce smaller drilled particles into the active system, which is evidenced in the two particle-size analyses with the fluid and cuttings separator system both on and off (**Fig. 7**). In turn, by recovering the drilling fluid back to the active system, the amount of waste generated and the overall requirement in the disposal process is reduced.

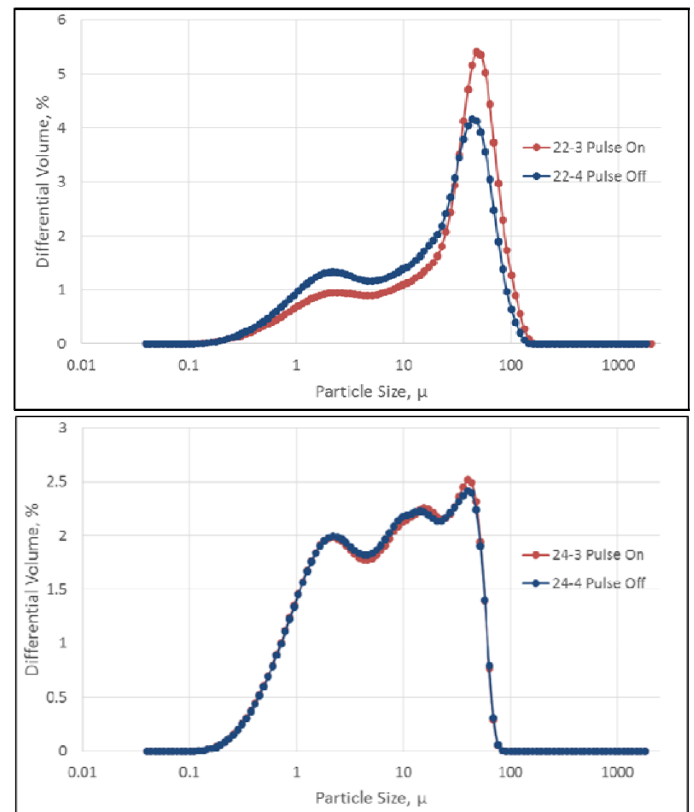


Fig. 7—Fluid samples from particle size analyses when the fluid and cuttings separator system is turned off and on.

Most common questions about the fluid and cuttings separator

Q: How big is the footprint of the fluid and cuttings separator system?

A: The pulse control panel is the only piece of equipment within the foot print and its size is 27.2W x 12.2D x 30.4H in inches and weighs 135 lbs.

Q: Does the fluid and cuttings separator system require electricity?

A: The fluid and cuttings separator system is totally pneumatic and is powered by the rig's air compressor or a stand-alone compressor.

Q: Does the fluid and cuttings separator system induce low gravity solids or ultra-fines into the drilling fluids?

A: No, the light indirect vacuum only pulls the residual fluid off the cuttings and the screen's surface. The cut point, or micron (μm) size, of the solids in the fluid would only be determined by the mesh size in the screens being run on the shakers, and all operators should run the tightest mesh possible for their drilling program.

Q: Do you need to weld or drill on the shakers to rig up the system?

A: No, the fluid and cuttings separator system is totally retrofitted without altering the shakers, the carbon fiber pans drop into the shaker under the last screen on the discharge end of the shaker, and the screen is reinstalled on top.

Q: Does the vacuum under the screen's surface cause premature wear of the screens?

A: No, the system has a light indirect vacuum that pulses on and off to allow stalled cuttings to travel when the pulse is in the off sequence.

Q: How long does it take to rig up the fluid and cuttings separator system?

A: Typically, it only takes one person 2 to 3 hours to rig up on three shakers.

Q: Can you replace a drying shaker with the fluid and cuttings separator system?

A: If shakers are used for drying cuttings and not as additional shakers, then the fluid and cuttings separator system can be used in place of a drying shaker; the retention on cuttings is typically similar. If additional shakers are required because the drilling ROP exceeds the primary shakers, then the fluid and cuttings separator system can be rigged up on those secondary shakers to achieve the savings.

Q: Can you replace a vertical dryer for the fluid and cuttings separator system?

A: The average oil on cuttings from the fluid and cuttings separator system is 11% by weight, so if the requirements are 11% or higher, then it is possible to replace a vertical dryer.

Conclusions

The fluid and cuttings separator system is a small piece of solids control equipment that can recover up to 40% of expensive drilling fluids from the drilled cuttings and reduce overall waste by 25% due to its pulsing technology. Implementing this technology can make drilled cuttings drier and remove free liquid in order to reduce transportation and processing expenses. The field proven system minimizes waste management costs, thus resulting in optimizing any operator's HSE profile.

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