Effect of Calcium Sulfate Contamination on Rheological Properties of Oil Based Mud

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Abstract
In this study, the effect of Calcium Sulfate ($CaSO_4$) contamination up to 5% on the rheological properties of mineral oil based mud (M-OBM) was investigated. Shear stress, Plastic Viscosity (PV) and Yield Point of M-OBM contaminated by Calcium Sulfate with low concentration (1%, 3%) were the same to that of M-OBM only. But 5% of Calcium Sulfate increased the rheological properties. Calcium Sulfate also decreased the pH but was not sensitive to the Calcium Sulfate concentration.

1. Introduction

Oil based fluids have some advantages that make them especially desirable for drilling certain types of formation. Oil based muds have been very effective in reducing torque, drag and pipe sticking problems (Fadairo et al. 2012). Calcium sulfate is one of the major scales that cause many significant and serious operating problems in producing oil and gas wells and in water injectors. Impermeable hard scale deposits of calcium sulfate can severely impair the formation permeability or lead to downhole equipment failure (Delorey et al. 1996). Maintaining an excess pH controlling agent is particularly important for some fluid system because these systems will lose all rheological properties if the pH was allowed to drop to less than 7 (Robert 2004).

2. Objectives

The overall objective was to investigate the effect of calcium sulfate contamination on the rheological properties of OBM. Also, the change in the pH and Resistivity of OBM with varying percentages of Calcium Sulfate was investigated.

3. Material and methods

In this study, oil based drilling mud samples were prepared by mixing mineral oil, water and cetyltrimethylammonium bromide (CTAB) surfactant. The ratio of oil to water was 4: 1. 1% of cetyltrimethylammonium bromide surfactant was added. Four 4% of oil based mud samples with 0%, 1%, 3% and 5% of Calcium Sulfate contamination were prepared. OBM without any sulfate contamination was the control sample. The rheological properties and resistivity of all samples were investigated by Ofite Model 900 Viscometer and Orion 125A+ conductivity meter under room temperature. Also pH was measured by Orion Model 420A pH meter. The rheological properties (Plastic Viscosity, Yield Point and Gel strength) were calculated by Bingham plastic model.

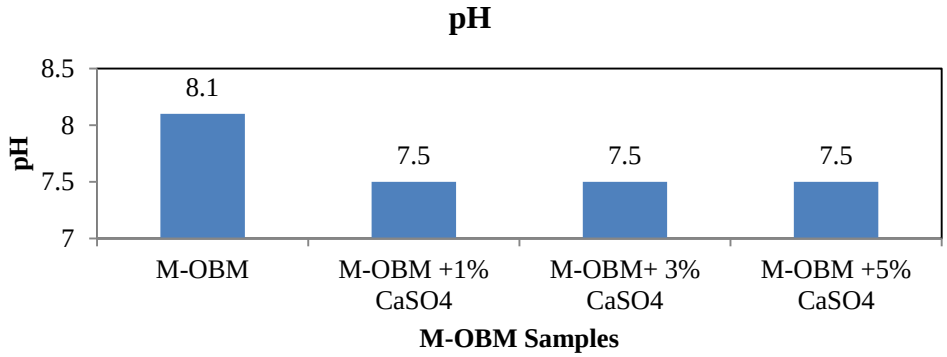

Figure 1 pH OBM with Calcium sulfate contamination

4. Results and discussion

In Figure 1, 1% of contamination decreased the pH of M-OBM by 0.6. Increase in contamination concentration did continue to change pH. In Figure 2 and 3, increase in Calcium Sulfate contamination up to 3% did not affect Shear Stress, PV and YP. But Shear Stress, PV and YP were increased with 5% contamination. Especially, PV was increased to three time of that of OBM.

