IonPac NS2 Columns

for separations of ionic species by RP-MPIC

The Thermo Scientific™ IonPac™ NS2 is a unique silica-based reversed-phase column designed for Mobile-Phase Ion Chromatography (MPIC) and compatibility with suppressed conductivity detectors. The separation of moderately to strongly hydrophobic organic ions such as ionic surfactants, quaternary amines and sulfonic acids, or the separation of multiple-charged ions requires MPIC for successful separation. Most ion chromatography columns are designed for the separation of small hydrophilic ions. The IonPac NS2 provides the performance, reliability, resolution and needed versatility to ionic analytes of moderate to high hydrophobicity.

MPIC is a technique where a moderately-hydrophobic MPIC agent in the eluent provides retention for oppositely-charged analyte ions on a hydrophobic column, and then the MPIC is removed by the suppressor to provide selective, sensitive detection of the analytes.

Compounds separated using the IonPac NS2 column:

- Analysis of hydrophobic amines
- Analysis of hydrophobic acids
- Analysis of amines

Hydrophobic Cations

Hydrophobic amines such as tetra-alkylammonium salts, cationic surfactants, and synthetic intermediates pose a unique challenge to ion chromatography (IC). The IonPac NS2 column when used with an anionic ion-pairing agent in the eluent provides the flexibility to adjust the ion-exchange capacity and hydrophobic retention to obtain the best selectivity. Chemical-mode suppression is compatible with a broad range of solvents, and is ideal for this separation mode.

Figure 1 shows the separation of a variety of common quaternary ammonium compounds separated using the IonPac NS2 column with suppressed conductivity detection. Quaternary ammonium surfactants are used as antimicrobial agents, phase-transfer catalysts, cleansers, and preservatives. Suppressed conductivity is selective for this class of surfactants, and provides good sensitivity.

An anionic ion-pairing acid in the eluent enhances retention of cations on the hydrophobic column; the ion-pairing acid is then later removed by the suppressor. Such acids include trifluoroacetic acid (TFA), heptafluorobutyric acid (HFBA), hexanesulfonic acid (HSA), and octanesulfonic acid (OSA). Retention and selectivity can be controlled by type and concentration of ion-pairing acid, organic solvent, and ionic strength.

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Hydrophobic Acids

Hydrophobic acids such as anionic surfactants and perfluorinated acids pose a similar set of challenges for ion chromatography. The IonPac NS2 column either with or without an ion-pairing agent in the eluent provides the retention for hydrophobic acids. Sodium borate is used to improve the peak shape and selectivity. Smaller, less hydrophobic acids can be retained by using an ion-pairing base such as tetrabutylammonium borate or tetrapropylammonium borate in the eluent. Chemical-mode suppression provides the selectivity. Conductivity detection provides the sensitivity.

Figure 2 shows the separation of perfluoro-octanoic acid (PFOA) and perfluoro-octanesulfonic acid (PFOS) using the IonPac NS2 column with suppressed conductivity detection. Perfluorinated acids (PFOS and PFOA) were once widely used in consumer products and as a processing aid for PTFE. They are persistent environmental contaminants that magnify through the food chain. Suppressed conductivity is selective for these strong acids and provides good sensitivity. Many common anionic surfactants are retained and detected under similar conditions.

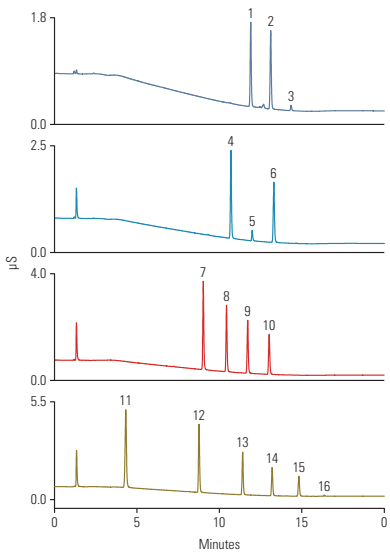
Analysis of Amines

Amines include biogenic amines such as spermine and aminoglycoside antibiotics such as gentamicin. They are often too hydrophilic for reversed-phase LC methods and too highly charged for standard IC methods. The IonPac NS2 column provides the flexibility to fine-tune the ion-exchange capacity and hydrophobicity to give better separations.

Figure 3 shows the separation of ethylamine, ethylenediamine, diethylenetriamine and triethylenetetramine using the IonPac NS2 column. Since these are very hydrophilic, they are retained mainly by reversed-phase ion pairing mode.

Reproducible Manufacturing

To meet the exact needs of our customers, each IonPac NS2 column is manufactured to stringent specifications to ensure column-to column reproducibility. Each column is shipped with a lot validation sheet showing the test results and specifications for the lot of bonded silica packed into the column. In addition, each column is individually tested and shipped with an individual test chromatogram validating the column performance, with respect to selectivity, retention, and efficiency.

