

# 2022 Mid-Continent Transportation Research Symposium

Ames, Iowa

September 14–15, 2022

[intrans.iastate.edu/events/midcon2022/](https://intrans.iastate.edu/events/midcon2022/)

---

## A Sustainable Air-Entraining and Internal Curing Agent

Ravi Yellavajjala, North Dakota State University

Asif Jalal, North Dakota State University

### Abstract

Air entrainment of concrete is crucial to dissipate the tensile stresses introduced by the volume expansion of frozen water in the capillary pores of the concrete. The air void system achieved using popular surfactants is sensitive to the properties of cementitious materials, water content, admixtures, aggregate, etc. Furthermore, vibration, compaction, and mechanical paving can lower the efficiency of surfactants. Every 1% increase in the air volume reduces the strength by 5% which could be partially compensated by higher binder content. In this study, we will discuss using bio-based and commercially available hydrogel crystals for air-entrainment and internal curing to compensate for the lost strength. A new characterization method is developed to assess the internal curing performance of hydrogels. Furthermore, micro-CT analysis is conducted to study the air void system generated by the commercially available and bio-based hydrogels. The bio-based hydrogels and commercially available hydrogel crystals were found to improve the degree of hydration and introduce a fine network of air voids. The details of the newly developed internal curing characterization method and the extent of air entrainment in cement mortar cubes infused with bio-based hydrogels will be discussed in the presentation.