

Structure-Property Relationships of Soft Materials and Complex Fluids

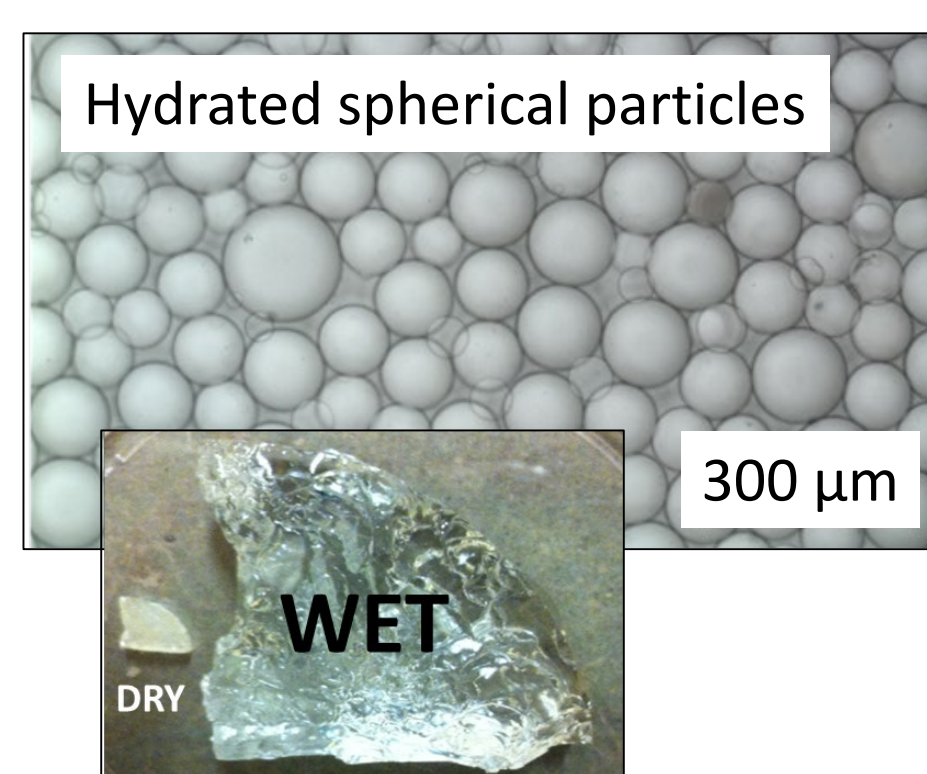
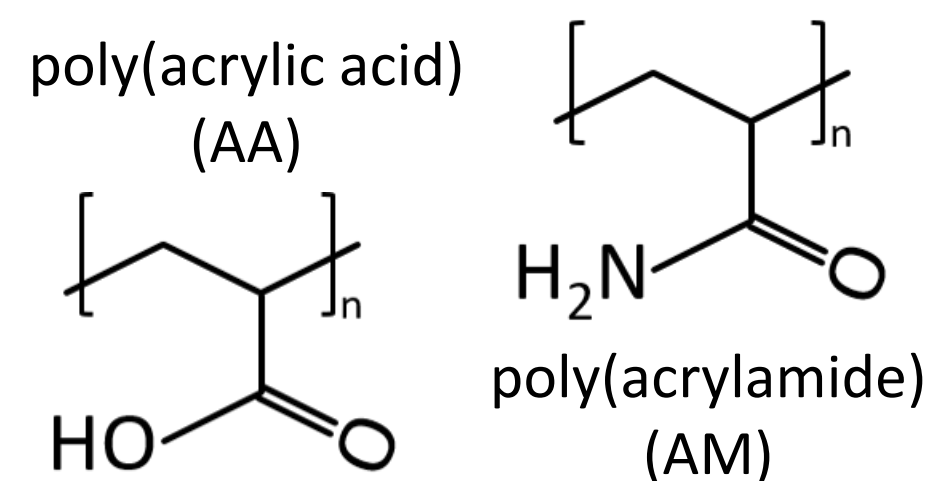
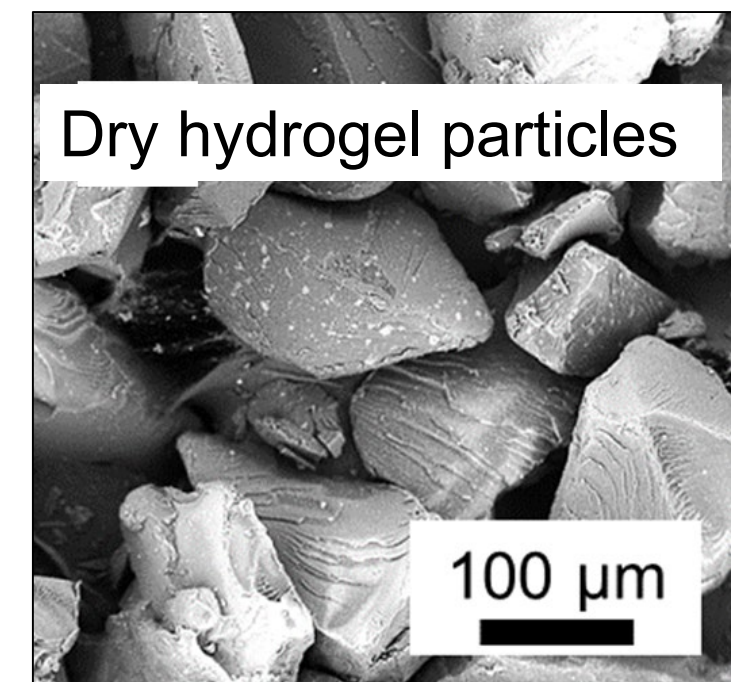
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Our mission is to better understand how soft materials and complex fluids deform and flow in response to externally applied forces. We achieve this through experimental study of model materials with well-defined chemical and physical structures and through rheometry coupled with in-situ flow visualization.

