Using Polymer Science to Improve Concrete: Superabsorbent Polymer Hydrogels in Highly Alkaline Environments

Kendra Erk

3PM, 28 September 2021 (Online via MS Teams)
URL to this MS Teams Meeting

Polymer hydrogels have many industrial uses, from drug-delivery and self-healing materials to the superabsorbent particles used in baby diapers and as soil additives. The broad application of these soft materials is due in part to the beneficial interactions of water and ions with the hydrogel's internal polymer network. Many of the polymer chemistries used to create these networks are also sensitive to changes in environmental temperature and pH. This presentation will describe how physical and chemical changes to the structure of the polymer network will directly impact the hydrogel's overall performance in a given application.

To put the fundamental polymer-water-ion interactions into an engineering context, this presentation will describe the design and use of hydrogel particles as internal curing agents in high-performance concrete. Hydrogel-based curing agents release water as the cement cures, preventing self-desiccation and increasing the concrete's strength, durability, and service life. Since 2012, we have conducted experiments at Purdue using custom synthesized hydrogel particles to determine the relationship between the chemical and physical structures of the hydrogels and their overall internal curing performance. We have recently discovered that certain hydrogel compositions encourage the formation of high-strength inorganic phases within the cement while the water sorption behavior of other hydrogel compositions can be complete disrupted by the multivalent cations that naturally occur in fresh concrete mixtures.

Kendra Erk is an Associate Professor of Materials Engineering at Purdue University in West Lafayette, Indiana. Before joining Purdue in 2012, she was a National Research Council Postdoctoral Research Associate in the Polymers Division of the National Institute of Standards and Technology (NIST, Gaithersburg, MD). She received her Ph.D. in 2010 from Northwestern University (Materials Science and Engineering) and her B.S. in Materials Engineering in 2006 from Purdue. Dr. Erk was the recipient of an NSF Career Award in 2015 for her work on hydrogel-based internal curing agents for high-performance concrete. The overall goal of Dr. Erk's research at Purdue is to develop a better understanding of important structure-property-processing relationships in a wide range of soft materials and complex fluids with engineering relevance, from polymer hydrogels to surfactant-oil-water emulsions. Characterizing the deformation and rheology of the materials is of primary interest, with an emphasis on understanding molecular-level phenomena through experimentation on model systems. @PurdueSoftMSE, http://soft-material-mechanics.squarespace.com/

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