Effect of Oil Contamination on the Behavior of a 6% Bentonite Drilling Mud

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Abstracts

The effect of oil contamination on the plastic viscosity and electrical resistivity of bentonite drilling mud (6% w/w) was investigated.The oil content in the mud was varied up to 3%. The plastic viscosity was reduced and the electrical resistivity was increased with increase in oil content.

1. Introduction

During construction of oil wells, there are many challenges (natural disasters, accidents etc.) that may results in the contamination of the drilling mud. The grounding of a crude oil carrier 'Metula' in the strait of Magellan in August 1974 resulted a loss of 52000 tons of crude oil spread over 250 km of shoreline (Marine Pollution Bulletin, 1978). Deepwater Horizon disaster caused 60 miles of shoreline in Alabama contaminated with crude oil (Hayworth et al. 2011). The shorelines are subjected to diurnal tide which potentially can cause the nearby rivers, channels and lake water to be affected with the spilled oil. Any drilling activity near these areas can be affected by the spilled oil while preparing the drilling muds. In order to advance monitoring technology, it is critical to quantify the changes in the bentonite drilling muds due to spilled oil contamination.

2. Objectives

To study the effect of oil contamination on the resistivity and plastic viscosity of 6% (w/w) bentonite drilling mud.

3. Materials and Methods

Commercially available bentonite was used with water to prepare the drilling mud. Various amount of oil (used engine oil) was added to determine the effect on the mud properties. Fann Viscometer was used to determine the plastic viscosity and to determine the resistivity, conductivity meter was used which gives the conductivity of the drilling mud (Figure 1).

Fann Viscometer

Conductivity Meter

Figure 1. Fann Viscometer and Cponductivity meter

After determining the conductivity of the drilling mud, the resistivity was determined from the relationship, Resistivity = 1/Conductivity.

4. Results and Discussion

4.1 Oil on viscosity: Plastic viscosity of a 6% (w/w) bentonite mud with different percentage (0 to 3% w/w) of oil content was determined with a Fann viscometer. Result (Figure 2) showed that oil had a tendency to reduce the plastic viscosity of bentonite mud. Viscosity was reduced by about 30% with an addition of 1% oil.

4.2 Oil on resistivity: Figure 3 shows the effect of oil on the resistivity of bentonite drilling mud. The resistivity is sensitive to the oil content. An addition of 2% (w/w) oil increased the resistivity by 20%.

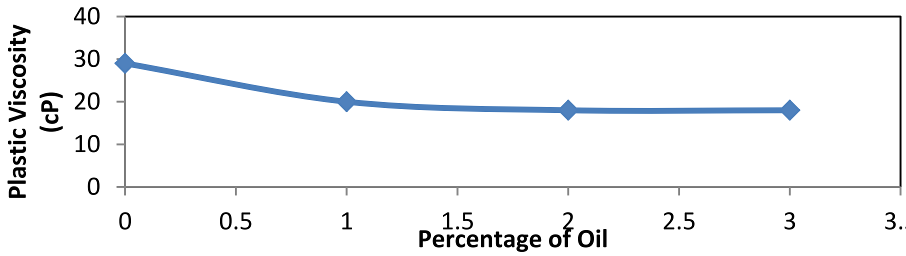

Figure 2. Effect of oil on the plastic viscosity of a 6% bentonite mud.

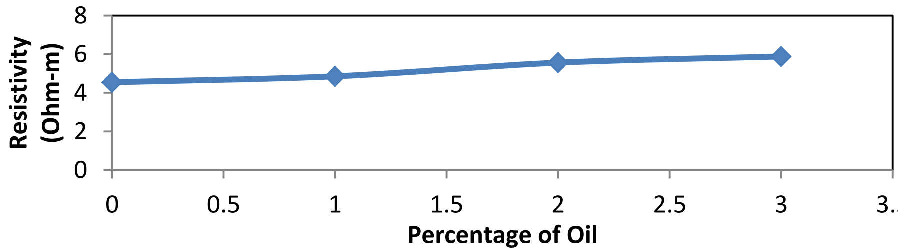

Figure 3. Effect of oil on the resistivity of a 6% bentonite mud

4.3 Relationship between resistivity and plastic viscosity A relationship between the resistivity and the plastic viscosity was determined from the experimental data and shown in Figure 4. Based on the limited data, a linear relationship is proposed as follows: $\mu = A\rho + B$ ……………..……(1)

Where, μ = Plastic viscosity (cP), ρ = Resistivity (Ohm-m), A and B are constants.
From this investigation, A was found as -2 (cP/Ohm-m) and B was found to be 30 cP. And the coefficient of determination $R^2 = 0.91$

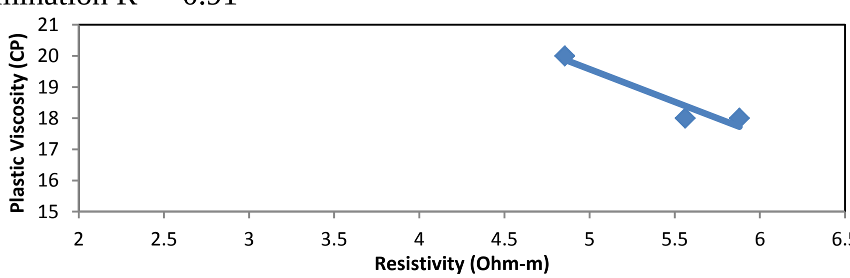

Figure 4. Relationship between the resistivity and the plastic viscosity

5. Conclusions

1. Oil reduced the plastic viscosity of 6% bentonite drilling mud.
2. Oil increased the resistivity of bentonite drilling mud. An addition of 2% oil increased the resistivity of the drilling mud by about 20%.
3. The relationship between the resistivity and the plastic viscosity was found to be linear.

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7. References

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