DIONEX

IONPAC® NS1 REVERSED PHASE POLYMERIC COLUMN

The IonPac NS1 column is an ethylvinylbenzene/divinylbenzene (EVB/DVB) reversed-phase column. This column is ideal for ion-pair or ion suppression separations of hydrophobic ionizable compounds such as organic acids and surfactants. This column can also be used to perform reversed-phase separations. The polymeric nature of the column permits use of acids, bases, and solvents in the eluent.

Now sold under the Thermo Scientific brand

Thermo SCIENTIFIC

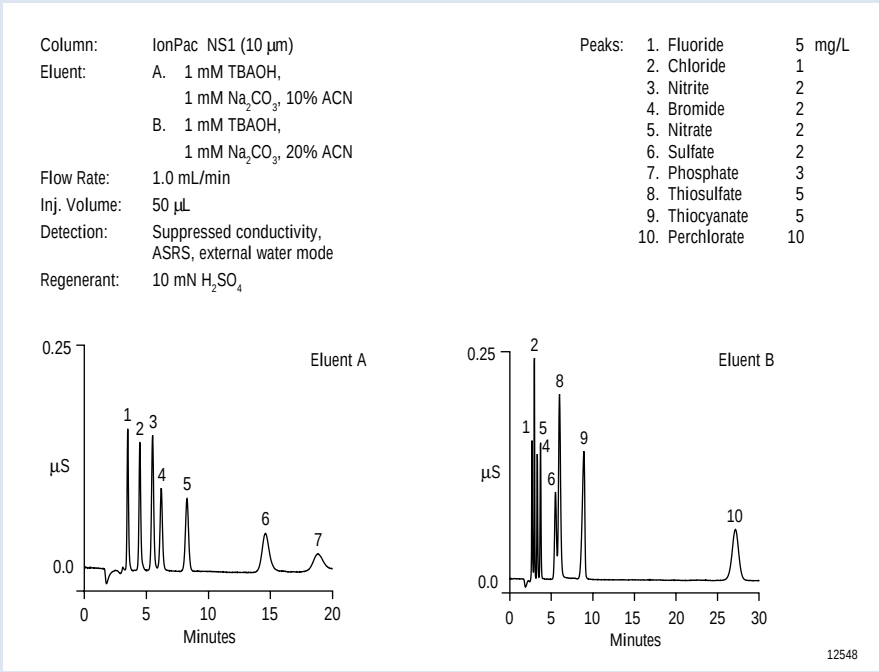


Figure 1 *Determination of inorganic anions by ion-pair chromatography.*

REVERSED-PHASE OR ION-PAIR CHROMATOGRAPHY

The NS1 column is ideal for Mobile Phase Ion Chromatography (MPIC), which combines ion-pair chromatography with suppressed conductivity detection. This combination can be used to determine high molecular weight ionic analytes that are difficult to separate using ion-exchange chromatography.

VERSATILE DETECTION

Suppressed conductivity detection improves the detection limits for acids or bases by reducing the eluent conductance and maximizing analyte conductance. Alternatively, the NS1 can easily be coupled with UV detection for aromatic molecules.

KEY APPLICATIONS

- High MW aliphatic carboxylic acids
- Anionic and cationic surfactants
- Alkyl sulfates and sulfonates
- Aromatic sulfates and sulfonates
- Quaternary ammonium ions
- Water-soluble vitamins
- Sulfur oxides
- Metal cyanide complexes
- Phenols
- Alkanolamines

WIDE pH RANGE

The IonPac NS1-10 µm and NS1-5 µm columns are packed with durable EVB crosslinked with 55 percent DVB. The wide pH range of the IonPac NS1-10 µm and NS1-5 µm columns permits the use of eluents from pH 0 to 14. These columns are ideally suited for ion-pair and ion-suppression reversed-phase chromatography—the two techniques that extend reversed-phase chromatography to ionizable compounds. The NS1-10 µm column is used for routine MPIC separations.

The NS1-5 µm column is packed with high-efficiency 5-µm diameter resin for more resolving power and greater sensitivity.

