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Tribological properties of water-based drilling fluids with borate nanoparticles as lubricant additives

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Abstract

In this work, several nanostructured borates such as magnesium, zinc, aluminum and titanium borates were synthesized. These borates were added to drilling muds and their ability to improve tribological properties of water-based drilling fluids, was investigated. The tribological properties of the fluids containing these nano-additives were compared with those of a typical mud (containing bentonite and water) with and without a commercial lubricant additive (BitcLub, M-I SWACO) as reference samples. The results indicated that adding nano-additives to the drilling mud increased its extreme pressure property by more than five times compared to the reference samples. At the same time, these nano-additives decreased the coefficient of friction due to their good ability in producing a strong protective film (tribo-film) on the contacting surfaces being stable at extremely high pressure and temperature conditions. Among all the prepared nano-additives, titanium borate, which is biodegradable, showed a significant improvement in tribological properties of drilling fluid as compared to the other borates.

Keywords: Drilling fluids; Nano-additives; Borates; Tribological properties

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