Application Note AN-PAN-1049

Online determination of bromate and other disinfection byproducts in drinking & bottled water with IC

In the past, drinking water disinfection was carried out by chlorination until it was discovered in the 1970s that disinfection byproducts (DBPs) such as carcinogenic trihalomethanes are formed during this process. Therefore, scientists searched for alternative disinfection techniques to minimize the amount of harmful compounds created.

The promising alternative to chlorination is UV light treatment or ozonation, a chemical water treatment technique based on the infusion of ozone (O_3) into water. This produces reactive oxygen species able to attack a wide range of organic compounds and all microorganisms. Unlike chlorine, O_3 leaves no harmful chlorinated byproducts in the water, and quickly reverts to pure oxygen if unused.

In most cases, the raw water being processed contains chloride and bromide. The latter is known to oxidize to the carcinogenic and nephrotoxic compound bromate (BrO_3^-), which is an inorganic DBP. Considering this health risk, health and environmental protection agencies like the World Health Organization (WHO) and the European Union have recommended a concentration limit of 10 µg/L of BrO_3^- in drinking water.

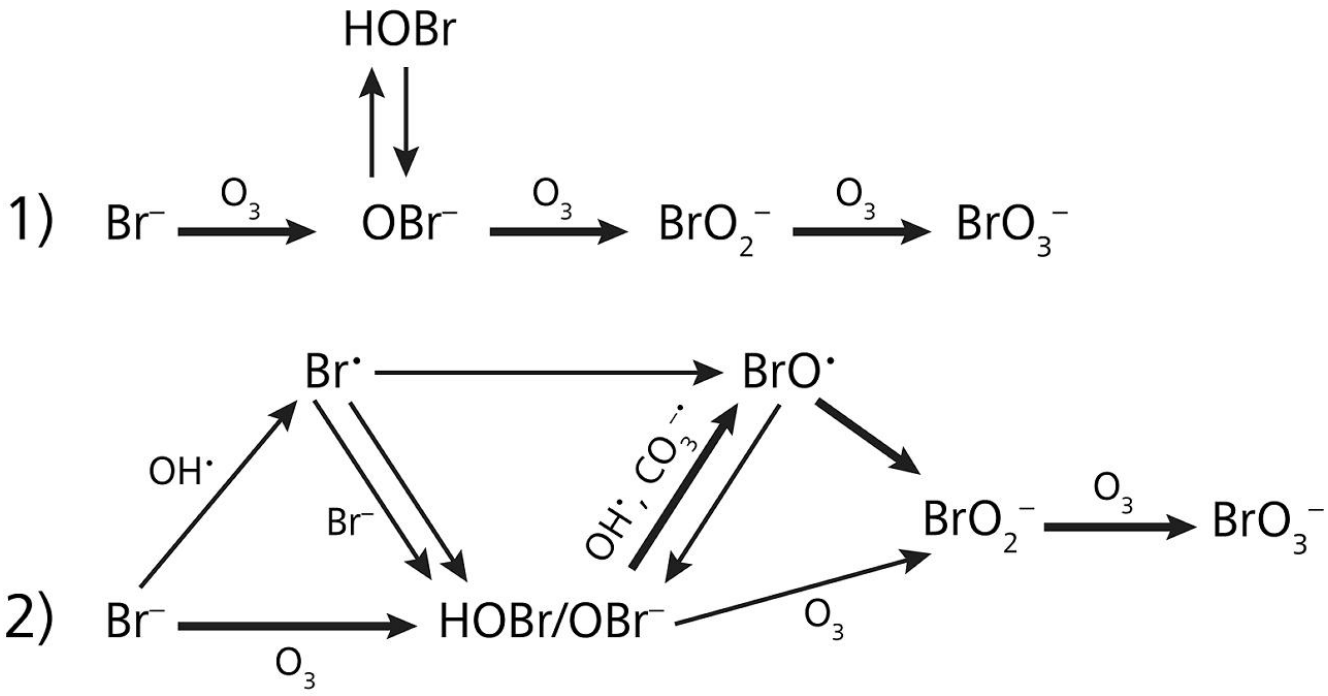

Figure 1. Mechanisms for the formation of bromate during ozonation.

The determination of DBPs such as bromate is crucial for drinking water utilities and beverage bottling companies. To determine trace levels of BrO3- in drinking water, ion chromatography is the foremost mentioned analytical method in standards and literature.

The 2060 Ion Chromatograph (IC) Process Analyzer from Metrohm Process Analytics is ideal for several accepted methods such as EPA 300.1, 317.0, 321.8, 326.0, ASTM D6581, ISO 11206, and ISO 15061. It is able to continuously measure and monitor bromate and other anions in drinking water at a µg/L level. Automated calibration guarantees excellent detection limits, a high reproducibility, and superior recovery rates.

