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Electro Separation Cell (ESC): Transforming Colloidal Solids Control and Base Fluid Recovery

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Abstract

This paper presents the field application of the Electro Separation Cell (ESC) technology for removing ultra-fine, colloidal solids in oil and synthetic based mud (OBM/SBM) systems. The paper will focus on the operational data from an onshore trial where the ESC was initially used to process stored non-reusable fluids at the liquid mud plant (LMP) facility to recover base fluid for reuse. The trial evolved into an evaluation of the ESC's effectiveness in improving the quality of stored centrifuged and uncentrifuged fluids previously considered unusable and destined for disposal, enabling their reuse. It also aimed to quantify the reduction in dilution requirements when conditioning and reusing drilling fluids in ongoing drilling operations. Subsequent to the trial, centrifuging at the LMP was eliminated and the ESC was integrated into the fluid management process to support an ongoing offshore development drilling campaign in the Caribbean. Field results from this implementation demonstrated dilution reductions of up to 80% when benchmarked against the operator's existing centrifuging and dilution practices for fluid reconditioning. The scope of this paper includes presenting historical ESC usage, detailed field performance data, the integration of ESC with existing solids control processes, environmental and operational performance, and the high-level cost saving metrics obtained in the ESC fluid treatment operations.

Introduction

ESC technology applies low-amperage, high-voltage electrokinetic principles to separate colloidal and ultra-fine solids from OBM without mechanical shearing, the addition of heat, or chemical additives. The technology has very low greenhouse gas emission using only 4.72 kWh of 3 phase – 460V electrical power and can be connected to the local grid power source or a standalone power generator. During an offshore campaign for a major operator, the ESC was used at the LMP to recover pure base fluid and recondition stored stress cage OBM. The ESC was operated in batch mode using programmable Coriolis-based density control to achieve reduction targets in mud density and low-gravity solids (LGS) content. Operational parameters such as feed fluid electrical stability (ES), solids concentration, Fann-35 rheology and base fluid recovery were monitored to adjust processing time and optimize fluid conditioning results

and treatment rates. Performance was compared against conventional stand-alone centrifuging and dilution to assess improvements in solids removal efficiency, reduction in dilution needs, and fluid reusability.

The field deployment showed that the ESC converted large volumes of stored unusable centrifuged and uncentrifuged OBM, containing excessive low-gravity solids (LGS) and progressive gels, into fluid suitable for reuse in further drilling operations. Processing removed a significant fraction of ultra-fine solids, reduced LGS to below thresholds required for reuse, and restored desirable rheological properties, including plastic viscosity, yield point, and gel strengths. Additionally, ES increased, improving the emulsion quality and overall fluid stability of the OBM. These improvements directly reduced the need for new base fluid additions (dilution), decreased the requirements for new additives consumption and decreased the storage volume and cost of non-usable OBM.

The system maintained high operational availability (>90% uptime) under continuous operation, with very low energy requirements from the local power grid. Because the ESC process requires no added chemicals, or heat, generates less waste through reuse of the OBM, and consumes relatively low energy, it is an environmentally favorable, lower-emissions approach to fluid reconditioning. Depending on the application, centrifuging can be eliminated. These outcomes demonstrate a practical, scalable method to extend OBM/SBM life and reduce waste handling and logistics across diverse drilling operations.

This paper will present the first large-scale field dataset demonstrating the use of ESC in the Caribbean to transform both centrifuged and uncentrifuged non-compliant OBM/SBM into high-quality, reusable fluids. The ESC technology introduces a novel approach that reduces dilution demand, extends fluid life, and supports measurable ESG improvements for drilling operations.

Electro Separation Cell Technology

Equipment Design

The Electroseparation Cell (ESC) is a fully integrated, skid-mounted processing system comprising a process vessel and internal cell pack, supported by a hydraulically actuated wiper mechanism. The system is equipped with a dedicated direct current (DC) power supply and pneumatically actuated controls, coordinated through a human-machine interface (HMI) and programmable logic controller (PLC) architecture.

Instrumentation is fully integrated and includes a Coriolis flow meter, automated valve control systems, level sensors, pressure transmitters, and temperature sensors. The ESC is further designed with comprehensive safety features, including an emergency shutdown (ESD) system, to ensure safe and reliable operation under varying process conditions.

In addition, the ESC incorporates a standalone hydraulic system responsible for the operation of variable frequency drive (VFD) controlled fluid loading and discharge pumps, as well as the sludge discharge pump. This hydraulic system also governs vessel lid actuation and supports critical internal components, including mechanical scrapers, a vibrator assembly, and an auger system for efficient sludge conveyance and removal.

The ESC currently comes with vessel capacities of 3m³, 5m³, and 10m³ and are configured to operate in Class 1, Division 1 or Division 2 hazardous locations. The 3m³ unit in [Figure 1](#) has physical dimensions of 8ft wide, 20ft long, 8ft high, with an approximate dry weight of 28,000 lbs.

