APPLICATION NOTE

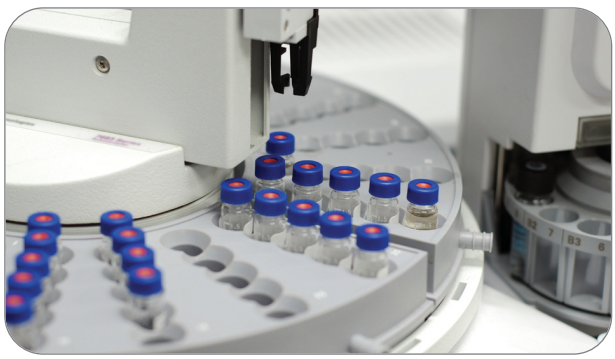
Type I ultrapure water essential for GC-MS analysis of volatile and semi-volatile organic compounds

Abstract

Gas chromatography (GC) is a technique commonly used in analytical chemistry for the separation of volatile, thermally stable molecules. It is typically used to establish the purity of a particular substance, or to separate, and if required quantify, the different components of a mixture. Combining GC with mass spectrometry (MS) provides the analyst with a versatile, highly sensitive and specific technique, gas chromatography mass spectrometry (GC-MS), with the capability to positively identify an unknown compound. GC-MS is the method of choice for the analysis of organic compounds that are volatile (VOCs) or semi-volatile (SVOCs) in water, and the assays are extremely sensitive and require the highest purity laboratory water in order to produce high quality mass spectral data.

Introduction

The presence of VOCs – carbon-based molecules that have significant vapour pressure at room temperature – in ground water is a concern, because of their association with health problems and they can be released into the environment where they can also migrate into the drinking water supply chain. Water, soil, soil gas and air are routinely analysed for VOCs and SVOCs, usually by GC or GC-MS.



Although GC / GC-MS methods do not generally use a lot of water, the analysis of aqueous samples may require the use of water in sample pretreatment, such as solid phase extraction, for the preparation of reagent blanks and standards, or for rinsing glassware. As GC-MS is an extremely sensitive technique, the quality of the water used for sample preparation is critical, with very low levels of total organic carbon (TOC) required[1-3]. Organic compounds – particularly VOCs and SVOCs – present in water used in the preparation of samples for GC-MS may cause an increase in background noise, with sensitivity and selectivity affected as a result, and extraneous or enlarged peaks.

Water should also be free from bacteria, which can degrade some VOCs and produce organic byproducts which could interfere with the analysis of volatile organic compounds. Chlorine may react with, and degrade, some VOCs, particularly aromatic compounds, while particulates can cause injector and column blockages.

Purifying water for GC-MS

Because GC-MS is highly sensitive, purified water is recommended for the preparation of all blanks and standards, and any sample pretreatments[4]. Very low levels of total organic carbon are essential, and ELGA's PURELAB® Ultra Analytic type I ultrapure water – with a typical resistivity of 18.2 MΩ.cm, a very low TOC value of less than 2 ppb and bacteria levels below 0.1 CFU/ml – is highly recommended.

Ultraviolet (UV) radiation

Passing water through a beam of ultraviolet light from a low pressure mercury discharge can break down organic compounds. A wavelength of 185 nm produces highly oxidising species which effectively break down and oxidise carbon-containing molecules, yielding ionised fragments for subsequent removal by ion exchange, whereas longer wavelength UV radiation (254 nm) disrupts the activity of bacterial enzymes, preventing replication. To maximise breakdown of organic molecules, the PURELAB Ultra Analytic uses a full spectrum UV lamp.

Media

The media cartridges in the PURELAB Ultra Analytic contain synthetic, activated carbon beads, which remove chlorine and adsorb a wide variety of organic compounds. Additionally, high purity ion exchange resins minimise the release of impurities.

