Percolation-based Image Processing for the Plastic Viscosity of Cementitious Mortar with Super Absorbent Polymer

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1 Abstract

Super absorbent polymers (SAP) are the recent promising chemical admixtures with the potential for reducing the shrinkage, cracking, freeze/thaw and increasing the durability of the concrete. These polymers are classified as hydrogels when cross-linked and can retain exceptionally high amount of liquid solutions of their own weight. In this paper, the flowability of the concrete is quantified by means of developing a percolation-based image processing method and the transient behavior of the viscosity of the SAP-contained mortar mixture is characterized via numerical solution of Navier-Stokes relationship. Additionally rheological measurements and the analytical development has been carried out for complementary verification of the viscosity trends. Controlling the flow within such relatively short period of time is essential for tuning the functionality of concrete during the construction as well as it's respective resilience during the extended period of application.

2 Introduction

One of the most important developments in concrete technology is to control the amount of water absorbed and maintained in the concrete mix [1]. Superabsorbent polymers (SAP) are new, very promising multipurpose chemical admixtures for applications in concrete with a wide window of potential for innovation. SAPs can trap water within up to ~ 100 times of their own weight [2], change the rheological properties of fresh concrete mixture [1] and tune it's autogenous and plastic shrinkage behavior during both fresh and hardened states through internal curing [3, 4, 5]. Such utilization as a self-curing agent saves water as the concrete dries to a large extent [6, 7, 8]. Typical chemical composition is sodium salt of poly-acrylate acid $[-CH_2-CH(CO_2Na)-]_n$, a crystal-like structure classified hydrogel when cross-linked [9]. SAPs are commonly used in diapers, sanitary napkins, biomedical purposes, agriculture etc.

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