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Case History – How Improved Flowline Shaker Performance Negates the Need for Secondary Drying Shakers in Certain Drilling Situations

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Abstract

Flowline shakers are the first line of defense for removing drilled solids brought back by the drilling fluid from the wellbore. In some cases, a secondary drying shaker package is needed downstream to allow for more screen surface area to retain drilling fluid and yield drier cuttings for disposal. These secondary shakers can be screened with a coarser screen to achieve drier cuttings but that poses the risk of allowing more solids into the underflow that will be returned to the active system.

If the flowline shakers were able to handle the drill rate and still yield drier cuttings, it would eliminate the need for a secondary shaker package. This capability would save the rental cost of the additional shakers, as well as the cost of additional screens and would allow for more efficient removal of solids and retention of fluid.

Introduction

Solids Control and waste management are integral parts of any drilling program. Drilling fluid is used in the drilling process to offer lubricity, cool the downhole tools, promote borehole stability, control formation pressures, suspend and carry the drilled solids (cuttings) back to the surface. Solids control refers to the process of using methods of mechanical or chemical separation to remove drilled solids from the drilling fluid for it to be reused downhole to continue drilling the well. Waste Management is the process that utilizes equipment in conjunction with the solids control suite focused more on removing additional fluid from the cuttings before they are disposed to reduce haul off and dilution.

Typically, primary shakers are viewed solely as a solids control device and a secondary drying system is used to re-coup fluid from the cuttings. In the past, the limiting factor of most primary shakers has been throughput/capacity, if the shaker couldn't handle the drill rate, running a finer screen to remove more solids would cause the fluid to run off the end of the shaker. The secondary drying system would then recover that fluid. If the primary shaker could handle more flow with a finer screen while still recovering the same amount of fluid could the secondary shaker system be eliminated?

This case study evaluates the operating cost of a secondary drying shaker package in the Midland Basin versus mud regained when using NOV ALPHA shakers, herein referred to as "primary shakers." The analysis involves accessing the retention on cuttings (ROC) data collected from the primary shakers and those from the secondary drying shakers to determine the cost of fluid loss from the primary shakers and the regained from the drying shakers.

Retention on Cuttings

Using a standard 50 mL retort, samples from both the primary shakers and the secondary shakers were tested to assess the amount of fluid on the cuttings. This data was used to determine the fluid loss from the primary shakers and then regained by the secondary shakers.

As drilling progressed deeper into the lateral, the size of cuttings decreased. Cuttings remain in the lateral longer, where they are ground up repeatedly, resulting in finer drilled cuttings and higher ROC values. See Table 1-1.

Table 1-1 ROC

	Avg. ROC (Oil) %	Avg. ROC (Mud) %
Primary	11.29	15.60
Secondary	9.72	13.41
Difference	1.57	2.19

Mud Loss

Mud loss volume for both primary and drying shakers is calculated by using the average ROC values. The volume of cuttings over the shakers is calculated by using 8.5 in. OD of the curve and lateral along with their respective depths. The density of formation is assumed to be 2.65 g/cc to calculate the total mass of cuttings, which is then multiplied by the average ROC value to calculate mud loss. See

$$V_{Cuttings} = \frac{(1-\emptyset)\ X\ D^2 X\ ROP}{1029.4}\ bbl/hr$$

$$V_{mud\ loss} = V_{cuttings}\ X\ Avg.ROC$$

Where:

$V_{Cuttings}$ is the volume of cuttings in bbl./hr.
∅ is formation porosity (%)
D is the wellbore diameter in inches
ROP is the rate of penetration in feet/hr.

To calculate the volume of cuttings, a 30% shale expansion factor is assumed.

Table 2-1 Mud Loss

Mud Loss		
Shaker Type	Oil Lost (bbl.)	Mud Lost (bbl.)
Primary	468.94	648.48
Secondary	393.04	542.07
Saved	75.9	106.4

Cost Analysis

This evaluation compares the cost of fluid loss from the primary and fluid regained from the drying shaker versus the operating cost of the drying shaker.

See Table 3-1 and Table 4-1.

Table 3-1 Mud Savings

Description	Gal/bbl., lb./bbl.	Price($/gal), ($/lb.)	Price ($/bbl.)
Base (Diesel)	24.8976	$3.11	$77.43
Base (Water)	7.0224	$0.01	$0.07
Weighting Agent (Barite)	261.223	$0.12	$32.00
Primary Emulsifier	1.31234	$22.84	$29.97
Secondary Emulsifier	0.249688	$22.15	$5.53
Filtration Agent (Fluid Loss)	0.232558	$91.00	$21.16
Viscosifier	0.062422	$29.86	$1.86
Alkalinity (Lime)	1	$0.14	$0.14
Salinity Source (Calcium Chloride)	33	$0.26	$8.51
Cost/bbl.:	**$ 176.68**	**Total Savings: $ 18,800.52**	

Table 4-1 Solid Control Cost

Category	Description	Price (per day or unit)	Total
Equipment	Shaker Tank Triple	$400.00	$6,400.00
Equipment	Distribution Panel	$65.00	$2,015.00
Equipment	Trucking	$1,116.00	$1,116.00
Labor	Day Hand	$700.00	$10,500.00
Labor	Night Hand	$700.00	$10,500.00
Labor	Subsistence	$75.00	$1,125.00
Labor	Subsistence	$75.00	$1,125.00
Supplies	Screens	$300.00	$2,400.00
Supplies	Mileage	$2.45	$225.40
Equipment	Rig Down		$7,000.00
Equipment	Roustabouts		$1,750.00
			Total Cost $44,156.00

Conclusions

The cost of mud loss from the primary shakers is less than the operating cost of running the drying shakers. Although operating the drying shakers is beneficial for ensuring more fluid recovery, the primary shaker is efficiently capable of achieving drier cuttings on its own. In this case, the cost of mud recovered ($22,438.97) from the drying shakers was less than the operating cost ($44,156.40) of the drying shaker package.

See Table 5-1

Table 5-1 Operating Cost of Drying Shaker

	Drying Shakers	No Drying Shakers
Cost ($)	44,156.40	18,800.52
Savings ($)	18,800.52	44,156.40
Net ($)	**(25,355.88)**	**25,355.88**

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