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Enhanced Performance of High-Density Synthetic-Based Drilling Fluids Utilizing Recovered Base Synthetic Extracted from a Waste Drilling Fluid using a Novel Thermomechanical Process

Mukesh Kapila, Circul8 Energy & Environment Inc and Nils Kaageson-Loe, Baker Hughes

Abstract

This study investigates the performance of 15.0 ppg synthetic non-aqueous drilling fluids (SNADFs) formulated with recovered base synthetic fluid (RBS), a product of a novel thermomechanical destabilization process applied to waste SNADF. The novel process selectively targets emulsifiers and surfactants using only heat and pressure. The feed for the process is a waste SNADF containing a 18% vol% concentration of low-gravity solids. This recovery process offers significant benefits by reducing waste volumes and lowering operational costs. The evaluation compares 100% virgin synthetic systems against blends containing 25% and 50% RBS, focusing on rheology, electrical stability (ES), and high-temperature, high-pressure (HTHP) fluid loss at 350 °F before and after hot rolling. Results demonstrate that RBS-inclusive formulations maintain stable rheological properties with fragile gels, exhibit high electrical stability that notably increases post-hot rolling, and achieve superior HTHP filtration control. Specifically, the 50/50 RBS blend yielded the lowest HTHP filtrate volume (18 mL). These findings confirm that RBS effectively preserves and can enhance SNADF performance, particularly for HPHT applications, offering a sustainable and high-performing alternative for drilling fluid formulations.

Introduction

Spent oil- and synthetic-based drilling fluids (OBM/SBM) are a significant waste stream in drilling operations. During drilling, ultra-fine solids (UFS) accumulate in the fluid from drill cuttings and barite degradation, increasing low-gravity solids (LGS) and ultra fine particulates beyond the removal capability of conventional solids control equipment (shakers, centrifuges). Particles below ~5 µm are especially difficult to remove and gradually build up, degrading drilling fluid properties. As fine solids rise, drilling fluid rheology and performance deteriorate, causing higher viscosity and lower rate of penetration (Azar, Samuel, 2004). Excessive LGS has been linked to increased non-productive time (NPT) and wellbore problems – for example, Eagle Ford field data showed wells drilled with >10% LGS experienced 3× more stuck-pipe incidents and ~15–18% slower drilling compared to wells with <10% LGS (Guo et al, 2014). Traditionally, operators restore drilling fluid quality by dilution with fresh base oil or synthetic, which is costly and increases total fluid volume. Ultimately, when dilution is no longer economical, the fluid is deemed "spent" and must be disposed of, typically via land filling, injection wells or thermal treatment (McCosh, Gilmour, Addicks 2007).

However, disposing of spent OBM/SBM incurs substantial economic and environmental costs. Each 100 bbl of spent fluid contains ~60 bbl of valuable base fluid (diesel, mineral oil, or synthetic, herein generically referred to as oil) that is lost to disposal. Disposal fees and transport can cost on the order of $2,000 per 100 bbl with remote or offshore sites costing two or three times more. Additionally, if left to degrade (e.g. in a landfill or pit), organic components in the waste can produce roughly 18–19 tonnes of CO_2 per 100 bbl disposed (EPA Website). In summary, conventional disposal wastes significant material value and contributes to GHG emissions. It is estimated that globally over $360 million USD of base oil value is lost each year in disposed drilling fluids. This dual challenge of economic loss and environmental impact drives the need for a better solution.

No widely successful technology has yet been adopted to cost-effectively reclaim base oil from high-solids drilling wastes. Thermal desorption units (TDUs) can recover oil by volatilization and condensation, but they are energy-intensive and can degrade the oil quality (cracking lighter fractions) due to high temperatures (Jones, Sanders, Chambers, 2002) (Murray, Kapila, 2008). Centrifuges alone cannot separate colloidal ultra-fines and emulsified oil, especially once surfactants and fine clays have formed a stable suspension. Cross-flow membrane filtration has been piloted to remove fines and recover base oil, achieving >50% oil recovery with <1% solids in permeate. But membrane systems face issues with fouling, high maintenance, and limited throughput for field scale (Garcia, Falgout 2016).

