

EFFECT OF SULFIDES IN THE PASSIVE LAYER OF STEEL REINFORCEMENT IN ALKALI-ACTIVATED SLAGS

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Steel reinforcing elements (rebars) embedded in Portland cement concretes are protected from corrosion by a thin passive film that is formed and maintained on rebar surfaces due to the high pH level of the surrounding concrete. Corrosion of reinforcing steel is frequently induced by its interaction with chloride ions, leading to local destruction of the passive layer. The nature and stability of this layer change when the surrounding concrete is produced with different cementitious materials, as the permeability of the matrix as well as the chemistry of pore solution can vary significantly. This is particularly the case when using non-Portland cements, such as alkali-activated slags (AAS). Ground granulated blast furnace slag can contain sulfur at levels between 1-2 wt.%, mostly in a reduced state. The sulfide ions are released during the alkali-activation of vitreous slag into the alkaline aqueous solution, and subsequently can alter the nature of the passive film formed on a steel surface.

In this study the influence of sulfide on the stability, chemical composition and morphology of the passive layer forming in steel embedded in alkali-activated slag mortars, and in simulated alkali-activated slag pore solutions were investigated. The potential influence of sulfide in corrosion induced in the presence of chlorides was also assessed. This was carried out by combining electrochemical measurement with a detailed inspection of the rebars specimens using different analytical techniques. The outcomes of this study revealed that in absence of sulfides, corrosion initiation is governed by localised breakdown of the passive film, followed by metastable/stable pit growth. However, in sulfide containing pore solutions localised pitting induced by chlorides was not identified. The presence of sulfides in these systems alters the mechanism of corrosion initiation, and its influence is strongly dependent on sulfides concentration at the steel/solution interface.