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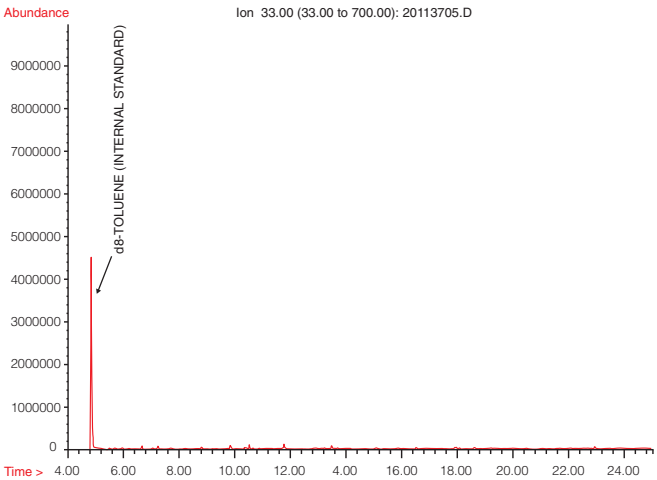

Figure 1: Analysis of SVOCs by GC-MS. Chromatogram of type I ultrapure water (ELGA's PURELAB Ultra Analytic)

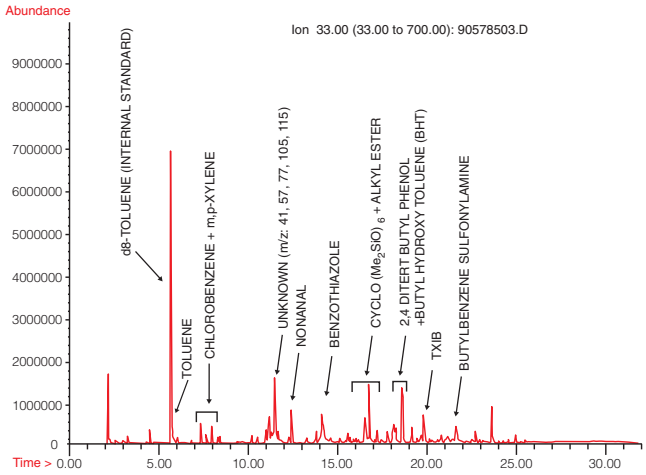

Figure 2: Analysis of SVOCs by GC-MS. Chromatogram of type II pure water (ELGA's PURELAB Pulse)

The extremely high sensitivity of GC-MS and the need to use type I ultrapure water is illustrated above. Figures 1 and 2 show the GC-MS data from, respectively, Type I ultrapure water and Type II pure water obtained by thermal desorption GC-MS (TD-GC-MS).

The type I ultrapure water from a PURELAB Ultra Analytic showed no peaks approaching the reporting limit of 25 ppt. The Type II pure water from ELGA's PURELAB Pulse showed the presence of a number of SVOCs at 33 ppt or less.

Conclusion

Type I ultrapure water with high resistivity (>18.2 MΩ.cm) and very low TOC should be used for sample preparation in all trace GC-MS applications to ensure good chromatographic performance and high quality mass spectral data.

To find out more about ELGA LabWater's water treatment technologies and solutions for analytical applications, visit **www.elgalabwater.com**

References

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2. Whitehead, P. (2003). Application Note: Laboratory Monitoring of Total Organic Carbon in Ultrapure Water American Laboratory 35 (17), 20-24.
3. Why monitor TOC in ultrapure water for laboratories http://www.water-purification-filters.com/12021-tap-water-and-filters.html
4. ASTM Standard Guide for Bio-applications Grade Water D 5196-06.

About ELGA LabWater

ELGA LabWater manufactures supplies and services laboratory, healthcare and clinical water purification systems. ELGA offices and distributors are located in more than 60 countries worldwide. ELGA is the global laboratory water brand name of Veolia Water Solutions & Technologies.

ELGA is an integral part of Veolia Water Solutions and Technologies. Veolia Water Solutions & Technologies (VWS), subsidiary of Veolia Water, is a leading design & build company and a specialized provider of technological solutions in water treatment. With over 9,500 employees in 57 countries, Veolia Water Solutions & Technologies recorded revenue of €2.15 billion Euros in 2010.

Veolia Water, the water division of Veolia Environment, is the world leader in water and wastewater services. Specialized in outsourcing services for municipal authorities, as well as industrial and service companies, Veolia Water provides water service to 95 million people and wastewater service to 66 million. With 96,260 employees in 66 countries, its 2010 revenue amounted to €12.1 billion.

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