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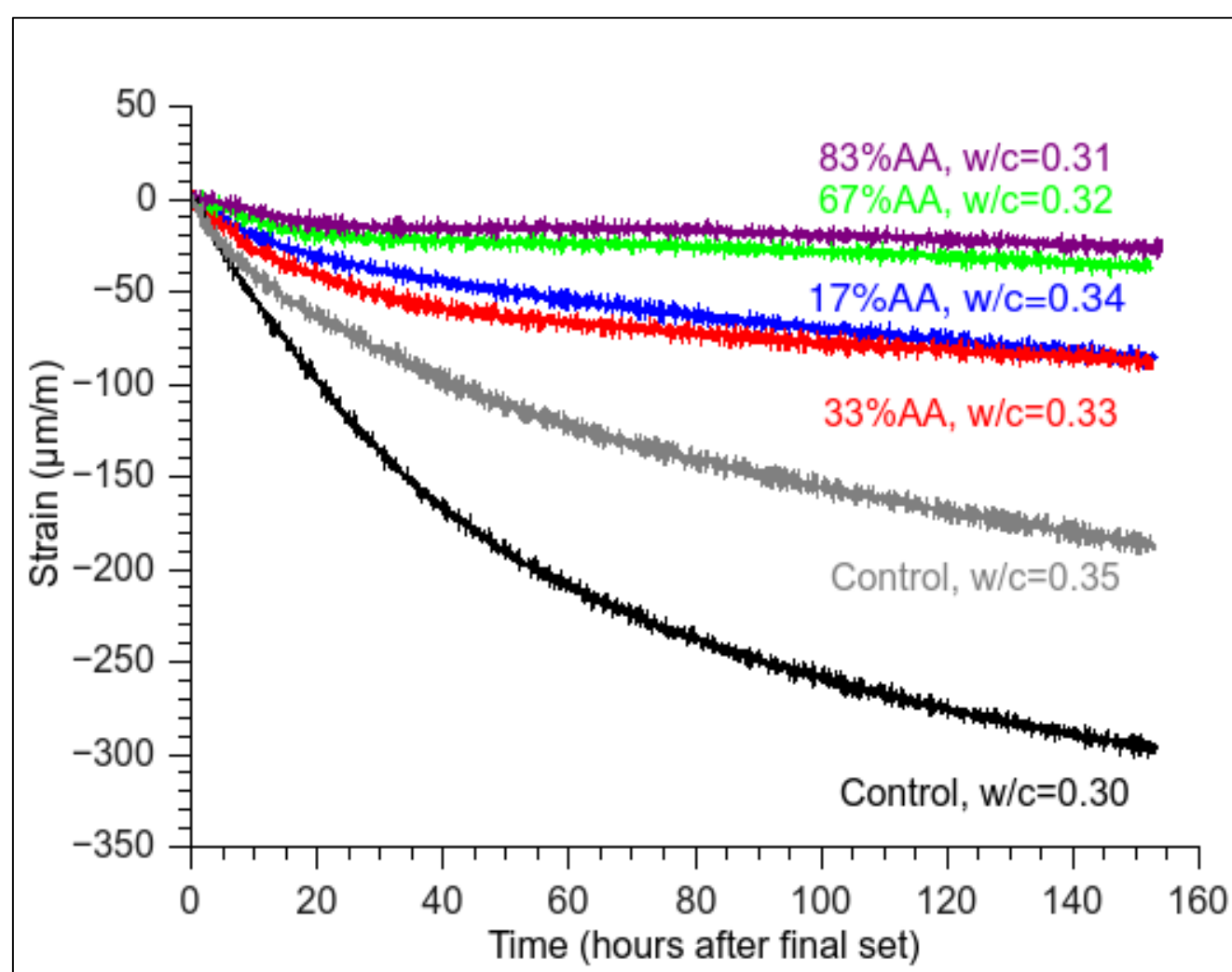
Polymeric Materials for High-Performance Concrete

Water released from hydrogel particles used as internal curing agents leads to beneficial reductions in volumetric shrinkage and cracking of concrete.

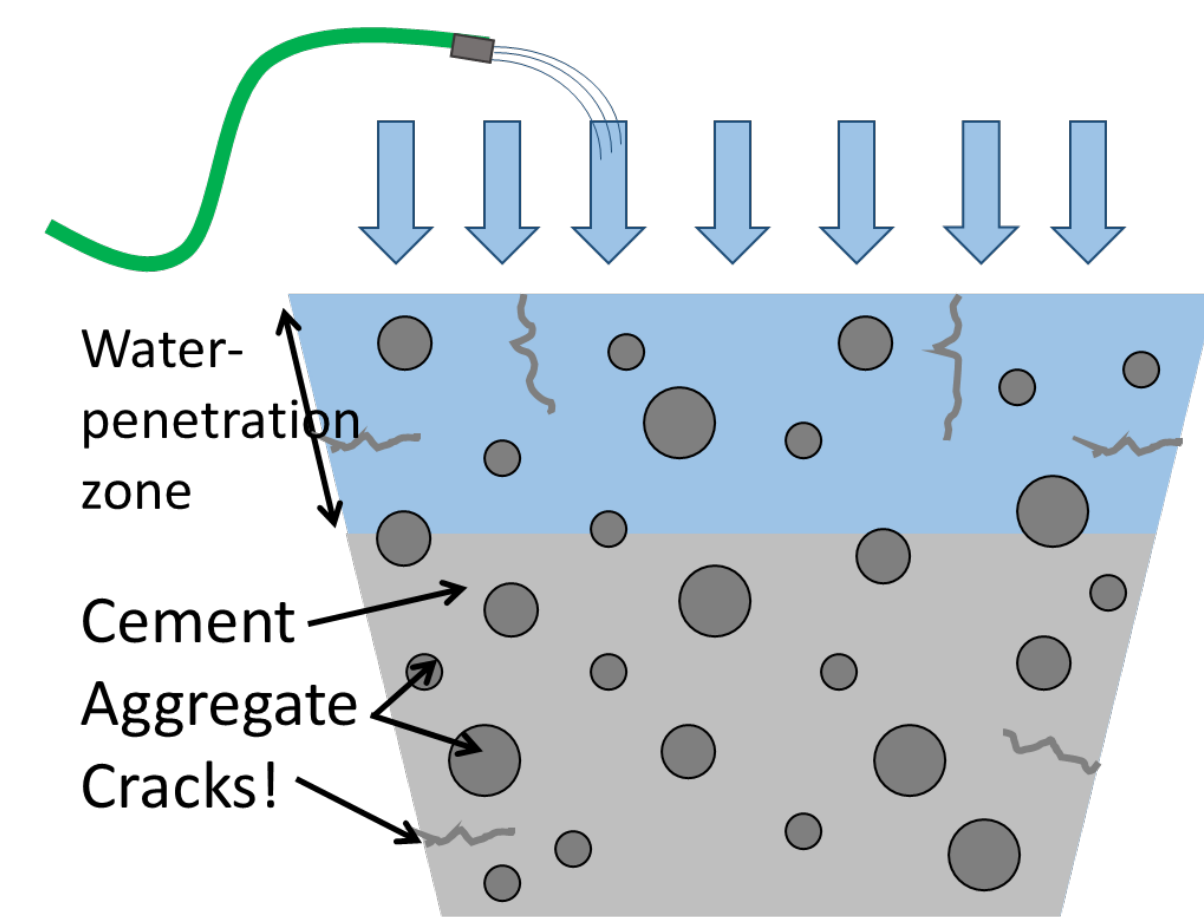


Hydrogel particle chemistry, shape, and size are controlled through different synthesis methods. Swelling behavior is strongly dependent on hydrogel chemistry (AA:AM).

