Effect of Ester Based Drilling Mud Contamination on the Behavior of Smart Oil Well Cement

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Abstract: In this study, the effect of temperature up to 85 ◦C on the resistivity and rheological behavior of synthetic based drilling fluids (SBF) was investigated. Resistivity of SBF decreased with the increasing in water content and temperature. Also the shear stress produced by the SBF decreased with increasing temperature and increasing in water content.

1. Introduction: Because of depletion of major onshore oil fields, and unstable conditions in major oil-producing countries led the industry to drill wells in increasingly challenging areas such as deeper water with high temperature and high pressure environments. Drilling fluids serve many purposes in a drilling operation; these include the removal of cuttings, lubricating the drill bits, maintaining the stability of the hole and preventing the inflow-outflow of fluids between borehole and the shale formation (Darley and Gray, 1988). Fatty acid methyl esters (FAME) are a type of ester that can be produced by an alkali-catalyzed reaction between fats or fatty acids and alcohol. The molecules in biodiesel are primarily FAMEs, usually obtained from vegetable oils by transesterification. This material is currently being used in the transformer industry as an insulator and also extensively used in the fuel industry as biodiesel. The biodegradation and toxicity performance of esters is considered to be the best among all synthetic based fluids currently used in the industry (Burrows et al. 2001).

2. Objective: The overall objective was to investigate the effect of temperature on the resistivity and rheological behavior of SBF with varying synthetic based fluid to water ratio(S/W).

3. Materials and Methods: The basic component of this system is water, UH-biosurfanctant and FAME of soybean oil. FAME was used as continuous phase for invert emulsions. The dispersed phase was tap water. Invert synthetic based drilling fluid were prepared by emulsifying water in FAME by adding 1% of UH-biosurfanctant based on the total weight of FAME and water. Three FAME to water ratios of 70:30, 60:40 and 50:50 were investigated. API resistivity meter in the range of 0.01 to 400Ω-m and Orion 125A+ conductivity meter in the range of 0 to 199.9μS/cm were used to measure the resistivity. All the rheology measurements were done using a commercially available Ofite Viscometer 900 model at 25 to 85 oC with the speed range of 0.3 to 600 rpm of viscometer.

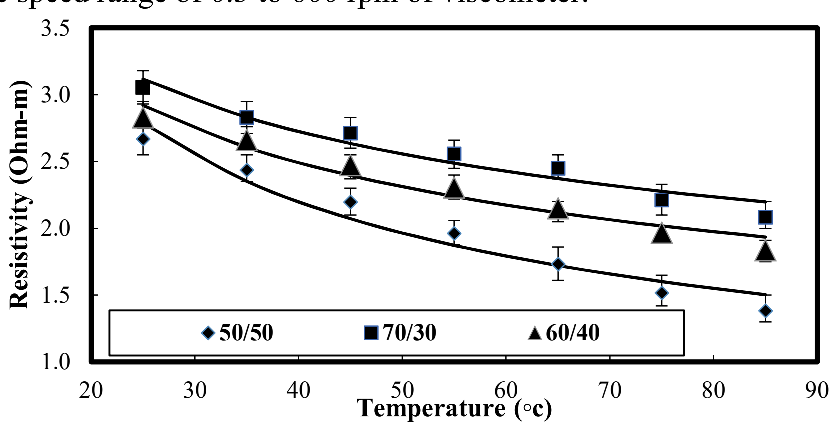

Figure 1. Resistivity of SBFD with S/W of 70/30, 60/40 and 50/50.

