Water absorption of particles immersed in a colloidal suspension: Application to recycled concrete

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Résumé

This study investigates the water transfer dynamics between porous aggregates and fresh cement paste, particularly in the context of generalizing recycled aggregate uses in construction practices. Indeed, the increasing adoption of recycled aggregates is due to limited alluvial resources and the distinct composition and structure of these recycled materials compared to natural aggregates.
This study establishes the relationship between colloidal suspensions (fresh cement paste) and a porous medium (hardened cement paste). Due to its high porosity, the hardened cement paste absorbs a substantial amount of water, despite having smaller pore sizes than the particles suspended in the fluid being absorbed.

To explore water transfer phenomena, we employed sintered glass beads as a model for porous media, and water serves as a substitute for cement paste to better understand the underlying physical processes. The influence of the porous medium's geometry and microstructure on imbibition kinetics during water immersion is investigated, necessitating the development of geometry-specific imbibition models since the traditional Washburn model is insufficient for describing the observed kinetics.

In the second part, the water transfer between fresh cement paste and the porous aggregates is characterized using advanced Nuclear Magnetic Resonance spectrometry (NMR) techniques. The findings reveal that the absorption of aggregates in fresh cement paste is lower than pure water absorption, primarily attributable to the contraction of the fresh cement paste during the imbibition process. Furthermore, the absorption kinetics in this scenario is notably slower than in pure water.
In conclusion, this study provides valuable insights into the complex interactions between water intake by porous media and compression of colloidal suspensions. Understanding the intricate water transfer dynamics will improve the mix-design of recycled concrete properties and, more generally, may be used to better understand many processes beyond building materials.

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