Short-term Compressive Behavior of Oil Well Smart Cements Prepared with Salt Water and Contaminated with Salt

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Abstract: In this study, the effect of salt (NaCl) concentration on the compressive behavior of oil well smart cement was investigated. Test specimens were prepared using 3% salt water and by contaminating the cement slurry with 3% salt. Smart cement prepared with salt water increased the one day compressive strength by 18% and reduced the piezoresistivity at failure by 42%. Smart cement contaminated with 3% salt increased the compressive strength by 31% and reduced the piezoresistivity at failure by 56%.

1. Introduction

Seawater intrusion due to hurricane and manmade disaster result in cement contamination and can cause cement to set prematurely. When sea water penetrates into oil well cement it results in many adverse effects. Cementing oil well using salted cement is not a novel technique but the salt may affect cement properties in multiple ways by either accelerating or delaying the cement thickening time and also its electrical properties. The continuous developments in petroleum engineering have led to well life extension beyond the conventional time, and thus cement properties are very important (Teodoriu et. al, 2015). Hence it is important to study the effect of salt water on oil well cement and studies have shown the effect of salt contamination on its compressive behavior.

2. Objectives

The overall objective was to investigate the effect of substituting water with salt water in preparing the cement slurry and contaminating the cement slurry with salt on the compressive behavior of smart Oil Well Cement.

3. Material and methods

Class H oil well cement with a water cement ratio of 0.38% was used in this experiment. Conductive filler at a percentage of 0.04% was incorporated. Samples were prepared in standard cylindrical moulds (2”x 4”) and were allowed to cure in air for 24 hours. Each mould had 2 wires which installed to measure the electrical resistance by two probe method using inductance capacitance and resistance (LCR) meter. Resistivity meter was used to measure the electrical resistivity of fresh cement slurry. In this study, two different sets of specimens were prepared, first set was mixing the cement with salt water and in the other set: salt was added after preparing the cement slurry. Both resistivity and piezoresistivity of these salt contaminated samples were compared with control sample.

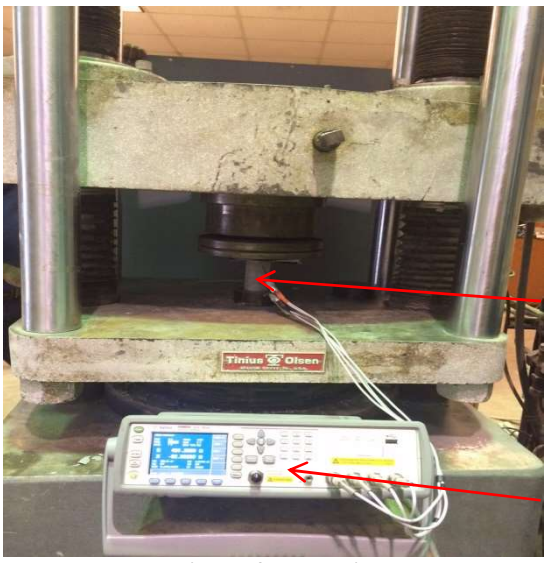

Figure 2: Experimental setup

4. Results and discussion

As shown in the Figure 2, the initial electrical resistivity decreased up to 0.49Ωm from 0.98 Ωm with the addition of 3% salt. Similarly after 24 hours salt water sample showed less resistivity than smart cement control sample. The resistivity of both samples increased 3 to 4 times after 24 hours of hydration.

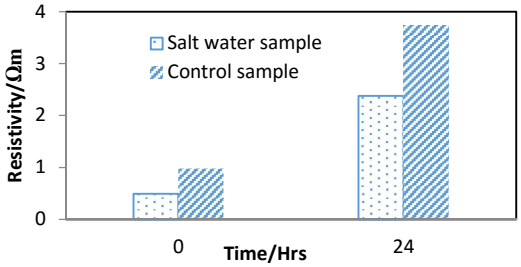

Figure 3: Effect of using salt water on initial resistivity

Figure 3(a) compares the piezoresistivity of salt contaminated sample with control sample. As seen in Figure, it is obvious that salt contamination enhanced the maximum compressive strength and decreased the piezoresistivity at the age of 24 hours, i.e. by adding only 3% NaCl to smart cement, compressive strength increased from 1209 psi to 1591 psi and piezoresistivity decreased from 109% to 47%. Figure 3(b) shows piezoresistive behavior of control sample with the sample prepared using 3% NaCl water. From the experimental results, it is clear that using salt water enhanced the maximum compressive strength from 1209psi to 1432 psi and decreased the piezoresistivity from 109% to 63%.

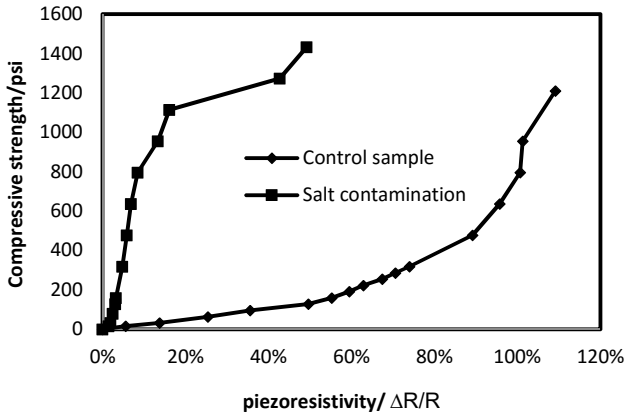

Figure 3(a): Piezoresistive behavior of sample with sal contmination

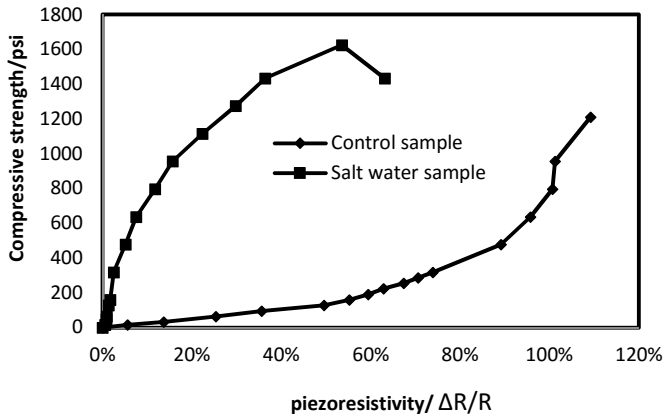

Figure 3(b): Piezoresistive behavior of sample prepared usi salt water

5. Conclusion

Addition of 3% salt enhanced the compressive strength and decreased the piezoresistive behavior of the oil well smart cement. Salt contamination on oil well cement increased the compressive strength by 31% and decreased the piezoresistivity by 56%. The sample prepared using NaCl water increased the compressive strength by18% and decreased the piezoresistivity by 42%.

6. Acknowledgement

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7. Reference

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