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SUPERABSORBENT POLYMERS TO MITIGATE AUTOGENOUS SHRINKAGE OF HIGH STRENGTH CONCRETES

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ABSTRACT

The general objective of this research is to investigate the efficiency of two types of super absorbent polymers (SAP) in mitigating autogenous shrinkage (AS) of high strength concrete. The autogenous shrinkage is measured experimentally from the instant it begins, i.e., from the time-zero (solid-suspension transition) using the technique of ultrasonic wave propagation until the age of 28 days. Time setting is also measured experimentally using Vicat apparatus for comparative purposes. It is studied the influence of SAP on the slump flow, the axial compressive strength and bending tensile strength.

Keywords: superabsorbent polymer, shrinkage, concrete, time-zero.

INTRODUCTION

Several strategies have been proposed to mitigate autogenous shrinkage of cimentitius materials, among them adding saturated porous lightweight aggregates, shrinkage-reducing admixture, fibers addition, use of expansive cements, have been studied (Bentz and Jensen, 2004; Kovler and Zhutovsky, 2006; Schröfl and Mechtcherine, 2012). A modern method, more recently proposed is the use of superabsorbent polymer particles (SAP). During the concrete mix the SAP particles absorb a large amount of water to form macro inclusions containing free water. From a chemical point of view, all the water inside a SAP can, essentially, be considered as bulk water. This free water promotes internal curing of cement paste around the particles of SAP, avoids self desiccation and reduces shrinkage. The unidirectional free autogenous shrinkage was measured according to Tazawa, 1999, with modification proposed by Silva, 2007 (Fig.1).

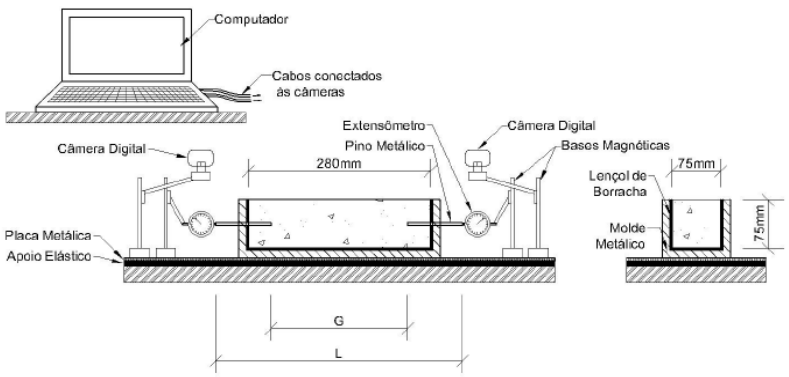

Fig. 1 - Schematic diagram of the methodology used to measure the autogenous shrinkage

Comparisons with the various strategies for mitigating autogenous shrinkage suggest that the additions of SAP in particular generate the best results, reaching in some cases, even the elimination of the phenomenon. The methodology used in this study was proposed by the scientific committee TC 225 - SAP, RILEM (Reunion Internationale des Laboratoires et Experts des Materiaux), to carry out round robin test (RRT). The reasoning for performing RRT is to promote the SAP technology by showing practitioners and researchers that for a given concrete or mortar composition SAP perform in a robust way all over the world independently from the particular choice of raw materials and lab equipment.

RESULTS AND CONCLUSIONS

The means results of autogenous shrinkage for concretes studied are shown in Fig. 2.

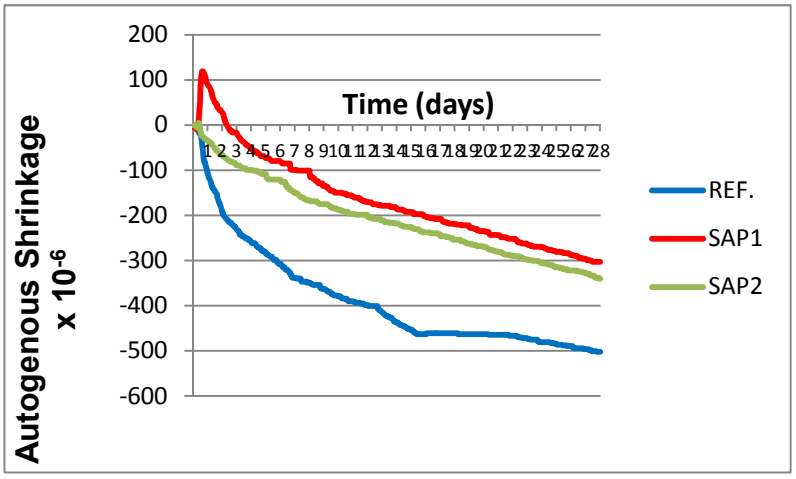

Fig. 2 - Mean results of autogenous shrinkage for mixtures studied.

The mixture containing the SAP-1 showed a small initial expansion and reduction in autogenous shrinkage of about 92% at 3 days and 40% at 28 days. Mixing with SAP-2 showed no initial expansion and shrinkage decreased 62% at 3 days and 32% at 28 days compared to reference mix. This shows the positive effect of using these polymers, especially in the early days, when the magnitude of autogenous shrinkage is significant. SAP is a promising strategy for reducing autogenous shrinkage of cementitious material, because autogenous shrinkage significantly decreased with slight reduction in the compressive strength (up to 8%).

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