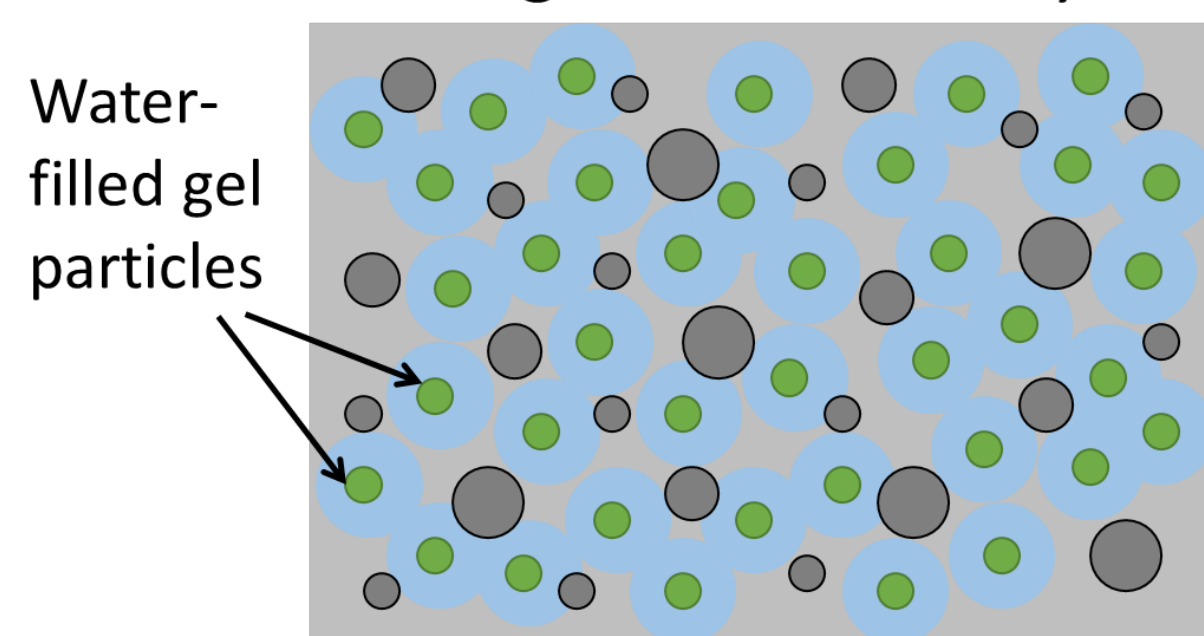
Addition of hydrogel particles significantly reduces mortar shrinkage, even at low water-to-cement (w/c) ratios:



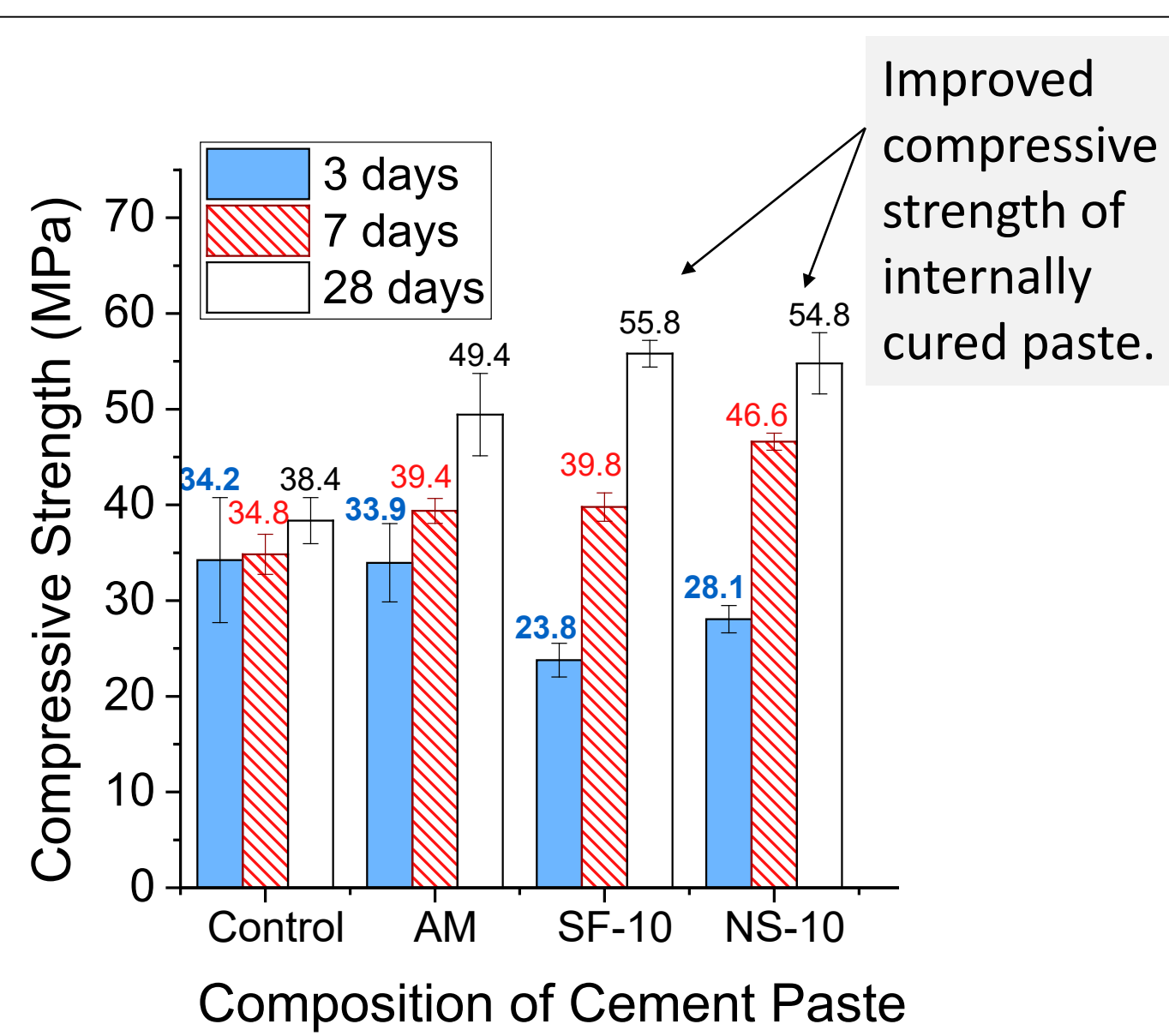
→ External curing: shrinkage!



