

# Cut Cleaning, Keep Cleanliness

**T**oilets have a large water footprint because solid waste tends to stick to their surfaces. Large volumes of water are needed to scour solid waste from ceramic and porcelain to minimize disease risks and keep toilets sanitary.

Researchers from Pennsylvania State University (PSU; University Park) and Cranfield (U.K.) University have developed an innovative coating for these surfaces that “essentially make a toilet self-cleaning,” said co-developer Tak Sing-Wong, a PSU mechanical engineering professor, in a release.

Applying the solution, known as a liquid-entrained smooth surface (LESS) coating, involves two steps. An initial spray applies molecularly grafted polymers to the toilet bowl surface that confer extreme smoothness and hydrophobic properties. A second spray adds a thin layer of lubricant around these polymers, resulting in a “super-slippery” surface that prevents solid waste from adhering to the fixture. The researchers claim the LESS coating can reduce a conventional toilet’s water cleaning demands by up to 90%.

Researchers predict that one application of the LESS coating, which takes about 5 minutes, can last for about 500 flushes before requiring reapplication. The LESS coating also grants properties that repel many types of bacteria that spread diseases and foul odors. Able to be applied even to waterless toilets, the researchers suggest that the LESS coating could help provide access to safe sanitation even in parts of the world facing water scarcity.

The research team, backed by funding from the U.S. National Science Foundation, U.S. Department of Energy, U.S. Department of Naval Research, and various business accelerators, has created a start-

**WHO:** Pennsylvania State University (University Park) and Cranfield (U.K.) University

**WHAT:** “Super-slippery” surface coating reduces toilet water demands by up to 90%.

**HIGHLIGHTS:**

- Liquid-entrained smooth surface (LESS) coating adds polymers that enhance smoothness and deflect water, which combine with a lubricant to prevent solid waste from sticking to toilet surfaces.
- Applying the coating takes about 5 minutes and stays active for approximately 500 flushes.
- Coating repels bacteria that spread disease and odors and can work with waterless toilets.
- Researchers have formed a startup company to bring the LESS coating to market.

**RESEARCH:** “Viscoelastic Solid-Repellent Coatings for Extreme Water Saving and Global Sanitation,” *Nature Sustainability*, 2019, No. 2, pp. 1097-1105, [bit.ly/LESS-coating](https://bit.ly/LESS-coating).

up company called spotLESS Materials LLC to bring LESS coatings to market. In addition to selling the coatings online, the company also offers instructions on offsetting the flush volume of toilets to use less water. 🌊

Researchers from Pennsylvania State University (University Park) and Cranfield (U.K.) University have developed a coating for toilets that restricts solid waste from sticking to such surfaces as ceramic and porcelain. Because scouring waste from toilet surfaces entails a large water footprint, eliminating the problem could cut toilet water usage by up to 90%, the researchers claim. Pxhere/Public domain