Another source of waste drilling fluid comes from the processing of drill cuttings with a vertical cuttings dryer which is a basket centrifuge that allows fluid to pass through the screen while discharging a relatively low residual oil content dried solid cuttings. A vertical cuttings dryer is a low energy, low capex and opex, high volume and relatively low complex equipment that is effective in removing the bulk of the oil/synthetic contamination on drill cuttings. However, the fluid recovered from the dryer despite downstream centrifugation contains high UFS concentration rendering the fluid unusable, requiring disposal and thereby limiting the application of the vertical cuttings dryer.

In practice, many operators still rely on dilution and disposal to manage solids buildup in the active fluid system. Ultimately, an improved process is needed to efficiently treat spent drilling fluid by removing ultra-fines and separating reusable base oil at the speed at which they are generated, without the high energy consumption or chemical costs of current methods.

This paper introduces a novel thermochemical destabilization process designed to recover base oil and recycle spent drilling fluids in a field-practical, energy-efficient way at processing rates that can keep up with the rate of production. The process specifically targets the drilling fluid surfactants and emulsifiers that stabilize the oil-water-solid emulsion. By degrading these surfactants under controlled thermal conditions, the process enables immediate oil-water separation and fine solids coagulation.

The following sections describe the process principles and apparatus, present experimental results from lab and pilot-scale trials, and evaluate the environmental and economic benefits. Relevant prior work on drilling fluid contamination and treatment is reviewed to contextualize this advancement. The goal is to demonstrate that this technology has the potential to significantly extend the life of drilling fluids and reduce waste, thereby improving drilling efficiency, lowering costs, and minimizing environmental footprint.

Thermochemical Destabilization Process and Methodology

This section describes the thermochemical destabilization process in detail, including the apparatus, operating conditions, and the experimental methods used to validate its performance. The process combines a proprietary thermomechanical reactor with conventional centrifugation to separate and recover fluid for reconstitution into an OBM/SBM.

Process Description and Mechanism

The heart of the technology is a destabilization unit, which is a specialized reactor contained in a pressurized vessel. Spent drilling fluid is pumped into the destabilization (HTD) unit, where it is heated in a continuous flow process. No chemicals are added; the process relies solely on thermal energy and mixing. At these conditions, as discussed, the drilling fluid's emulsifiers (surfactants such as petroleum sulfonates, imidazolines, etc.) are altered (Amani, 2012) (Ibeh, 2007) such that the oil coalesces into a continuous oil phase, water separates out, and formerly oil-wetted clay particles lose their surfactant coating and begin to flocculate (aggregate) with water (Kapila, 2025). The HTD unit is designed to provide sufficient residence time and mixing to ensure uniform demulsification throughout the fluid.

Importantly, the process is tuned so that only the surfactants are affected: the base oil remains in liquid phase and does not boil or crack under these controlled conditions. This treatment is fundamentally different from vacuum distillation or thermal desorption, which evaporate fluids. The output leaving the HTD Unit is a destabilized slurry with distinct phases (oil and water wetted solids) intimately mixed.

Immediately downstream, the process employs a high-speed decanter centrifuge to do the bulk phase separation. The centrifuge (e.g. lab unit or full-scale decanter) is operated at ~2,100 G to split the stream into a light phase (oil) and heavy phase (solids + water + residual oil). Because the fluid has been chemically destabilized, the centrifuge can efficiently recover a clarified oil phase without requiring any chemical flocculants. In our bench tests, no additional surfactants or demulsifiers were needed to separate phases after the wet thermal treatment. The result is a recovered oil product and a wet solids cake.

The thermochemical process has several notable operational advantages (Kapila, 2025):

- No chemical additives – avoids cost and logistical complexity of chemical demulsifiers; also means the recovered oil is not contaminated by new chemicals.
- Energy efficiency – it uses heat but at lower temperatures and intensity than thermal desorption. The entire process energy usage is ~52 kWh per ton of fluid (~12 kWh/bbl), which is 80% less energy than typical thermal dryers or distillation units.
- Preserves oil quality – since base oil isn't vaporized or overheated, its composition (GC-Fingerprints) remains unchanged. Light ends are not generated or lost, and critical properties like flash point and viscosity are retained. There is no foul odor or cracking of the recovered oil.
- Robust to feed variation – testing has shown the process can handle a wide range of OBM/SBM types and even miscellaneous wastes (e.g. emulsified wastes, cuttings dryer effluent with high solids, etc.). High water content or high LGS content do not significantly hinder the oil recovery once the fluid is destabilized.