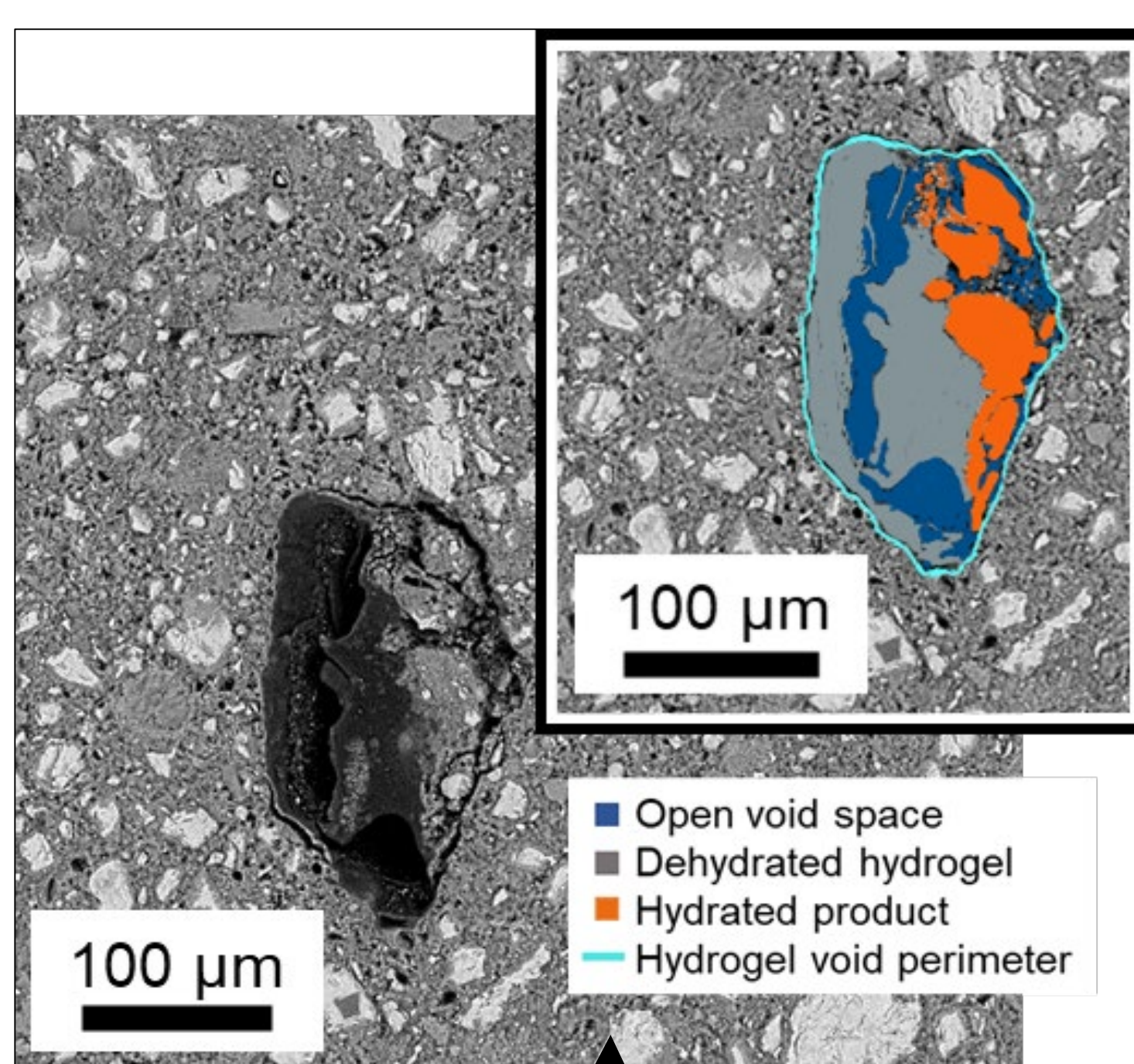
→ Internal curing with gels: increased strength and durability!



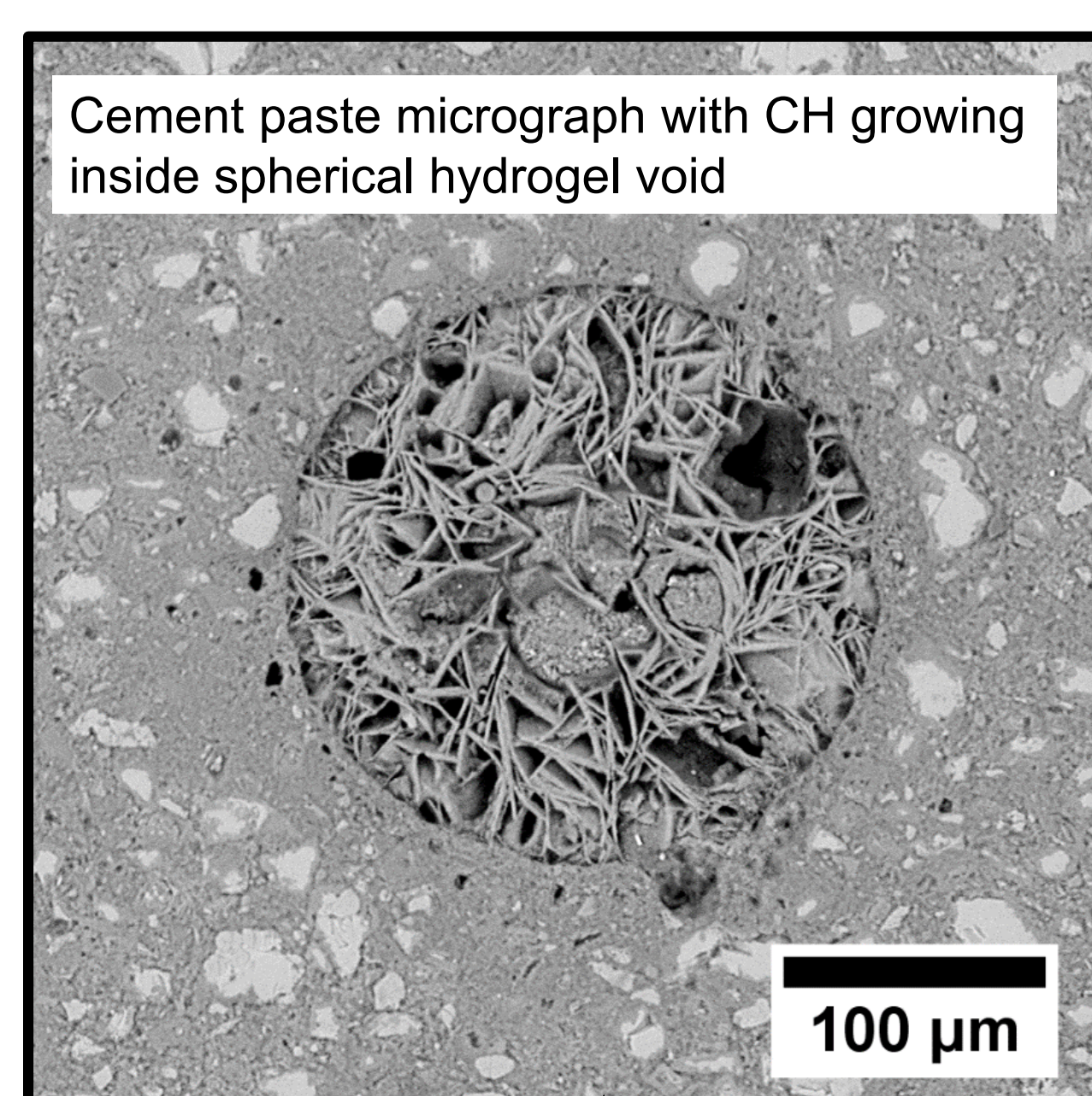
Despite voids remaining from deswollen hydrogels, cement paste strength increased at 28 days, implying more hydration resulting from complete curing and less microcracking from shrinkage:



Improved compressive strength of internally cured paste.

