Effect of Salt Water on the Initial Curing of Acrylamide Polymer Modified Cement

K. Tharmakulasingham 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: ktharmakulasingham@uh.edu, cvipulanandan@uh.edu Phone: (713) 743-4278

ABSTRACT: In this study the effect of mixing the acrylamide polymer modified cement in 3.5% salt water on the initial curing up to 3 days was investigated. After 24 hours of curing, the maximum resistivity of 3.5% NaCl modified sample was 47% lesser than non NaCl Modified Sample

1. INTRODUCTION:

There are several studies carried out to use salt water an alternative to water in construction purposes. Annually billion tons of water is used for mixing and curing of concrete. The durability of the sea water used concrete is affected due to steel corrosion. From a study by Islam, Islam, Amin, & Islam (2012) it is concluded that, specimen casted with seawater exhibited compression strength loss of 10%. In another study by Novokshchenov (1995) it was found that the serious deterioration of the structures can be occurred in the structures due to steel corrosion from chloride and sulphate attack from seawater.

2. OBJECTIVE:

The objective is to study the effect of mixing of salt water with the acrylamide modified ultrafine cement samples.

3. MATERIALS AND METHODS:

Ultrafine cement with water/cement ratio of 0.8 was used in this study. Carbon Fibers were used as conductive filler. Conductive filler of 0.05% of the cement weight was used. Acrylamide polymer of 5% of the cement weight was added. For the study, cement sample was prepared with 3.5% Sodium Chloride (NaCl) water. The conductive fillers were dispersed in the 3.5% salt water. Then, the 5% polymer solution was added to the salt-water solution. Then, cement sample was added, and mixing was carried out using hands.

Conductive meter has been used for the measurement of conductivity. The resistivity value was calculated using the reciprocal value of the conductivity. LCR meter was used to measure the resistance values. The resistance values were taken in 1v voltage, AC current and 300 Hz frequency. Two Probe wire method was used in the study.

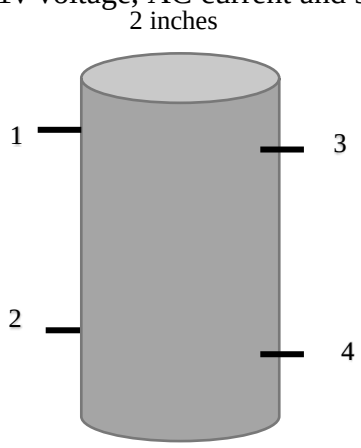


Figure 1 Sample configuration

Electrical resistivity of the curing of cement was predicted using the Vipulanandan Curing Model

(Vipulanandan et al. 2015, 2016) . The model is as follows:

$$\frac{1}{\rho} = \left(\frac{1}{\rho_{min}}\right)\left[\frac{\left(\frac{t+t_o}{t_{min}+t_o}\right)}{q+(1-p-q)*\left(\frac{t+t_o}{t_{min}+t_o}\right)+p*\left(\frac{t+t_o}{t_{min}+t_o}\right)^{\frac{q+p}{p}}}\right]$$

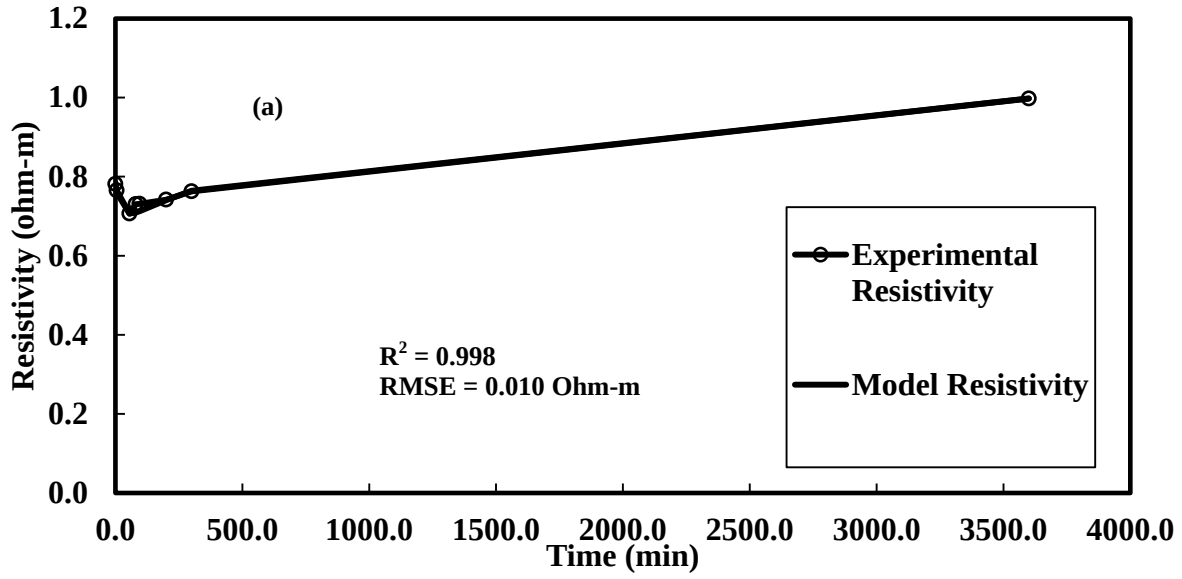
$r_{,min}$ = resistivity and minimum electrical resistivity
t = time of curing
t_{min} = time corresponding to minimum resistivity
p, q, t_o = model parameters

