Detecting Water and Salt Water Penetration into Acrylamide Polymer Grout

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Abstract: In this study, amount of water and salt water penetration into modified acrylamide polymer was quantified. Modified acrylamide polymer specimens which were soaked in to water showed increase in resistivity by 37% for 2.6 % increase in moisture content and soaked in salt water decreased the initial resistivity by 58% for 2.7% increase in Moisture content.

1. Introduction

Maintaining the aging storm water and wastewater systems is always being as a major challenge, and costs are escalating. Loss of soil from the backfill and surrounding areas can cause sinkholes, undermining the pipes and tunnels causing major damage to the civil infrastructure above it. Grouts are being used in a number of applications to solve short-term and long-term problems. Since 1950s, acrylamide grouts have been repeatedly used in USA in grouting applications for stabilizing the soil and for resolving pipeline leaks. Seawater intrusion due to hurricane and manmade disaster result in material contamination and can cause failures in grouting. In order to reduce the damages and repair costs it is important to monitor the condition of the grout exposed to water and sea water. Piezoresistive (Changing in resistivity) behavior of modified acrylamide polymer, which behaves more like a sensor, will be an enhanced outcome for civil engineering industry as well as in repair materials.

2. Objectives

The overall objective was to quantify the infiltration of water and sea water into modified acrylamide polymer based on resistivity measurements.

3. Material and methods

In order to quantify the amount of penetrating water in to polymer, first acrylamide polymer test specimens were prepared. Here commercial product AV 100 Chemical grout was used to produce acrylamide polymer. AV101 and AV102 were used as activator and initiator respectively 0.1 % of conductive filler was added. To increase the effectiveness of water penetrating in to polymer, hollow cylindrical samples (2” x 4”) were prepared. Samples were separated into two parts and one part was soaked in normal water and other set was submerged in sea water. Here 5%, 10% and 15% of salt content is used in water for characterize the salt water penetration into polymer. Measurements have been taken in two hours interval up to 8 hours. The increase in total weight with time was measured and moisture content was calculated. Resistance measurements were taken by using inductance capacitance and resistance (LCR)meter (Figure 1). Here 1V current was supplied and readings were taken with different frequency. Since the sample has four probes, six combinations of readings were taken and analyzed to study the quick response of modified polymer with normal and salt water.

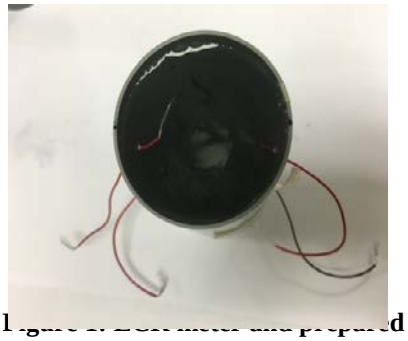

Figure 1. LCR meter and prepared hollow cylinderical specimen

4. Results and discussion

Figure 2 explains the impedance curve of modified acrylamide polymer sample. When frequency increases Impedance of material decreases and in very high frequency it shows the impedance value of bulk material. For salt water penetrated sample it shows the same trend but contact resistance is two times higher than control sample. Because of salt penetration its bulk resistance reduced as well.

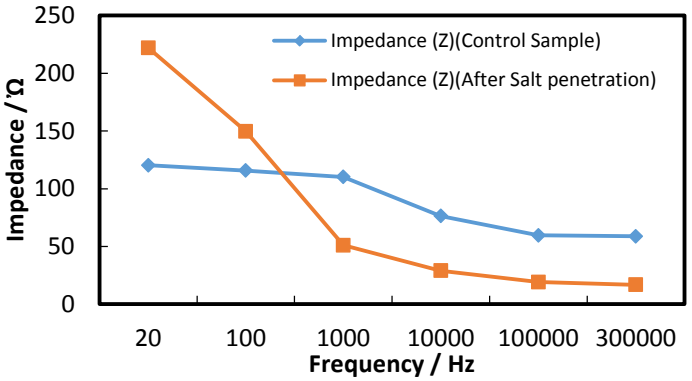

Figure 1: Impedance curve

Figure 3 compares the increase in moisture content of modified acrylamide sample in salt water and normal water. As seen in Figure, it is obvious that salt water penetrates more in to polymer than normal water in 8 hours. It is around 3% for 15% salt content water. Figure 4 shows Changing in resistivity ($\Delta\rho/\rho/\%$) of polymer material with salt water and normal water. Resistivity of sample which was soaked into normal water increased by 37% for 2.6% moisture content. In contrast penetration of sea water in to polymer sample decreased the resistivity by 55% for 5% salt water and 75% for 15% salt water respectively.

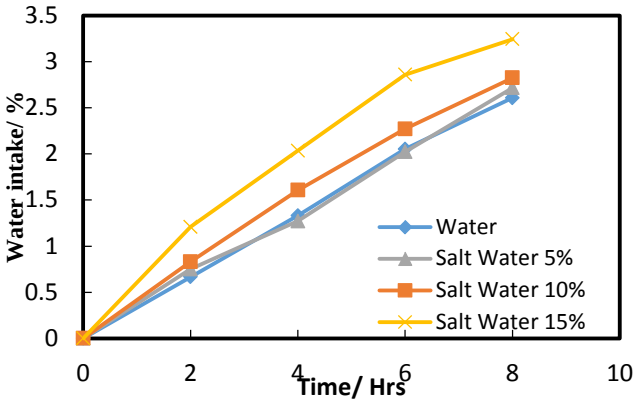

Figure 3: Change in Water intake with time

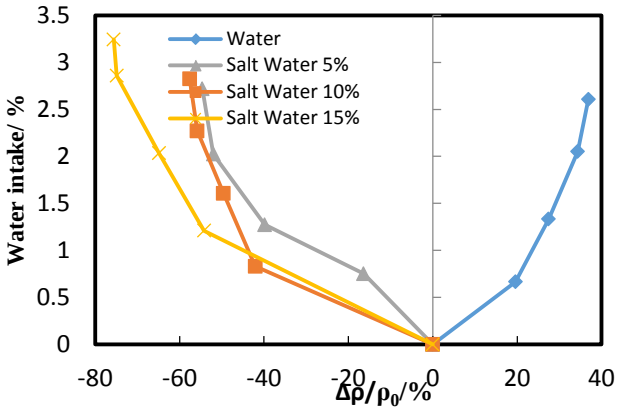

Figure 4: Change in Resistivity with water intake

5. Conclusion

Increase in moisture content in modified acrylamide polymer increased the value of initial resistivity by 37% and Salt water penetration in to modified acrylamide polymer decreased the initial resistivity by 75%. From the results it is clear that modified acrylamide polymer is sensitivity to water and salt water penetration.

6. Acknowledgment

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7. Reference

1. Snoeck D., Steuperaert S. Van Tittelboom K. and Dubruel P. (2012) "Visualization of waer penetration in cementitious materials with superabsorbent polymers by means of neutron radiography", Journal *of Cement and Concrete Research*, Vol. 42, pp 1113-1121

1.Teodoriu C. and Asamba P. (2015) "Experimental study of salt content effect on class G cement properties with application to well integrity", Journal *of Natural Gas Science and Engineering*, Vol. 24, pp 324-329.