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Cationic and hydrophobic chitosan nanoparticles as emulsion stabilizing agents for underbalanced drilling fluids

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The discovery of the pre-salt in Brazil led to drilling operations through reservoirs located above the pre-salt that have produced oil and gas for decades, being, therefore, depleted zones presenting very low pore pressure. For drilling through a depleted zone, underbalanced drilling (UBD) is used to avoid rock fracture, loss of circulation and imprisonment of the column. Researchers have reported the use of various methods in UBD, such as the addition of hollow glass spheres, foams, Aphrons and emulsions. Direct emulsions are interesting because they are environmental friendly, since they form a water-based fluid, present low cost and higher penetration rates. Emulsions-Pickering is a stabilization mechanism through the use of particles that can lead to very stable systems. The purpose of this study is to use chitosan derivatives nanoparticles as emulsion-Pickering stabilizers for the formulation of low density aqueous base drilling fluids. The nanoparticles of chitosan derivatives were prepared by the ionic gelatinization technique and were characterized by FTIR, interfacial tension, TGA and scanning electron microscopy. The nanoparticles were added to the aqueous phase and an olefin was used as the oil phase for the oil-in-water (o/w) emulsion, which was the base for the low density drilling fluid. The stability of the emulsions was assessed by visual aspect, DLS, optical microscopy and DSC. The complete drilling fluid formulation had its performance evaluated by API tests. The chitosan derivatives nanoparticles have shown to be able to produce high stability o/w emulsions and the cationic derivative (TMQ) nanoparticles were more efficient than the nanoparticles from the cationic and hydrophobic derivative (TMQ-C14). It is believed that their particle shape and size are responsible for this difference in efficiency. The density and the API parameters for the formulated drilling fluids did meet the needs for a UBD.

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