



Chemist Randal Shogren performs a test to determine how much sorbitol citrate is needed to prevent scale, the crusty buildup of calcium carbonate from so-called hard water. Sorbitol citrate could be used as an inexpensive, environmentally friendly detergent additive.

Corn: A New Ingredient for Detergents?

A greener future could be in store for laundry and dishwashing detergents, thanks to new, environmentally friendly ingredients developed by Agricultural Research Service (ARS) scientists and Folia Inc., of Birmingham, Alabama.

Under a 4-year cooperative agreement, the ARS-Folia team has developed detergent additives called “cobuilders” that prevent buildup of crusty deposits known as “scale.” In hard-water regions, scale can cause harm ranging from discolored clothing and cloudy dishes to diminished cooling and washer damage.

Phosphate-based cobuilders were once used to soften water and improve detergent cleaning power by preventing

crystallization of calcium carbonate as scale. Now, the petroleum derivative polyacrylic acid is used. But it isn’t biodegradable, notes chemist Randal L. Shogren, with ARS’s National Center for Agricultural Utilization Research in Peoria, Illinois. “It goes down the drain and into the water supply, where its accumulation could be a problem.”

In 2001, Folia asked Shogren and ARS chemical engineer J.L. Willett about developing a biodegradable alternative to polyacrylic acid. A cooperative research project ensued. In studies with Graham Swift (then Folia’s chief technology officer), two former ARS postdoctoral researchers—Sergio Gonzalez and Ken Doll—and Daniel Graiver of Michigan

State University-East Lansing, the ARS scientists explored the scale-stopping potential of citric acid and sorbitol.

Derived mainly from cornstarch, both compounds “are plentiful, renewable, and inexpensive resources,” says Shogren. “We combined them and heated them to form biodegradable polyesters.”

In a solution, calcium carbonate generally starts forming crystals within 1 minute. But adding the new corn-based polyester cobuilders prevented crystal formation for 10-30 minutes. Although less polyacrylic acid is needed to do the same, the biobased polyesters have the advantage of degrading naturally after use.

Adding biodegradable cobuilders to detergent isn’t a new idea, and it has been demonstrated before. But the high costs of using solvents to produce them has restricted their sales to niche markets.

To get around the costly solvent problem, the team fused the sorbitol with the citric acid under heat and passed the mixture through a twin-screw extruder, producing the polyesters.

“This work is part of a larger effort to develop reactive extrusion as a continuous means of making biobased products. It’s faster and more efficient than batch processes,” adds Willett, who oversees the ARS center’s Plant Polymer Research Unit.

According to Howard Bowman, Folia’s current chief technology officer, the company has sent samples of the patent-pending, corn-based cobuilders to detergent makers for independent testing. With ARS’s help, Folia seeks commercial-scale production capabilities of at least 1,000 pounds of cobuilder per hour.—By **Jan Suszkiw, ARS.**

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