ION-PAIR CHROMATOGRAPHY

Ion-pair chromatography using the IonPac NS1 column is an excellent alternative for analytes that are difficult to separate by ion-exchange chromatography. The IonPac NS1-10 µm and NS1-5 µm columns have been designed for high solvent resistance, making them ideal for solvent gradient separations in the reversed-phase mode. These columns are ideally suited for reversed-phase separation of ionic and nonpolar organic compounds simultaneously.

Ion pairing can be used as an alternative to ion exchange for the separation of inorganic anions. Figure 1 illustrates the analysis of seven common inorganic anions along with more hydrophobic anions, including thiocyanate, thiosulfate, and perchlorate. Retention times of these analytes can be changed by adjusting the solvent concentration of the eluent.

The mechanism of ion pairing is illustrated in Figure 2. This example illustrates the process of cation ion pairing on the NS1 column. An acetonitrile/water eluent containing octanesulfonic acid as the ion-pair reagent is used in this example. The cations in the sample are retained by the degree of interaction with the octanesulfonate ions in the hydrophobic resin region and also by their interaction with the ion-pairing ions in solution. The neutral EVB/DVB resin can be used either for anion or cation analysis by selecting the approriate ion-pair reagent.

Typical ion-pair reagents for ion-pair chromatography using the IonPac NS1 are:

- For anion analysis: ammonium and tetramethyl-, tetraethyl-, tetrapropyl-, and tetrabutyl-ammonium hydroxides.
- For cation analysis: hydrochloric, perchloric, and perfluorocarboxylic acids; pentane-, hexane-, heptane-, and octanesulfonic acids.

