CASE STUDY

Efficient Recovery of Loss Prevention Materials by MD-3 Shaker Results in Reduced Treatment Cost

"The unique design of the MD-3* Shale Shaker allows the operator the ability to simultaneously recover valuable LPM while discarding LGS. Keeping the fluid clean and reusing the LPM resulted in less waste and an overall lower fluid cost."

Mike Miller, Verification Testing Manager, M-I SWACO

THE SITUATION

Traditional shaker technology is ineffective in differentiating and separating valuable LPM from undesired finer drilling solids resulting in increased costs for the operator.

THE SOLUTION

The MD-3 Shale Shaker in recovery or series configuration offers a multi-deck solution for efficient solids separation. Valuable LPM is recovered and returned to the active fluid system for reuse, while undesirable solids including cuttings and fines are discarded for disposal.

The Situation

Excessive fluid loss is one of the most common and costly problems encountered during drilling operations. One method of controlling these losses is by plugging the thief zones with Loss Prevention Material (LPM). These special sized additives are introduced into the drilling fluid, and through differential pressure, are drawn into the formation to bridge the voids. The LPM that is not drawn into the formation will generally be carried back out of the wellbore with the fluid returns.

Good drilling practices dictate that the shaker screens should be sized as fine as possible to remove as many low gravity solids (LGS) as possible. However, traditional shale shaker equipment cannot preferentially screen the larger sized LPM from the finer drilled solids, so both end up being discarded off of the shaker resulting in increased LPM replenishment and solids disposal costs for the operator. Clearly a more cost-effective solution is required for well bore strengthening applications where high concentrations of specific sized LPM are required.

The Solution

The MD-3 Shale Shaker is a multi-deck shaker engineered to provide efficient solids separation using a top scalping deck and two primary lower decks (middle and bottom) to be used in series or in parallel configuration. The series or recovery configuration allows solids to be progressively and preferentially screened, thereby simultaneously recovering LPM and cleaning the drilling fluid of undesirable solids. This is achieved by processing the drilling fluid through a top scalping deck to remove the cuttings, a middle deck to recover LPM that is returned back to the active fluid system, and a bottom deck to discard the LGS and degraded LPM, which are detrimental to mud performance. This preferential separation results in less overall product consumption, less waste and reduced cost.

THE RESULTS

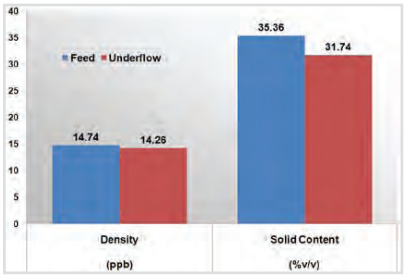

Figure 1: Mud properties before and after treatment.

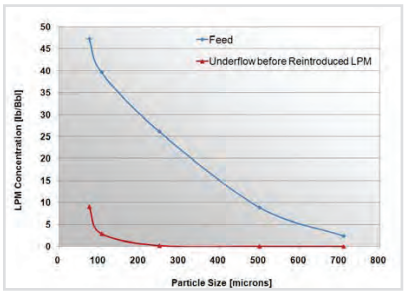

Figure 2: LPM concentration calculated using stacked wet sieve analysis before and after treatment.

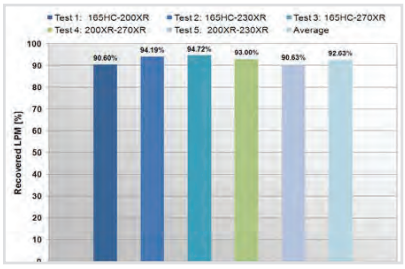

Figure 4: Percentage of LPM recovered from the middle deck

The Results

Testing took place during drilling operations at 21,542 ft (6,566 m). A diesel-oil-based Versadril* fluid system designed for wellbore stabilization with a hoop stress enhancement treatment containing sized calcium carbonate and synthetic carbon products was used. The LPM was recovered in the middle deck and fine particles were discarded from the bottom deck.

The trial was conducted using a +1 degree shaker angle and five screen configurations as shown in Table 1. All tests were conducted with mud weighing 14.5 lb/gal and under similar drilling conditions: 2 ft/hr rate of penetration (ROP), 275 gal/min flow rate and 21,542 ft (6,566-m) average depth.

Table 1: Test matrix for screen configurations tested during LPM recovery trial with the MD-3 Shaker.

#	Top Deck	Middle Deck		Bottom Deck	
1	10x20	165HC	API 80	200XR	API 120
2	10x20	165HC	API 80	230XR	API 140
3	10x20	165HC	API 80	270XR	API 170
4	10x20	200XR	API 120	270XR	API 170
5	10x20	200XR	API 120	230XR	API 140

Figure 1 and Figure 2 show mud properties and LPM concentration before and after treatment. The feed stream shows the characteristics of the untreated fluid coming from the wellbore, while the underflow stream shows the characteristics of the clean fluid treated by the MD-3 Shale Shaker before the recovered LPM is reintroduced to the active fluid system.

