RECLAIM technology cuts costs for oil-based mud treatment in Wyoming pilot field trial

By Alan Gilmour, J.O. Pruett II, M-I SWACO

A CHEMICALLY ENHANCED centrifugation process, designed to remove the bulk of fine colloidal particles and/or increase the oil/water ratio (OWR) in oil- or synthetic-based drilling fluids, has proved its capacity to reduce costs significantly during a Wyoming field trial.

The patented RECLAIM technology comprises proprietary flocculants and surfactants and a 20-ft skid containing all components required to effectively flocculate fine solids in a non-aqueous fluid. Surfactants may be used to weaken the emulsion, and flocculating polymers are used to agglomerate the fine solids so they can be easily removed by centrifugation. The polymer also promotes the demulsification of the brine droplets in the mud, and a secondary effect of this process is that water is removed with the solids, raising the oil/water ratio.

The portable system is suitable for all onshore and offshore rigs employing synthetic- or oil-based drilling fluids, where extending the useful life of the mud system is paramount. In addition, RECLAIM is applicable to operations where the objective is recovering reusable base fluid from spent mud and in liquid drilling fluid plants for reducing costs associated with fluid reconditioning and disposal.

Conventional solids-control equipment is unable to remove low-gravity solids smaller than 5 to 7 microns that accumulate and degrade the performance of premium oil- and synthetic-base drilling fluids. Using a combination of proprietary chemistry and specialized equipment, RECLAIM removes low-gravity solids while recovering valuable base oil.

Moreover, the technology has been shown to improve drilling fluid performance and increase ROP while reducing formation damage, stuck-pipe incidents and disposal, storage and transportation costs. From an environmental perspective, the RECLAIM technology reduces the volume of waste mud and the risk of spillage during transportation.

RECLAIM provides a dry, closed-loop system onsite and produces cleaner fines for disposal.

The RECLAIM technology was recently used in a successful field trial in Wyoming that proved its economic value. The package was trailer-mounted and included the RECLAIM unit, a generator and a CD500 centrifuge with stand.

WYOMING PILOT TEST

The system has been used in a variety of locations worldwide, including Abu Dhabi and Calgary. More recently, a successful trial of the RECLAIM technology for an operator in Wyoming clearly demonstrated economic value. As a result, the equipment has been retained on contract and will continue to recondition diesel oil-based mud (DOBM) on location.

The specification for mud being delivered to the rig is a density of 10.0 lb/gal with an 80/20 OWR. While drilling, the density of the fluid is raised to between 14.0 lb/gal and 15.0 lb/gal, and often there is significant water contamination, in some cases resulting in a decrease in the OWR to 60/40 or lower.

At the end of a well, the standard treatment of the mud is to centrifuge the mud to lower the density as much as possible, then dilute with base oil to further lower the density and re-adjust the oil/water ratio. In most cases, this results in high costs for dilution, and in additional temporary storage and/or increased disposal costs for excess volumes of mud. The purpose of the field trial was to demonstrate that the RECLAIM technology would effectively remove fine solids and part of the brine phase; reduce the density of the fluid, while at the same time eliminating the need for expensive dilution.

SETUP, LOCATION

The RECLAIM package used for the trial was trailer-mounted, consisting of the RECLAIM unit, a generator and a CD500 centrifuge with stand. The location was situated next to an existing rig-site waste pit that was used for storage of cuttings from DOBM drilling operations, and was lined and bermed prior to setting up the equipment. Three 400-bbl storage tanks were provided to receive mud and processed fluid.

The customer operates 15 rigs in the area, and the objective was to use the RECLAIM package as a central in-field processing facility, with the capability to receive and process mud from any of the rigs after each well had been completed.

