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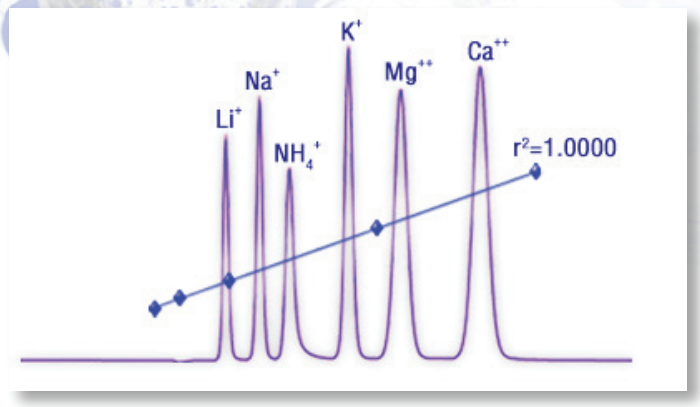
PRODUCT SPECIFICATIONS



Thermo Scientific Dionex SC-CERS 500 Salt Converter-Cation Electrolytically Regenerated Suppressor

Expanded capabilities in ammonium and amine detection

Benefits

- Broadened ammonium and amine linearity
- Increased ammonium and amine sensitivity

Keywords

Electrolytic suppression, process waters, semiconductor industry, salt converter, cation exchange chromatography, SC-CERS, amine hydroxides, ammonium, methanesulfonic acid

Introduction

The Thermo Scientific™ Dionex™ SC-CERS™ 500 Salt Converter-Cation Electrolytically Regenerated Suppressor provides extended linearity and increased sensitivity for the determination of ammonium and amines using conductivity detection. The Dionex SC-CERS 500 post-column electrolytic suppressor converts weakly ionized amines and ammonium to the highly ionized MSA form, thus increasing their response and extending the linear range to three orders of magnitude. The Dionex SC-CERS 500 suppressor is used as a replacement for the Thermo Scientific™ Dionex™ CERS™ 500 suppressor in cation-exchange applications where extended linearity or increased sensitivity for ammonium and amines is required.

Applications

- Amine content or contamination in oil, gas, and industrial chemicals
- Process waters and process chemicals in the semiconductor industry
- Cooling waters in the refinery and power generation industries
- Environmental monitoring of ammonium

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Ammonium and amine conductivity detection

In cation exchange chromatography with suppressed conductivity detection, Group I and Group II cation analytes form strong bases in the eluent suppressor. For example, the sodium ion is converted to sodium hydroxide. These strong bases are fully dissociated and therefore give a linear response over a wide concentration range. In contrast, the weak bases such as ammonium and amine hydroxides, which are formed in the suppressor, are partially dissociated and thus give a nonlinear response as the analyte concentration increases. This nonlinear response can be overcome by converting the weak base analyte to a fully ionized salt form, thus extending the linear response. The Dionex SC-CERS 500 suppressor is designed to make this conversion.

When to use the Dionex CERS 500 suppressor

For most applications, the nonlinear response of weak bases can be managed easily. Many applications do not require a wide calibration range. When a wider calibration range is required for weak bases, chromatographers should use a quadratic fit of the calibration curve to produce accurate, reliable data. See the comparison of the correlation coefficients for a quadratic vs. linear curve fit in Table 1. For most cation exchange applications, a Thermo Scientific™ Dionex™ CERS™ 500 Cation Electrolytically Regenerated Suppressor is recommended to perform the analysis. With proper data management, both of these electrolytic suppressor devices produce accurate, reliable results for cation determinations.

Table 1 lists the correlation coefficients for a broad range of aliphatic amines and ammonium using the Dionex SC-CERS 500 and Dionex CERS 500* suppressors. Note the excellent correlation coefficient for the weak base, triethanolamine, over the concentration range of 0.1–100 mg/L, when using the Dionex SC-CERS 500 suppressor.

When to use the Dionex SC-CERS 500 suppressor

Thermo Scientific has developed the Dionex SC-CERS 500 suppressor for applications where an extended linear range and increased response for weak bases, such as ammonium and amines, are required.

A linear response increases the accuracy at higher concentrations, requiring fewer calibration check standards over the calibration curve. Reduced calibration requirements increase sample throughput for industries, such as power generation, which have high sample workloads. The Dionex SC-CERS 500 suppressor should be used in industries where regulated methods require a linear response, such as for boiler industrial furnace compliance monitoring. The Dionex SC-CERS 500 suppressor may also be beneficial for amine determinations where the increased conductivity response improves sensitivity for these analytes.