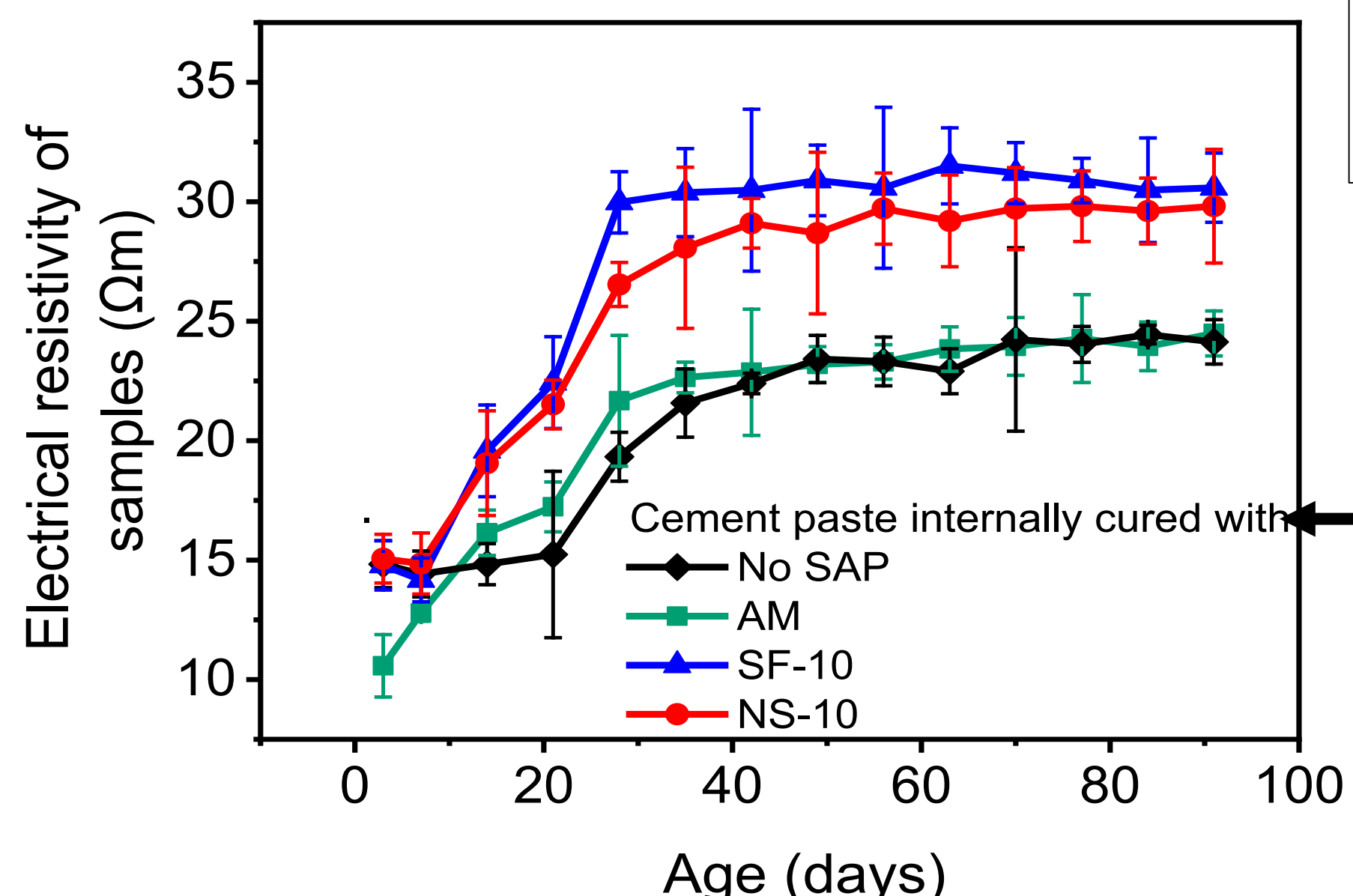


Majority-acrylamide hydrogel particles result in void space that is partially refilled with calcium hydroxide (CH) and calcium-silicate-hydrate phases.