Density and solid content decreased slightly after shaker treatment as presented in Figure 1, which is a common behavior for shakers. Density cut was limited to using the finest screens available removing LGS and degraded LPM while maintaining barite in the system. Higher density cut points and a larger reduction in solids content could be observed for faster rate of penetration (ROP).

LPM concentration was measured using the stacked wet sieve analysis with a range of screens between 75 and 710 microns. Results from this test (Figure 2) show a significant reduction in undesirable fine particle concentration after treatment; from 77lb/bbl in the feed stream to 14 lb/bbl in the underflow total LPM larger than 75 microns.

Analyzing the overall MD-3 triple-deck shaker performance diagram (Figure 3), the total solids distribution shows that 56.5% of the total mass treated with the MD-3 Shaker was recovered by the middle deck, 36.3% was returned to the underflow, and 7.2% of the total treated mass was discarded by the top and bottom screen decks. Although both decks contained a mixture of solids, it was determined through X-Ray Diffraction (XRD) and X-Ray Fluorescence (XRF) that most of the material recovered in the middle deck was LPM in a desirable size range, and the material discarded in the bottom deck was mainly degraded LPM, large barite particles, and LGS. Other materials encountered were dolomite, hematite, and pyrite as shown in Figure 3.

The Results (continued)

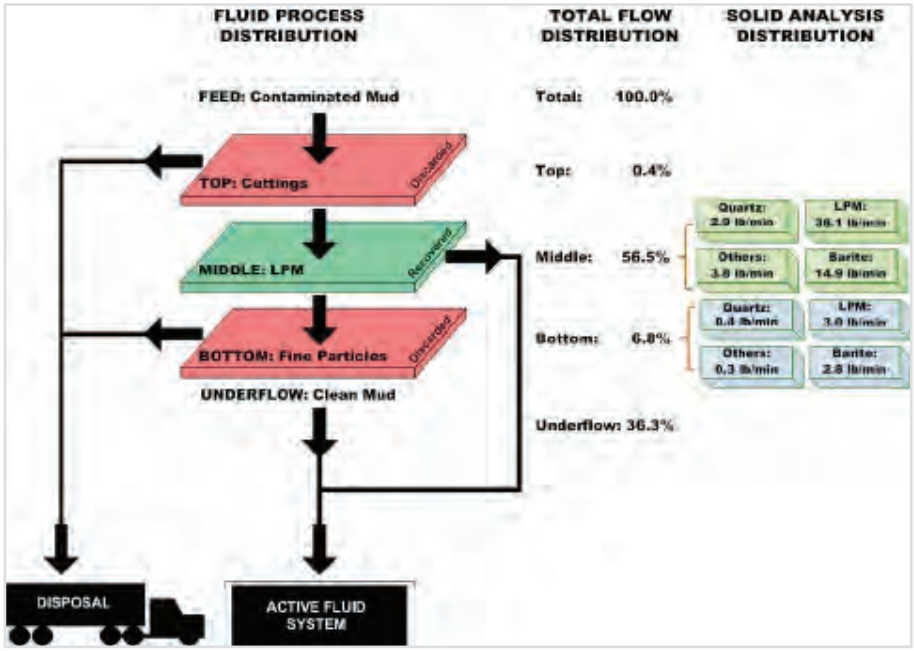

Figure 3: MD-3 Shaker overall performance diagram.

Comparing the ratio of the LPM recovered from the middle deck and the LPM discarded from the bottom deck, a total volume of LPM recovery was calculated for each screen configuration. On average, a total of 93% LPM was recovered and returned back to the mud system regardless of the screen configuration (small variance of ±4%). Results are presented in Figure 4.

The concentration of LGS in the mud before use of the MD-3 Shaker typically reached 100 lb/bbl with traditional shale shakers, and the fluid system eventually had to be heavily diluted or discarded due to excessive rheology and reductions in drilling efficiency. After installing the MD-3 Shaker, the LGS concentration dropped to about 40 lb/bbl and the fluid could be continually reused.

If required, the underflow of the MD-3 Shale Shaker can be further processed by secondary equipment.

Summary

The M-I SWACO MD-3 Shale Shaker has proven to be an effective tool for cleaning up diesel-oil-based drilling fluid while recovering and returning to the fluid the majority of the LPM used for wellbore strengthening. In particular and under current field conditions, the unit was able to:

- Efficiently recover a significantly large concentration of LPM thereby reducing the cost of treatment.
- Remove undesired fine particles that are detrimental to mud performance.
- Optimize processing time by removing cuttings and undesired fine particles while recovering LPM.
- Provide optimum mud treatment to maintain proper well control, reduce seepage losses, and avoid stuck pipe incidents.
- Effectively remove large particles off the top deck to prevent bit clogging, reduce pump wear and improve screen life on the lower decks.
- Return an engineered particle size distribution back to the active fluid system to improve well bore strengthening material effectiveness.

Questions? We'll be glad to answer them.
If you'd like to know more about the M-I SWACO MD-3 Shale Shaker and how it is performing for our other customers, please call the M-I SWACO office nearest you.

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