Synthetic-based muds (SBMs) are a type of drilling fluid used in oil and gas exploration and production. They are designed to provide superior drilling performance compared to water-based fluids, particularly in challenging environments. SBMs are typically composed of a synthetic base, water, emulsifiers, weighting agents (like barite), and various additives to control properties such as viscosity, fluid loss, and stability.

15 ppg drilling mud is a typical fluid composition for scenarios requiring high hydrostatic pressure for wellbore control:

- Permeable formations: To prevent influx of formation fluids.
- Abnormal pore pressures: To counteract high pressures and prevent kicks/blowouts.
- Deepwater drilling: To maintain wellbore control due to the long fluid column.
- Extended Reach Drilling (ERD): For better hole

cleaning and stability in long horizontal sections.
- HPHT environments: Often selected for pressure control in high-pressure reservoirs.

Feed Spent SBM and Destabilization Process

The recovered base synthetic (RBS) used in this evaluation was produced from a waste spent 9.93 ppg SBM, which contained Neoflo 4633 base synthetic (an isoparaffin with a density of 0.79 kg/L or 6.59 ppg). The spent SBM had an oil/water/solids content of 70%/12%/18% by volume and a density of 9.9 ppg or 1.19 kg/L .

The proprietary thermomechanical destabilization process was applied to this spent SBM. This process selectively degrades emulsifiers and surfactants in the spent OBM/SBM using heat and pressure, without the need for additional chemicals, filtration, or electrostatic forces while avoiding degradation of the base hydrocarbon (oil or synthetic). Following destabilization, efficient downstream centrifugation separates the clarified hydrocarbon from water-wetted solids.

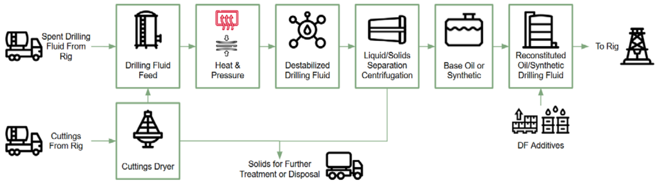

Figure 1 Simplified illustration of the thermochemical destabilization process

Testing of the SBM sample using the thermomechanical destabilization process yielded a 64% recovery of the available synthetic in the SBM. The recovered synthetic had a density of 0.82 SG, comparing favorably to the 0.79 SG of virgin Neoflo synthetic, which was in line with expectations. Minimal water of 2% and <3% solids were present in the recovered synthetic, as anticipated. The chart shows the mass/volume balance results of the pre and post destabilization process using an example 100 bbl of feed fluid. The chart also illustrates the overall recovery of 45% of the total fluid volume and a significant 94% reduction of solids in the recovered synthetic.

Table 1 Recovered Synthetic Fluid from Spent Waste SBM

Property	**Feed Spent SBM (100 bbl)**	**Recovered Synthetic Fluid (45 bbl)**
Hydrocarbon Content (vol%)	70%	95%
Water Content (vol%)	12%	2%
Solids Content (vol%)	18%	2.7%
LGS Content (vol%)	18%	2.7%
Density (SG)	1.19	0.82
Density (ppg)	9.93	6.84
Synthetic Recovery (from feed)		64%
Overall Solids Mass Reduction		94%

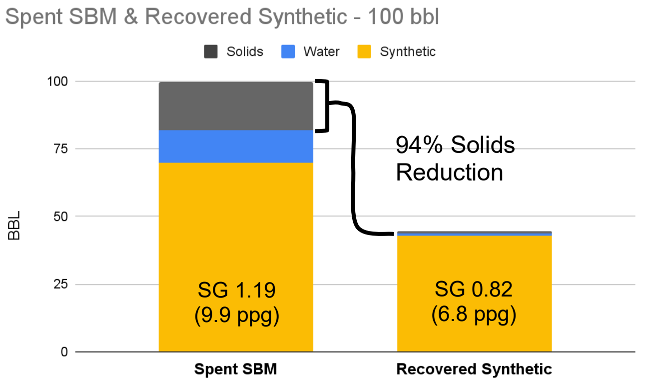

Figure 2 Recovered Synthetic from Waste Spent SBM

Three 15.0 ppg SBMs (100% Neoflo; 75/25 Neoflo/RBS; 50/50 Neoflo/RBS all by volume) were mixed, hot-rolled 16 h at 350 °F, and tested per API RP 13B-2 (rheology, gels, ES, HTHP @ 350 °F) with following concentrations:

Table 2 Recovered Synthetic Fluid SBM Formulations

Formulations			
Product	**Neoflo 4633**	**75% Neoflo 4633 25% Recovered Synthetic**	**50% Neoflo 4633 50% Recovered Synthetic**
NeoFlo 4633, bbl	0.5341	0.4018	0.2686
Reclaimed base oil, bbl	--------	0.1339	0.2686
Emulsifier A, lb	15	15	15
Emulsifier B, lb	3	3	3
Lime, lb	6	6	6
Organoclay, lb	6	6	6
Brine, bbl	0.101	0.1112	0.1115
Barite 4.1, lb	407.35	404.65	401.94

Raw data collected is shown in Table 3 Fluid Rheology Before Hot Rolling, Table 4 Fluid Rheology After Hot Rolling and Table 5 Calculations in Appendix A.

Results

The charts below summarize PV, YP, ES, HTHP @ 350 °F, and YP/PV before and after hot-rolling.

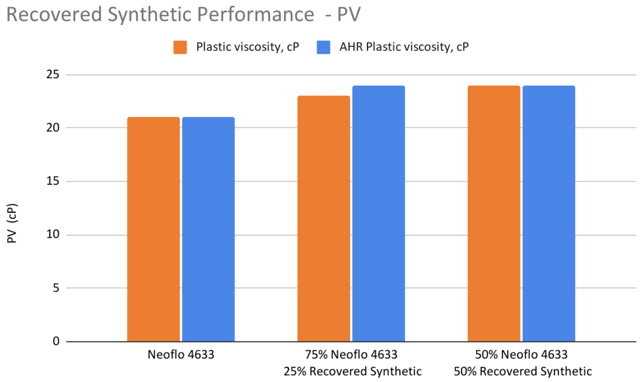

Figure 3 Recovered Fluid SBM Plastic Viscosity

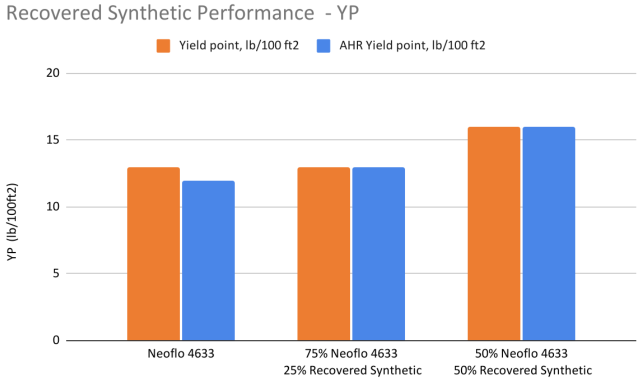

Figure 4 Recovered Fluid SBM Yield Point

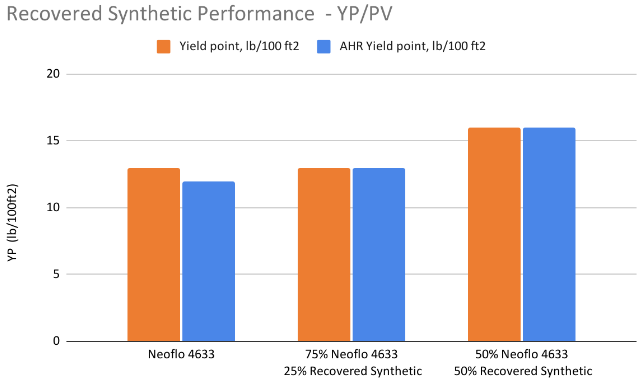

Figure 5 Recovered Fluid SBM YP/PV Ratio

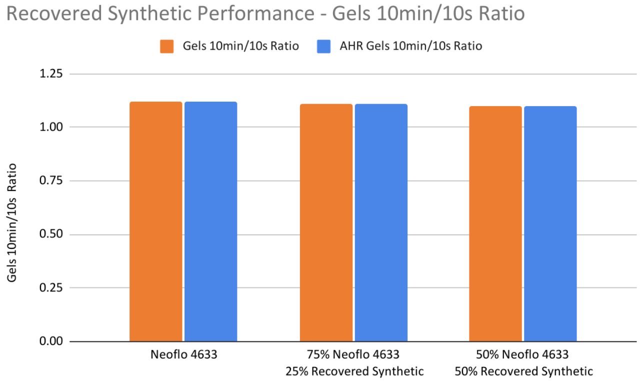

Figure 6 Recovered Fluid SBM 10min/10s Gels Ratio

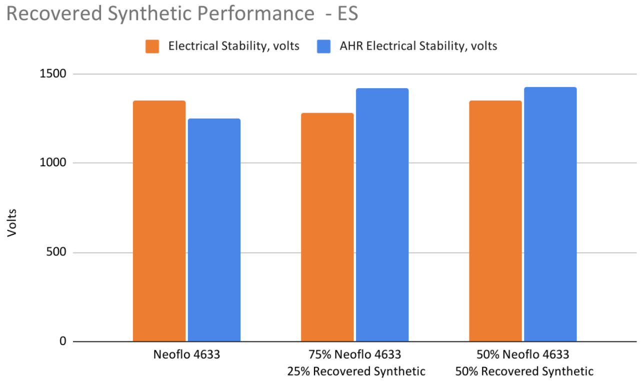

Figure 7 Recovered Fluid SBM Electrical Stability

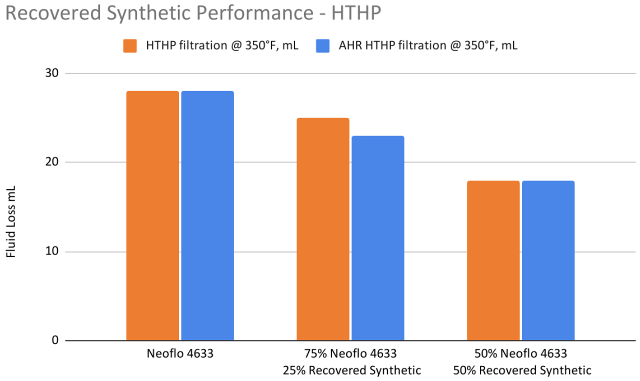

Figure 8 Recovered Fluid SBM HTHP Fluid Loss

Discussion and Interpretation

Rheological Properties and Hole Cleaning Capabilities

The rheological properties of the 15 ppg RBS SBM were thoroughly evaluated, focusing on Plastic Viscosity (PV) and Yield Point (YP), which are crucial indicators of a drilling fluid's performance.