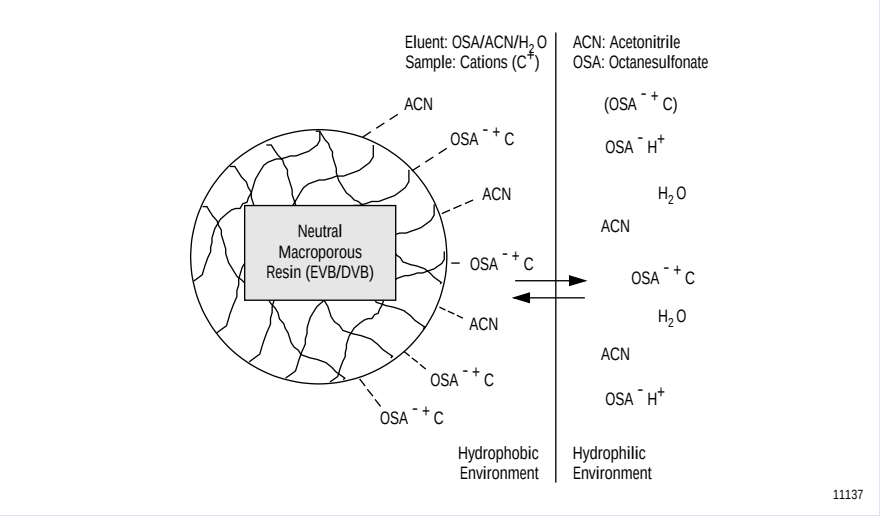


Figure 2 *Mechanism of cation ion-pairing interactions.*

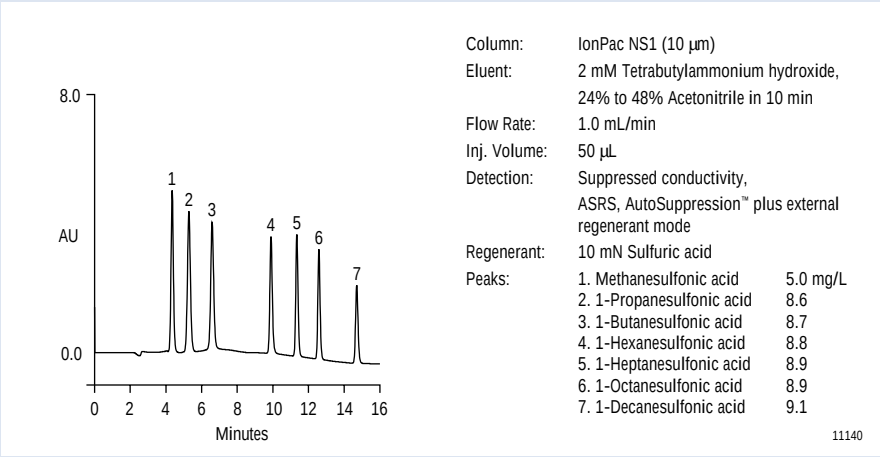


Figure 3 *Separation of aliphatic sulfonic acids using tetrabutylammonium ion as the ion-pair reagent.*

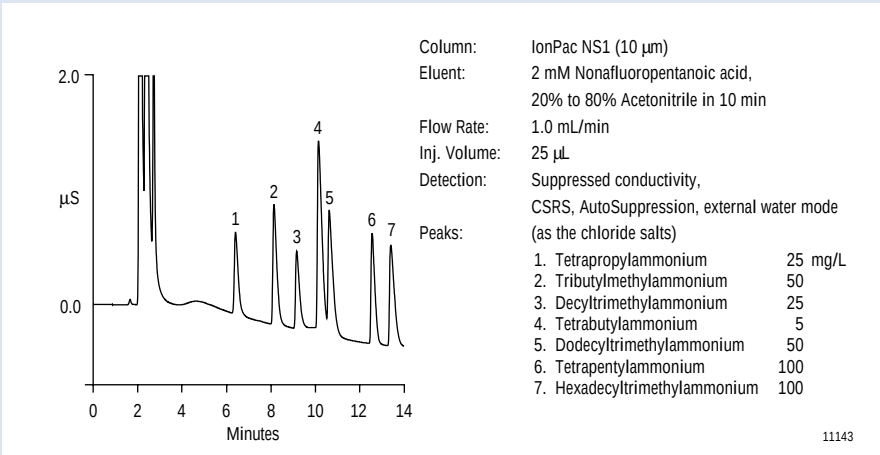


Figure 4 *Determination of aliphatic quaternary ammonium ions using nonafluoropentanoate ion as the ion-pair reagent with an acetonitrile gradient.*

SEPARATE SURFACTANTS AND QUATERNARY AMINES WITH MPIC

MPIC is a good technique for the determination of ionic surfactants and quaternary ammonium compounds in detergents and other matrices. Figures 3 and 4 illustrate the analysis of these compounds using ion-pair chromatography with suppressed conductivity detection.

Aliphatic compounds, which are often nonchromophoric, can easily be determined using MPIC. When combined with ion-pair chromatography, suppressed conductivity is a sensitive, universal detection mode for analytes such as aliphatic carboxylic acids, sulfonic acids, and quaternary ammonium ions. For aromatic acids or bases, UV detection provides optimum sensitivity.

As illustrated in Figure 5, MPIC can be used by food and cosmetics manufacturers for the determination of additives such as alkanolamines. In the pharmaceutical industry, the technique can be used for a variety of nonchromophoric, ionic species.

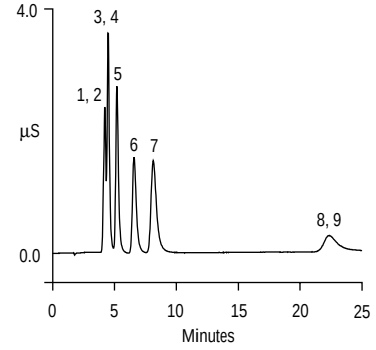
USE THE NS1 COLUMN FOR ION SUPPRESSION

Ion suppression is a technique used to suppress the ionization of weak acids to enhance reversed-phase retention. As illustrated in figures 6 and 7, ion suppression can be used to separate a variety of compounds, including aliphatic carboxylic acids and substituted benzoic acids.

CHEMICAL SUPPRESSION WITH CONDUCTIVITY DETECTION

Anion-MPIC

The eluent suppressor used for anion-MPIC is the Dionex ASRS, which is designed to suppress ammonium or tetraalkylammonium ion-pair reagents as well as to suppress conventional anion-exchange eluents. The eluent suppressor used for cation-MPIC is the Dionex CSRS, which can also be used to suppress conventional cation-exchange eluents.



