Estimation of chloride contents

in hardened OPC pastes

RESEARCH SCHOOL
INTEGRAL DESIGN OF STRUCTURES

Speerpunt BOUW

SUBJECT: the interaction between individual hydrated cement phases (especially **CSH** and **AFm**) and intruding chloride ions in reinforced concrete structures exposed to marine environments or de-icing salts.

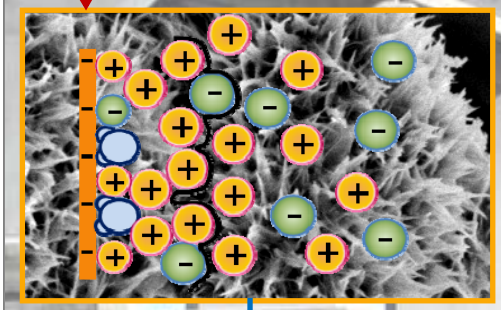
GOALS:

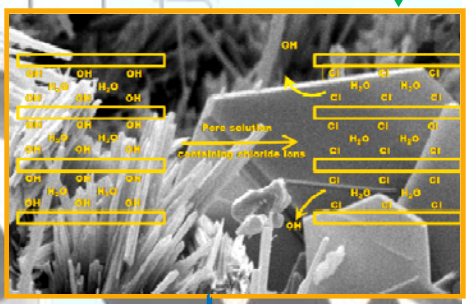
To develop an algorithm for estimating the chloride binding capacity of hydrated OPC pastes;

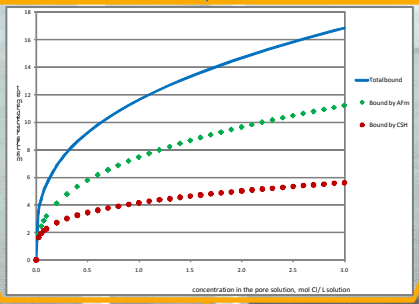
To study the influence of a number of parameters on the chloride binding capacity of mortar and concrete mixes.

CSH

AFm







EXPECTED RESULTS: A correlation between free and bound chlorides that can be used for designing new concrete mixes with increased durability to chloride attack.

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Subject

Chloride attack is the main cause of structural damage in reinforced concrete buildings exposed to marine environments. When a certain threshold concentration of chlorides is reached at the concrete-reinforcement interface, the corrosion of the steel rebars is initiated. A part of the intruding chloride ions will be retained by the hydration products of the binder in concrete, either through chemical binding or by physical adsorption. Therefore, chloride binding can delay the achieving of the threshold chloride concentration at the level of the reinforcement by removing chloride ions from the pore solution.

Goals

Quantifying the chloride binding process helps predict the service-life of reinforced concrete structures exposed to chloride attack, and allows for a better planning of their maintenance and repair periods. Another important purpose of studying chloride binding is the design of new cement mixes that are able to slow down chloride intrusion, thus improving the durability of future marine structures.

Research Questions

- How do intruding chloride ions change the composition of the hydrated cement paste?
- What is the contribution of each hydrated phase to the chloride binding process?
- What is the relation between the free chlorides concentration and the bound chlorides amount?

Strategy

Since the hydration products of cement are responsible for the chloride binding in concrete, this study will focus on the chloride binding in hardened cement paste. A new reaction model will be used in order to predict the hydration products and their relative amounts in an OPC hardened paste. The model also estimates the amounts of capillary and gel water, thus permitting the calculation of the maximum amount of free chloride ions in the pore solution.

Expected Results

The final scope is to develop an algorithm in order to evaluate the chloride binding capacity of a given cement paste. Two main chloride binding mechanisms – through physical adsorption and through chemical reactions- were taken into account, along with quantifying the amount of chloride in the pore solution. Other parameters that will be considered include the carbonation degree of the cement paste, sulfate content of the binder, pH of the pore solution in the hardened paste.

Preferred Partners Applications / Sponsors

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Research Period

September 2008 – September 2012