Modified Ultrafine Cement as Piezoresistive Repair Material for Damaged Oilwell Structures

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Abstract
Using modified ultrafine cement to repair damaged oilwell cement was investigated. The results showed that the repaired sample recovered piezoresistive behavior and the laterally cracked sample regained 95% of the initial strength.

1. Introduction

Repairing damaged structures after a natural or manmade disaster is an economic way of rehabilitating the structure rather than reconstructing it. The extend up to which the structural strength could be regained, after the repair, is a matter of importance. If the structure had self-sensing ability to monitor its structural health, regaining this sensing ability is another challenge.

2. Objective

Objective of this study was to investigate the effectiveness of using modified ultra-fine cement to repair damaged oilwell cement in order to regain the strength of structural and piezoresistive properties.

3. Materials and Methodology

Modified class H oilwell cement was used to prepare 2x4" standard cylindrical specimen with a water:cement ratio 0.4. To determine the strength of the material before damage, these samples were tested for compressive strength using destructive method with a loading rate of 0.01inch/min. Figure 1 shows the piezoresistive behavior and the strength of the undamaged material after 30 days of curing.

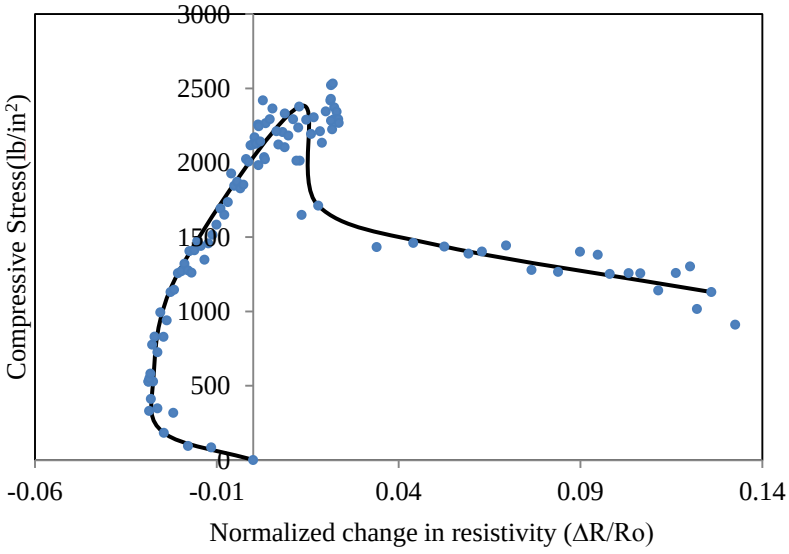


Figure 1: Piezoresistive behavior of initial sample

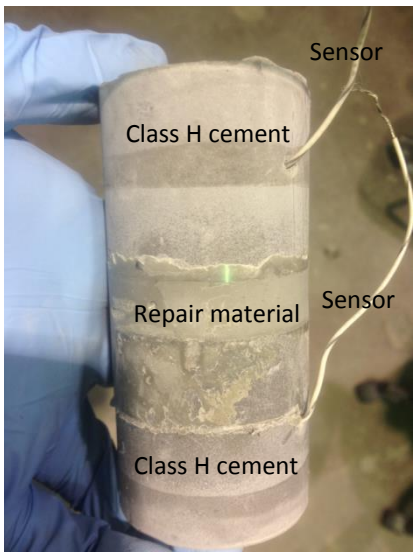
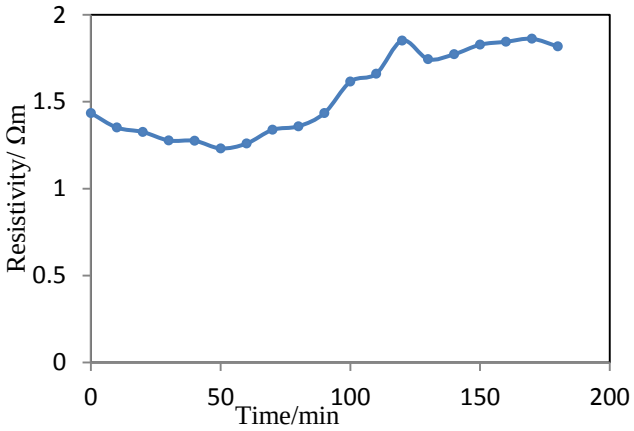


Figure 2: Repaired lab sample

To represent the repaired damaged structure, sample was split into two and was repaired with modified ultrafine cement, as shown in Figure 2.

For a better understanding of the repair material itself, 2x4" standard cylindrical ultrafine cement specimen was made with water: cement ratio 0.6 and its properties were studied. Figure 3 shows its resistivity behavior from mixing through hardening to curing in the air for 3 hours. The compressive strength of 21 day old samples and its piezoresistive behavior are shown in Figure 4.



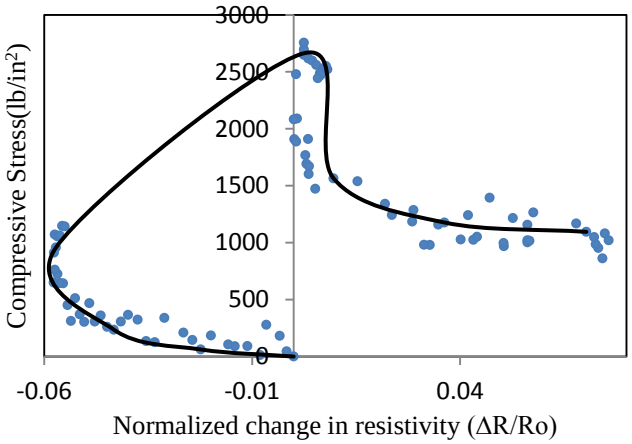


Figure3:Resistivity change of repair material **Figure 4:Piezoresistive behavior of repair material**

Test results showed that the repairing material itself has approximately equivalent compressive strength as of class H cement and also it possessed piezoresistive behavior. Then the compressive strength of repaired sample (shown in Figure 2) was tested and the results are shown in Figure 5 below. The original sample was made with class H cement and air cured for 30 days before tested. The repaired sample was allowed to cure in air for 21 days before tested.

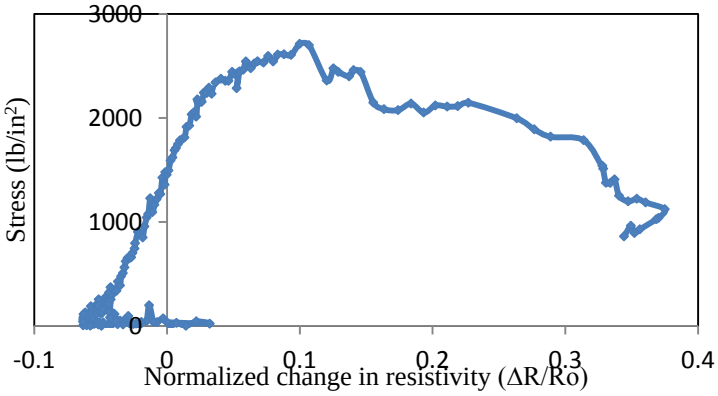


Figure 5: Piezoresistive behavior of repaired sample

Above analysis showed that the repaired sample recovered almost 95% of the original strength and it regained the piezoresistive properties too.

4. Conclusion and Discussion

Using modified ultrafine cement was effective in repairing cracked oil well cement. The results showed that the repaired material regained 95% of the initial strength and also the piezoresistivity.

5. Acknowledgement

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