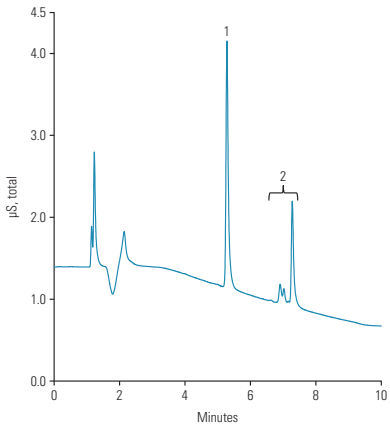


Column:	**IonPac NS2**			
Dimensions:	5 µm, 4.0 × 150 mm (PEEK)			
System:	Thermo Scientific™ Dionex™ ICS-3000 Ion Chromatography System			
Mobile Phases:	A: Acetonitrile			
	B: 25 mM trifluoroacetic acid			
	C: Water			
Gradient 1:	-8.0	0.0	14.0	20.0
%A	5	5	80	80
%B	4	4	4	4
%C	91	91	16	16
Flow Rate:	0.80 mL/min			
Inj. Volume:	5 µL			
Temp.:	25 °C			
Detection:	Suppressed conductivity			
Suppressor:	CMMS-4mm; 0.05M TBAOH at 3 mL/min			

Peaks:

1. C_{12} Bz Me_2 N+
2. C_{14} Bz Me_2 N+
3. C_{16} Bz Me_2 N+
4. C_{12} pyridinium
5. C_{14} pyridinium
6. C_{16} pyridinium
7. C_{10} Me_3 N+
8. C_{12} Me_3 N+
9. C_{14} Me_3 N+
10. C_{16} Me_3 N+
11. $(C_3H_7)_4N+$
12. $(C_4H_9)_4N+$
13. $(C_5H_{11})_4N+$
14. $(C_6H_{13})_4N+$
15. $(C_7H_{15})_4N+$
16. $(C_8H_{17})_4N+$

Figure 1: Quaternary ammonium surfactants separation

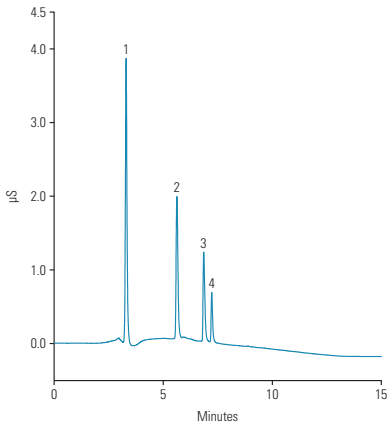


Column:	**IonPac NS2**			
Dimensions:	5 µm, 4.0 × 150 mm (PEEK)			
System:	ICS-3000 Ion Chromatography System			
Mobile Phases:	A: Acetonitrile			
	B: 20 mM sodium hydroxide + 100 mM boric acid (pH 8.5)			
	C: Water			
Gradient :	-8.0	0.0	7.0	10.0
%A	25	25	50	50
%B	50	50	50	50
%C	25	25	0	0
Flow Rate:	0.80 mL/min			
Inj. Volume:	10 µL			
Temp.:	25 °C			
Detection:	Suppressed conductivity			
Suppressor:	AMMS-4mm; 0.02 N sulfuric acid at 2 mL/min			
Sample:	Standards 50 µg/mL in 50% methanol			

Peaks:

1. Perfluorooctanoic acid
2. Perfluorooctanesulfonic acid

Figure 2: Perfluorinated acids using IonPac NS2 with acetonitrile gradient



Column:	**IonPac NS2**			
Dimensions:	5 µm, 4.0 × 150 mm (PEEK)			
System:	ICS-3000 Ion Chromatography System			
Mobile Phases:	A: Acetonitrile			
	B: 10mM heptafluorobutyric acid			
	C: Water			
Gradient:	-7	0	11	16
%A	5	5	60	60
%B	20	20	20	20
%C	75	75	20	20
Flow Rate:	0.80 mL/min			
Inj. Volume:	5 µL			
Temp.:	25 °C			
Detection:	Suppressed conductivity			
Suppressor:	CMMS-4 mm; 0.05M TBAOH at 3 mL/min			

Peaks:

1. Ethylamine
2. Ethylenediamine
3. Diethylenetriamine
4. Triethylenetetramine

Figure 3: Separation of polyamines using MPIC

Specification and Operating Conditions

Operating pH Range:	2.0–10.0 (2.5–9.0 recommended for maximum life)
Operating Temperature	< 50 °C
Operating Pressure	< 4000 psi
Flow Rate	< 1.2 mL/min
Storage Solution	Acetonitrile
Aqueous Compatibility	0–100% aqueous mobile phase
Organic Compatibility	Fully compatible with common HPLC solvents except for acetone and THF

Ordering Information

Description	Part Number
IonPac NS2, Analytical, 5 µm, 4 × 250 mm	088786
IonPac NS2, Analytical, 5 µm, 4 × 150 mm	088787
IonPac NG2, Guard, 5 µm, 4 × 35 mm	088788

Accessories and Reagents

Description	Part Number
Hexanesulfonic acid MPIC agent for cation analysis, 0.1 M, 500 mL	035361
Octanesulfonic acid MPIC agent for cation analysis, 0.1 M, 500 mL	035362
Tetrapropylammonium hydroxide MPIC agent for anion analysis, 0.1 M, 500 mL	035363
Tetrabutylammonium hydroxide MPIC agent for anion analysis, 0.1 M, 500 mL	035360
Tetrabutylammonium hydroxide regenerant concentrate for cation suppressors, 2.06 M, 500 mL	057561
Reagent delivery system for chemical mode suppression or external water mode suppression	038018

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