The power source requirements needed for the ESC platform to treat OBM is minimal. Typically, a 3-Phase, 460-480 V, 60Hz 100A AC power supply, electrical feed (3M unit) is all that is required. Ancillary components include, a dedicated feed tank supplied directly from the LMP OBM storage tanks that feeds the ESC loading pump, a dedicated tank for receiving treated fluid from the ESC, and skips for receiving the sludge generated from the ESC sludge pump while executing treatment operations.



Figure 1—Model 3M Skid Mounted ESC.

Theory of ESC Operation

ESC is a patented process that uses the principle of high voltage/low energy electrokinetics to temporarily destabilize and separate solids from invert emulsion oil/synthetic oil-based drilling fluids (OBM/SBM). Electrokinetics consists of three principles: electrophoresis, electroosmosis and electromigration. The key principle to the ESC operation is electrophoresis which is the movement of charged particles through a fluid under the influence of an electrical field. Figure 2 depicts the fundamental principle of electrophoresis.

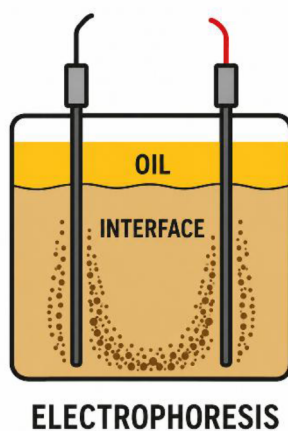


Figure 2—Illustration of the principle of Electrophoresis.

The ESC consists of a vessel full of parallel spaced, vertically hanging, metal electrode plates (known as the cell pack). The vessel is pumped full of OBM, and then 3-Phase, 460-480 V alternating current (AC) power is supplied to the unit from the local grid or a suitable diesel generator. Direct current (DC) is converted by the power supply unit of the ESC and is then used to energize the cell pack. An electrical field is created between the plates of the cell pack, causing the OBM inside the vessel to become temporarily destabilized. Solids within the OBM migrate towards and adhere to the surface of the electrode cellpack plates. After the treatment is completed the accumulated fluid inside the vessel has a density hierarchy consisting of the original Base Oil fluid density at the top and increasing in density towards the bottom of the vessel. The lighter conditioned OBM, containing a reduced solids concentration, is then transferred out of the vessel. The density cut point is determined by the treatment objective and is verified when it is pumped through the Coriolis density meter that is integrated into the ESC system. The remaining OBM in the vessel is pumped back to the feed tank as recycle fluid for continued processing.

The treatment parameters including voltage applied, amperage, and treatment time (time exposed to the applied voltage) are monitored and adjusted by the unit operators and are established based on the properties of the drilling fluids. The solids that accumulate on the plates of the cell pack are mechanically wiped from the plates to the bottom of the vessel, where they are augured to a sludge pump for removal. The ESC unit is operated via a programmable logic controller (PLC) with a touch screen human machine interface (HMI). With the correct software installed locally and internet connection, the control system can be remotely accessed for troubleshooting. Depending on the ESC unit, all the processing parameters can be stored and downloaded for future analysis.

The process does not require mechanically induced motion, increasing temperature or chemical additions under normal ambient conditions, creating zero to minimal impact on the characteristics of the Base Oil, such as an increase in fluid rheology after processing as seen with some other technologies.

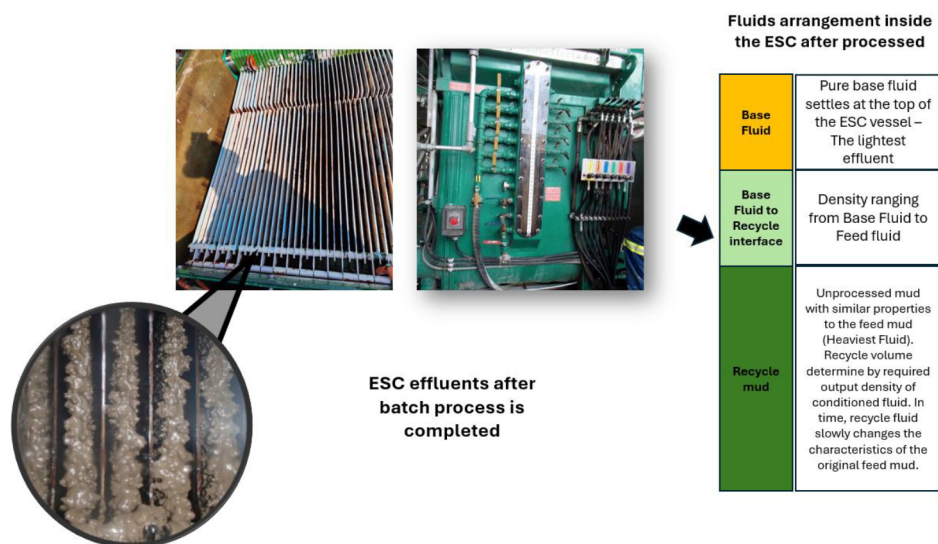


Figure 3—ESC Processing Basic Principle and Theory.

