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Structural Engineering Department

THE EFFECT OF CEMENT TYPE ON THE RESISTANCE OF CONCRETE AGAINST CHLORIDE PENETRATION

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Islam Fawzi Kamel

STATEMENT

This thesis is submitted to Ain Shams University, Cairo, Egypt, for the degree of Master of Science in Civil Engineering (Structural).

The work included in this thesis was carried out by the author in the Structural department, Faculty of engineering, Ain Shams University. No part of this thesis has been submitted for a degree or qualification at any other University or Institute.

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Abstract of the M.Sc. Thesis Submitted by
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ABSTRACT

Chloride induced corrosion of embedded reinforcement is one of the most severe durability problems of concrete structures and is one of the major causes of the short service life of such structures. When a concrete structure is exposed to aggressive environments, soluble chlorides can penetrate into concrete cover by absorption through its surface, diffusion in interconnected capillary pores or direct access through cracks in the concrete. Chloride ions act to depassivate the steel surface so that corrosion is initiated and then it participates in the corrosion process as well. Therefore, the resistance to chloride ions penetration becomes more important in the design and construction of concrete structures in marine environment.

This thesis studied the effect of cement types on the resistance of concrete against chloride penetration for given compressive strength classes. These cements included ordinary Portland cement (CEM I 42.5N), Portland blast furnace slag cement (CEM II /A-S 32.5N), sulfate resisting Portland cement (SRC 42.5N), and using supplementary cementing material by substituting ordinary Portland cement (CEM I 42.5N) with 15% silica fume. For each binder type, four concrete mixtures of grades C30, C35, C40 and C45 were produced.

Rapid chloride ion penetration test according to ASTM C 1202 was conducted. In addition, electrical resistivity and capillary water absorption tests were carried out.

In order to characterize the concrete quality, compressive strength of the specimens were determined at 7 and 28 days.

From the analysis and the discussion of test results obtained in this research, it was found that concrete produced using ordinary Portland cement had lower rapid chloride permeability, while concrete produced using sulfate resisting Portland cement had the highest chloride permeability for all concrete grades. The use of silica fume as a supplementary cementing material had a substantial effect on reducing the chloride permeability of concrete. It can also be noticed that concrete of higher grade had higher resistance to chloride penetration.

Based on the test results obtained from the experimental study, it was concluded that substituting ordinary Portland cement by mineral additives is one of the effective ways of minimizing the chloride diffusion of concrete.

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