Electrical Characterization of Interface of Carbon Composite With smart cement

A. K. Hassani and C. Vipulanandan[1], Ph.D., P.E.
[1]Texas Hurricane Center for Innovative Technology (THC-IT)
Department of Civil and Environmental Engineering
University of Houston, Houston, Texas 77204-4003
E-mail: akacimiel-hassani@uh.edu, cvipulanandan@uh.edu Phone: (713) 743-4278

Abstract: In this study, interface behavior of carbon composite was investigated. Samples were prepared based on water/cement ratio of 0.38 and 0.04% of conductive fillers. Two-probe method was used to measure the electrical resistance and monitor the interface behavior of carbon composite material. The bulk resistance change with time is found lower than the interface resistance change. Further investigations are ongoing to assess the effect of coating and aggressive environments.

1. Introduction

Fiber-Reinforced Polymer (FRP) materials have recently gained more attention of researchers and decision makers due to their advantageous properties and superior performance especially strength, durability and exceptional resistance to corrosion. Their uses in the construction are various in different applications such as: bridges, pavements, buildings and marine structures. One of the urgent needs after disastrous events such as hurricanes and earthquakes is the quick response through effective rehabilitation solutions to retrofit the damaged infrastructures. Use of new materials such as Carbon Fiber-Reinforced Polymer CFRP is an effective solution to repair the produced damage. Furthermore, CFRP materials have potential sensing properties that allow the health monitoring of structures during service. This study aims to investigate the interface characteristics of CFRP with smart cement.

2. Objective

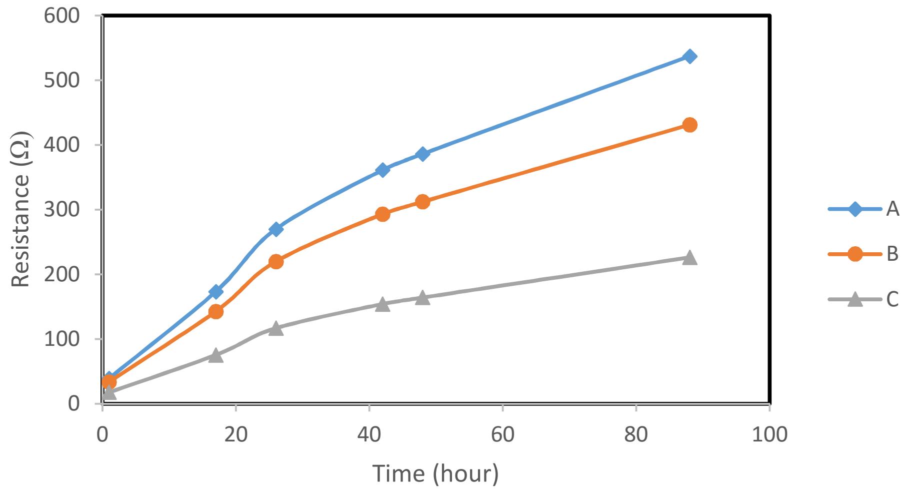
The main objective of this study is to assess the interface behavior of CFRP materials using the piezoresistive properties of the smart coating cement. In the second plan, the study addresses the characterization of the piezoresistivity properties of the CFRP.

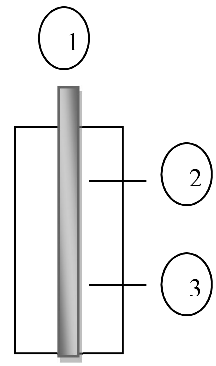
3. Material and testing program

CFRP is a stranded Carbon Fiber Polymer that has approximately 4 mm diameter and the matrix is made of resin epoxy. Commercially available class H Cement was used. The samples were prepared according to API standards. An amount of 0.04% of carbon fibers was added to the cement as base modification to enable its sensing property. The used water/cement ratio was 0.38. The mixture of water, cement and carbon fibers was blended at the speed of 4000 rpm for 3 minutes and at the speed of 1200 rpm for 30 seconds. Previously, A CFRP strand was embedded in the prepared mold and two wires were placed in the mold in one side of the specimen. The vertical distance between the two wires was 2 inch and the embedded conductive depth was 1 inch. Three specimens were prepared and the measurements were carried out using LCR device. The monitoring was performed by two-probe method using different combinations to assess the bulk and interface resistance changes.

4. Results and discussion

Both interface and bulk resistances gradually increased with time however the interface resistance change was higher. This is due to the interaction of organic CFRP with inorganic cement at the interface.





A: 1-2
B: 1-3
C: 2-3

Figure 1. Change of resistance with time measured for different combinations A, B and C (AC, 300 KHz)

5. Conclusion

The focus of this study was to assess the interface behavior of CFRP strand with smart cement and demonstrate the potential of detecting damage in the strand or in the interface with coating cement. Further investigations are planned to address the interface behavior of CFRP composites in aggressive environments.

6. Acknowledgement

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7. References

Vipulanandan, C. (2014) “Development of Smart Cement for Real Time Monitoring of Ultra-Deepwater Oil Well Cementing Applications”.CIGMAT-2014 Conference and Exhibition.