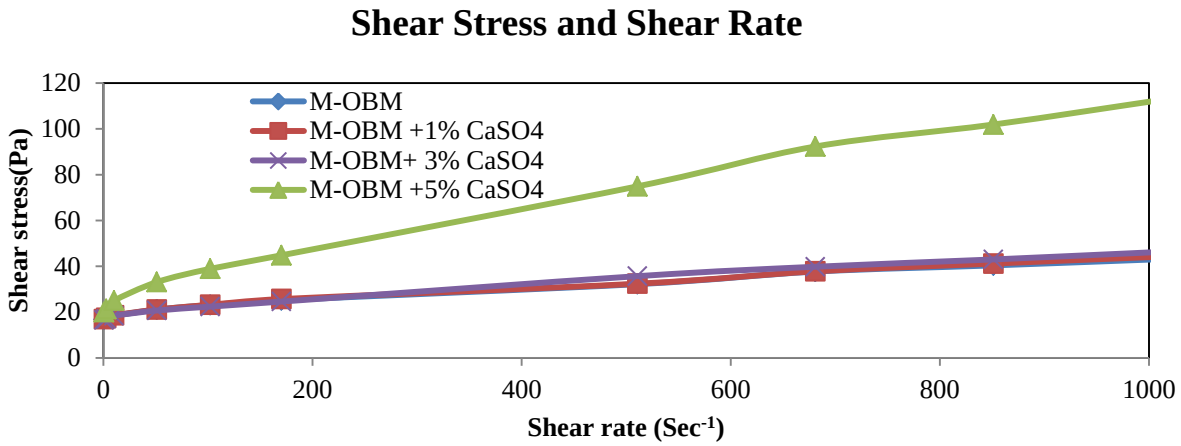

Figure 2. Shear stress and shear rate of M-OBM with Calcium Sulfate Contamination

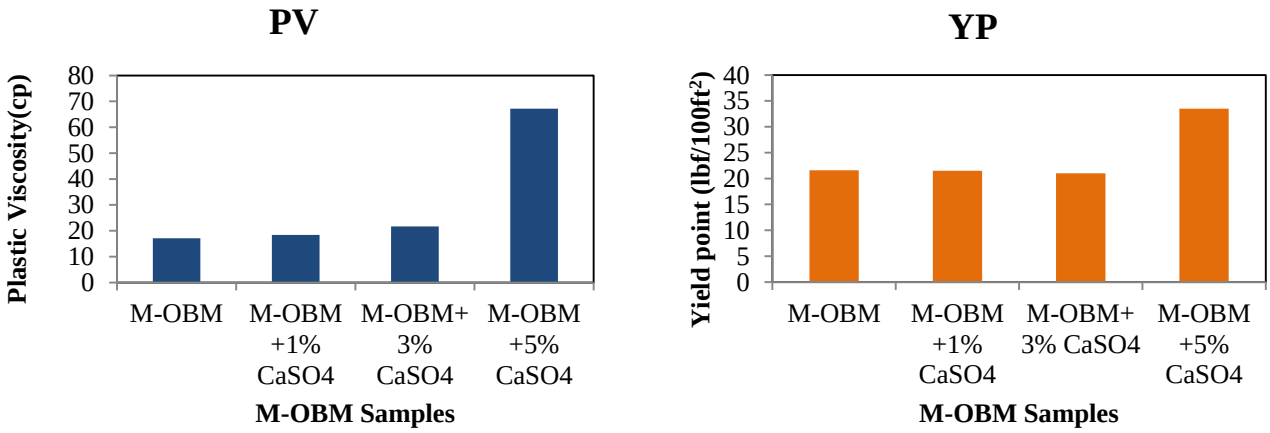

Figure 3. (a) PV and (b) YP of M-OBM with Calcium Sulfate Contamination

5. Conclusion

Change of shear stress, plastic viscosity and yield point were not sensitive to up to 3% of calcium sulfate contamination of mineral oil based mud (M-OBM). Calcium sulfate commination decreased the pH of M-OBM from 8.1 to 7.5.

6. Acknowledgement

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7. Reference

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