Plastic Viscosity (PV) Figure 3: Measured values of 21–24 cP fall well within the customary range for weighted invert-emulsion SBMs, which typically exhibit PVs between 15 and 35 cP. (Katendea, 2019). This indicates a fluid with acceptable internal friction, allowing for efficient pumpability and minimizing pressure losses in the wellbore. The consistent PV values across samples suggest good formulation control and stability of the fluid.

Yield Point (YP) Figure 4: The observed YP values of 12–16 lb/100 ft² are also within the typical range for this class of drilling fluids (10–25 lb/100 ft²). A sufficient YP is essential for suspending drill cuttings and weighting materials when circulation is stopped, preventing their settling to the bottom of the wellbore and potential issues like stuck pipe.

Carrying Capacity and Equivalent Circulating Density (ECD): Based on API RP 13D interpretations, the combination of these PV and YP values strongly indicates adequate carrying capacity for drill cuttings at manageable Equivalent Circulating Densities (ECDs). This is a critical operational advantage, as it minimizes the risk of excessive pressure on the formation, which can lead to lost circulation or formation damage. The balance between PV and YP ensures efficient hole cleaning without imposing undue stress on the wellbore.

YP/PV Ratios and Low-Shear Rheology Figure 5: The YP/PV ratios, ranging from approximately 0.54–0.67, are considered conservative. This suggests a fluid that is not overly shear-thinning, which can be beneficial in maintaining hole cleaning efficiency, particularly in challenging wellbore geometries. These ratios can be further corroborated with low-shear rheological checks, such as measurements at 6 rpm. Such low-shear data are particularly important for high-angle or horizontal well intervals, where effective suspension and transport of cuttings under low-flow conditions are paramount.