ESC Technical Capability and Benefits

The ESC is capable of removing solids from the OBM, including colloidal low-gravity solids (LGS) ranging from 5 microns down to particles smaller than 1 micron in size. Based on the principle of operation of the ESC, solids are not further reduced in size during processing.

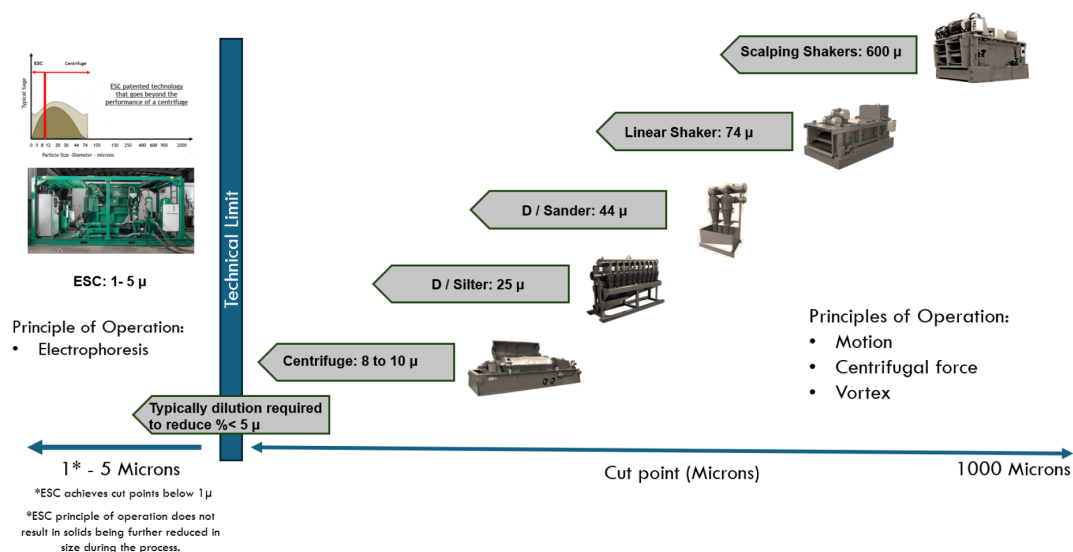
Colloids of this small size cannot be removed by centrifuging and are managed through expensive dilution with the required Base Oil and the addition of mud chemicals in order to recondition the OBM for reuse in drilling. Fluid reconditioning that utilizes dilution results in ever-increasing volumes of OBM inventory that requires additional storage and management.

The accumulation and recirculation of LGS in the OBM causes multiple adverse effects in drilling operations and increased costs to mitigate or offset. Some of these effects include but are not limited to:

- Higher fluid rheologies that increase circulating pressures;
- Increased equivalent circulation density (ECD);
- Detrimental impact on wellbore stability;
- Degradation of downhole tool and bit life;
- Increased requirements for tripping and the associated risks that come with increased surge and swab pressures; and

- Slower rates of penetration (ROP).

Figure 4 identifies the cut point capabilities of typical equipment used for solids control in drilling fluids (shakers, desanders, centrifuges, etc.) and the limitations of LGS removal below the 8 to 10 micron range.



ESC Operational History

Prior to the operational support for the offshore development drilling campaign in the Caribbean, the ESC had been deployed on multiple field pilot test trials to demonstrate the effectiveness for treating OBM fluids (Chandler et al 2019). Use of the technology was predominantly focused on a Base Oil recovery mode of operation from OBM stored inventories along with waste minimization; not integration with ongoing drilling operations. Figure 5 below depicts the ESC deployment history.