4. RESULTS:

The initial resistivity of the 3.5% NaCl added Polymer modified sample was 0.23 Ωm whereas for the non NaCl Polymer modified sample was 0.78 Ωm. The conductivity of the salt water was measured as 57.2 mS/cm. High conductivity of the salt water has increased the conductivity of the salt water added cement sample by 236.72%.

Maximum resistivity value of the 3.5% NaCl added Polymer modified sample was 0.54 Ohm-m after 24 hours of curing whereas for non NaCl Polymer modified sample, maximum resistivity was 1.02 Ohm-m. This implies addition of saltwater has reduced resistivity after 24 hours by 47%

Figure 2 shows the electrical resistivity of curing of non NaCl polymer modified sample and 3.5% NaCl added polymer modified sample



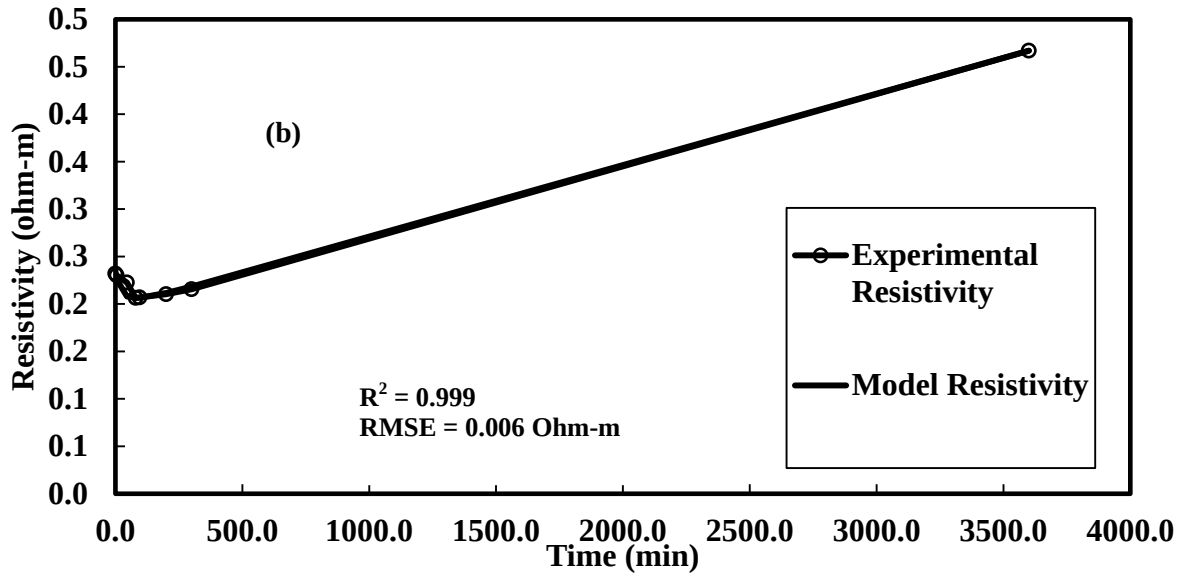


Figure 2 Electrical Resistivity of curing polymer modified cement (a) tap water (b) 3.5% salt water

The curing model parameters are summarized below in Table 1. R2, RMSE are 0.998 and 0.010 Ohm-m, 0.999 and 0.006 Ohm-m for figure 2 (a) and 2 (b) respectively.

Table 1: Model parameters for curing of non NaCl Polymer modified sample and 3.5% NaCl added Polymer modified.

Material Details	Initial Resistivity, ρ_o (Ω-m)	ρ_{min} (Ω-m)	t_{min} (min)	to (min)	$\rho_{24\,h}$ (Ω-m)	RI_{24} (%)	p1	q1
Cement with 5% Polymer	0.78	0.71	55.00	26.28	1.02	41.18	0.89	0.11
Cement with 5% Polymer and 3.5% Salt water	0.23	0.21	80.00	18.20	0.47	126.23	0.04	0.04

5. CONCLUSION:

Based on the experimental results and modelling following conclusions are advanced:

1. Initial resistivity of 3.5% NaCl salt water mixed cement was 29% of the of the cement mixed with the tap water.
2. After 24 hours Curing, the maximum resistivity of 3.5% salt water mixed cement was 47% of the cement mixed with tap water.

3. Addition of 3.5% salt water reduced the resistivity of the curing polymer modified cement during the initial 60 hours of curing.

6. ACKNOWLEDGEMENT:

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