** Data were collected using the Thermo Scientific™ Dionex™ SC-CSRS™ and Thermo Scientific™ Dionex™ CSRS™ ULTRA suppressors. Performance for the Dionex SC-CERS 500 and Dionex CERS 500 suppressors is equivalent or superior.*

Table 1. Linearity comparison for amines using Dionex CERS 500 and Dionex SC-CERS 500 suppressors.

Amine Concentration Range 0.1–100 mg/L	pKa	Correlation Coefficients[a]		
		CERS		SC-CERS
		Quadratic Fit	Linear Fit	Linear Fit
Triethanolamine	7.92	0.9977	0.9789	0.9994
Morpholine	8.33	0.9978	0.9778	1.0000
Ammonia	9.25	0.9946	0.9644	1.0000
Trimethylamine	9.76	1.0000	0.9986	0.9994
Methylamine	10.62	0.9998	0.9967	1.0000
Ethylamine	10.70	0.9999	0.9960	1.0000
Diethylamine	11.09	1.0000	0.9990	1.0000

[a]Chromatography conditions: Thermo Scientific™ Dionex™ IonPac™ CS16 column, 5 × 250 mm, 30 mM methanesulfonic acid, 1.0 mL/min.

Eluent suppression and analyte conversion using the Dionex SC-CERS 500 suppressor

When using the Dionex SC-CERS 500 suppressor, methanesulfonic acid (H^+MSA^-) eluent is suppressed to dilute H^+MSA^- in the eluent suppressor (ES) component. The analyte converter (AC) component converts the analytes to methanesulfonic acid H^+MSA^-.

Figure 2 shows the detailed ion movement through the Dionex SC-CERS 500 suppressor as described below.

1. The eluent and ammonium analyte, as an example of the cation analytes, exit the analytical column as methanesulfonic acid (H^+MSA^-) and ammonium methanesulfonate ($NH_4^+MSA^-$).
2. In the ES, the majority of the eluent is suppressed to water and the analyte is converted to the base form, $NH_4^+OH^-$.
3. However, a small amount of MSA^- reenters the eluent chamber near the exit. This low concentration of MSA^- converts the analyte back to the salt form, and the analyte exits the ES as $NH_4^+MSA^-$. The eluent exits the ES as a low concentration of methanesulfonic acid.
4. In the AC, the NH_4^+ analyte is replaced with a hydronium ion, H^+, resulting in conversion of the analyte, mole for mole, to methanesulfonic acid, H^+MSA^-. The eluent remains unchanged in the AC as a low concentration of methanesulfonic acid.
5. In the conductivity detector, the analyte is detected as fully dissociated methanesulfonic acid in a low background of methanesulfonic acid. This means that at the time the analyte would have passed through the detector cell, the methanesulfonic acid concentration increases proportionally to the concentration of the analyte.

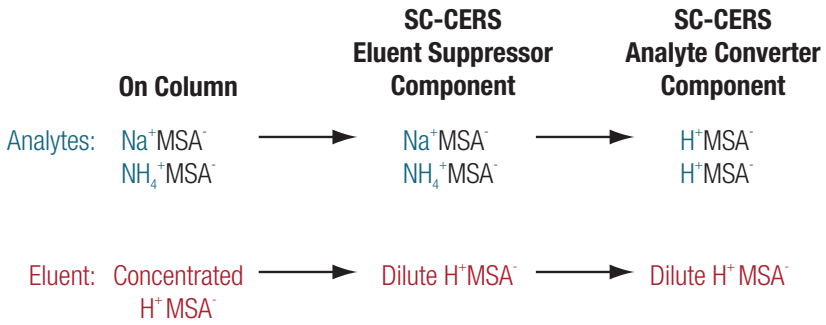

Figure 1. Dionex SC-CERS Salt Converter-Cation Electrolytically Regenerated Suppressor Mechanism.

