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Anomalous nanosilica imbibition in cement-based materials

Friday, 4 June 2021 09:40 (1 hour)

Improving the durability and lifespan of concrete transportation infrastructure is a major concern. Penetration of aggressive agents such as chloride ions is known to accelerate structural decay. Several nanotechnology-based treatments intended to decrease permeability are currently under study. The use of nanosilica as a surface treatment has proved to be one possible solution, particularly on aged cementitious infrastructure. The working mechanism is rather unclear as nanosilica may interact in several chemical or physical ways with the concrete composition and microstructure.

In this work, we focus on the imbibition of hardened cement paste by colloidal silica suspensions. We monitor the invasion process using an X-Ray scanner. The imbibition of the silica suspension shows anomalous kinetics. Our results suggest that clogging occurs and that the advent of clogging is controlled by a non-trivial relationship between the colloidal particle size and the pore size. A probabilistic clogging model allows us to interpret semi-quantitatively the experimental data. Moreover, nano silica is a source of pozzolan that affects cement hydration and modifies microstructure. As anticipated, the imbibition of water on treated cement paste shows an induction period related to the clogging depth, which significantly slowed the liquid and ionic transfer rate inside the post-treated materials.

Time Block Preference

Time Block A (09:00-12:00 CET)

References

Roussel N, Nguyen TLH, Coussot P (2007) General probabilistic approach to the filtration process. Phys Rev Lett 98:. <https://doi.org/10.1103/PhysRevLett.98.114502>

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