Effect Of Silane with Coating In Protecting Concrete in Salt Environment

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Abstract

Concrete treated with two commercially available silanes (Silane-1 and Silane-2) in combination with a latex based coating (Coating-1) in resisting absorption of 15% NaCl solution was studied at room temperature. Based on 21 day immersion test, weight increase of specimens with Silane-2 with Coating-1 was less than for specimens coated with Silane-1 and Coating-1. Finite element modeling of the weight change phenomenon revealed that the initial rate of solution intake by coated concrete is governed by the mass transfer coefficient of the protective layer on the concrete surface however the final amount of solution absorbed depends on the quality of concrete behind the protective layer. A thin film model is proposed to predict the weight change of coated concrete cylinder for the drying phase.

1 Introduction

Materials used to protect concrete in corrosive environments include epoxies, methacrylate, urethane, silicate, siloxane and silanes. The change in weight of coated concrete could be used as a measure of degree of deterioration of the concrete and hence, the prediction of the weight change for coated concrete is very important for predicting the service life of coated concrete.

2 Objective

The objectives of the study were as follows:

1. To develop a mathematical model for prediction of the weight change for the drying phase of concrete.
2. Finite element modeling of the weight change phenomenon of concrete cylindrical specimens.

3 Materials and Testing Program

Silane1 was a microemulsifiable concentrate based on silanes and alkoxysilanes.Silane-2 was a silane based, penetrating, and breathable water repellent .Coating-1 was a latex water based coating with rapid drying, good adhesion. The testing program comprised of two main phases immersion and the drying phase. Weight change was monitored for 21 days immersion phase followed by a 21 days drying phase in accordance with NCHRP 244[1].

4 Results and Discussion

Figure 1 shows the model prediction of the weight change data for the immersion and the drying phase. Vipulanandan and Liu's[2] model is used for the immersion phase. The drying phase is predicted by the new proposed model. It can be observed that Silane-2 with Coating-1 proved to

be a better combination over Silane-1 with Coating-1 in resisting the weight change. Figure 2 shows the finite element simulation of the weight change phenomenon. It can be seen that the initial rate of solution intake by coated concrete increases with the increasing mass transfer coefficient of the protective layer on the concrete surface however the maximum wt. change tends to approach a common value which implies that the final amount of solution absorbed depends on the quality of concrete behind the protective layer.

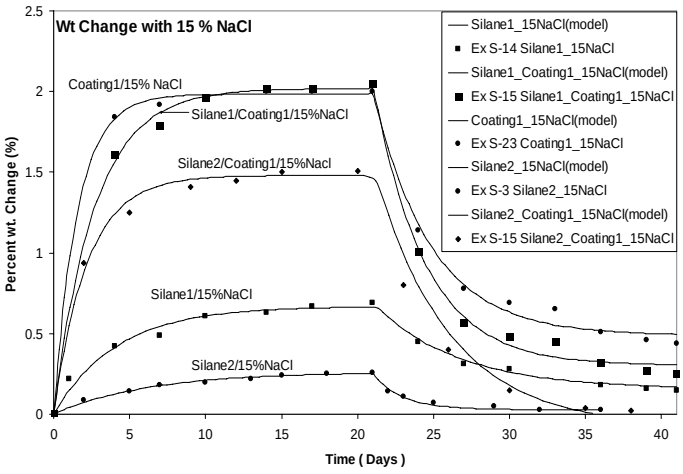

Figure 1 Wt. change in 15% NaCl solution

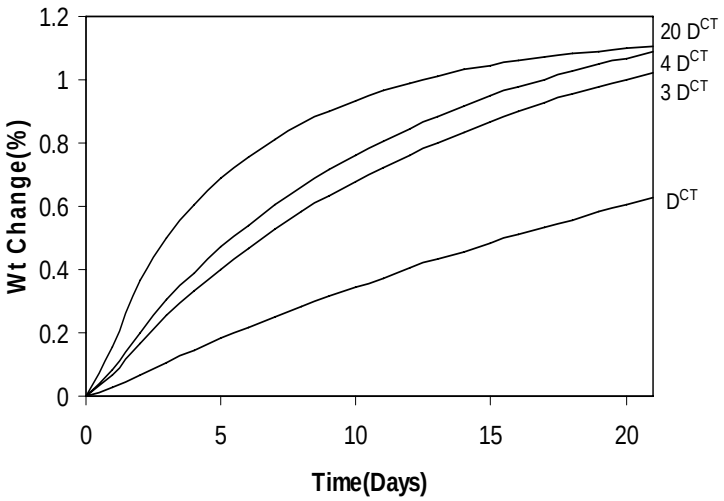

Figure 2. FEM prediction of wt. change for different mass transfer coefficients

5 Conclusions

The following conclusions are forwarded based on the study:

1. A model to predict the weight change has been proposed for the drying phase of the cylindrical specimens. A good correlation is observed between the model prediction and the experimental data.
2. Finite element modeling of the weight change phenomenon of a coated concrete cylinder revealed that the initial rate of weight gain is governed by the quality of the coating material however the total amount of weight gain is governed by the quality of substrate behind the coating.

6 Acknowledgement

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7. References

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2. C. Vipulanandan, J. Liu," Film model for coated cement concrete", Cement and Concrete Research 32 (2002), pp 1931-1936.