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FROM PFAS TO DE-FLUORO™

HOW WE INVENTED A PROCESS TO BREAK DOWN THE 'FOREVER CHEMICAL'

In response to concerns about PFAS being released into the environment, AECOM invented an on-site destruction process. **Rachael Casson** describes how a modular system can be scaled to fit the problem.

Like many great ideas, AECOM's world-first PFAS destruction technology DE-FLUORO™ was born out of serendipity. It was 2016 and the relative safety of a class of fluorinated chemicals was sparking debate in Australia and the U.S., where high-profile cases had raised public awareness and attracted regulatory attention.

In production since the 1940s, per and polyfluoroalkyl substances, commonly known as PFAS, are found in everything from pizza boxes to firefighting foam. Made by saturating double-bonded carbon chains (alkenes) with fluorine, the carbon-fluorine bond is one of the strongest in organic chemistry, meaning many PFAS compounds are very difficult to break down. Some of the most common, such as PFOS and PFOA, are environmentally persistent, earning them the moniker 'the forever chemical.'

Because of this, they can accumulate in humans, animals and other parts of the environment. Whilst toxicological effects are uncertain, some PFAS chemicals have been linked to weakened childhood immunity, thyroid disease, cancer and other health problems. Industries such as oil and gas, chemical and industrial companies, landfills, ports and harbours, defence, aviation, and water treatment companies all face PFAS issues that require identification and intervention.

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Until recently, the only way to break down the carbon-fluorine bonds in PFAS was through high-temperature incineration. This is a costly solution due to the high energy consumption for incineration and the need for transportation to a suitable facility. It has also raised concern over pollution from burning the toxic compounds.

The issue had been troubling AECOM's Rachael Casson, now Director of the International PFAS Program. The Australian Department of Defence had identified PFAS contamination on several of its sites, including the need for large scale remediation at the RAAF Base in Williamtown,100 miles north of Sydney. In particular, they were looking for a technology to remove PFAS from drinking water and groundwater.

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Rachael introduced a contact of hers to the defence ministry, a U.S. contractor with a promising water filtration treatment technology. After a meeting at the ministry, they retired to the Wharf Bar in Manly, a prime seaside spot on Sydney Harbour. Rachael asked the contractor what they were going to do with the contaminant once they'd separated the PFAS from the water streams. "They didn't have an answer," she said.

Meanwhile, colleagues in the U.S. had been looking at how to address PFAS contamination with researchers at the University of Georgia. There was a huge amount of academic research on the topic, but a commercial solution to onsite destruction of PFAS remained elusive. Rachael joined the dots and AECOM teams on both sides of the Pacific began looking into two technologies that had worked with other contaminants: biological treatments and electrochemistry. Gavin Scherer, who now leads the PFAS response in Australia and New Zealand, said collaborating with teams in different geographies has its challenges. "Working through those has made us stronger and more effective as a team," Scherer said.

Early results looked favourable for electrochemical treatment of PFAS-impacted waters, but it took some time to find the right electrode. Given the quantities required, an economical material was needed that could be manufactured in any size. "Fortunately, we found a good one," said Rosa Gwinn, AECOM's Americas PFAS Lead.

A patent was filed and AECOM subsequently funded two prototypes to test samples supplied by clients. The first was called NEMO because it was the size of a fish tank. Like the little orange fish that won hearts in the 2003 Disney classic, NEMO was capable of great things: by direct electron transfer and free radical reactions, the reactor destroyed the PFAS. Buoyed by the results, the team progressed to tests on real world samples, then moved out of the lab to conduct pilots in the field including at multiple US Department of Defense (DoD) sites under grants awarded by the Strategic Environmental Research and Development Program and U.S. Air Force Broad Agency Announcement.

Ongoing trials are providing encouraging results for creating a full-scale solution for spent firefighting foam, industrial wastewater, remedially-derived waste, and source area groundwater. AECOM's technology has demonstrated it can successfully destroy between 95 percent and 100 percent of the PFAS influent mass in complex, real-life samples.

At the same time, regulations are evolving, posing new challenges for the environmental and infrastructure industries. Because of their historic widespread use, PFAS have touched many parts of our businesses and social communities. Regulations protecting human health and the environment from the potentially harmful effects of PFAS are becoming increasingly stringent. This could continue as additional scientific information regarding the many thousands of PFAS is collected — particularly in Europe where regulation and enforcement is evolving, with stricter rules anticipated.

"The potential is enormous," said Rick Parkman, who is leading AECOM's PFAS offering in Europe, Middle East and Africa. "We are proud to have developed a technology which could have such a huge benefit to society."

To date, AECOM has invested heavily in an economical solution to PFAS contamination which crucially can be used onsite. Having worked on more than 400 PFAS projects globally, and successfully managed two of Australia's precedent setting PFAS investigations, the destructive treatment technology (DE-FLUORO™) AECOM is developing is at the forefront of efforts to destroy these potentially toxic chemicals.

Casson described working on DE-FLUORO™ as a "once in a lifetime opportunity."

"Overall, I feel so blessed to have been supported by AECOM and the team," she said. "I don't expect to get the keys to such an amazing project ever again." WL