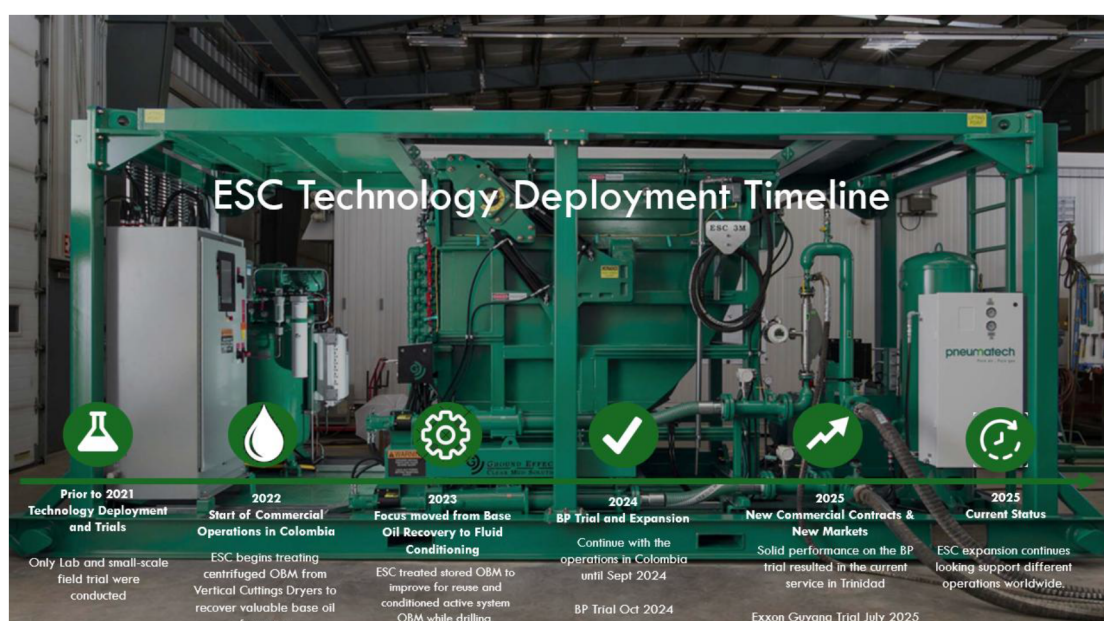


Figure 5—ESC Deployment Timeline.

In 2022 an ESC 3M model was deployed to Colombia where the unit was initially utilized for Base Oil recovery mode from existing stored OBM. The ESC was next moved to remote onshore active drilling sites where OBM inventory was being stored at the drilling locations and utilized during drilling operations. Initially, on these active drilling sites, the ESC was deployed to recover Base Oil from centrifuged OBM recovered from vertical cuttings dryers (VCD).

Through the field experience and continuous learning it was quickly realized that the value proposition for the ESC was in the reconditioning of the used drilling fluids. OBM treatment was performed on fluid removed from the active system while drilling. The objective was to reduce density, remove LGS, improve rheology, and then reintroduce it back into the active mud system.

OBM was also treated outside of the drilling critical path between hole sections and entire wells to improve fluid quality. It was particularly beneficial that the ESC, and the used OBM, were both located at the same drilling location, eliminating the need to mobilize the OBM to an LMP. The fluid was treated and subsequently transferred with the ESC unit to the next drilling location.

The ESC was successfully utilized for various OBM reconditioning purposes including:

- Decreasing water content from a fluid impacted by a major water influx;
- Reconditioning of weighted fluids using barite recovery to retain weighting material and minimize waste;
- Fluid optimization of the active mud system while drilling

In over 7,000 hours of ESC operational history, the unit treated approximately 14,000 barrels of OBM in Colombia.

Figure 6 shows the treatment results obtained while using ESC in conjunction with the barite recovery system.

The operational learnings and the data derived from the onshore field campaign in Colombia formed the basis of the drilling fluid improvement key performance indicators (KPI) for the introductory trial and subsequent ESC adoption for a major Caribbean operator.

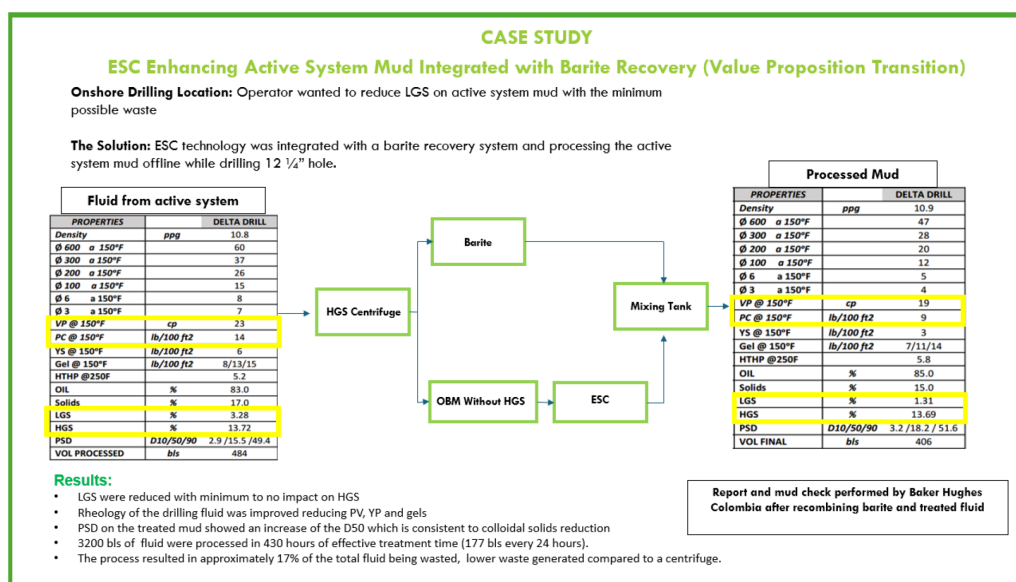


Figure 6—ESC conditioning in combination with a Barite Recovery System.

Application of the ESC Technology in Trinidad and Tobago Operations

The operator had a considerable volume (8,563 bbls) of previously used OBM in storage. The OBM was both uncentrifuged and centrifuged stress cage fluid and considered both unusable and uneconomical for reconditioning purposes due to the high LGS content.

