Modeling water transport in concrete at early age

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Abstract

Water transport in concrete at early age is an important topic especially for low w/c high performance concrete, since it affects the efficiency of water curing. In this study, a poromechanical model is applied for describing water transport in hydrating cement paste. Two cases of water curing and consequently two scales at which water migrates in the hydrating paste are investigated. The first case regards internal curing, where water is introduced into the cement paste in the form of small, uniformly distributed internal reservoirs (e.g. superabsorbent polymers, SAP). In this type of water curing, transport takes place on a length-scale of up to a couple of millimeters, which results from the volume of paste surrounding a single reservoir. The second case considered in this work regards macroscopic water transport, where water is provided on the surface of a hydrating concrete element. The results show that the refinement of porosity, especially after the depercolation of the capillary porosity, has a pronounced influence on reduction of water transport efficiency. As an effect, external curing becomes ineffective in promoting the hydration process and reducing autogenous shrinkage in low w/c materials as water can penetrate only up to couple of mm-cm from the wetted surface. On the contrary, internal curing is efficient in distributing the water uniformly in the cement paste, since the internal water reservoirs are emptied early in the hydration process and water is then redistributed locally in the cement paste.