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Influence of tensile cracking and of aggregate size on concrete permeability

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Abstract. The aim of this study is to investigate the interaction between crack opening (COD), aggregate size and gas transfer in concrete submitted to mechanical loading in the Brazilian splitting tensile test. The lab-made devices have been developed to investigate physical phenomena during loading and to provide data to validate a developed mesoscale hydromechanical model by the same authors, based upon a 3D lattice approach to represent the heterogeneity of the material [1]. Experimental studies has been carried out on five materials with different aggregate sizes. The results emphasize that permeability of mortar increases with cracking following a sigmoid law, with the most important kinetics due to passing-through connected crack growth, after nonsymmetric one-face crack initiation. Furthermore, the obtained results highlight that permeability increase, due to aggregate size, may be separated from permeability increase due to tensile cracking: for all the five materials tested results fall on the same master sigmoid curve. This behaviour law represents a strong advantage for concrete modelling.

1 Introduction

Permeability is a parameter that may indirectly influence the durability of concrete structures by governing the penetration rate of aggressive agents responsible for degradation under a pressure gradient, or directly in the case of structures with tightness role. Hence, there is a clear motivation to investigate the variation of the permeability with cracking of concrete-like materials during loading.