The current OBM reconditioning process used by the operator was the same standard process used across the industry. The process involved centrifuging the fluid to remove the solids content down to the maximum capability of the available centrifuges, typically reduced to an LGS content of 6 – 8%. The remaining fluid was then diluted with Base Oil and treated with new OBM additives to restore the fluid properties to the required drilling fluid specifications. Stress cage / weighting agent that was removed during the centrifuging process, was also replaced.

Samples of the stored OBM were taken and provided to the Ground Effects Environmental lab in Canada for bench-scale testing and verification of the effectiveness of the ESC technology on the stored fluid. QA/QC mud reports were also provided for the stored fluids and the OBM properties were compared to the Colombia field generated historical data to verify treatment feasibility.

Using the bench testing results and comparing it to the ESC field test data from Colombia, a phased project approach and KPIs were identified and agreed by the operator. This would establish the baseline for Phase One of the ESC trial in the Caribbean.

Phase One of the ESC Trial

The objective of Phase One of the Trial was to use the ESC technology to treat 2,700 bbls of ‘out of specification’ stored OBM by recovering the original Base Oil. All 2,708 bbls of OBM in storage was centrifuged stress cage mud that contained LGS contents of up to 11.8%. Additionally, the OBM had considerable progressive gels and abnormally high rheology profiles.

[Table 1](#) below provides the QA/QC results of the typical fluid being treated in Phase One.

Table 1—Summary of Fluids Processed in Phase One.

Summary of SOBM Processed in Phase One							
TANK	Stress Cage SOBM L2#13	STD SOBM L2#9	SOBM L3#17	SOBM L2#14	SOBM L2#14-13	SOBM L1#06	SOBM L1#08
DENSITY							
Mud Density (ppg)- Pressurized Mud Balance	9,8	9,40	9,50	10,05	10,00	9,1	8,9
RHEOLOGY @ 50°C							
10 Sec gel	13	12	13	8	10	28	15
10 min gel	55	27	27	31	43	51	55
30 min gel	67	34	45	39	48	62	70
PV (cP)	30	21	20	30	33	31	25
YP (lb/100ft ²)	15	7	10	10	14	23	15
ELECTRICAL STABILITY@ 50°C							
Electrical Stability (Volts)	438	360	707	271	265	297	566
RETORT ANALYSIS							
% Oil	59,8	72,2	70,0	58,4	57,8	61,6	64
% Water	24,2	14,4	15,2	26,2	26,2	27,2	26
%Solids	16	13,4	14,8	15,4	16	11,2	10
OWR	71.2/28.8	83.4/16.6	82.1/ 17.9	69/31	68.8/31.2	69.4/30.6	71.1/28.9
LGS% volume	11,9	9,1	10,4	8,5	10,9	7,7	6,4
HGS% volume	2,9	3,7	3,3	5,0	3,8	2,6	2,5
WATER PHASE SALINITY							
WPS, mg/l	159.740	181.611	251.657	222.099	185.491	130.854	156,251
WPS, ppm	143.366	159.818	213.402	192.495	163.050	119.122	139.817

The following KPI's were mutually agreed to between both parties, including:

- A recovery factor of available oil in the OBM of between 50 – 65%;
- Recovered Base Oil solids content of < 3% and 0% water content (The ESC can generate essentially pure Base Oil, but typically the target is <3% solids and then the final solids content is allowed to settle for a period of time to obtain essentially 0% solids); and
- Complete the total treatment of the 2,708 bbls of OBM in storage in under 45 days.

In terms of performance of the ESC technology treating the 2,708 bbls of stored OBM, all KPIs were met:

- Recovery factor of available oil of 51%;
- A recovered Base Oil solids content average (before settling) of 2.6%; and
- Total treatment time completed in 42 days of all 2,708 bbls in storage.

In total, 927 bbls of reusable Base Oil was recovered and 1781 bbls of sludge was generated.

The Base Oil recovered by the ESC was sent to an independent laboratory in Houston (Benchmark Lab), Texas for QA/QC analysis. The results confirmed that the properties of the ESC recovered base fluid remained the same when compared to an original sample of Base Oil, enabling it to be used for the blending of new OBM for drilling operations.

A detailed report (Base Oil and Recovery Analysis, [Benchmark Lab. 2024](#)) was generated by the Benchmark Lab on the Base Oil and recovery oil analysis. The executive summary of the report stated the following, after analysis of two Base Oil samples and two recovered oil samples were submitted for Gas Chromatograph (GC) / Mass Selection (MS) and viscosity analysis:

- Two recovered oil samples were analyzed for Fourier Transform Infrared Spectroscopy (FTIR). The FTIR showed similar absorption peaks for the two recovered oils;
- Both the GC/MS and viscosity analysis indicated that all samples of the original and recovered Base Oils had similar compounds;
- The recovered Base Oils were slightly more viscous than the original oil with the recovered oils having a viscosity of 9 cps versus the two original Base Oil samples viscosity of 8 cps.

