SMART WATER WATCH

Allonnia's protein breakthrough brings commercial PFAS sensor a step closer

With the US EPA decimating its health advisory limits for PFOA and PFOS, all eyes are on detection methods to catch up. As biotechnology firm Allonnia makes its latest sensor breakthrough, GWI finds out how it seeks to revolutionise PFAS monitoring.

In July 2022, the US-based biotechnology specialist Allonnia announced the discovery of a game-changing protein that can accurately and quickly detect PFOA (a type of PFAS) down to parts per trillion levels. The US EPA's publication of an unexpectedly stringent new health advisory on PFAS levels in drinking water has underscored a need for accurate detection of low concentration PFAS compounds that is greater than ever before. Yet to date, there is no automated sensor commercially available that can meet this need.

Currently, analysis for these harmful and persistent contaminants is done using complex laboratory samples which take several days to yield results. "One of the big challenges with PFAS is you have low concentrations in huge volumes of water," explained Kent Sorenson, chief technology officer at Allonnia. This makes accurate detection very difficult.

After screening over a trillion proteins, Allonnia has identified one which shows strong binding potential to PFOA, enabling detection down to single digit parts per trillion in purified water. In partnership with a hardware provider, Allonnia is working on creating a portable, hand-held device that combines this protein with electrochemical sensing to produce a quantitative measurement in close to real-time. As water passes across a chip with the target protein tethered to its surface, the specific PFAS compounds will attach themselves to the proteins. An electrical signal then goes through the chip to indicate how many of the proteins have PFAS compounds attached to them.

Using a prototype, Allonnia will be starting field testing with environmental consultants at the end of 2022 and then move to testing at utilities towards the middle of 2023. This testing period will enable Allonnia to better assess the pretreatment steps that will be needed to remove contaminants that might interfere with PFAS detection, primarily those found in wastewater. Commercial launch is scheduled for 2023.

PFOA is a priority for detection in drinking water. "PFOA is particularly interesting because when water is being treated with granular activated carbon (GAC) or ion exchange (IX) resin, PFOA is one of the first widely-regulated molecules to break through. Detecting PFOA at low concentrations can really inform the change out timing, for GAC or IX," Sorenson explained. PFOS and PFHxS are also priorities for monitoring, while the EPA's latest guidance includes health advisories for further shorter-chain compounds, PFBS and GenX.

However, the new health advisories for PFOS and PFOA go as low as parts per quadrillion (*see GWI July 2022, p20*), which are challenging to detect in laboratories, let alone using automated sensing. "We'll want to try to meet whatever the market demands are over time but if we can get the parts per trillion levels with multiple compounds, we'll be pretty excited in the near term," commented Sorenson in response to this development. Aside from the US, Allonnia anticipates that countries with highest immediate demand for the sensor will include Australia, Sweden and Denmark, followed by the rest of Europe.

"The places where the biosensor is going to make the biggest impact, both financially and in terms of strategic decision making and regulatory compliance, are going to be those where routine PFAS monitoring is required," explained Sorenson, referencing utilities, remediation sites and environmental consultants. There is potential to use the sensor not only for drinking water but also wastewater. "It'll be useful for wastewater utilities to understand if there is PFAS contaminated water entering their plant so that they can make sure the water is getting treated before it gets to them," he commented.

Allonnia is not alone in creating a PFAS sensor. Pacific Northwest National Laboratory in Washington State is taking a different approach to detect PFOS, using microfluidics rather than proteins. This proprietary lab-on-a-chip sensor is also able to detect PFOS levels down to parts per trillion and is currently available for licensing. For both sensors, affordability will likely be a priority. "Using the biosensor approach, I think we have a very good chance of being able to detect the individual PFAS compounds with sensitivity relatively inexpensively," claimed Sorenson.

As for next steps, Allonnia has two immediate priorities. Firstly, to assess how specific the protein is in the presence of other compounds that have a similar structure to PFOA. Secondly, to evaluate how sensitive the protein is in the presence of more complex groundwater samples, and therefore the pretreatment required for different water qualities. Allonnia is continuing to screen proteins for binding potential for other PFAS compounds and in the long-term is looking to partner with more local distributors, particularly in Europe (especially the UK) and Australia. ■

SENSING OPPORTUNITY

CTO Kent Sorenson is confident that Allonnia's biosensor can pave the way for rapid and cost-effective PFAS detection.

Source: Allonnia