Column: IonPac NS1 (10 µm)
Eluent: 2 mM Nonafluoropentanoic acid/2% Acetonitrile
Flow Rate: 1.0 mL/min
Inj. Volume: 25 µL
Detection: Suppressed conductivity, CSRS, AutoSuppression plus external regenerant mode
Regenerant: 10 mN Boric acid

Peaks:		
	1. Lithium	5.0 mg/L
	2. Sodium	2.0
	3. Ammonium	5.0
	4. Potassium	5.0
	5. Monoethanolamine	25
	6. Diethanolamine	50
	7. Triethanolamine	100
	8. Calcium	50
	9. Magnesium	2.5

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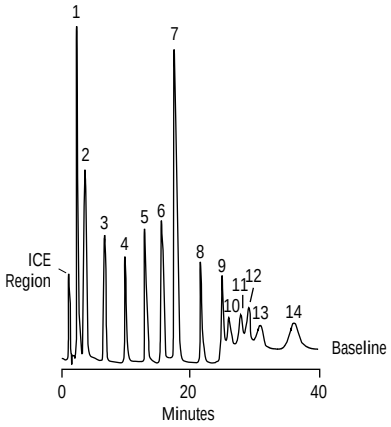
Figure 5 *Separation of alkanolamines on the NS1 column using ion pairing with suppressed conductivity detection.*



Column: IonPac NS1(10 µm)
Flow Rate: 1.0 mL/min
Eluent 1: 24% ACN, 6% MeOH, 0.03 mM HCl
Eluent 2: 60% ACN, 24% MeOH, 0.05 mM HCl
5 mM Octanesulfonic acid,
Gradient: 0 – 100% E2 in 20 min.
Detection: Suppressed conductivity, AMMS-ICE Suppressor
Temp: 42 °C

Peaks:		
	1. Butyric	8. Dodecanoic
	2. Pentanoic	9. Tetradecanoic
	3. Hexanoic	10. Linolenic
	4. Heptanoic	11. Linoleic
	5. Octanoic	12. Hexadecanoic
	6. Nonanoic	13. Oleic
	7. Decanoic	14. Octadecanoic

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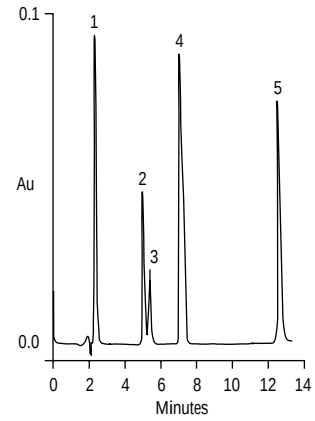
Figure 6 *Determination of aliphatic carboxylic acids using the IonPac NS1 column.*



Column: IonPac NS1 (5 µm)
Eluent Conditions: 3.0 mM Hydrochloric acid
32% to 48% Acetonitrile in 10 min.
Flow Rate: 1.0 mL/min.
Detection: UV, 254 nm
Peaks:
1. *p*-Aminobenzoic acid
2. *o*-Nitrobenzoic acid
3. Benzoic acid
4. *p*-Nitrobenzoic acid
5. *p*-Bromobenzoic acid

3379

Figure 7 *Determination of substituted benzoic acids using ion-suppression chromatography.*

Using the ASRS, the water regenerant undergoes electrolysis to form hydronium ions.

The hydronium ions neutralize the basic eluent, while ion-pair counterions of the basic eluent or sample move across the membrane to waste. The result of this suppression process is a sample of anions paired with highly conductive hydronium counterions resulting in optimum conductance in a water eluent.

In anion-MPIC, the quaternary ammonium counterions have a very high affinity for the cation-exchange membrane. The sulfuric acid regenerant is added to effectively displace the quaternary ammonium ion-pair reagent from the membrane, lowering the resistance in the suppressor.