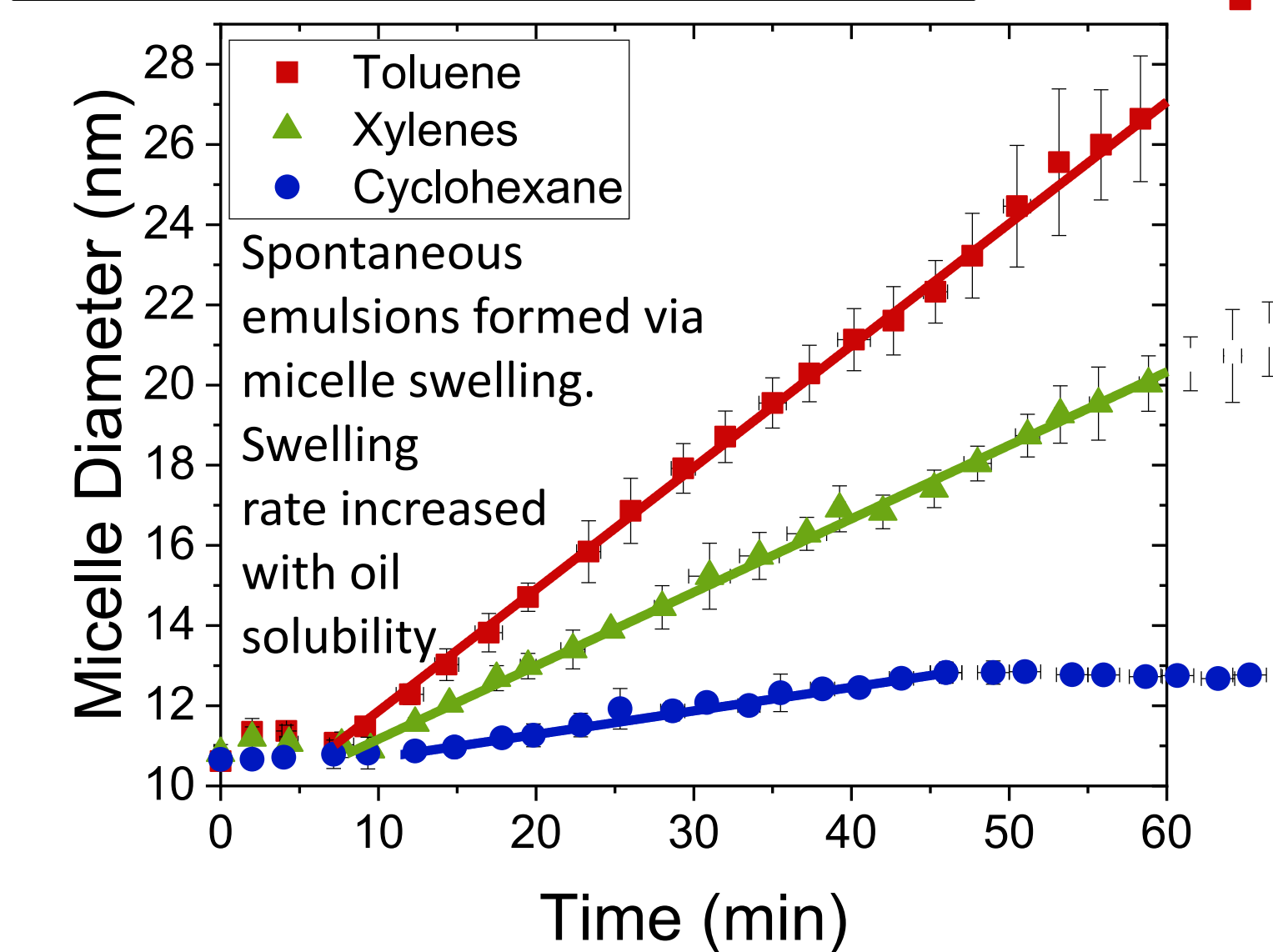
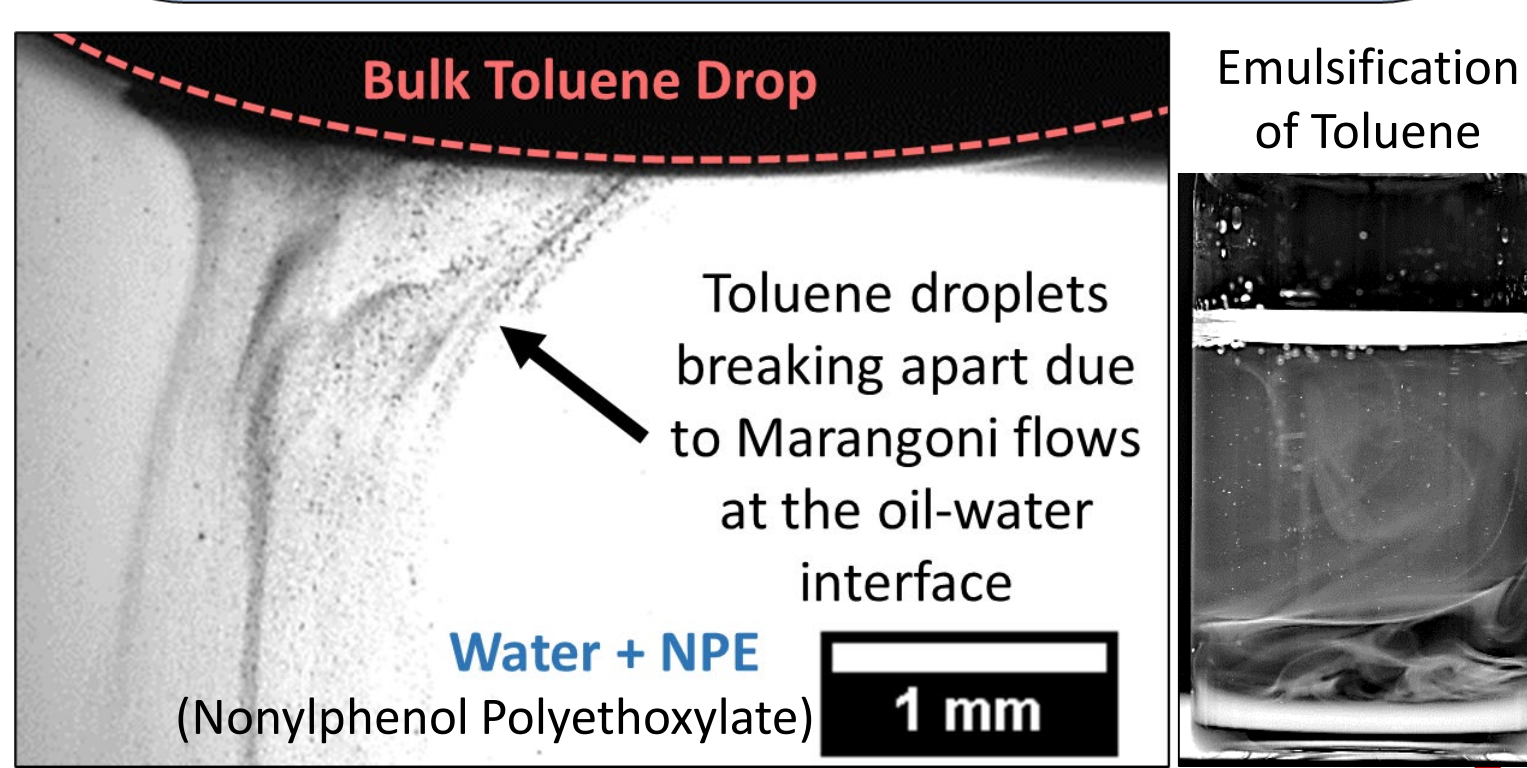
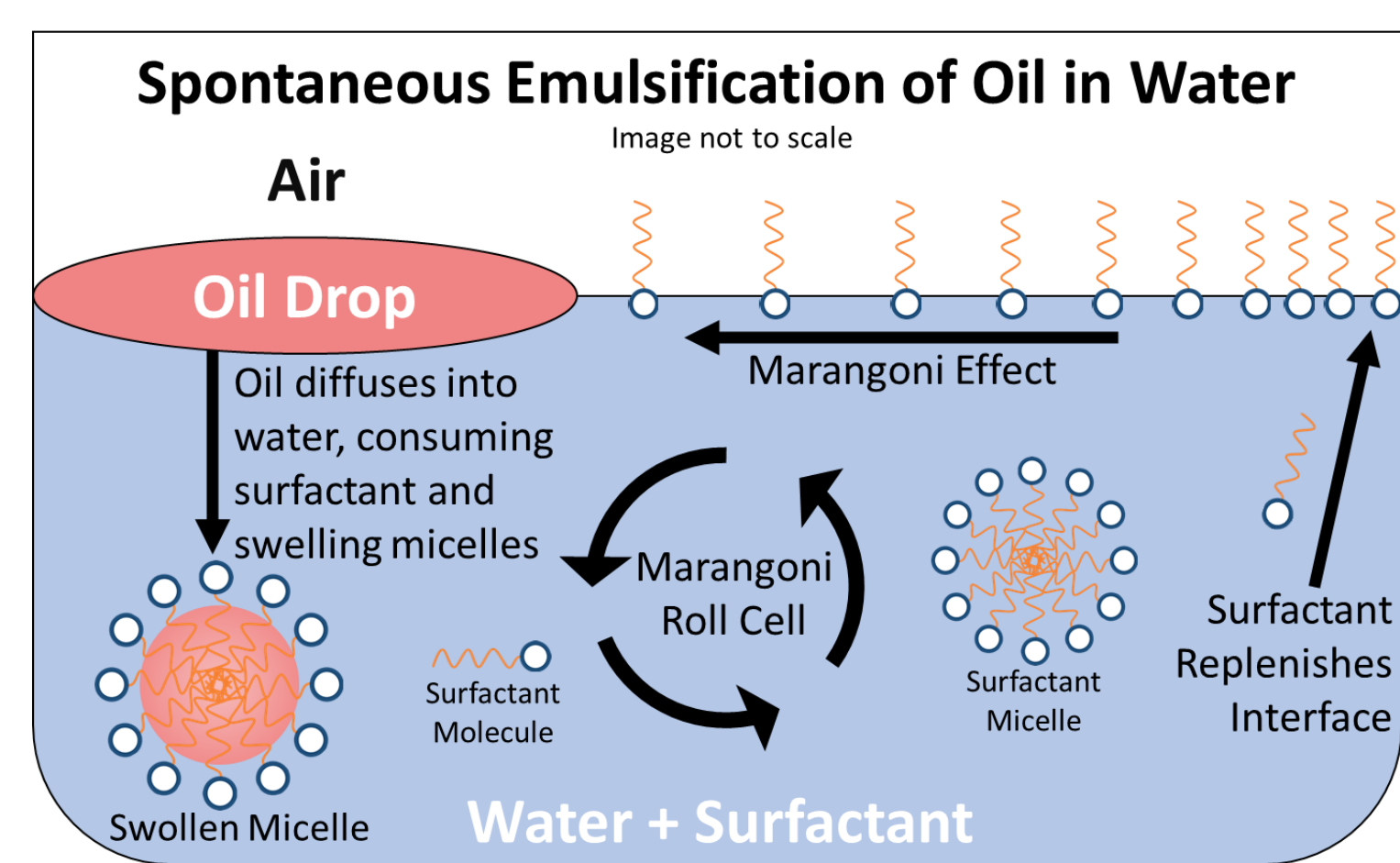
The hydrogel chemistry directly impacts the formation of inorganic phases in the cement microstructure.

