

Salt (NaCl) Contamination on the Resistivity and Plastic Viscosity of a Bentonite Drilling Mud

K. Ali¹, C. Vipulanandan¹ and Donald Richardson²

¹Center for Innovative Grouting Materials and Technology (CIGMAT)

Department of Civil and Environmental Engineering

University of Houston, Houston, Texas 77204-4003

Email: kausar91@yahoo.com, cvipulanandan@uh.edu Phone: (713) 743-4278

Program Manger –RPSEA, Sugar Land, Texas 77478

Abstracts: The effect of salt contamination on the plastic viscosity and electrical resistivity of bentonite drilling mud (6% w/w) was investigated. The salt (NaCl) content in the mud was varied up to 0.3%. Both plastic viscosity and the electrical resistivity were reduced with increase in salt content.

1. Introduction: Salt from various geological formations can contaminate the drilling muds and affects their performance. Salt reduces the electrical resistivity of drilling mud (Sherborne et al. 1942) and also affects the electrical resistivity of the filtrate (Patnode 1949). In these studies salt contents were varied from 0 to 1%. But the minimum percentage of salt that can affect the resistivity of the drilling mud is not known. Also how salt affects the basic mud properties like plastic viscosity has not been quantified. In order to advance monitoring technology, it is critical to quantify the changes in the bentonite drilling muds due to salt contamination.

2. Objectives: To study the effect of salt 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 salt (NaCl) was added to determine the effect on the mud properties. Fann Viscometer was used to determine the plastic viscosity. To determine the resistivity, two probe method with fixed 2 electrical wires (Figure 1) were used to measure the resistance.

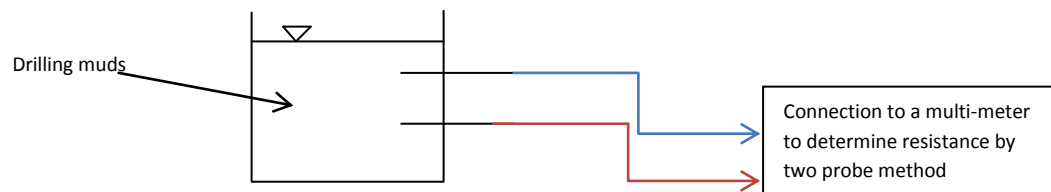


Figure 1. Diagram of the mold and electrical wire setting used to determine the resistance

Mold Calibration: The resistivity (ρ) is defined as RA/L (where, R = measured resistance, A = area of the electrical flow, L = distance between the probe). The two probe test mold was first calibrated using a salt solution of known resistivity. Using the test mold, the resistance of the solution was determined. Then from the resistivity relationship, the A/L ratio of the test mold was determined. This ratio was used to determine the resistivity of the drilling muds.

4. Results and Discussion:

4.1 Salt on viscosity: Plastic viscosity of a 6% (w/w) bentonite mud with different percentage (0 to 0.3% w/w) of salt content was determined with a Fann viscometer. Result (Figure 2) shows that salt had a tendency to reduce the plastic viscosity of bentonite mud. Viscosity was reduced by about 10% with an addition of 0.1% salt.

4.2 Salt on resistivity: Figure 3 shows the effect of salt on the resistivity of bentonite drilling mud. Here the resistivity is very sensitive to the salt content. Even an addition of 0.1% (w/w) salt reduced the resistivity by 18%.

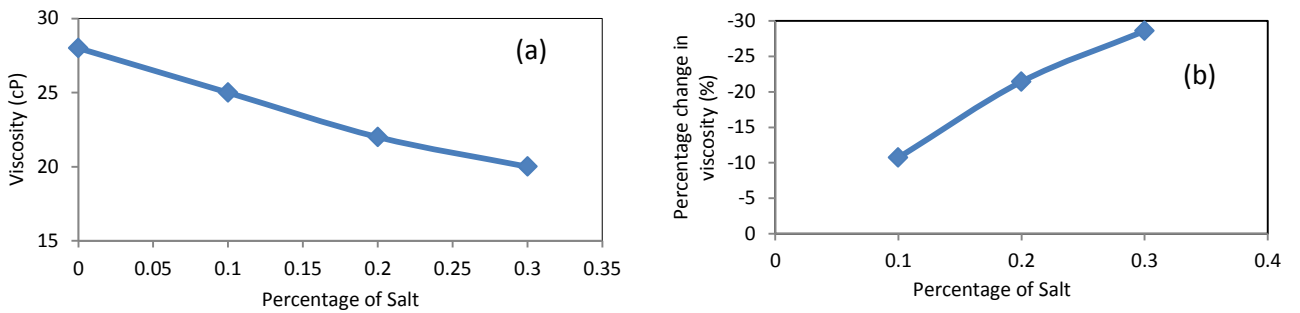


Figure 2. Effect of salt (a) on the plastic viscosity and (b) percent change in viscosity

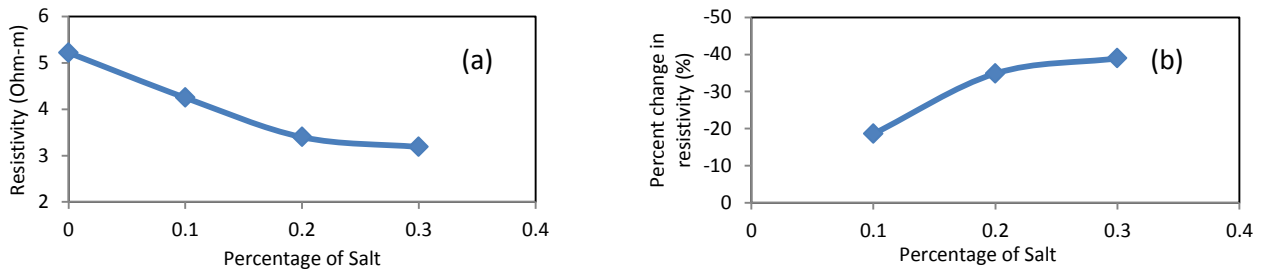


Figure 3. Effect of salt(a) on the resistivity of bentonite mud and (b) percent change in resistivity

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 3.74 (cP/Ohm-m) and B was found to be 8.76 cP. And the coefficient of determination $R^2 = 0.97$

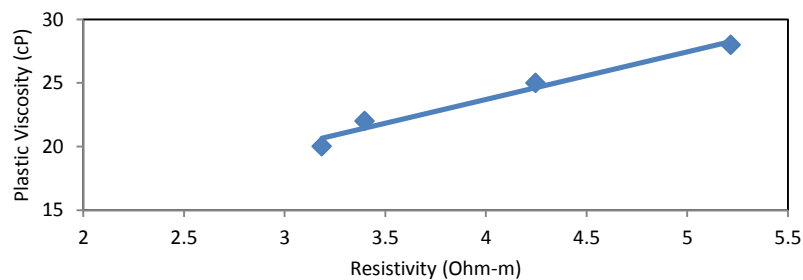


Figure 4. Relationship between the resistivity and the plastic viscosity

5. Conclusions:

1. Salt reduced the plastic viscosity of bentonite drilling mud.
2. Salt reduced the resistivity of bentonite drilling mud. Even an addition of 0.1% salt can reduce the resistivity of the drilling mud by about 20%.
3. The relationship between the resistivity and the plastic viscosity was found to be linear.

6. Acknowledgements This study was supported by the Center for Innovative Grouting Materials and Technology (CIGMAT), University of Houston, Houston, Texas with funding from the Ultra Deepwater Program DOE/NETL/RPSEA (Project No. 10121-4501-01).

7. References

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