Gel Strengths and Static Stability: A Key to Efficient Drilling Operations

The rheological properties of drilling fluids, particularly their gel strengths and static stability, are paramount to ensuring efficient and safe drilling operations. In the fluid under consideration, the gel strengths are characterized as "fragile," a highly desirable attribute for several critical reasons.

- **10-second vs. 10-minute Gel Strengths** Table 3 **&** Table 4: The observation that 10-minute gel strengths are only slightly higher (approximately 1.10–1.13 times) than 10-second gel strengths is a direct indicator of this fragile nature. Figure 6 This minimal increase signifies that the internal structure of the fluid, formed when it is static, is easily disrupted.
- **Easy Restart of Circulation**: This property directly translates to the ease with which circulation can be re-established after periods of inactivity. During drilling, operations frequently require static periods, such as when making pipe connections, running logging tools, or during power outages. With fragile gels, minimal pressure is required to break the gel structure and resume flow, significantly reducing non-productive time (NPT).

The most significant advantage of fragile gels is their ability to prevent "progressive gelation." This phenomenon, where gel strengths continuously build over extended periods of time, poses numerous challenges and risks:

- **Excessive Standpipe Pressures:** As gels progressively strengthen, more pressure is required to initiate circulation, leading to excessively high standpipe pressures. This can strain pumps, hoses, and other surface equipment, potentially leading to equipment failure.
- **Surge and Swab Pressures During Tripping:** Strong gelation during pipe tripping causes significant surge and swab pressures. Lowering pipe (surge) can induce formation fractures due to increased flow resistance, while pulling pipe (swab) can lead to formation fluid influx (kicks) as strong gels resist flow into the annulus. Both scenarios are undesirable and can cause costly well control issues.
- **Difficulties in Breaking Circulation:** As mentioned, breaking circulation after static periods becomes increasingly difficult with strong, progressively gelling fluids. This can prolong NPT and increase the risk of equipment damage.
- **Increased Non-Productive Time (NPT) and Operational Risks:** All the aforementioned issues contribute directly to increased NPT, driving up operational costs. More importantly, they escalate operational risks, potentially leading to well control incidents, equipment failures, and safety hazards.

The "fragile" nature of the gels is not to be mistaken for instability. On the contrary, it indicates a highly stable fluid that consistently maintains its desired flow properties even after prolonged periods of inactivity. This inherent stability ensures predictable fluid behavior, which is crucial for effective wellbore cleaning, suspension of cuttings, and maintaining wellbore integrity. In essence, the fluid exhibits thixotropic behavior where the gel structure is easily broken under shear but rebuilds quickly when static, yet without excessive strength. This balance is key to optimizing drilling performance and minimizing operational complexities.

Emulsion Integrity (ES)

The emulsion integrity using electrical stability (ES) measurements, a critical indicator of drilling fluid performance, consistently exceeded 1,200 V across all tested fluid formulations, demonstrating exceptional stability. Table 3 **&**

Table 4. Notably, an increase in ES was observed for the RBS SBM blends after HR, further highlighting their robust performance under dynamic conditions. Figure 7. The methodology for determining ES values is defined by API Recommended Practice 13B-2, an industry-standard guideline for the field testing of oil-based drilling fluids. According to this standard, commonly accepted baseline ES values for oil-based mud (OBM) and synthetic-based mud (SBM) typically range from 500 V to 700 V. However, for HPHT drilling applications, significantly higher internal thresholds are often required to ensure the long-term integrity of the emulsion in extreme downhole environments. The consistently high ES values obtained in these tests, well above the generally accepted baselines and even exceeding typical HTHP requirements, provide compelling evidence of the strong emulsion robustness and thermal stability of both RBS SBM blends. This superior emulsion integrity is crucial for maintaining wellbore stability, optimizing drilling efficiency, and mitigating potential issues such as fluid loss and differential sticking in challenging drilling scenarios.

