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1 EFFECTS OF SILANE SURFACE FUNCTIONALIZATION ON INTERFACIAL FRACTURE ENERGY AND DURABILITY OF ADHESIVE BOND BETWEEN CEMENT PASTE AND EPOXY

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Abstract

Epoxy adhesives are experiencing widespread use in concrete structures. However, a common concern regarding the adhesive joints in the infrastructure is their durability when exposed to harsh environments, most particularly, high levels of moisture. This work recognizes that adhesive bond between epoxy and substrate resists applied loads by a combination of chemical (hydrogen) bonds and mechanical interlock. Given the complexity of the stress-transfer mechanism this work focused exclusively on the chemical bond component between epoxy and cement paste, while the mechanical interlock was minimized through polishing of the cement paste substrate. A beam adhesion test method with notched interface was developed to assess the durability of chemical bonds between the adherents when aged by water immersion; surface functionalization of cement paste substrate was additionally explored as means of improving the chemical bonding and adhesion along the interface. Test results indicated that interfacial fracture energies were improved in both dry and conditioned groups with silane surface treatment. Analysis of interfacial failure modes with respect to the analytical crack kink criterion revealed that interphase region between epoxy and cement paste is characterized with higher fracture toughness than the cement paste substrate. The study lays groundwork for improvement in the durability of adhesive joints in related infrastructure through bottom-up interface design.

Keywords: epoxy; concrete; silane; adhesion; durability; hygrothermal.

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