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Behavior of Mortars with Different Porosities in Front of Attack of Aggressive Agents

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1 Introduction

Chemical reactions leading to decreased durability in concrete structures may result from chemical interactions between aggressive agents present in the external environment and cement paste compounds or may result from internal reactions like alkali-aggregate reaction, or from reaction of delayed hydration CaO and MgO crystalline, if present in excessive amounts in Portland cement, or electrochemical corrosion of concrete reinforcement. Chemical reactions manifest themselves through the physical failures of concrete such as porosity and permeability, decreased strength and cracking.

Among the various aggressive agents that attack reinforced concrete structures, chloride ions, sulphate ions and carbon dioxide can be highlighted.

The objective is to analyze different traces of mortars made with type CP II – F32 cement with w/c factors of 0.4 and 0.7 when subjected to the attack of sulfates, chlorides and carbonation.

2 Materials and Methods

To evaluate the durability, the specimens were exposed for 70 days to aggressive agents. The tested mortar has a 1:3 trait (cement: sand), varying the water/cement ratio in two levels, being 0.4 to obtain less porous mortar and w/c of 0.7 for a more porous mortar.

For durability analysis against the aggressive agents the specimens were submitted after cure of 28 days in a humid chamber, for the sulfate solution was used 10% magnesium sulfate ($MgSO_4$). For the accelerated chloride attack, 10% sodium chloride (NaCl) solution was added and for carbonation depth evaluation, the specimens were deposited in a carbonation chamber with 10% controlled CO_2 concentration, without the control of humidity and temperature.

The chemical test to determine the sulphate ions content in the samples was made according to an adaptation of the standard APHA Method 4500-SO_4^{2-} (1997) to determine the percentage of sulphate in the sample**.**

The chloride concentration of the mortar powder sample was obtained Volhard's titration method. The procedure consists an indirect titration to determine the chloride ion that precipitates with silver ion. The acid soluble chloride content was calculated as a percentage of chloride ions by weight of the binder.

Phenolphthalein was used as test to carbonation penetration. The lower the pH, the lighter its appearance, tending to colorless in the less alkaline regions. A non-carbonated concrete in the most alkaline region turns purple when using this same indicator.

3 Results

The average values of the analyzes of the three tests performed for the sample group, considering the w/c variations are presented in Table 1.

Table 1. Mean values for durability analyzes.

Specimens		Sulphate content (%)	Chloride content (%)	Carbonation Penetrarion (mm)
CP II – F32	w/c 0.4	6.28	0.55	-
	w/c 0.7	8.39	0.69	2.1

Sulphate content increased by more than 33% when the water factor used in the mortar was added. CP II – F32 cement analysis for chloride determination by chloride submerged samples resulted in chloride content of 0.69% for samples with water/cement ratio of 0.7 and 0.55% for samples with water/cement ratio of 0.4. Therefore, all the samples exceeded this reference. It was not possible to measure the carbonation depth for the samples with water/cement ratio of 0.4 because no sufficiently measurable points were observed for the caliper measurement. For the trace with w/c 0.7 the average carbonation point was 2.1 mm.

4 Conclusions

- OPC cement mortars using w/c fractions of 0.4 show better durability results when compared to 0.7 water dosing.
- The proposed tests serve as durability indicators for previous considerations due to the attack of sulfates, chlorides and carbonates.

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