شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

HANAA ALY

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HANAA ALY

AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Structural Engineering

Investigation of Chloride Binding Capacity of Concrete Using Different Cementitious Materials

A Thesis submitted in partial fulfillment of the requirements of the degree of

Master of Science in Civil Engineering

(Structural Engineering)

by

Heba Abd El-Fattah Ahmed Ali

Bachelor of Science in Civil Engineering

(Structural Engineering)

Faculty of Engineering, Ain shams, 2018

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STATEMENT

This thesis is submitted as partial fulfillment of Master of Science in Civil Engineering (Structural Engineering), Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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ABBREVIATIONS

OPC:	Ordinary Portland cement
SCMs:	Supplementary cementitious materials
GGBFS:	Ground Granulated blast furnace slag
FA:	Fly ash
MK:	Metakaolin
Cl^-:	Chloride ions
OH^-:	Hydroxide ions
C_3A:	Tri calcium aluminate
CBC:	Chloride binding capacity
XRD:	X-Ray diffraction
RCPT:	Rapid chloride penetration test
DC:	Direct current

ABSTRACT

Steel corrosion is known to be a very common kind of deterioration of reinforced concrete which affects the integrity of any concrete structures and may cause human losses. All issues related to Corrosion process like its mechanisms, causes, and consequences should be well-understood in order to avoid spending a lot of money, time, and effort in repair works to restore the integrity of any concrete building suffers from corrosion issues.

Corrosion of reinforcing steel occurs due to carbonation process and/or free chloride ions. In this research work we will focus on chloride-induced corrosion. Chlorides in concrete can exist as free ions which cause steel corrosion or as bound chlorides that almost have no risk of corrosion. It is beneficial to bind free chloride ions to reduce the corrosion probability of the reinforcement embedded in the concrete.

The chloride binding process can be physical; by absorption of chloride ions on the surface of the hydration process, or chemical (which is more stable) by interaction with alumina phases to produce an insoluble salt called Friedel's salt. The binding capacity of the concrete varies and depends on the chemical composition of its cementitious system.

This thesis investigates the chloride binding capacity of different kinds of SCMs that used as a partial replacement of CEM I. It is confirmed by other researches that those materials have a higher binding capacity than CEM I, also, they showed a higher resistance against corrosion. Different properties of concrete after chloride binding are assessed through carrying out the following tests: half cell potential, accelerated corrosion test, compressive strength, pull-out test, rapid chloride penetration test, sorptivity test, measuring pH value of concrete, and XRD. The results showed that utilizing the SCMs in concrete can enhance the

chloride binding capacity, especially those materials that have high quantities of aluminate and calcium in their chemical composition like ground granulated blast furnace slag (GGBFS). Also, all mixes made with SCMs had a better behavior against corrosion than control mixes that were made using CEM I only.

Based on such results, the limit of the chloride content in the different codes should be revised regarding the binding capacity according to the type and quantity of the cementitious materials used.

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