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Rheological and filtration control performance of water-based drilling muds at different temperatures and salt contaminants using surfactant-assisted novel nanohydroxyapatite

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ABSTRACT

Today, the high-performance rheological and filtration properties of nanosized particles (NPs) in water-based muds (WBMs) are continuously reported. Nevertheless, NP's properties performance at different temperatures and salt environments, specifically the salt-screening process, needs additional knowledge. Hence, this study developed a WBM system using sodium dodecyl sulfate (SDS)-assisted nanohydroxyapatite (Nano-HAp) for different temperatures and salt contaminants. The impacts of the newly-produced Nano-HAp on the density, pH, rheology, and filtration characteristics of WBM at 298 K and 353 K were examined. The effects of salt cations (Ca^{2+}/Na^{+}) on a bentonite-based suspension (BN-WBM) at 298 K and 393 K and SDS-aided Nano-HAp as a salt-tolerant ingredient in drilling muds were also examined. The Herschel-Buckley and Power law models best described SDS-aided Nano-HAp drilling mud's rheology at 298 K and 353 K, respectively. Nano-HAp improved the rheological and filtration capabilities in salt and water solutions at 298 K, 353 K, and 393 K, making it a perfect field additive. 1.0 g of SDS-aided Nano-HAp is recommended, and it is thermally very stable, according to the thermal gravimetric analysis findings. It increased the viscosity performance by 78.6% at 298 K and by 79.2% at 353 K, provided desirable shear stress between 1.0 and 1000 s^{-1} shear rates, and decreased the fluid loss by 31.8% ($\leq$ 8 mL) at 298 K and 25% ($\leq$ 11 mL) at 353 K. In BN-WBM, it decreased the viscosity of the BN-salt solution from a 35-fold increase to less than a 5-fold increase and made the BN-based suspension less salt-reliant. It operated by attaching to the BN platelets' positive edge and negative face surfaces, shielding Ca^{2+}/Na^{+} cations from the BN's ion-susceptible regions to decrease the viscosity and filtration of the BN-based suspension. This study demonstrates the possible use of Nano-HAp particles as effective filtration and rheological control additives in WBMs. It further demonstrates that Nano-HAp was appropriate for enhancing the drilling performance of BN-WBMs while increasing their resistance to salt cation contamination.

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