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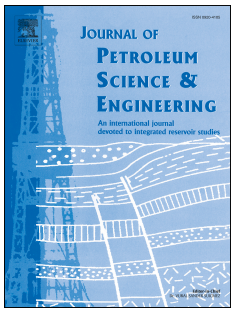


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# Viscoelastic Properties of Drilling Fluids and their Influence on Cuttings Transport

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## Abstract

Cleaning the wellbore from drilled material is important to continue drilling efficiently and to prevent high torque and drag, as well as reducing down time due to reaming operations. Drilling fluids used for this purpose are complex fluid systems, generally with water or oil as a base substance. Water-based and oil-based drilling fluids are performing differently in terms of hole cleaning, even when their density and viscosity are fairly similar. Comparative studies performed by several research groups have resulted in diverse outcomes, showing superior behavior of either water- or oil-based drilling fluids, or no significant differences between the fluids at all.

In the present study, a water-based and an oil-based drilling fluid have been investigated regarding their viscoelastic properties, using the Anton Paar rheometers MCR 102 and MCR 302. Amplitude sweep tests, 3-intervall-thixotropy tests, temperature sweep tests, and low-shear rate flow curves with controlled shear stress and shear rate were performed and analyzed. Cuttings transport experiments in a flow loop with a 10 m long test section and a free-whirling inner-rotating drill string were conducted with the same fluids to study the hole-cleaning efficiency of different drilling fluids. The results from both experimental parts are presented. The rheometer results are used to interpret the cuttings transport behavior in the flow-loop experiments. The water-based drilling fluid was a KCl brine based fluid, and the oil-based fluid a water-in-oil emulsion. Both fluids are actual field fluids, used during drilling operations on the Norwegian Continental Shelf and have similar viscosities and densities.

The oil-based drilling fluid showed better hole-cleaning abilities during the flow-loop experiments, leaving a lower sand bed in the test section. This fluid displayed viscoelastic properties, such as a yield stress and a linear viscoelastic range. The water-based drilling fluid showed no yield stress and a 50 to 100 % higher elasticity than the oil-based drilling fluid.

## Keywords

Drilling fluid, Cuttings transport, Rheology, Hole cleaning

## 1. Introduction

Cuttings transport is an important part of every drilling operation. The removal of drilled material is necessary to avoid cutting accumulation in the borehole and proceed drilling. Optimal fluid

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