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PFC contamination rises up the agenda for embattled US municipal water sector

As water utilities in the US weather the lead crisis fallout, many communities are also facing the thorny issue of groundwater supplies contaminated with toxic perfluorinated chemicals. Technology providers are sizing up the opportunities for tailor-made solutions.

Groundwater supplies contaminated with toxic perfluorinated chemicals (PFCs) have become a growing area of concern in the municipal water sector in the US, driven in part by mainstream media coverage of drinking water quality issues, federal and state regulatory initiatives, and legal cases against leading chemical manufacturers.

The announcement by the US Air Force earlier this month that it intends to spend $2 billion to clean up sites contaminated by PFCs derived from fire-fighting foams provides some indication of the potential price tag associated with remediation efforts – and the scale of the opportunity for water treatment equipment manufacturers.

On the back of widely reported contamination cases such as Hoosick Falls, NY, the attention surrounding PFCs was brought into sharper focus this year when the EPA took the decision to lower its drinking water lifetime health advisory level for the two most common PFCs – perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) – to a maximum combined limit of 0.07 µg/L (from 0.4 µg/L and 0.2 µg/L, respectively).

"Prior to the health advisory, the limits for PFOA/PFOS were in the hundreds of parts per trillion," Nora Stockhausen, vice president at Calgon Carbon, told GWI. "When the limit was reduced to 70 parts per trillion in May, it caught a lot of utilities off guard."

As a result of these more stringent guidelines, scores of sites across the US are now exceeding the health advisory levels. Data gathered as part of the EPA's third Unregulated Contaminant Monitoring Rule (UCMR3), conducted between 2013 and 2015, identify 50 public water systems with PFOA/PFOS concentrations in excess of 0.07 µg/L (*see map below*).

In addition to fire-fighting foams, PFCs are used for applications such as non-stick coatings, and their high solubility in water means that they have been prone to leaching into groundwater. Although the EPA has worked alongside chemical manufacturers such as DuPont and 3M to gradually phase out production, areas surrounding industry discharge points have been the main focus of contamination to date.

More recently, however, military fire-fighting test sites have also been drawn into the fray – the Department of Defense announced earlier this year that it is investigating 664 sites across the country for potential contamination resulting from fire-fighting foam runoff.

Although this appears to imply a widespread issue, observers have stressed that contamination will ultimately remain a localised concern.

"While [PFCs] are very stable molecules and their plumes tend to spread, contamination will likely be limited to locations surrounding chemical manufacturing sites and military bases, or where those chemicals are used, such as in carpet manufacturing areas in Georgia," Shalene Thomas, emerging contaminants programme manager at Amec Foster Wheeler, told GWI.

That said, the attention surrounding the issue has continued to drive public awareness and regulatory action. While the EPA advisories do not amount to enforceable regulations, John Lombardo, product manager at Evoqua, expects a maximum contaminant level (MCL) for PFOS/PFOA to emerge under the federal Safe Drinking Water Act (SDWA) at some point in the future.

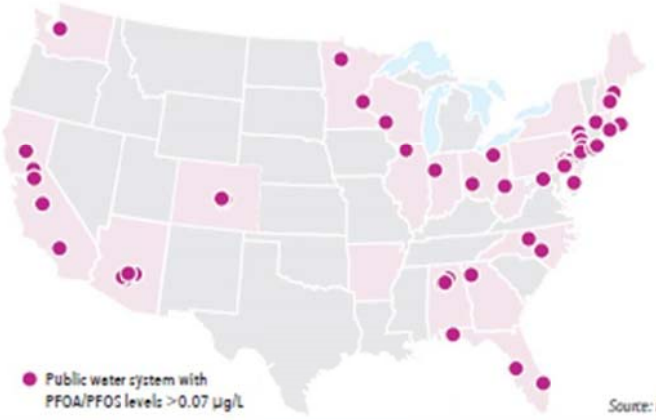
"Even in places where [PFCs] are showing up below the combined advisory limit, municipalities and water purveyors are taking proactive steps, because they realise it's only a matter of time before [PFOA and PFOS] become an MCL," Lombardo told GWI. "They are reading the writing on the wall."

In the meantime, some states are beginning to take matters into their own hands. In August, New Jersey announced that it is considering lowering its own advisory limit to 14 parts per trillion (from 0.4 µg/L), and that this may form the basis for an enforceable MCL. Elsewhere, New York has had a temporary PFOA and PFOS ruling in place since April 2016 while it works to finalise a rule for full implementation.

Additionally, with other states adopting more stringent ambient groundwater quality criteria for PFCs – such as New Hampshire last month – remediation efforts are ▶

MAPPING LOCALISED CONTAMINATION

The EPA's UCMR3 identifies 50 public water systems exceeding PFOA/PFOS health advisory levels. However, as the data is primarily derived from systems serving populations greater than 10,000, the scale of the issue among small utilities and private groundwater wells remains far from clear.



Source: EPA

also likely to expand into the realm of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or Superfund, a federal programme introduced in 1980 to clean up sites contaminated with hazardous substances. This could unlock additional funding for PFC remediation projects.

"The SDWA has definitely pushed things along in the water utility environment, but from a groundwater contamination perspective it's really just the tip of the iceberg," Amec Foster Wheeler's Thomas told GWI. "Moving forward, we're starting to see a shift now into the Superfund remediation realm."

Increased attention on the presence of PFCs in groundwater has resulted in a greater level of interest among affected communities in the available treatment options. To date, granular activated carbon (GAC) has been the primary treatment method, though ion exchange (IX) and reverse osmosis (RO) are recognised alternatives.

Although experts agree that adsorptive processes such as GAC and IX are likely to remain the primary means of treating PFCs going forward, questions have been raised about the efficacy of existing technologies when treating shorter-chain PFCs such as perfluorohexanoic acid (PFHxA) and perfluorobutanesulfonic acid (PFBS).

Whereas PFOA and PFOS are longer-chain compounds consisting of more than six carbon molecules, shorter-chain counterparts include by-products created in the manufacturing process, as well as alternative materials which have been adopted following the phasing out of PFOA and PFOS. Although less prevalent than the longer-chain PFCs, these short-chain compounds also pose health implications, though the EPA has not yet issued advisories for their limits in drinking water. The treatment of shorter-chain PFCs has been shown to present additional challenges.

"What we have found is that activated carbon works well for the longer-chain compounds, but the shorter chains break right through," Gary Birk, managing partner at groundwater remediation technology firm Tersus Environmental, told GWI.

Likewise, Shalene Thomas explained that the results of a bench- and pilot-scale test carried out by Amec Foster Wheeler and technology company ECT2 demonstrated that the GAC and IX technologies being applied were unable to remove shorter chain compounds to satisfactory levels.

Both Calgon Carbon and Evoqua told GWI that they are carrying out internal investigations into the effectiveness of their existing products. Tersus, meanwhile, is distributing Ziltek's RemBind technology – a powdered reagent combining activated carbon and aluminium hydroxide – which the company claims is more effective at treating shorter-chain PFCs than GAC.

"Most of our emphasis in the past fifteen years has been on PFOA and PFOS," Calgon Carbon's Stockhausen explained. "With some of the next generation replacement materials now being the shorter-chain compounds, those have also become of interest." ■