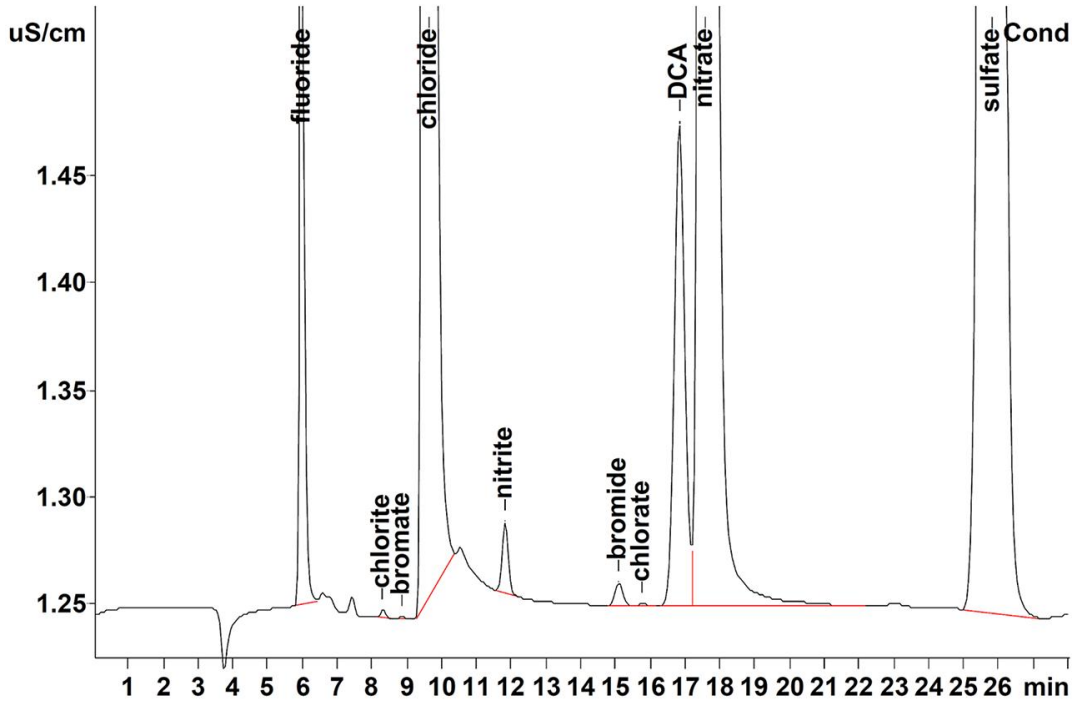

Figure 2. Example chromatogram of bromate and other anions in drinking water.

APPLICATION

Drinking water samples can be analyzed according to methods such as EPA 300.1, 317.0, 321.8, 326.0, ASTM D6581, ISO 10304-4, ISO 11206, and ISO 15061 with Metrohm Inline Sample Preparation (MISP) techniques for extra application flexibility. Analyte detection is by conductivity or UV/Vis.

The drinking water stream is sampled frequently, giving up-to-date information about the bromate concentration. The 2060 IC Process Analyzer can provide an alarm if pre-set warning or intervention concentration limits are reached, helping to save costs by preventing the release of an out-ofspecification production batch of bottled water that then would require an expensive public recall. One 2060 IC has the possibility to connect to up to 20 sample streams, meaning multiple bottling lines or parts of the purification process could be monitored for impurities by a single instrument, saving time and money.

The 2060 IC Process Analyzer can run for extended periods in less-frequented areas, as there is adequate space in the reagent cabinet for reagents, ultrapure water and/or prepared eluent. Contactless reagent level sensors ensure that you are always alerted when liquid levels are low. By choosing a built-in eluent production module and optional PURELAB® flex 5/6 from ELGA® for continuous pressureless ultrapure water supply, the 2060 IC Process Analyzer can be configured to run even trace analyses, such as for bromate, autonomously.

Figure 3. The 2060 IC Process Analyzer is available with either one or two measurement channels, along with integrated liquid handling modules and several automated sample preparation options. This configuration is depicted with two measurement channels (conductivity) and an optional ELGA PURELAB® flex 5/6.

REMARKS

ISO 11206 (reference AN-U-051) involves a postcolumn reaction with potassium iodide, followed by detection in the UV range. This improves the sensitivity for BrO_3^- as compared to EPA 300.1, ISO 10304-4, and ISO 15061. With this method, the European maximum limit of 3 µg/L for bromate in natural mineral and spring waters disinfected by ozonation can be met.

The 2060 IC Process Analyzer can also be configured to measure other oxyhalides, anions, and cations according to ISO 10304-1, ISO 14911, ASTM D4327, and ASTM D6919.

BENEFITS FOR IC IN PROCESS

- **Online eluent preparation** ensures consistently stable baselines
- **Ensure regulatory compliances** for safe drinking water
- **Automated sampling and calibration** to guarantee excellent detection limits, a high reproducibility, and superior recovery rates
- **High precision analyses** for a wide spectrum of analytes with multiple types of detectors

FURTHER READING

Related application notes

TA-004 Trace determination of bromate in water

AN-S-047 Bromide and sulfate in a pharmaceutical product

AN-U-051 Trace bromate in drinking water – Determination according to ISO 11206

AN-M-015 Trace haloacetic acids, dalapon, and bromate in water – Determination as per US EPA 557 applying IC-MS/MS

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