Cation-MPIC

The Cation Self-Regenerating Suppressor (CSRS) operation is very similar to the ASRS. The CSRS is used for the neutralization of acidic eluents containing anionic ion-pair reagents.

Ion Suppression

The AMMS-ICE Suppressor is used for the acidic eluents used in ion suppression chromatography of organic acids. Potassium hydroxide is typically used as the regenerant for the AMMS-ICE suppressor. The AMMS-ICE contains cation-exchange membranes, which exchange the hydronium ion of the acids for potassium ion, thus causing complete ionization of the acids and allowing conductivity detection of the analytes.

SPECIFICATIONS

Analytical Column Dimensions
IonPac NS1-10 µm, 4 x 250 mm
IonPac NS1-5 µm, 4 x 150 mm

Guard Column Dimensions
IonPac NG1-10 µm, 4 x 35 mm

Maximum Operating Pressure:
<27.6 MPa(<4000 psi)

Mobile Phase Compatibility:
pH 0–14; 1–100% HPLC solvents

Column Construction:
PEEK with internal style 10-32 threaded ferrule-style end fittings. All components are nonmetallic.

Substrate Characteristics:
Particle Diameter: 5 and 10 µm
Crosslinking (%DVB): 55%
Hydrophobicity: High

ORDERING INFORMATION

In the US, call 1-800-346-6390 or contact the Dionex Regional Office nearest you. Outside the US, order through your local Dionex Office or Distributor. Refer to the part numbers below.

Analytical and Trap Columns

IonPac NS1-10 µm Analytical Column
(for routine MPIC determinations)
(4 x 250 mm) ..... P/N 35321

IonPac NG1-10 µm Guard Column
(4 x 35 mm) ..... P/N 39567

IonPac NS1-5 µm Analytical Column
(for high resolution MPIC determinations)
(4 x 150 mm) ..... P/N 39568

IonPac ATC-1 Anion Trap Column
(for anion gradient operation)
(9 x 24 mm) ..... P/N 37151

IonPac CTC-1 Cation Trap Column
(for cation gradient operation)
(9 x 24 mm) ..... P/N 40192

Suppressors

ASRS (4-mm) Anion Self-Regenerating Suppressor for anion ion pairing ..... P/N 43189

CSRS (4-mm) Cation Self-Regenerating Suppressor for cation ion pairing ..... P/N 43190

AMMS-ICE Micromembrane Suppressor for anion ion suppression .... P/N 37107

MMS/SRS External Regenerant Kit ..... P/N 38018

Ion Pairing Reagents

Tetrabutylammonium Hydroxide, 500 mL 0.1 M TBAOH (MPIC-AR1) ..... P/N 35360

Tetrapropylammonium Hydroxide, 500 mL 0.1 M TPAOH (MPIC-AR2) ..... P/N 35363

Hexanesulfonic Acid, 500 mL 0.1 M HSA (MPIC-CR1) ..... P/N 35361

Octanesulfonic Acid, 500 mL 0.1 M OSA (MPIC-CR2) ..... P/N 35362

Regenerant Reagents

Anion Regenerant Solution, for MPIC, 4 x 200 mL 0.5 N H_2SO_4 20X concentrate ..... P/N 37164

Dionex Corporation
1228 Titan Way
P.O. Box 3603
Sunnyvale, CA
94088-3603
(408) 737-0700

Dionex Corporation
Salt Lake City Technical Center
1515 West 2200 South, Suite A
Salt Lake City, UT
84119-1484
(801) 972-9292

Dionex U.S. Regional Offices
Sunnyvale, CA (408) 737-8522
Westmont, IL (630) 789-3660
Houston, TX (713) 847-5652
Smyrna, GA (770) 432-8100
Marlton, NJ (609) 596-0600

Dionex International Subsidiaries
Belgium (015) 203800 *Canada* (905) 844-9650 *France* (1) 39 46 08 40 *Germany* (06126) 991-0 *Italy* (6) 66030052
Japan (06) 885-1213 *The Netherlands* (076) 57 14 800 *Switzerland* (062) 205 99 66 *United Kingdom* (01276) 691722
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