



Application Note AN-PAN-1049

用离子色谱法在线测定饮用水和瓶装水中的溴酸盐及其他消毒副产品

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 $10\text{ }\mu\text{g/L}$ of BrO_3^- in drinking water.

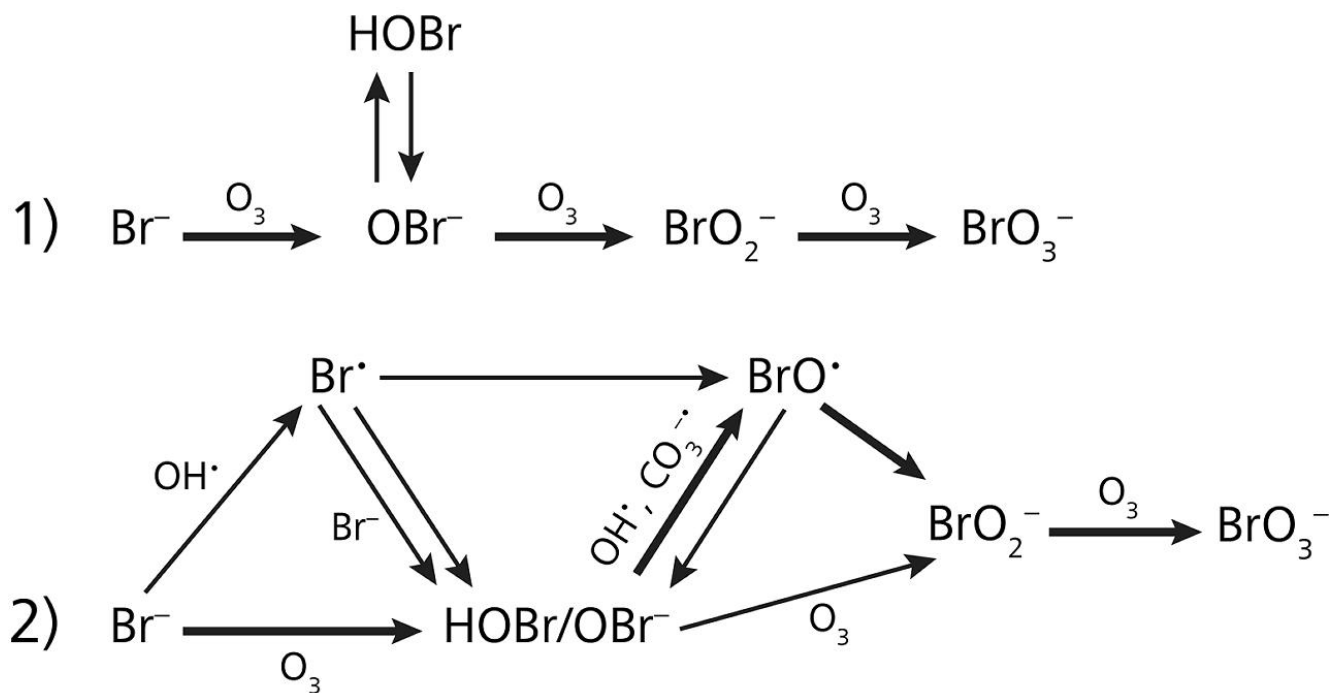


Figure 1. Mechanisms for the formation of bromate during ozonation.

The determination of DBPs such as bromate is crucial for drinking water utilities and beverage bottling companies. To determine trace levels of BrO_3^- 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 $\mu\text{g/L}$ level. Automated calibration guarantees excellent detection limits, a high reproducibility, and superior recovery rates.

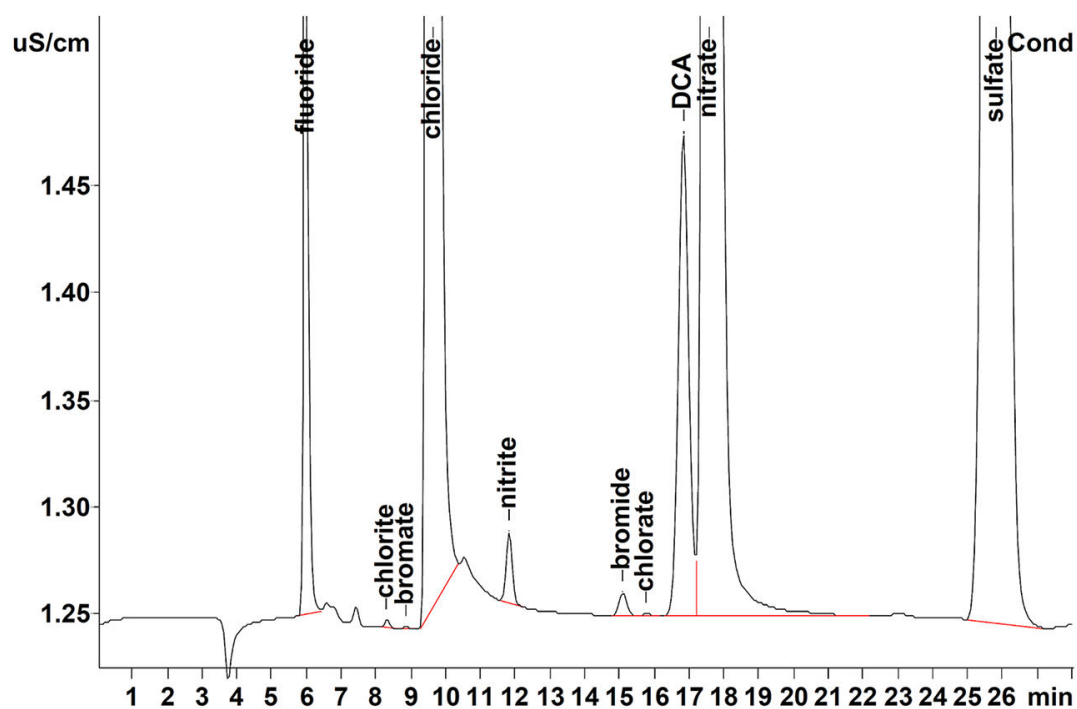


Figure 2. Example chromatogram of bromate and other anions in drinking water.

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-of-specification 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.

ISO 11206 (reference [AN-U-049](#)) 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

$\mu\text{g/L}$ 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.



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.

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

[AN-S-047 Bromide and sulfate in a pharmaceutical product](#)

[AN-U-049 Analysis of bromate in drinking water according to ISO 11206 and EPA 317 – Enhancing precision and sensitivity for trace](#)

[bromate detection with IC-UV/VIS](#)

[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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CONFIGURATION



2060 IC Process Analyzer

Metrohm Process Analytics 的 2060 Ion Chromatograph (IC) Process Analyzer 基于模块化 2060 平台概念。这种模块化的体系结构可将机柜分开在工厂周围的不同位置,并可连接多达 20 个样本流,从而可在工厂内部的多个区域进行省时的顺序分析。

此分析仪在硬件、软件和应用定制方面没有限制。从连续淋洗液生成模块、用于样品预滴定的取样部模块以及多个 IC 检测池,2060 IC Process Analyzer 具有任何工业应用需要的所有选项。

2060 软件是一种 "多合一" 软件解决方案,可控制分析仪执行常规分析,并有不同的操作方法、时间表和趋势图。此外,由于过程通信协议多种多样(例如 Modbus 或 Discrete I/O),可对 2060 软件进行编程,以向过程发送自动反馈和警报,并必要时采取行动(例如,重新测量样品或开始清洁周期)。所有这些功能可确保每周 7 天全天候对工业过程进行全自动诊断。