

# Shrinkage-Reducing Admixture for Cast/Printed Concrete Using Post-Industrial & Consumer Absorbent Waste

**Hygiene-waste-derived powders recycle absorbents to curb concrete cracking and boost curing.**

Researchers at Purdue University have developed a novel concrete admixture created from post-industrial and post-consumer hygiene waste products. Standard concrete mixtures are apt to prematurely "dry out" when incorporated into complex structures. This loss of water can precipitate the development of stress cracks, ultimately decreasing the overall compressive strength and durability of the final concrete product. Consequently, there is large demand for concrete admixtures that recycle waste and improve the hydration of cement.

To create the admixture, waste materials from the manufacture and recycling of absorbent hygiene products are blended with a silica-based binder to create free-flowing dry powders that absorb water, swell, and provide micro-reservoirs for curing when incorporated into concrete mixtures. Powders are intentionally formulated to act as internal curing agents as well as viscosity modifying admixtures, classes of additives that are necessary to create low-carbon and low-water concretes with good strength and durability. Powders can be packaged in dissolvable bags for easy addition by concrete producers and contractors into any mixture.

The novel concrete mixture developed by Purdue University researchers helps contractors and concrete admixture manufacturers create high-performance cast and printed concrete with increased strength and durability. Instead of using conventional petroleum-derived materials, this technology leverages superabsorbent polymer particles to absorb and release water during curing and a silica source to promote cement hydration reactions. More sustainable and cost-effective, this admixture significantly reduces volumetric shrinkage, material segregation, and stress cracking during casting, printing, and curing. Not only does this admixture help reduce concrete's overall carbon footprint, but it also increases the service

**Technology ID**  
2024-ERK-70582

## **Category**

GreenTech/Circular Economy &  
Waste Reduction  
Materials Science &  
Nanotechnology/Composites &  
Hybrid Materials  
GreenTech/Environmental  
Remediation & Pollution Control

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life and eco-efficiency of concrete.

### **Technology Validation:**

Prof. Erk has prior work on the use of silica combined with superabsorbent polymer particles to create concrete admixtures, including:

-Bose, B., Davis, C. R., & Erk, K. A. (2021). Microstructural Refinement of Cement

-Paste Internally Cured by Polyacrylamide Composite Hydrogel Particles Containing Silica Fume and Nanosilica. Cement and Concrete Research, 143, 106400. <https://doi.org/10.1016/j.cemconres.2021.106400>

-Krafcik, M. J., Bose, B., & Erk, K. A. (2018). Synthesis and characterization of polymer-silica composite hydrogel particles and influence of hydrogel composition on cement paste microstructure. Advances in Civil Engineering Materials, 7(4), 590–613. <https://doi.org/10.1520/ACEM20170144>

-And 1 existing patent: Erk, K. A. (2020). CEMENTITIOUS MIXTURES, COMPOSITIONS FOR USE IN CEMENTITIOUS MIXTURES, AND METHODS OF PRODUCING CEMENTITIOUS MIXTURES - US Patent 10,752,547.

### **Advantages:**

- Prevents premature drying and corresponding shrinkage of concrete
- Enhances concrete strength and durability
- Helps propel countries towards a more circular economy
- Powders can be packaged in dissolvable bags for easy addition by concrete producers and contractors into any mixture
- Recycles expensive, energy-intensive materials
- Depending on the quality of the waste material, can be tuned to applications requiring varying levels of strength

### **Applications:**

- Cementitious mixtures such as mortar, paste, and concrete
- Conventionally cast concrete
- Printed concrete

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-Low-water mixtures, including high-performance concrete (HPC) and ultra-high-performance concrete (UHPC)

-Low-carbon mixtures, including Portland limestone cements (PLC), cements containing slag and fly ash, and limestone calcined clay cements

-Pavement and sidewalks

-Concrete used in bridge decks and bridge deck overlays

**TRL: 2**

**Intellectual Property:**

Provisional-Patent, 2024-03-11, United States

Utility Patent, 2025-03-11, United States

**Keywords:** Additive Manufacturing, Cement, chemical admixture, Civil Engineering, Concrete, concrete admixture, concrete printing, internal curing, Materials and Manufacturing, mineral admixture, mortar, pozzolan, pozzolanic admixture, shrinkage reducing admixture, silica fume, viscosity modifying admixture