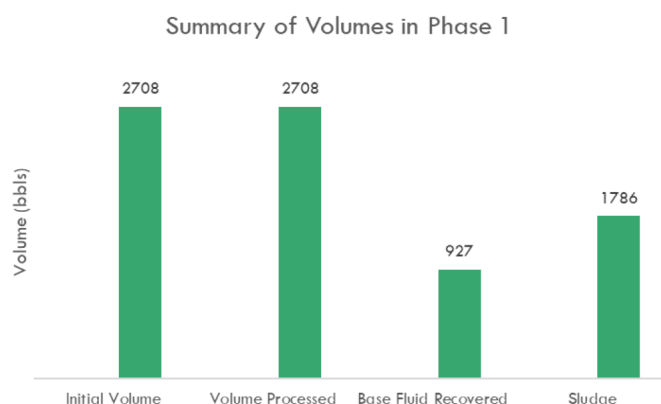


Figure 7—Volume Summary of Phase One.

Phase Two of the ESC Trial

The objective of Phase Two of the Trial was to treat 2,385 bbls of out of specification stored OBM to both recover Base Oil and recondition the fluid properties for reuse. The OBM for Phase Two was both uncentrifuged OBM with LGS concentrations greater than 10%, and centrifuged OBM with LGS concentrations exceeding 6%. Similar to Phase One, the OBM had considerable progressive gels and abnormally high rheology profiles (Refer to [Table 2](#)).

Table 2—Summary of Uncentrifuged and Centrifuged Fluids Processed in Phase Two.

Summary of SOBM Processed Phase Two					
TANK	L1#8 (After-roll)	L1#7 Dec 10	L3#20	L2#16	L2#19
DENSITY				Uncentrifuged	Uncentrifuged
Mud Density (ppg)-Pressurized Mud Balance	9	9,5	9,6	11,8	12,2
RHEOLOGY @ 50°C					
10 Sec gel	9	16	17	15	16
10 min gel	30	72	30	34	38
30 min gel	36	84	44	40	61
PV (cP)	21	30	32	31	36
YP (lb/100ft ²)	11	20	26	30	18
ELECTRICAL STABILITY@ 50°C					
Electrical Stability (Volts)	343	314	426	482	474
RETORT ANALYSIS					
% Oil	63,2	59,2	59,6	58,0	57,8
% Water	25,8	27	25	19,6	18
%Solids	11,0	13,8	15,4	22,4	24,2
OWR	71.0/29.0	68.7/31.3	70.4/29.6	74.7/25.3	76.3/23.7
LGS% volume	7,8	9,8	12,3	10	10,4
HGS% volume	2,2	2,8	1,8	11,2	12,4
WATER PHASE SALINITY					
WPS, mg/l	151.808	141.148	180.143	198.427	246.095
WPS, ppm	136.245	128.207	159.187	173.619	209.833

Based on historical field data from Colombia, it was agreed with the operator, that a portion of the 2,383 bbls would be treated with the objective to recondition the fluid. A volume of 300 bbls of centrifuged OBM with a density of 9.4 ppg was treated and reconditioned to a mud density of approximately 7.7 ppg. The LGS was reduced from 9% to 4.8%. Table 3 shows the results of the initial and final OBM after fluid reconditioning.

Based on the reconditioned fluid properties obtained, and in particular the reduction in colloidal and ultra-fine solids, the operator decided to continue the Phase Two Trial with the reconditioning of uncentrifuged OBM. A density reduction of 3.0 ppg from the original OBM density was agreed. It was determined that the 3.0 ppg density reduction also reduced the LGS sufficiently to economically minimize dilution. As a result, the reconditioned fluid was once again used in the mixing of new OBM volumes for the ongoing offshore operations.

Table 3—Fluid Reconditioning Mode Results.

SOBM	Solids Control Trial - Initial Sample	Solids Control Trial Final Sample
Mud Density (ppg)-Pressurized Mud Balance	9,4	7,75
RHEOLOGY @ 50°C		
6 rpm	9	1
3 rpm	8	1
10 Sec gel	10	1
10 min gel	38	2
30 min gel	56	2
PV (cP)	26	4
YP (lb/100ft ²)	13	1
ELECTRICAL STABILITY@ 50°C		
Electrical Stability (Volts)	369	312
RETORT ANALYSIS		
% Oil	61,4	81,2
% Water	25,6	12,4
% Solids	13	6,4
OWR	70.6/29.4	86.8/13.2
ASG	3,01	2,67
LGS% volume	9	4,8
HGS% volume	3,1	0,2

The ESC effectively replaced conventional centrifuges as a more efficient and energy favorable LGS removal solution, focusing exclusively on uncentrifuged fluids, resulting in meaningful improvements in overall fluid management efficiency, a considerable reduction in dilution (80% reduction on average), and tangible cost savings for the operator.

The ESC treatment in Phase Two resulted in:

- A recovery factor of 56% of available Base Oil in the OBM;
- A total of 1,029 bbls of reusable Base Oil was recovered.
- 1,356 bbls of sludge were generated.

