Effect of Salt Contamination on the Fluid loss, Early Strength and Piezoresistive Response of Smart Oil Well Cement

A. Zomorrodian[1], C. Vipulanandan[1] and D. Richardson[2]
[1]Center for Innovative Grouting Material and Technology (CIGMAT)
University of Houston, Houston, Texas 77204-4003
Tel: 713-743-4278: E-mail: cvipulanandan@uh.edu
[2]Program Manager – RPSEA, Sugar Land, Texas 77478

Abstract
Effect of salt contamination on the oil well cement slurry was investigated at room temperature. Results showed that salt contamination increased the fluid loss, early compressive strength and also modified the piezoresistive behavior of the oil well cement slurry. With 4% salt contamination, the initial resistivity of the cement slurry was reduced by over 80%.

1. Introduction
Based on the location and zonal characteristics of the geological formation and/or during a hurricane, there is a potential for contamination of the cement with salt during installation. Hence there is a need to quantify the effect of salt contamination on the properties of oil well cement. This has led to many studies on evaluating the impacts of salt contamination on different properties of fresh and hardened oil well cement (Ismail et al 1993; Hunter 2010). Studies have shown the effect of salt contamination on the mechanical, free water, rheological and thickening properties of cement. Hence there is a need for better characterization the behavior of smart cement slurry contaminated with salt.

2. Objective
The objectives of this study are to investigate effect of salt contamination on the slurry and hardened properties of smart oil well cement with enhanced sensitivity properties. Also of interest was the early compressive strength and piezoresistive behavior of salt contaminated smart cement slurry.

3. Materials and Methods
All specimens were mixed based on API 10-B standard, at room temperature. Different tests were performed on rheological, fluid loss, mechanical and electrical properties of up to 4% salt contaminated modified cement slurries. Modified API fluid loss tests was performed at 100 psi at room temperature and filtrate liquid was collected and measured at 1 minute intervals, until the blow out. Mechanical properties were evaluated by measuring the 24 hour compressive strength and the piezoresistivity of modified cement slurries.

4. Discussion and Results
As shown in fig.1, increasing salt concentration from 1% to 4% increased the 24 hour compressive strength by 54% and 42%, respectively. Filtrate volume was increased up to 5% with the increasing the salt content. Tests indicated that increased salt content reduced the electrical resistivity. Cement electrical resistivity during the first 3 hours of curing was decreased up to 65% and 86%, with adding 1% and 4% salt content, respectively. Piezoresistivity behavior of hardened cement slurries are shown in Fig.2. Tests showed that increasing salt content to 1% increased the piezoresistivity property of hardened cement.

5. Conclusion
Tests investigated the effect of salt contamination on the behavior of smart oil well cement. Due to salt contamination the electrical resistivity reduced. With 4% salt contamination the resistivity was reduced by over 80%. The early compressive strength and piezoresistive behavior were enhanced by salt

contamination. The changes in resistivity at failure for cement without and with salt contamination were 1.5% and 6% respectively.

6. Acknowledgement
This study was supported by the Center for Innovative Grouting Materials and Technology (CIGMAT) with funding from DOE/NETL/RPSEA (Project 10121-4501-01).

7. References
Simao C. A., Miranda C.R., Vargas A.A., Pereira R. F. L., Santos R.L.L., Soares M.A.S., Conceicao A.C.F. (2010). Cementing in Front of Soluble Salt Zones, Society of Petroleum Engineers. Doi: 10.2118/145719-MS
Ismail, S.A.A., Khalaf, F. (1993). Effectiveness of Low-Salt Cement Opposite Salt Bodies, Society of Petroleum Engineers. Doi: 10.2118/25542-MS

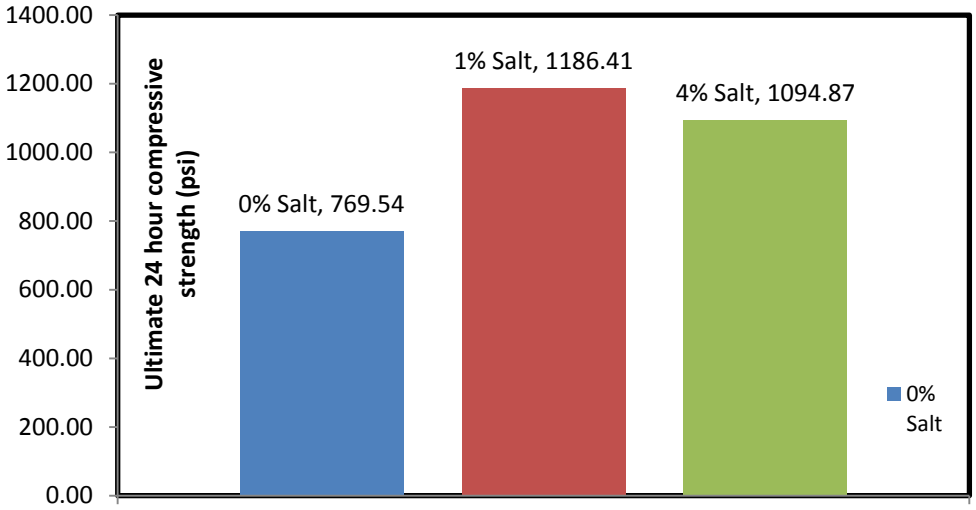

Figure 1 – 24 hour compressive strength of class H cement slurries with salt concentration

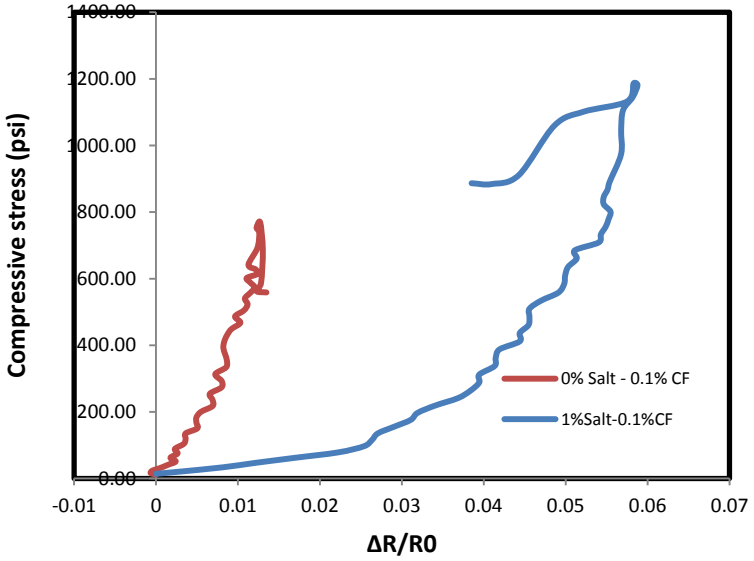

Figure 2 - Effect of salt on the piezoresistivity behavior of of hardened oil well cement