

Science for Environment Policy

Disinfection by-products in drinking water: new detector may meet need for monitoring and detection of broader range of DBP classes, Sweden

The presence of disinfection by-products (DBPs) in drinking water is an emerging health concern. DBPs come in many classes and are chemically diverse, making them challenging to monitor. Swedish researchers have evaluated a new method for the simultaneous determination of a broader range of DBPs than typically possible using other available techniques. The method uses gas chromatography (a laboratory technique that separates and analyses vaporisable compounds in a mixture), together with a halogen-specific detector (XSD). Having been tested in real water samples from two municipal waterworks in Sweden, the method has been optimised for the simultaneous determination of a wide range of neutral DBPs.

As climate change and an expanding population place pressure on the world's water supply, disinfectants are increasingly being used to produce clean drinking water. However, chemical disinfectants can react with natural organic matter, anthropogenic contaminants, bromide or iodide present in the source water, resulting in unwanted DBPs. This is a cause of public health concern as DBPs may pose a risk to human health, with some compounds having carcinogenic, mutagenic (genetic mutation-causing) and genotoxic (genetic damage-causing) properties.

To date, over 600 DBPs have been identified. Of these, trihalomethanes (THMs) and haloacetic acids (HAAs) have received the most attention and been subject to the most regulation. [The EU regulates total THMs and bromate¹](#) in drinking water while [the USA regulates levels of THMs, HAAs and bromate](#). However, in recent years, there has been [growing interest](#) in the health risks posed by unregulated DBPs and emerging DBPs which, despite being found in lower concentrations, are often more toxic and so may represent a larger public health concern. According to [a recent review](#), the majority of analytical methods currently used in routine monitoring can only determine one or two classes of DBPs. The development of new methods capable of simultaneously detecting several classes could facilitate the monitoring of a broader range of DBPs.

One recently developed method combines gas chromatography with XSD to achieve this goal. The method, designed for the detection of halogenated DBPs, has high selectivity and specificity for halogens. Halogenated DBPs exist across a wide spectrum of DBP classes, including regulated DBPs, e.g. THMs and HAAs, unregulated DBPs, e.g. halo ketones (HKs), and emerging DBPs, e.g. haloacetonitriles (HANs) and halonitromethanes (HNMs).

To evaluate the effectiveness of the method, researchers attempted to use it to simultaneously monitor a range of halogenated DBPs of interest to the Swedish waterworks, including neutral DBPs (THMs, HANs, HKs and HNMs) and acidic HAAs. Initial laboratory experiments produced promising results, but demonstrated that the method is not appropriate for the simultaneous determination of HAAs and THMs since some HAA methyl esters degrade in the process, producing false THM positives.

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1. Drinking water — essential quality standards, summary of: [Directive 98/83/EC — quality of water intended for human consumption](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3AI28079) <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3AI28079>

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Therefore the method was further evaluated for the simultaneous determination of neutral DBP classes only, using real drinking water samples from two Swedish waterworks. Overall, a broad spectrum of neutral halogenated DBPs were successfully detected, with the method allowing detection down to $0.05 \mu\text{g L}^{-1}$. Importantly, both regulated DBPs and unregulated (but toxicologically important) DBPs could be detected using this method.

As knowledge of the effects of unregulated and emerging DBPs develops, it may be necessary to update regulations to ensure the routine monitoring and detection of a broader range of DBP classes. If this is to be achieved, there is a need for analytical methods that can simultaneously detect several classes of DBPs in an affordable and reliable way. According to the researchers, this method meets these criteria, being easy to operate and, early results indicate, likely to provide sufficiently high selectivity and specificity for routine DBP monitoring. However, additional testing and confirmation are required.