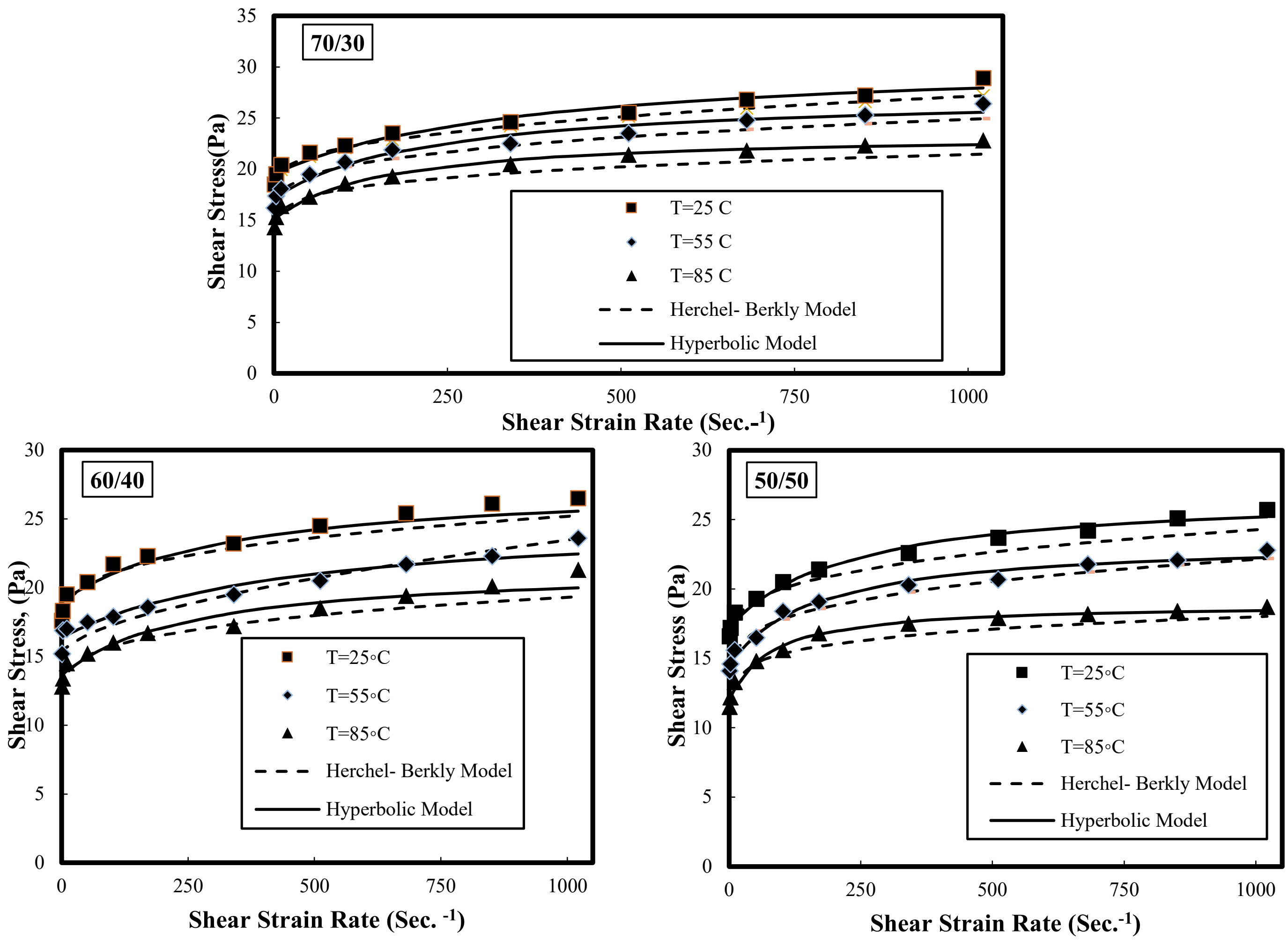

Figure 2. Flow behavior of SBF with S/W of 70/30, 60/40 and 50/50

4. Results and Analysis: In Figure 1, resistivity of SBF decreased with the decreasing in S/W and temperature. SBF with S/W of 50/50 has more decreasing in resistivity from 2.7 Ω.m at 25 deg C to 1.6 Ω.m at 85 deg C. Also shear stress decreased with increasing temperature and decreasing S/W (Figure 2). The Herchel-Berkly and Hyperbolic models were selected to model the flow behavior with R2 more than 0.95 of in this study.

5. Conclusion: The Resistivity of SBF decreased with the increasing water content and temperature. Also shear stress causing the flow decreased with increasing temperature and water content.

6. Acknowledgement: The study was supported by the THC-IT (http://www.egr.uh.edu/hurricane/) with funding from DOE/NETL/RPSEA.

7. References:

1. Burrows, K., Evans, J., Hall, J., & Kirsner, J. (2001) "New Low Viscosity FAME Is Suitable for Drilling Fluids in Deepwater Applications" SPE/EPA/DOE Exploration and Production Environmental Conference, 26–28 February. San Antonio, Texas.
2. Darley, H. C. H. and G. R. Gray, "Composition and Properties of Drilling and Completion Fluids", Gulf Publishing Company, Houston, TX, 1988.