Fluid Loss (HTHP @ 350 °F)

The investigation into fluid loss under high-temperature, high-pressure (HTHP) conditions at 350 °F yielded compelling results, particularly highlighting the efficacy of the 50/50 RBS blend. Table 3 **&** Table 4. This specific formulation achieved the most favorable outcome, demonstrating the lowest filtrate volume at 18 mL. Crucially, this performance was sustained even after hot rolling, indicating robust thermal stability and resistance to degradation.

In contrast, the 75/25 blend showed a commendable improvement in fluid loss, decreasing from an initial 25 mL to 23 mL. While positive, this reduction was less pronounced than that observed with the 50/50 RBS blend. The 100% Neoflo, serving as a reference, maintained a consistent filtrate volume of 28 mL throughout the testing. Figure 8

When comparing these results to published SBM baselines at 350 °F, a common range for filtrate volumes is typically around 15–25 mL. It is also well-documented that achieving single-digit fluid loss values is possible through the application of suitable fluid loss packages. The current findings strongly suggest that the inclusion of RBS plays a significant role in enhancing the fluid's properties. Specifically, it appears to contribute to the formation of a tighter emulsion, which is critical for minimizing filtrate invasion. Furthermore, RBS seems to facilitate more favorable solids packaging under the demanding HTHP conditions, ultimately leading to improved filtration control. This implies that RBS can be a key component in optimizing drilling fluid performance in challenging environments.

The improved HTHP control and stable ES align with the thermomechanical destabilization mechanism: deactivation of surfactants in waste fluid and efficient phase separation yield a clean hydrocarbon base with minimal water and ultra-fines, which blends readily with Neoflo and responds predictably to standard emulsifier packages. Prior bench/pilot evidence reports high hydrocarbon recovery with preserved hydrocarbon fingerprints and low energy intensity—enablers for both technical performance and cost/ESG benefits.

Commercial Applications and Implementation Considerations

RBS can substitute 25–50% of fresh synthetic in new builds or maintenance blends. Key applications include liquid mud plant reconditioning of spent OBM/SBM; closing the loop on cuttings-dryer effluent losses; on-rig recycling during pad or ERD drilling; and recovery at waste-management facilities. High ES and reduced HTHP filtrate favor the 50/50 blend for HTHP intervals; the 25% blend is advantageous where slightly lower PV is preferred.

To maintain fragile gels, a 10-minute/10-second ratio of approximately 1.1 and a YP/PV ratio between 0.55 and 0.75 are recommended; transport should be confirmed at 6 rpm. If the PV/ECD ratio is elevated, dilution and centrifugation are necessary to remove ultra-fines, organoclay should be trimmed, and the wetting agent verified.

The thermomechanical destabilization process has been demonstrated from bench to pilot and packaged for ~100–300 bbl/d containerized units that integrate with standard solids-control centrifuges. Specific energy demand is typically ~80% lower than thermal desorption because no vaporization is required and energy is exchanged. A single operator can operate the units, and recovered hydrocarbons are returned to active inventory, cutting disposal volumes and new-base purchases.

Environmental Impact

By avoiding landfill or deep-well disposal of OBM, the process curtails the CO_2 and methane emissions that such waste would generate. Landfilled oil-based waste decomposes and can emit ~180 kg CO_2-equivalent per barrel. In contrast, the process emits only ~6 kg CO_2e per barrel utilizing the US Environmental Protection Agency grid emissions factor for the year 2020 of 454 g CO2/kWh, which is a 95% reduction in carbon footprint. In concrete terms, treating 100 bbl of waste drilling fluid saves ~18 tons of CO_2 emissions using 3.2 kg of CO2 per kg of diesel that would occur in traditional disposal via natural biodegradation.

Conclusions

This study successfully demonstrated the efficacy of a novel thermomechanical destabilization and centrifugation process for the sustainable recovery of valuable base hydrocarbon from spent waste synthetic drilling fluid. This innovative approach, specifically involving the precise application of heat and pressure followed by centrifugation, proved effective in destabilizing and separating the various components from these challenging high LGS fluids. These types of fluids are typically classified as "end-of-life" materials and are conventionally designated for costly and environmentally impactful disposal.

The recovery process achieved a 64% yield of the available synthetic base from the waste feed synthetic NADF. A crucial aspect of this success is the quality of the recovered synthetic fluid, which exhibited a density of 0.82 SG or 6.8 ppg. This density closely matches that of the virgin Neoflo synthetic, which has a density of 0.79 SG or 6.6 ppg, indicating a high degree of usability for the recovered product.

