ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

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Oxyhalide Disinfection by-products

Disinfection by-products are formed when chemicals used in water treatment react with halides and/or the natural organic matter present in the raw water. The inorganic *'oxyhalide'* group of disinfection by-products for which regulations have generally been established in drinking water (including bottled water), are Bromate, Chlorate and Chlorite. ALS is now NATA accredited for the analysis of these chemicals to extremely low levels.

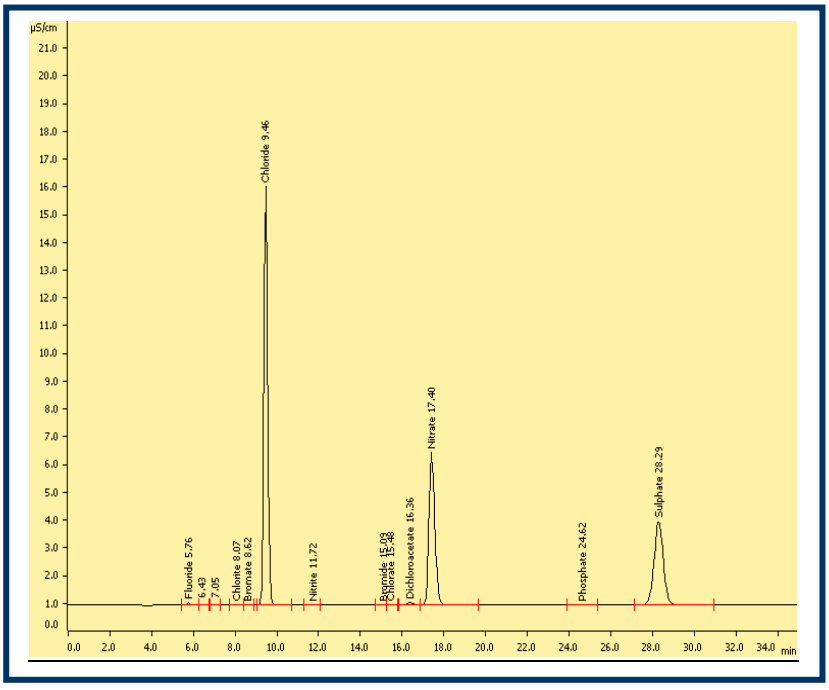
Background

The disinfection process is used to improve water quality and prevent the spread of water born pathogens that cause disease such as dysentery, cholera, typhoid and gastroenteritis. Disinfection is generally a final step in a treatment plant and different disinfectants produce different types or amounts of by-products.

Chlorination is the most commonly used disinfectant process because of its safeness, reliability and cost effectiveness. This process however can lead to the formation of Trihalomethanes (THMs), Chlorate and Chlorite. Concern over the toxicity of THMs has lead to the development of ozonation plants, which can disinfect water without generating THMs. Unfortunately ozonation can generate both Chlorate and Bromate from the Chloride and Bromide in raw water. Studies have indicated that the toxicity of Bromate exceeds that of total THMs.

Oxyhalide Analysis at ALS

ALS NATA Accredited methodology for Oxyhalide analytes utilises Ion Chromatography and follows protocols documented in USEPA 300.1 Rev-1.0 (1997). In order to exceed the regulatory detection levels especially for Bromate, ALS uses state of the art chemical suppression technology. This provides very low background – over 20 times lower than reported for USEPA method 300.1. A typical chromatograph is shown opposite.



Right solutions….
….Right partner

Regulatory Limits

Drinking water limits for these Oxyhalides have been established to protect human health. These thresholds and ALS limits of reporting (LOR) are shown below.

ANALYTE	NHMRC (2004)	USEPA (1998)	WHO (2008)	ALS LOR
Bromate	20µg/L	10µg/L	10µg/L	**5µg/L**
Chlorate	N/A	N/A	700µg/L	**5µg/L**
Chlorite	300µg/L	1000µg/L	700µg/L	**5µg/L**

General Sampling and Preservation Requirements

Ethylenediamine (EDA) is the primary preservative. EDA preserves chlorite by chelating iron as well as any other catalytically destructive metal cations and also removing hypochlorous acid/hypochlorite ion by forming an organochloroamine. EDA also preserves the integrity of chlorate which can increase in unpreserved samples as a result of chlorite degradation. In addition EDA preserves the integrity of bromate by binding with hypobromous acid/hypobromite which is an intermediate formed as a by-product of the reaction of either ozone or hypochlorous acid/hypochlorite with the bromide ion. If hypobromous acid/hypobromite is not removed from the matrix further reactions may form bromate ion.

Recommended holding times and sample preservation is detailed below:

ANALYTE	PRESERVATION	HOLDING TIME
Chlorite	50 mg/L EDA* in 40mL amber glass vials cooled to 4°C	14 Days
Bromate & Chlorate		28 Days

Note 1: Bromide analysis can be performed on the same 40mL vial as Oxyhalides or on the unpreserved green plastic bottle.

Note 2: Iodide analysis requires a separate unpreserved green plastic bottle and is often associated with this suite of analyses.

Logistics

Samples should be packed appropriately in an esky and submitted via the ALS Laboratory Group Network. For further details please contact ALS Sydney on (02) 8784 8555, or your local ALS Office.

References:

NHMRC – National Water Quality Management Strategy: Australian Drinking Water Guidelines (2004)
USEPA – National Primary Drinking Water Regulations: Disinfectants and Disinfection by-Products (1998)
WHO – Guidelines for Drinking Water Quality: Third Edition (2008)
Australian Guidelines for Water Recycling – Managing Health and Environmental Risks: Phase 1 (2006)