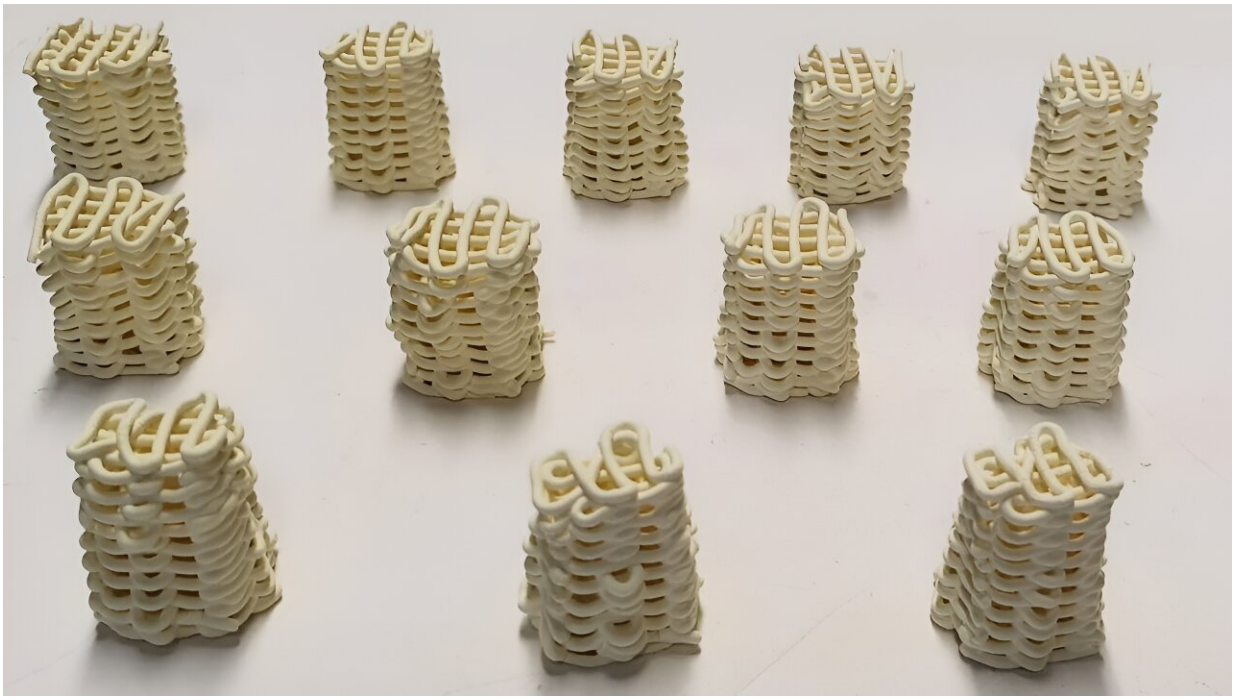
Health-threat 'forever chemicals' removed from water with 3D-printed ceramic ink

August 1 2024, by Will McManus



3D printed ceramic lattices have been proven to remove harmful 'forever chemicals' from water. Credit: University of Bath

Engineers have invented a new way to remove health-harming 'forever chemicals' from water—using 3D printing.

Researchers at the University of Bath say their method, using ceramic-infused lattices (or 'monoliths'), removes at least 75% of

perfluorooctanoic acid (PFOA), one of the most common perfluoroalkyl and polyfluoroalkyl substance (PFAS), from water, and could become an important tool in future efforts to eliminate the chemicals from water supplies.

Their findings were published in the *Chemical Engineering Journal*.

Known as forever chemicals due to the incredibly long time they take to break down—in some cases over 1,000 years—PFAS are man-made and known for causing health issues including harms to reproductive, developmental, cardiovascular systems, and in increasing likelihood of diabetes.

Sources of PFAS include domestic products, often with water-repellent properties, such as non-stick pans, raincoats, paints, fabrics and firefighting foams.

Dr. Liana Zoumpouli, a Research Associate in Bath's Department of Chemical Engineering and a member of the Center for Digital, Manufacturing and Design, says, "PFAS, or forever chemicals," are a major focus in water treatment and public health. We have created an efficient way to remove these chemicals from water without using lots of energy.

"Using 3D printing to create the monoliths is relatively simple, and it also means the process should be scalable. 3D printing allows us to create objects with a high surface area, which is key to the process. Once the monoliths are ready, you simply drop them into the water and let them do their work. It's very exciting and something we are keen to develop further and see in use."

While legislators around the world, particularly in the US and EU, have brought in some rules on acceptable levels of PFAS and similar

chemicals in drinking water, the researchers say further legislation is likely as the scale of health threats comes into clearer focus.

Co-author Professor Davide Mattia adds, "Currently, these chemicals are not strongly regulated in the UK in drinking water, but there are guidelines, and we expect changes in policy quite soon. Water companies are likely to be looking at integrating systems to deal with them."

Made of ink infused with the ceramic indium oxide, the 4cm monoliths are created by extruding the ink from a 3D printer—like squeezing toothpaste from a tube—and forming it into a lattice shape. Because indium oxide bonds with PFAS, the chemicals immediately stick to the monoliths and can be removed from the water in under three hours, which is compatible with current water treatment plants in the UK and abroad.

While testing has so far found that the monoliths remove 75% of PFAS from water, the team is aiming to increase the efficiency of the process with further refinement.

Testing of the monoliths has surprisingly shown they have become more effective under repeated use—they undergo high-temperature thermal 'regeneration' treatment after each use. This is something the researchers are keen to understand more fully with further experimentation.

More information: Alysson Stefan Martins et al, 3D-printed indium oxide monoliths for PFAS removal, *Chemical Engineering Journal* (2024). DOI: 10.1016/j.cej.2024.154366

Provided by University of Bath