Bonding Test Methods for Coated Cement Concrete

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Abstract

In this study, two commercially available coatings were selected to test their bonding strength to concrete. CIGMAT CT-2 test and CIGMAT CT-3 test were used to determine the bonding strength of the coatings to dry and wet concrete surfaces. The tests were conducted for two years. Five failure types were identified for both of the test methods based on the failure mechanism during the tests. The CIGMAT CT-2 test and CIGMAT CT-3 test had agreement in the bonding test results for the two polymer based coatings.

1. Introduction

Protective coatings must be tightly and permanently bonded to the substrate to provide long-term corrosion protection. Unfortunately, the adhesion of coatings applied to concrete is much less than that of coatings applied to steel. Usually, the tensile strength of concrete will fall somewhere between 8% to 12% of its compressive strength[1]. Soebbing [2] suggested that the minimum recommended surface strength of concrete for using coatings is in the range of 1.4 to 1.75 MPa (200-250 psi). The bonding of coatings to concrete substrates is affected by a number of variables, including the characteristics of the coating or primer being used, the way the coating or primer is applied, the presence or absence of contaminants on or within the substrate, and the way in which the substrate surface is prepared for coating. In this study, five coating materials were selected. The bonding strength of the coatings to dry and wet concrete substrates was investigated.

2. Objective

The objective of the study was to verify the possibility of using two bonding tests to determine the bonding strength of coatings to concrete.

3. Materials and Testing Programs

Two commercially available coatings were selected for the study. One coating was a polymer concrete coating and the other was a fiber-matt reinforced epoxy coating.

In this study, CIGMAT CT-2 test (modified ASTM D 4541) and CIGMAT CT-3 test (modified ASTM C 321) were used to determine the bonding strength of coatings to concrete over a period of two years. Compared to CIGMAT CT-2 test, this is an easier test to be performed since no coring or gluing of metal fixture is required.

4. Test Results And Discussions

Five failure types were identified. The failure types are: *Type 1 failure* - concrete failure, *Type 2 failure* - coating failure, *Type 3 failure* - bonding failure, *Type 4 failure* – bonding and concrete failure, and *Type 5 failure* - bonding and coating failure.

CIGMAT CT-2 test The variations of bonding strength of the coatings on dry and web concrete in the CIGMAT CT-2 test are shown in Fig. 1. The bonding strength of the polymer concrete on dry concrete surface decreased during the test period while the

bonding strength of the coating on wet surface varied during this period. All the failures were Type 3. With the fiber-matt reinforced epoxy coating, the predominate failure type was Type 3. Initially the fiber-matt reinforced epoxy coating had low bonding strength on wet surfaces, but the bonding strength of the coating on wet concrete surfaces increased with time. The bonding strength of the coating didn't change much on dry surfaces during the test period.

CIGAMT CT-3 test The variations of the bonding strength with time in CIGMAT CT-3 tests are shown in Fig. 2. For the polymer concrete coating, the variation of the bonding strength on dry concrete was from 1.3 MPa (160 psi) to 1.7 MPa (220 psi) during the test period. The failure type changed from Type 3 to Type 1 after 24 months of immersion. The bonding strength of the coating on wet concrete was higher than 1.9 MPa (280 psi) in the test period. Type 1 and Type 4 failure were observed in the tests. The fiber-matt reinforced epoxy coating had low bonding strength (<200 psi) initially on both dry and wet concrete surfaces. The failure type was Type 3. With longer curing, the bonding strength was higher than 1.7 MPa (240 psi) on both dry and wet concrete surface and all the failures were Type 1. The results indicate that after some time of curing, the fiber-matt reinforced epoxy developed very good bonding strength with concrete.

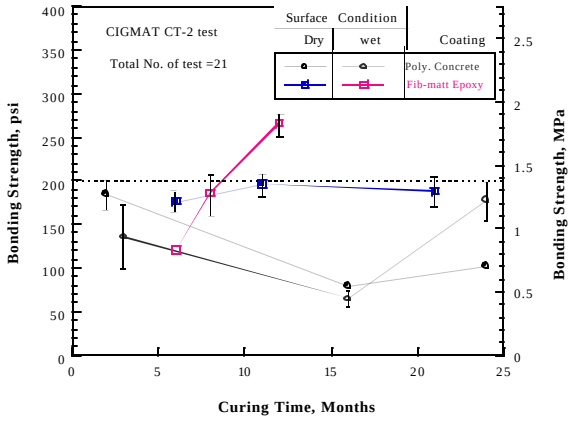

Figure 1. Bonding Results in the CIGMAT CT-2 Tests

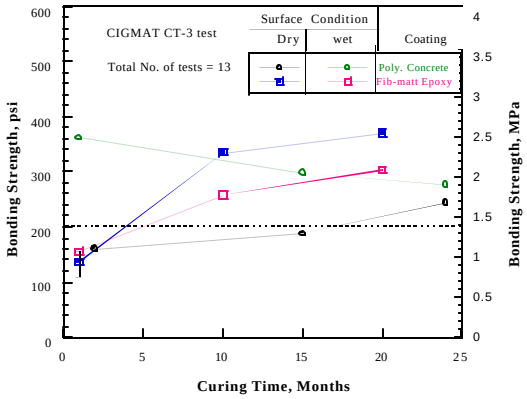

Figure 2. Bonding Results in the CIGMAT CT-3 Tests

5. Conclusions

The bonding strength of the two coatings to concrete varied with time and can be evaluated by using CIGMAT CT-2 and CIGMAT CT-3 tests. Although the bonding strength from the CIGMAT CT-3 test was higher than from the CIGMAT CT-2 test, the failure types from the two tests were similar for the two coatings tested.

Acknowledgement

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References

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2. Soebbing, J. B., Skabo, R. R., Michel, H. E., Guthikonda, G. and Sharaf, A. H., Journal of Protective Coatings & Linings, 13 (5) (1996) 54-64.