Further investigation into the performance of the RBS when substituted into new drilling fluid formulations revealed significant advantages. The research specifically found that the incorporation of RBS at substitution rates of 25–50% not only preserved the essential rheology and emulsion integrity of the drilling fluid but also demonstrably improved the HTHP filtrate properties when compared to formulations using 100% virgin Neoflo for a 15.0 ppg SBM.

Beyond these improvements, other critical fluid properties such as plastic viscosity, yield point, and gel strength remained consistent with formulations using virgin Neoflo. Gel strength, a measure of the thixotropic properties of a fluid, indicates its ability to suspend solids when at rest and to flow readily when agitated. The YP/PV ratio (yield point to plastic viscosity ratio) is a key indicator of a fluid's flow characteristics, influencing its efficiency in carrying cuttings and maintaining hole cleaning. The consistency of these properties with virgin Neoflo formulations suggests that the blended RBS fluids will perform comparably in these critical operational aspects, ensuring operational compatibility and performance.

Based on these results, specific recommendations for practical application can be made. A 50/50 RBS substitution ratio can be adopted in scenarios where stringent filtrate control is of paramount importance. Conversely, for applications where a slightly lower PV is desirable, a 25% RBS substitution rate can be adopted.

The re-utilization of recovered hydrocarbon base fluids in drilling operations offers substantial advantages. Environmentally, it significantly reduces the demand for virgin base fluids, thereby conserving natural resources and decreasing the carbon footprint associated with their production and transportation. It also minimizes the disposal of waste fluids, reducing the CO2 emissions from biodegradation in landfills. Economically, this practice leads to considerable cost savings by lowering expenses related to the purchase of new base fluids and the disposal of used ones. Furthermore, it can reduce operational costs by optimizing fluid performance and extending equipment life.

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Appendix A – Raw Test Data & Calculations

Table 3 Fluid Rheology Before Hot Rolling

Property	**Neoflo 4633**	**75% Neoflo 4633 25% RBS**	**50% Neoflo 4633 50% RBS**
Electrical Stability, volts	1353	1282	1348
600 rpm reading	55	59	64
300 rpm reading	34	36	40
200 rpm reading	26	28	31
100 rpm reading	18	20	22
6 rpm reading	9	9	10
3 rpm reading	8	8	9
10-sec Gel, lb/100 ft2	8	9	10
10-min Gel, lb/100 ft2	9	10	11
Plastic viscosity, cP	21	23	24
Yield point, lb/100 ft2	13	13	16
HTHP filtration @ 350°F, mL	28	25	18

Table 4 Fluid Rheology After Hot Rolling

Property	**Neoflo 4633**	**75% Neoflo 4633 25% RBS**	**50% Neoflo 4633 50% RBS**
Electrical Stability, volts	1248	1422	1429
600 rpm reading	54	61	64
300 rpm reading	33	37	40
200 rpm reading	26	29	31
100 rpm reading	18	21	23
6 rpm reading	8	10	10
3 rpm reading	7	9	9
10-sec Gel, lb/100 ft2	8	9	10
10-min Gel, lb/100 ft2	9	10	11
Plastic viscosity, cP	21	24	24
Yield point, lb/100 ft2	12	13	16
HTHP filtration @ 350°F, mL	28	23	18

Table 5 Calculations

Fluid	**Stage**	**PV** (cP)	**YP** (lb/100ft²)	**YP/PV Ratio**	**AV** (cP @600)	**Gels** 10s	**Gels** 10min	**Gel Ratio** (10min/10s)
Neoflo 4633	After HR	21	12	0.57	27.0	8	9	1.12
Neoflo 4633	Before HR	21	13	0.62	27.0	8	9	1.12
75% Neoflo 4633 25% RBS	After HR	24	13	0.54	30.5	9	10	1.11
75% Neoflo 4633 25% RBS	Before HR	23	13	0.57	29.5	9	10	1.11
50% Neoflo 4633 50% RBS	After HR	24	16	0.67	32.0	10	11	1.10
50% Neoflo 4633 50% RBS	Before HR	24	16	0.67	32.0	10	11	1.10