APPLICATION NOTE

ELGA VEOLIA

The key to sensitive, reproducible ion chromatography – Type I ultrapure water

Abstract

Ion chromatography (IC) is a form of liquid chromatography that is used to separate atomic or molecular ions for qualitative or quantitative analysis. As scientists demand ever more rapid analyses with smaller sample volumes, ultrapure water plays a key role in maintaining the sensitivity and reproducibility of IC applications.

Introduction

Ion chromatography has maintained its popularity due to its relative simplicity and good reliability and utility. An ion exchange-based stationary phase is used to retain analyte ions which are eluted sequentially for detection, typically by electrical conductivity. Anion or cation exchange or ion exclusion may be used[1], although anion exchange chromatography is the most widely used IC technique. IC has a broad range of applications, which include bioanalysis, geochemistry[2] and environmental analysis, and the water, pharmaceutical, food and beverage[3] and power industries.

When pre-concentration techniques are used, IC is capable of providing detection down to ppt levels and providing results in a matter of minutes. With such a low limit of detection, the use of Type I ultrapure water for all aspects of IC – sample dilution, preparation or pre-treatment, preparation of blanks and standards and as an eluent – is essential[4,5], as any impurities present in the water can interfere with the analysis in a number of ways (Figure 1). All IC manufacturers confirm that poor quality water is the major source of non-instrumental problems in ion chromatography.

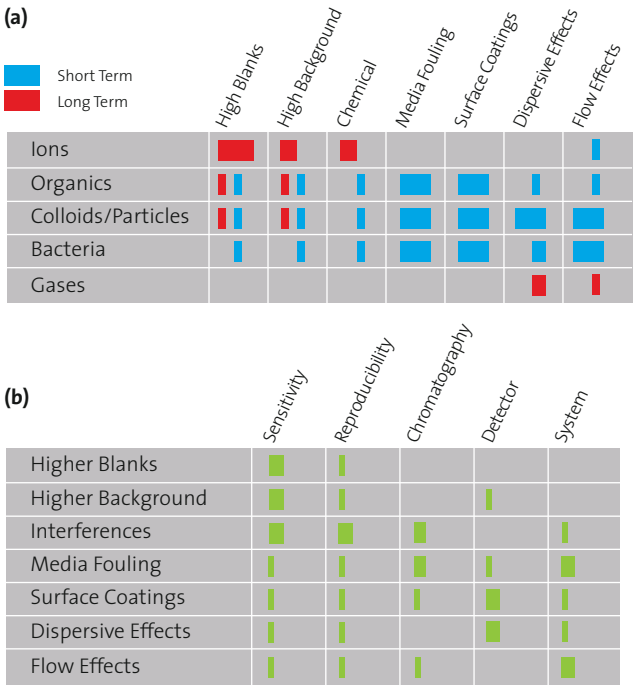

Figure 1: The effect of water impurities on ion chromatography: (a) the effect on the system and (b) the subsequent potential impact on experimental results. The size of the area in each box indicates the significance of each effect (qualitative)[4].

Ions

Trace levels of ions can interfere directly with IC analysis (Figure 2), resulting in artificially high sample concentrations, inaccurate calibrations or an increase in blank signal. Ionic compounds may also contaminate the mobile phase, leading to distorted or negative peaks.

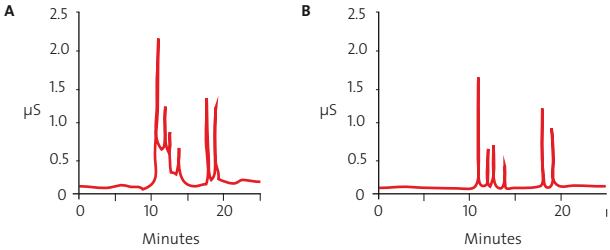

Figure 2: The effect of ionic contaminants from water on baseline, integration and resolution: (A) poor water quality and (B)Type I (18.2 MΩ.cm) water[4].

Organic compounds

Organic compounds can cause higher background and blank values. They may have an affinity for the column media – reducing the column lifetime and modifying elution times – or they may form a surface coating that can affect the detector or the inner surfaces of the system itself. Additionally, some charged organics, such as ammonium and carboxylate, may interfere with the analysis by forming complexes with the inorganic ions being monitored, and plasticisers can leach from plastic tubing or containers during storage.

