



HICHROM

Chromatography Columns and Supplies

LC COLUMN SELECTION Ion Chromatography Phases

Catalogue 9

Hichrom Limited

1 The Markham Centre, Station Road
Theale, Reading, Berks, RG7 4PE, UK

Tel: +44 (0)118 930 3660 Fax: +44 (0)118 932 3484

Email: sales@hichrom.co.uk www.hichrom.co.uk

Introduction

Ion chromatography (IC) is a special form of ion-exchange chromatography developed as a means of separating the ions of strong acids and bases. The most important form of ion chromatography involves a combination of specific ion-exchange phases with conductivity detection. It is a sensitive technique, in some cases being able to detect ppb levels of ions.

Suppressed or Non-Suppressed Detection

Eluents used in IC contain a relatively high level of salt ions and therefore exhibit high conductivity. This leads to a high background signal which could inhibit the detection of low level analytes. Suppression of eluent conductivity post column is necessary for efficient detection of sample ions and is the most common method for anion analyses. Although isocratic elution is more commonly used, the use of suppressors enables gradient elution to be used for complex samples.

Phases

Silica and polymer based phases are available for anion and cation analyses. Silica based columns, although showing better efficiency, have a limited pH range. As a result, they are not compatible with anion IC methods requiring suppressed detection, due to the high pH of the eluents required. Polymer based materials are stable over a wider pH range and have higher capacities.

Tables 1 and 2 show typical base materials and bonding for anion and cation chromatography phases respectively. The majority of phases for anion chromatography are bonded with quaternary ammonium groups, with a permanent cationic charge. For cation chromatography phases, sulphonate is the most common functionality. Columns optimised for non-suppressed IC generally have lower capacity than those for suppressed detection, in order to achieve a relatively low background conductivity. They are therefore not suitable for suppressed detection.

Eluents

The choice of eluent for IC depends on whether the method is suppressed or non-suppressed. For suppressed anion IC, carbonate/bicarbonate or hydroxide are the most common eluents. Hydroxide eluents have the advantage of producing water only in the suppressor and thereby giving a very low background conductivity. However, some phases are not stable at the high pH (12) of this eluent. For non-suppressed anion IC analyses, typical eluents include p-hydroxybenzoic acid and phthalic acid. Typical eluents for suppressed and non-suppressed cation IC include HCl, HNO₃, tartaric acid and succinic acid.

Applications

High sensitivity ion analyses are important in a wide spectrum of industries including pharmaceutical, food, water, semiconductor etc. In addition to the common inorganic anions eg. F⁻, Cl⁻, NO₂⁻, NO₃⁻, SO₄²⁻, acid salts can also be analysed by IC eg. formate, acetate. Quantitative analysis of anions at the ppb level can be achieved. Cation chromatography is used for the separation and detection of Group I and II metal ions, in addition to some transition metal ions, ammonium ions and ethanolamines. Small ions are generally eluted before larger ions and monovalent ions before di- and trivalent ions.

Table 1. Anion Chromatography Phases

Base Material	Functional Group	Typical pH Range
Silica	Quaternary ammonium	2 – 5.5
Polystyrene-divinylbenzene	Quaternary ammonium	2 – 12
Polymethacrylate	Quaternary ammonium	2 – 10
Polyvinyl alcohol	Quaternary ammonium	3 – 12

Table 2. Cation Chromatography Phases

Base Material	Functional Group	Typical pH Range
Silica	Carboxylate, sulphonate	2 – 7
Silica	Polybutadiene/maleic acid coating	2 – 7
Polystyrene-divinylbenzene	Sulphonate	2 – 12

A selection of ion chromatography columns can be found in the following sections:

Hamilton page 130
MCI GEL page 171
Shodex page 212

Please contact Hichrom for advice on further IC column selection.

Please see page 355 for details of the SAMS membrane suppressor for IC.