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Investigation of the effects of zinc oxide nanoparticles and synthesized cellulose nanocrystals (CNCs) on emulsion-based drilling fluids

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Abstract

Drilling Mud holds an important role in the drilling process in such a way that it is a determinant key to the success of the operation as well as the money spent throughout the process. Indeed the success and the cost of the operation can be severely impacted by some challenges experienced while drilling such as temperature and pressure conditions which leads to fluid loss, fluid deterioration...As a result there is a need to formulate a fluid with desirable rheological properties to withstand such undesirable parameters.

Therefore this work was aimed to improve emulsion drilling fluids (EDFs) based nanoparticles with enhanced properties. Many investigations were performed to find a proper emulsion stability as well as a good drilling fluid performance. The stability of the prepared emulsion drilling fluids was done using surfactant with different concentrations for several days. After several days of preparation, the EDFs containing DTAB as surfactant have showed a better emulsion stabilizer compared to the Triton X-100 ones.

In addition an investigation combining both NPs and surfactants confirmed the used of NPs to improve DF and revealed the effective use of ZnO NPs for drilling fluids application and preferentially with DTAB as surfactant.

Following that result, the 2nd part of the work was based on the synthesis and characterization of CNCs as NPs to formulate EDF with DTAB as surfactant. The CNCs NPS were successfully obtained via the method of oxidation of microfibrillated cellulose through TEMPO-mediate and after characterization using TEM, spherical NPs with small size varying from 10-50nm were observed. The FANN® Model 35 viscometer served to display the behavior of the shear stress and viscosity of the prepared fluids against variable shear rate at variable NPs and temperature concentration.

The rheological and filtration properties were increase with increase in CNCs content from 0.8 to 1.2% of fluid in room temperature and with an increase in temperature.