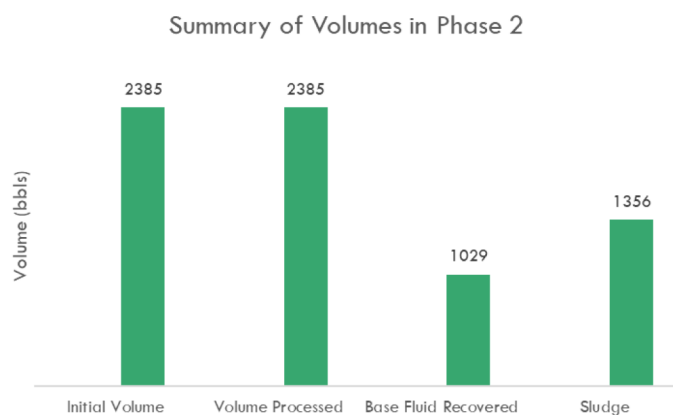


Figure 8—Total Volumes of Phase Two.

Phase Three of the ESC Trial

For Phase Three of the Trial, a total of 3,470 bbls of high LGS contaminated OBM was treated with the objective of reconditioning the OBM properties for reuse in the ongoing offshore drilling campaign, similar to Phase Two. All fluids were uncentrifuged stress cage OBM. These fluids had mud densities as high as 12.6 ppg and contained total solids and LGS as high as 28.4% and 16.7%, respectively. The targeted density reduction of the uncentrifuged OBM with the ESC was 3.0 ppg below the original feed OBM density.

Table 4 summarizes the OBM properties of the fluids from individual tanks processed during Phase 3 operations. Table 5 presents the QA/QCs conducted during Phase 3 on the blended conditioned fluids, from the individual feed tanks, throughout the entire phase.

ESC treatment in Phase Three resulted in:

- A recovery factor of 55% of available Base Oil in the OBM; and
- A total of 1,396 bbls of reusable conditioned OBM recovered.

Table 4—Summary of Fluids Processed in Phase Three.

Summary of SOBM Processed Phase Three						
TANK	L2#16	L2#19	L3-22	L3-23	L3-17	L2-09
DENSITY	Uncentrifuged	Uncentrifuged	Uncentrifuged	Uncentrifuged	Uncentrifuged	Uncentrifuged
Mud Density (ppg)-Pressurized Mud Balance	11,8	12,2	12	12,2	12,2	12,6
RHEOLOGY @ 50°C						
10 Sec gel	15	16	17	13	17	17
10 min gel	34	38	56	52	36	32
30 min gel	40	61	68	65	63	54
PV (cP)	31	36	37	39	43	43
YP (lb/100ft ²)	30	18	23	13	18	15
ELECTRICAL STABILITY@ 50°C						
Electrical Stability (Volts)	482	474	457	517	488	566
RETORT ANALYSIS						
% Oil	58,0	57,8	57,8	57,4	56	52,4
% Water	19,6	18	18,8	18,6	18	19,2
%Solids	22,4	24,2	23,4	24	26	28,4
OWR	74.7/25.3	76.3/23.7	75.5/24.5	75.5/24.5	75.7/24.3	73/27
LGS% volume	10	10,4	10,4	10,1	14,1	16,7
HGS% volume	11,2	12,4	11,7	12,5	10,3	10,4
WATER PHASE SALINITY						
WPS, mg/l	198.427	246.095	228.753	238427	261221	217324
WPS, ppm	173.619	209.833	196.701	203850	220905	188375

Table 5—Average Fluid Properties of Blended Reconditioned OBM During Phase Three.

QAQC Conditioned SOBM Phase Three			
TANK	L3-22	L3-22	L3-17
DENSITY	Tucker QAQC Feb 1 (L1-04)	Tucker QAQC Feb 5 (L1-04)	Tucker QAQC Feb 10 (L1-04)
Mud Density (ppg)-Pressurized Mud Balance	9,9	9,8	8,9
RHEOLOGY @ 50°C			
10 Sec gel	2	2	1
10 min gel	5	2	2
30 min gel	6	3	3
PV (cP)	10	10	9
YP (lb/100ft ²)	1	1	1
ELECTRICAL STABILITY@ 50°C			
Electrical Stability (Volts)	668	650	671
RETORT ANALYSIS			
% Oil	75	73,6	77,6
% Water	10,2	11,2	11,4
%Solids	14,8	15,2	11
OWR	88.0/12.0	86.8/13.2	87.2/12.8
LGS% volume	6,8	8,3	7,4
HGS% volume	7,3	6,2	14,2
WATER PHASE SALINITY			
WPS, mg/l	219.592	186.547	233062
WPS, ppm	189.168	163.637	199860

2,074 bbls of sludge was generated. This volume of sludge generated in Phase Three was 56% water plus solids and oil.

The conditioned fluid showed improved rheology profiles and LGS reduction that, once again, significantly minimized dilution requirements.