Addition of composite hydrogel particles improves the electrical resistivity - an indication of improvement in durability of internally cured cementitious composites.

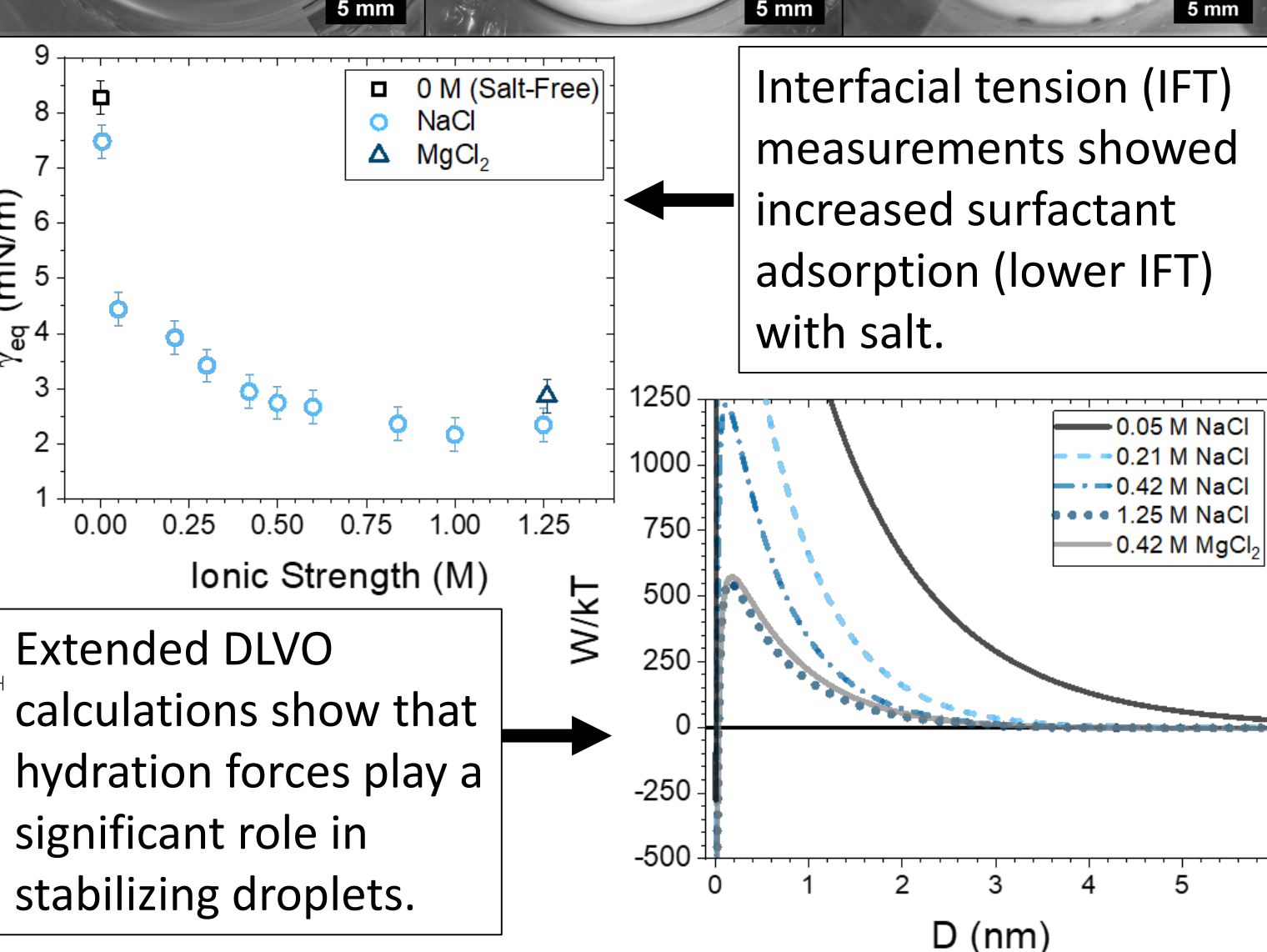
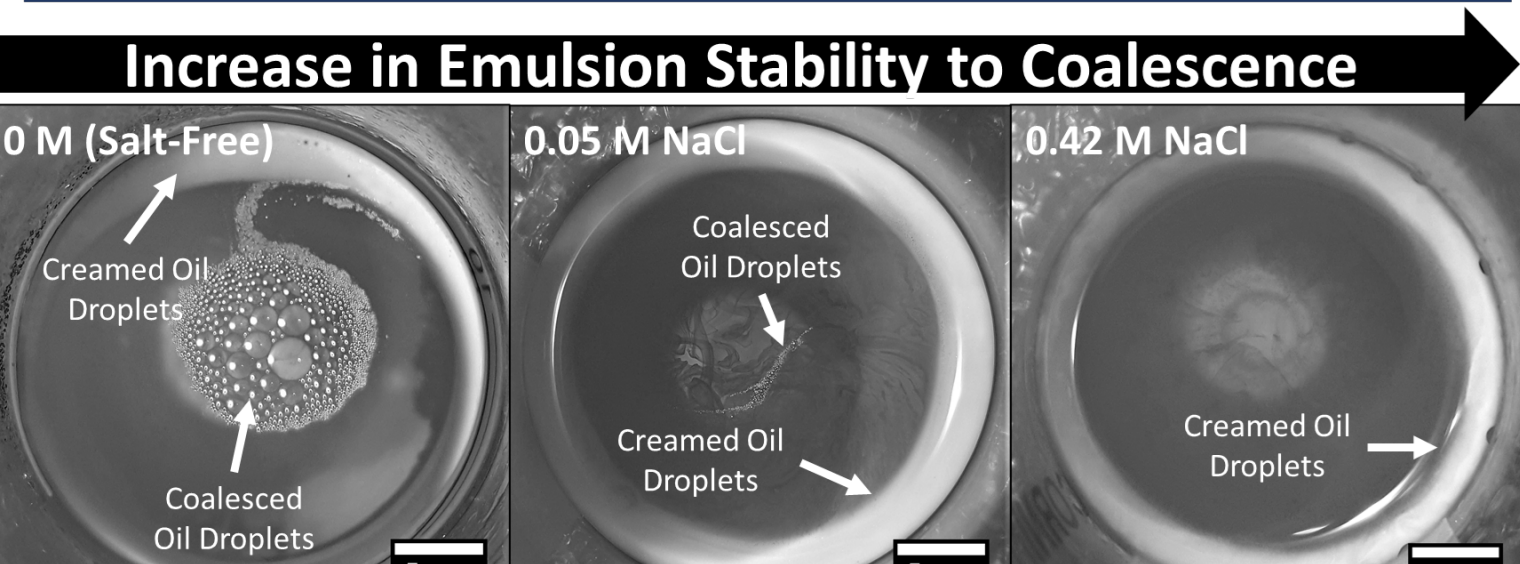
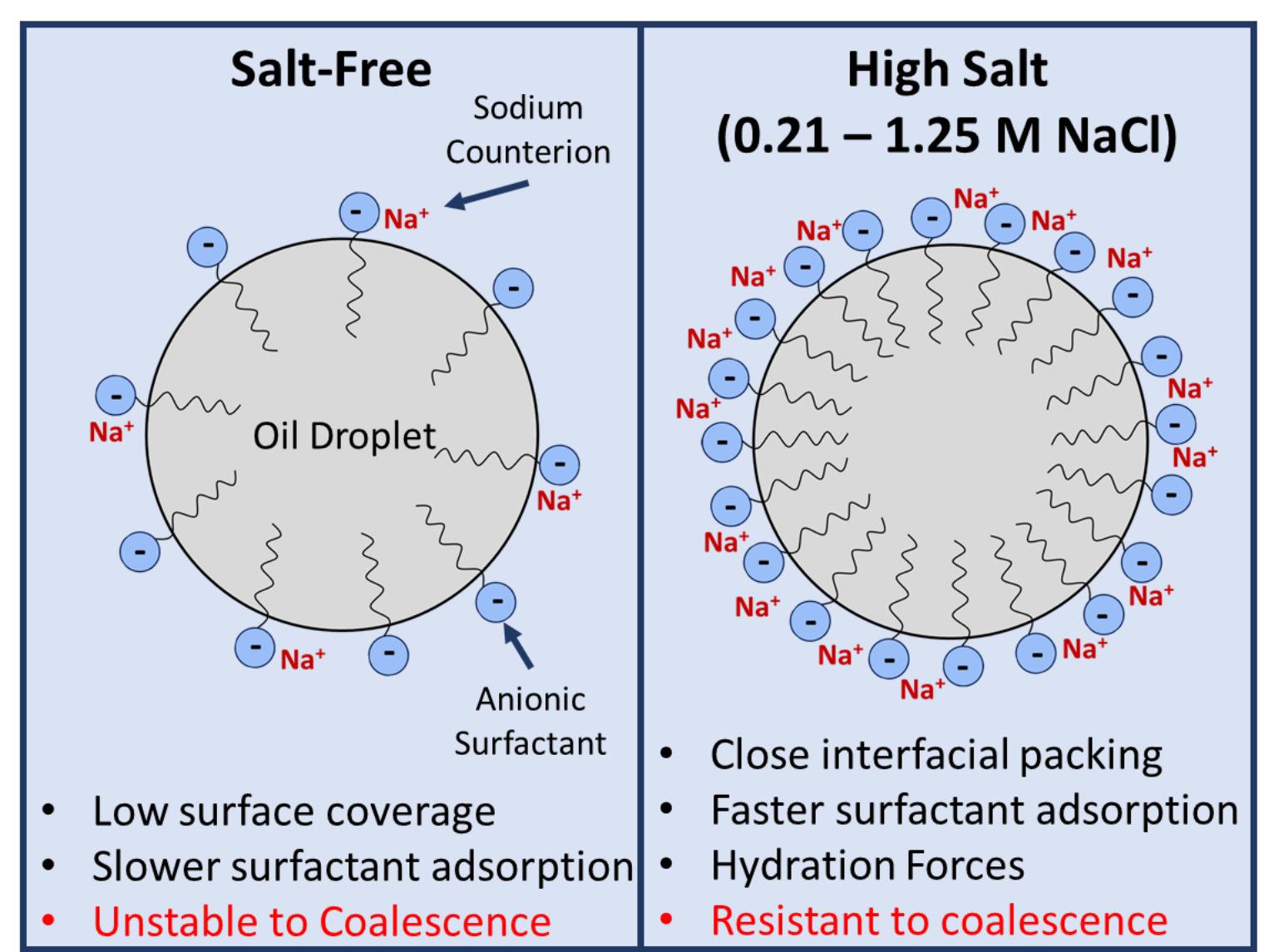


Emulsion Formation and Stability

Nano-sized emulsions can form spontaneously



Salt hinders coalescence of ionically-stabilized emulsions



Flow Behavior of Biomass Slurries

Flow and deformation properties of lignocellulosic second-generation biofuels correlated with various processing treatments necessary for ethanol conversion.

