Benchmark of Reactive transport tools for unsaturated reactive applications: the case of cement materials carbonation

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At every stage of product life cycle, the physics and chemistry of carbonation is ubiquitous to building cementitious materials. Hardening via carbonation, carbonation induced reinforcement corrosion or recycled concrete aggregate carbonation all rely on specific aspects of unsaturated rock/water/gas reactions and transfers.

The monitoring of pH front has long proved as an indicator for service life estimation of concrete structure. Now, the large variety of processes, materials and environmental conditions of interest has called for more robust testing strategies of material properties. Recent studies have focused on gas diffusivity [1], carbonation reaction [2], water sorption and transfer properties for different carbonation degree [3] and coupled mechanisms [4].

Experimental evidence within available datasets on carbonation properties and performance are now available. They cover a range of concrete mix design including cement type, dosage and initial water content. They also a cover a range of environmental conditions, from real atmospheric conditions to industrial gas such exhaust gas from cement plant.

Even if not exhaustive, these datasets could prove to be very useful to validate and benchmark holistic reactive transport model by 1) selecting the right physics and chemistry at play, 2) highlighting the relevant non-linearity of constitutive laws and 3) quantifying coupled processes.

References

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