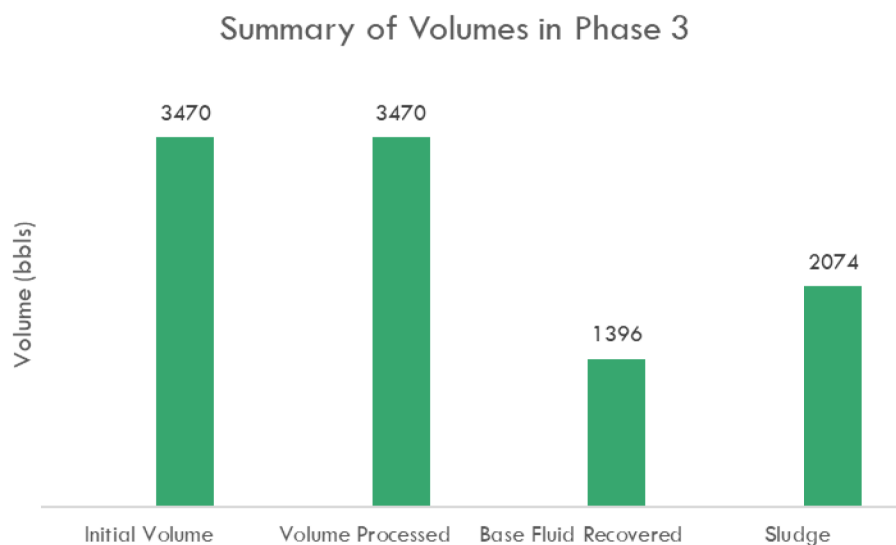


Figure 9—Total Volumes of Phase Three.

Conclusions

The field results presented in this paper demonstrate that the ESC technology can be effectively and economically applied at scale to treat, recover, and recondition oil-based and synthetic-based drilling fluids that would otherwise be considered economically unusable to recondition or would require considerable dilution after centrifuging in order to be reused. Across three consecutive trial phases, the ESC consistently reduced colloidal and ultra-fine low-gravity solids to levels suitable for reuse, while preserving the integrity of the base fluid and restoring acceptable drilling fluid properties.

ESC processing achieved meaningful reductions in fluid density and low-gravity solids (LGS) content without relying on mechanical shear, chemical additives, or thermal input. In addition to lowering solids concentration, the process improved key rheological properties and electrical stability, indicating better emulsion quality and overall fluid stability.

These improvements were driven by the ESC's ability to remove colloidal and ultra-fine solids that were previously difficult or impractical to remove. As a result, the treated fluid required less dilution with new Base Oil and additives, reducing dilution requirements by up to 80% compared with the previous LMP practice of centrifuging and diluting the mud.

The ESC also demonstrated the ability to process uncentrifuged mud for the operator, treating fluid with a maximum density of 12.6 ppg and total solids content of 28.4%. This capability allowed the LMP to eliminate centrifuge use. By processing the fluid directly through the ESC, the operation significantly reduced the volume of waste generated during mud reconditioning.

Base Oil recovery performance was consistent across all phases, with recovery factors in the range of 51 to 56% of the available oil. Independent laboratory testing confirmed that recovered Base Oil maintained chemical composition and viscosity comparable to fresh Base Oil, supporting its reuse in new OBM formulations. In addition to oil recovery, ESC demonstrated the capability to recondition both centrifuged and uncentrifuged fluids for direct reuse in active drilling systems, effectively replacing conventional centrifuging in the supported offshore campaign for the operator.

Operationally, the ESC system proved reliable and well-suited for continuous field use, maintaining high availability (approximately 97%) with relatively low power consumption (Average of 4.72 kWh). The ability to deploy ESC at both liquid mud plant facilities and drilling locations provides flexibility in fluid management and allows treatment to be performed outside of the drilling critical path. This reduces logistics complexity, minimizes fluid handling, and limits the accumulation of non-compliant stored OBM inventories.

From an environmental perspective, ESC contributes to lower waste generation and improved material efficiency by extending drilling fluid life and reducing the volume of fluid and sludge requiring disposal. The combination of low energy demand, reduced dilution, and minimized waste handling positions the ESC as a lower-emissions alternative to traditional solids control and fluid reconditioning methods.

Overall, the results confirm that ESC technology provides a practical and scalable approach to improving drilling fluid management by recovering value from high-LGS, non-compliant OBM that would otherwise require extensive dilution, centrifugation, or disposal. By removing colloidal and ultra-fine solids that are not effectively addressed through conventional solids control methods, the technology enables degraded OBM to be reconditioned into reusable drilling fluid while reducing the need for new Base Oil, additives, and waste handling.

These benefits translate into measurable operational efficiencies, lower fluid maintenance costs, reduced waste volumes, and improved environmental performance. The ability to process both centrifuged and uncentrifuged mud further supports its application across a range of drilling and liquid mud plant operational conditions. As operators continue to seek technologies that improve fluid reuse, reduce disposal requirements, and support more sustainable drilling practices, the ESC technology represents a viable advancement in solids control strategy for both onshore and offshore drilling operations.

References

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