Short term Effect of Salt Contamination on The Setting, Compressive Strength, Piezoresistive Response and Thermal Conductivity of smart Oil Well Cement

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Abstract: The effect of salt contamination on the smart oil well cement slurry containing metakaoline and sodium silicate as additives was investigated at room temperature. Results showed that salt contamination reduced the setting time, increased the early compressive strength and also changed the piezoresistive behavior. By adding 2% salt contamination, the initial resistivity and setting time of the cement slurry decrease by 46.7% and approximately 11% respectively.

1. Introduction

Seawater intrusion due to hurricane and manmade disaster result in cement contamination and can cause cement to set prematurely. Special additives may have to be used to prevent the premature setting of the cement caused by salt entering the cement mixture as the mixture is pumped. Studies have shown the effect of salt contamination on its setting time. Still there is need to clarify behavioral characteristics of contaminated cement. [1]

2. Objective

The main objective of this study was to investigate the effect of salt contamination on oil well cement's properties. In this study the focus was on setting time, Thermal conductivity and piezoresistivity behavior of smart oil well cement. Sodium silicate and metakaolin were used as additives.

3. Materials and Methods

In mixing process, sodium silicate was added to water and mixed for 2 seconds. Metakaolin was added after stirring cement for 4 minutes. At last, sodium chloride powder was added to the slurry. Twenty-eight day compressive test's samples were demold after 1 days and kept for 26 days under saturated sand.

4. Results and Discussion

As shown in fig.1 thermal conductivity increased up to 3.4% during four hours with adding salt and decreased initial electrical resistance up to 46.7 %. It was observed that adding of 2% of sodium chloride decreased setting time by 11% comparing to control sample (see fig. 3). There was no significant change in compressive strength after 28 days but initial strength increased by 50%.

5. Conclusion

The study investigated the effect of salt contamination on the behavior of smart oil well cement. Due to salt contamination the thermal conductivity increased by 3.4% and the electrical resistivity reduced up to 46.7%. While, no indication of change was observed in 28 days compressive strength, the early compressive strength enhanced by salt contamination.

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7. References

[1]Technology Subgroup of the Operations & Environment Task Group (November 2011), Plugging And Abandonment Of Oil And Gas Wells, Working Document of the NPC North American Resource Development Study, http://www.npc.org/Prudent_Development-Topic_Papers/2-25_Well_Plugging_and_Abandonment_Paper.pdf.

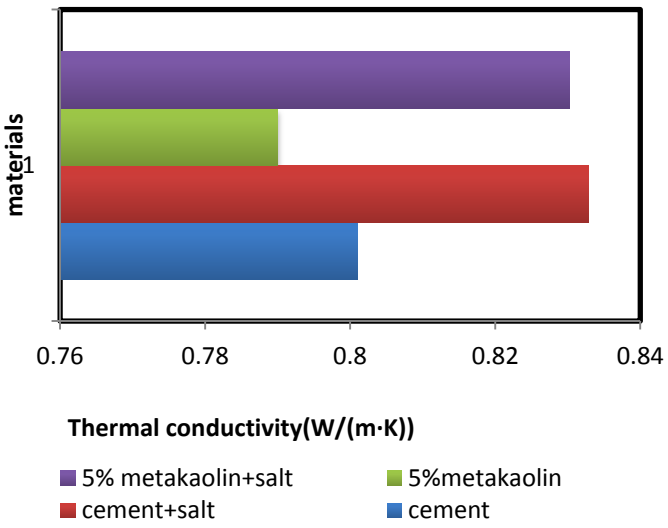

Figure 1. Effect of salt on thermal conductivity

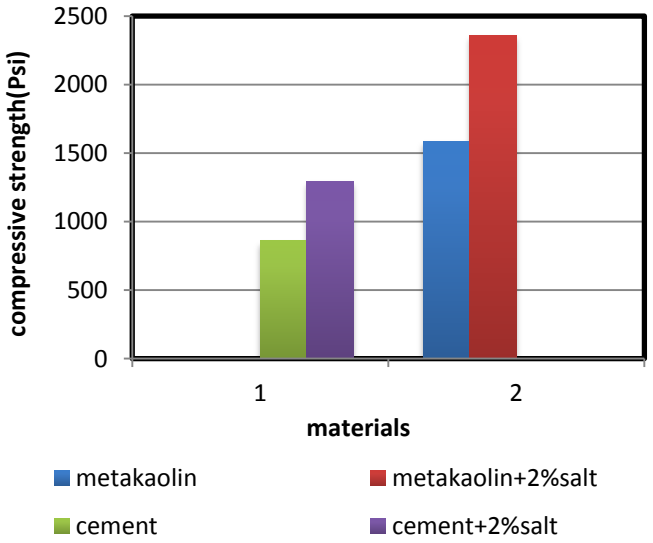

Figure2. 24 hours compressive strength

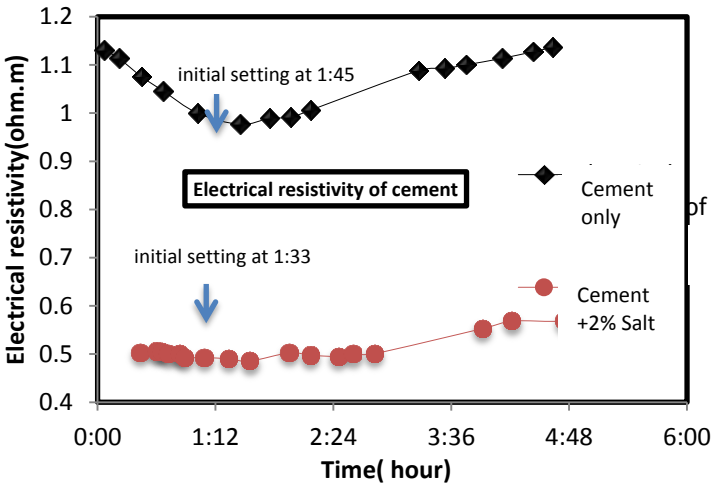

Figure 3. Effect of salt on electrical resistivity during setting

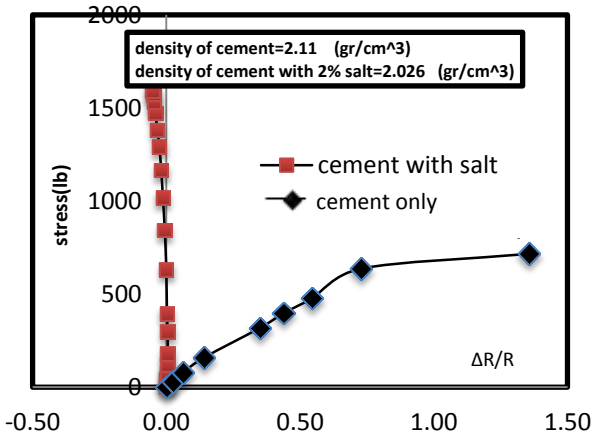

Figure4. Effect of salt on piezoresistive behavior