# Tensile Piezo-Resistive Behavior of Salt Contaminated Smart Oil Well Cement

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**Abstract:** Tensile piezo-resistive behavior of salt contaminated oil well cement slurry under splitting tensile loading condition was investigated. Sea salt from 2% and 4% of weight of cement and conductive fillers of 0.1% of total weight of cement composite were used as key admixtures in this study. Splitting tensile test was done after 28 days of curing. With 4% salt contamination the tensile piezo-resistivity was reduced from 17% to 7%, 59% reduction. The splitting tensile strength was increased from 544 psi to 599 psi with 4% of salt, 10% of increment.

## 1. Introduction

Salt contamination in offshore structures causes structural failures due to corrosion and deterioration of strength. Absorption of salt by cement slurries modifies its rheology, free fluid and compressive strength (Simao et.al, 2012). Low salt concentration accelerates the hydration of oil well cement and high salt concentration retards it (Zhou et.al, 1996). There are numerous studies about salt contamination based on compressive behavior of cement and concrete. It is important to study about the effect of salt contamination on tensile behavior of oil well cement since it is used as an accelerator in cold formations (Teodoriu et.al, 2015).

## 2. Objective

The main objective was to investigate the effect of 4% salt contamination on the oil well cement tensile piezo-resistive behavior and splitting tensile strength.

## 3. Materials and Method

Class H cement was used as a binder. Sea salt from 2% and 4% of weight of cement was mixed with water first and then mixed with cement and conductive fillers of 0.1% of total weight of cement composite. Water to cement ratio was 0.38. Cylindrical molds were used with height of 4 inches and diameter of 2inches. Cement specimens were demolded after 24 hours of curing and let cure further under water for 7 days at room temperature. Splitting tensile test was done after 28 days.

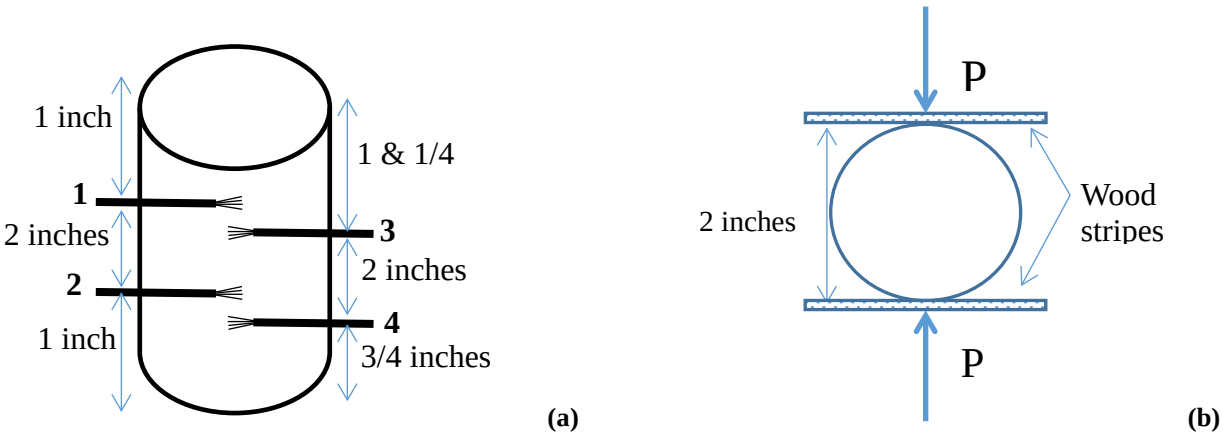
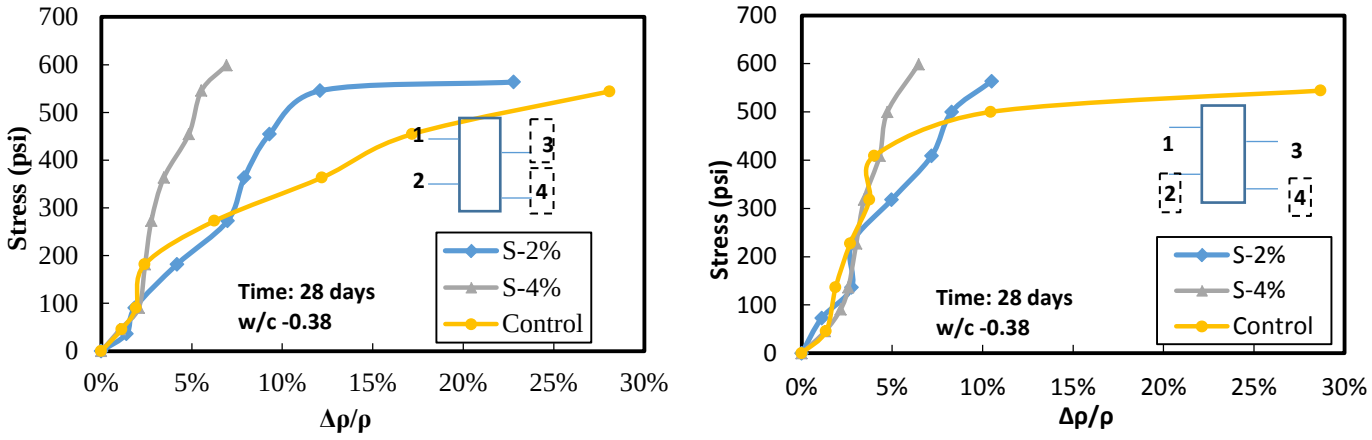



**Figure 1: Schematic diagram of (a) specimen configuration and (b) test method**

## 4. Results and Discussion




**(a)** **(b)**

**Figure 2: Splitting tensile stress Vs Piezo-resistivity (a) 3-4 wires and (b) 2-4 wires**

As shown in figure 2 (a), sensitivity between wires 3 and 4 for control specimen is 31%/ ksi and for the specimen contaminated with 4% of salt is 12%/ ksi. As shown in figure 2 (b), sensitivity between wires 2 and 4 for control specimen is 18%/ ksi and for the specimen contaminated with 4% of salt is 10%/ ksi. Specimens contaminated with salt showed 59% of reduction in piezo-resistivity and 10% of increment in strength compared to the control specimen. The precipitation of salt and chemical reactions can be the reasons for reduction in piezo-resistivity and increment in strength.

## 5. Conclusion

Salt contamination in smart oil well cement slurries reduced the sensitivity and increased the splitting tensile strength. With 4% salt contamination, tensile piezo-resistivity was reduced by 59% and splitting tensile strength was increased by 10%.

## 6. Acknowledgment

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## 7. References

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