Bacteria

Like organic compounds, bacteria may cause an increase in background and blank values, or have a longer term effect on columns and instrumentation through media fouling and surface coating. They can also release inorganic ions and small organic acids – which may interfere with the analysis – and behave as particulates, causing an increase in column back pressure.

Particulates and colloids

Particulates and colloids can cause an increase in column back pressure, and may affect the pumps. Colloids, like bacteria and organic compounds, increase background and blank values and may also cause problems through media fouling and surface coating.

Dissolved gases

During storage, oxygen, nitrogen and carbon dioxide dissolve in water. Dissolved carbon dioxide generates weakly acidic carbonic acid, altering the pH of the mobile phase, which can cause variations in elution time. The weak anion produced may also reduce the capacity of anion exchange resins.

Purifying water for IC

With pre-concentration, IC can provide detection limits down to low ppt, requiring the use of high quality ultrapure water for the preparation of all reagents, standards, blanks and samples[7] (Table 1). Type I water from ELGA's PURELAB® Ultra Analytic, with resistivity 18.2 MΩ.cm, a very low total organic carbon (TOC) value of less than 2 ppb and bacteria levels < 0.1 CFU/ml, is preferred. ELGA's award winning PURELAB flex, with resistivity 18.2 MΩ.cm, a TOC of less than 5 ppb and bacteria levels below 0.1 CFU/ml, is suitable for all other IC applications.

Impurity	Routine IC	Trace and ultra-trace IC
Ions	Low ppb (g/l)	Low ppt (ng/l)
Organics	< 200 ppb	< 10 ppb
Bacteria	< 10 CFU/ml	< 1 CFU/ml
Particles	0.2 m filter	0.2 m filter
Gases	<< saturation	<< saturation

Table 1: Water purity required for ion chromatography[4].

In producing purified water suitable for IC, the key requirements are passage through a reverse osmosis membrane and the highest purity ion exchange resins. Ultraviolet (UV) radiation will also reduce levels of organic contaminants and bacteria.

Reverse osmosis

The semi-permeable membranes used in reverse osmosis (RO) remove a very wide range of water contaminants. They remove in excess of 95 % of ionic contamination, organic contamination with molecular weight typically over 200 and virtually all particulate contamination, including bacteria.

Media

The media cartridges in the PURELAB Ultra Analytic and PURELAB flex contain high purity synthetic, activated carbon beads, which adsorb a wide variety of organic compounds, and the highest purity ion exchange resins to ensure removal of ions and minimise the release of impurities.

Filtration

Point-of-use filtration removes any particles, macromolecules and bacteria which may have been introduced during purification. ELGA's PURELAB flex combines high capacity purification cartridges to minimise particle release, with point-of-use filters for effective particle control.

Ultrapure water on demand

Additionally, the use of freshly produced ultrapure water is a key asset in preventing the introduction of contaminants during water storage.

Conclusion

Contaminants of all kinds can have an impact on IC applications, particularly for trace level analysis. A water purification system capable of generating Type I ultrapure water with high resistivity (18.2 MΩ.cm), free from particulates, bacteria, organic and ionic compounds is essential to guarantee the ionic and organic purity of the water and ensure accurate, sensitive and reproducible IC results.

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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About ELGA LabWater

ELGA manufactures supplies and services water purification systems for use in laboratories, healthcare and clinical environments and has been a trusted brand for over 75 years. Water qualities meet the requirement specifications for general laboratory, healthcare and clinical grades of water. ELGA offices and distributors are located in more than 60 countries worldwide. ELGA is the global laboratory water brand name of Veolia.

Veolia is the global leader in optimized resource management. With over 200,000 employees* worldwide, the company designs and provides water, waste and energy management solutions that contribute to the sustainable development of communities and industries. Through its three complementary business activities, Veolia helps to develop access to resources, preserve available resources, and to replenish them. Veolia Water Technologies specializes in technological solutions and design and build projects for water and wastewater treatment, serving industrial and municipal clients.

In 2013, Veolia supplied 94 million people with drinking water and 62 million people with wastewater service, produced 86 million megawatt hours of energy and converted 38 million metric tons of waste into new materials and energy. Veolia (Paris Euronext: VIE and NYSE: VE) recorded revenue of €22.3 billion* in 2013.

For more information please visit

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