A multiscale approach to predict diffusion properties in new cement based materials: effects of different recycled aggregates

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Abstract

The prediction of the durability due to environmental aggressions of new cement based materials containing recycled aggregates is the general topic of the study presented here. In this research context, the diffusion coefficient of mortar is one of the most important property. Degradation phenomena can be related to penetration of aggressive agents in the core of the cementitious material by diffusive phenomena. The characterization of diffusion properties of these materials seems essential in order to predict the kinetics of degradation at the level of the material.

Despite a good agreement between modeling and experimental data, empirical diffusion equations proposed for cement past cannot be applied for non-standard mortars and concretes. To determine a general diffusion equation for new cement based composite, it is necessary to take into account the presence of aggregates and recycled inclusions. While a non porous volume with no diffusion phenomenon, aggregates affect the diffusion inside the material. The explanation can be found with the formation of an ITZ (Interfacial Transition Zone). Because of a higher porosity than the cement paste one, the interfacial zone is favorable to the diffusion of chemical species.

In this context, we propose here a multiscale approach incorporating the microstructure characteristics to predict the diffusion of mortars. After the development of the physical-based approach, we will evaluate its accuracy by comparing its predictions with experimental results of mortars with different number of aggregate types (sand, rubber or light clay), of aggregate dimensions and of ITZ layers. The diffusion of ionic species will occur primarily through the porous network of the cement matrix, but also at the interface of aggregates. Some porous aggregates such as clay beads may also contribute to diffusion. The method used for modeling is based on a standard homogenization schemes as self-consistent [1] and spherical n-phase inclusion model published by Hervé and Zaoui [2] allowing this transition interface to be taken into account.

References

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