CRITERIA FOR SUCCESS

Three distinct phases have been identified in the RECLAIM process to help identify when the process is effectively removing the fine solids. Phase 1 is achieved when flocculated solids start to appear in the centrifuge underflow discharge. If there is no change/increase in the OWR, this indicates the RECLAIM

Table 1: RECLAIM results summary

Feed Mud density (lb/gal)	Flow rate (gpm)	Surfactant (%V/V)	Polymer (%V/V)	Diesel (%V/V)	Effluent OWR	Effluent Density (lb/gal)	Solids (%)	Phase
14.5	8.0				59/41	9.3	19	
14.5	8.0	2	4.0	0	59/41	8.6		1
14.5	8.0	1.5	4.0	0	59/41	8.5		1
14.5	8.0	1.5	3.0	0	59/41	8.4		1
14.5	8.0	2.0	5.0	15.0		8.2		1
14.5	8.0	1.5	3.0	15.0		8.1		2
14.5	8.0	2.0	3.0	15.0		8.0		
14.5	8.0	2.0	2.5	15.0	85/15	7.9	< 2	2
11.2	7.5				63/37	9.6	24	
11.2	7.5	1.4	3.0	10.0		8.3		1
11.2	7.5	2.0	3.0	10.0	90/10	7.9	< 3	2

process has not been achieved and only the coarser non-colloidal solids are being flocculated and removed. Phase 2 is achieved when the flocculated solids discharged contain significant amounts of brine. This indicates successful RECLAIM treatment and results in removal of the bulk of the solids, including colloidal solids, and a portion of the brine phase. Phase 3 occurs when the bulk of the brine phase is removed along with the solids and results in the generation of virtually clean base oil.

Therefore the criteria for success is the removal of both fine solids and a portion or all of the brine phase, i.e., a reduction in solids to 1% or less, and a significant increase in the OWR to 85/15 — 99/1 or higher. The transition between the three phases is controlled by the levels of chemical treatment used in the RECLAIM process.

FIELD TRIAL RESULTS

The DOBM processed during the trial was delivered from another rig that had just completed drilling a well. A total of 375 bbl of water-contaminated DOBM was received, with an initial density of 14.5 lb/gal, 55/45 OWR and 24% solids. A baseline result was initially established by processing the fluid through the CD500 centrifuge with no RECLAIM treatment. This resulted in a reduction in density from 14.5 lb/gal to 9.3 lb/gal.

Using a feed rate of 8 gpm, and with additions of 1.5% to 2% surfactant and 3% to 4% flocculant polymer, phase 1 conditions were achieved, resulting in effluent densities in the range 8.4 lb/gal to 8.6 lb/gal and no change in the OWR. Phase 2 conditions were reached by introducing some dilution of the feed mud with base oil. With 15% diesel dilution and an 8-gpm feed rate, the density was reduced to 7.9 lb/gal using 2% surfactant plus 3% flocculant polymer. The OWR was increased to 85/15 and solids reduced to less than 2%.

Table 2: Mud properties before and after RECLAIM treatment

	Feed Mud	CD 500 (no RECLAIM)	RECLAIM #1	RECLAIM #2
Mud Weight (lb/gal)	11.2	9.6	7.9	7.9
PoM	3.25	3.1	1.2	1.6
Chlorides, whole mud	55000	55000	15500	11500
OWR	61/39	61/30	90/10	85/15
%Solids	24	22	0	0
10 sec Gel	13	12	1	1
10 min Gel	16	15	1	1
PV	18	16	3	3
YP	23	22	2	3
LGS%	21.1	17.0	0.0	0.0

A second batch of 205 bbl used mud was received, after having been centrifuged to reduce the density to 11.2 lb/gal. This fluid had a 63/37 OWR and contained 24 solids. After further centrifuging with the CD500, the density was reduced to 9.6 lb/gal. Using a feed rate of 7.5 gpm, with 2.3% surfactant, 3% polymer and 10% dilution with diesel, the RECLAIM process successfully reduced the density of the effluent to 7.9 lb/gal, with a 90/10 OWR and 0% solids.

A total of 580 bbl of used mud was processed on location during the trial. Over 380 bbl of solids-free fluid was recovered with a density of 8.0 lb/gal fluid and 90/10 OWR. The cost for the RECLAIM process was approximately 15% below the cost of dilution to recondition the fluid, not including mixing, handling, trucking or disposal costs for the contaminated solids. Along with reduction in dilution cost, several intangible benefits were a by-product of the process. These include :

- The ability to recycle and re-use oil-base fluid.
- Reduce the volume of slop-oil to be disposed, thereby reducing disposal costs.
- Reduce offsite trucking.
- Reduce temporary storage costs.
- Reduce processing time for mud changeovers from 14.5 to 10.0 lb/gal.

RECLAIM proved to be an economically viable, “fit-for-purpose” solution and demonstrated that the technology is applicable to the full range of oil-base mud used in this field.