

Corrosion of reinforcing steel in sulphur concrete

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Abstract

In the past two decades, extensive research on sulphur concrete has shown that it can be used as an alternate to conventional Portland cement concrete in certain specialized situations due its high early strength and high chemical resistance. Much emphasis has been placed on the durability of unreinforced sulphur concrete in aggressive environments and in cycles of freeze and thaw. So far no attempt has been made to evaluate the performance of reinforced sulphur concrete in terms of corrosion of steel reinforcement which is believed to be one of the major causes of structural failures in adverse climatic conditions. The behavior of sulphur concrete in this regard was considered doubtful because sulphur can itself be a source of steel corrosion in the presence of moisture, aeration and high temperature. But, on the other hand, sulphur concrete is more impermeable as compared to Portland cement concrete which can reduce the ingress of corrosion inducing agents (O_2 , H_2O , CO_2 and Cl^-) to the steel surface and consequently retard the corrosion phenomenon.

This thesis outlines an experimental study in which reinforced and unreinforced specimens of sulphur concrete using elemental and modified sulphur along with portland cement concrete were cast for the determination of physical properties (compressive strength and permeability) and corrosion monitoring. Corrosion monitoring was conducted in terms of half-cell potential measurement of steel reinforcement of the specimens immersed in 5% NaCl and 5% $MgSO_4$ solutions and the time taken by the specimens to crack by accelerating the corrosion phenomenon using impressed current technique. The test program also included the measurement of acoustic emissions under impressed current on a limited set of specimens. A comparison has been made between the performance of sulphur concrete and Portland cement concrete. The effects of chloride ions, permeability and aggregate quality have been found to be very significant in this study. Test results have indicated that elemental sulphur concrete has very poor resistance in conditions favourable to reinforcement corrosion while modified sulphur concrete due to its very low permeability and high electrical resistivity has a potentially superior performance than elemental sulphur concrete and Portland cement concrete even when low quality aggregates were used.