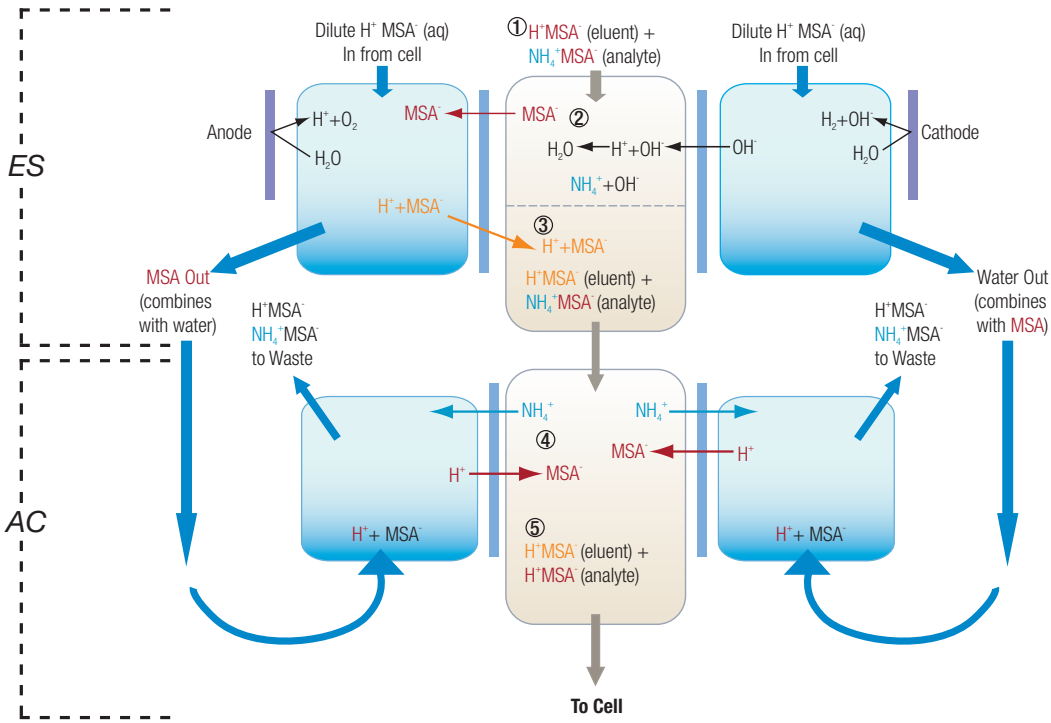

Figure 2. Dionex SC-CERS 500 Suppressor Operational Schematic.

Increased linearity for ammonium and amines

When using the Dionex SC-CERS 500 suppressor, the response at varying concentrations is linear because the analyte is detected as fully dissociated methanesulfonic acid. Figure 3 shows the linear calibration plots for ammonia comparing the Dionex SC-CERS suppressor and the Dionex CERS* suppressor over three orders of magnitude (0.1–100 mg/L). The Dionex SC-CERS suppressor calibration will yield far more accurate data for samples with varying concentrations of ammonium and amines.

Increased sensitivity for ammonium and amines

The Dionex SC-CERS 500 suppressor improves ammonium and amine response to the conductivity detector. Because the analytes are detected as fully dissociated methanesulfonic acid, which has a higher equivalent conductance, the sensitivity is increased. The greatest increase in response is observed at higher concentrations, as illustrated in Figure 3 for ammonium.

Figure 4 shows a comparison of separations of inorganic cations and ammonium at different concentrations using a Dionex SC-CERS* suppressor. The concentrations in Figure 4A are 1 ppm for each analyte and the concentrations in Figure 4B are 0.1 ppm. The Dionex SC-CERS 500 suppressor increases ionization and therefore has a larger effect at higher concentrations. Method detection limits for Group I and II cations, ammonium, and amines using the Dionex SC-CERS 500 suppressor are equivalent to those achieved using the Dionex CERS 500 suppressor.

** Data were collected using the Dionex SC-CSRS and Dionex CSRS ULTRA suppressors. Performance for the Dionex SC-CERS 500 and Dionex CERS 500 suppressors is equivalent or superior.*

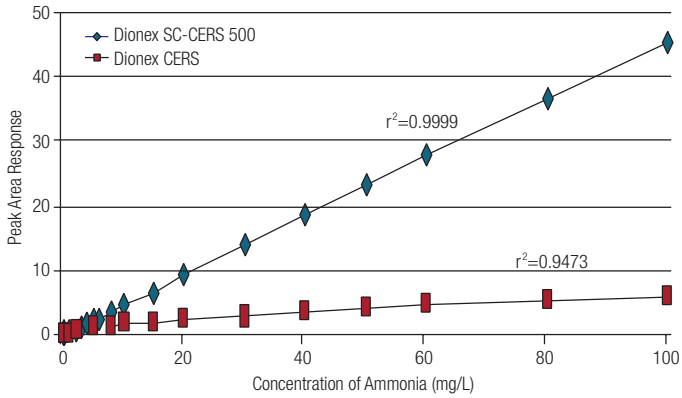

Figure 3. Comparison of response of ammonia using the Dionex SC-CERS suppressor and Dionex CERS* suppressor.

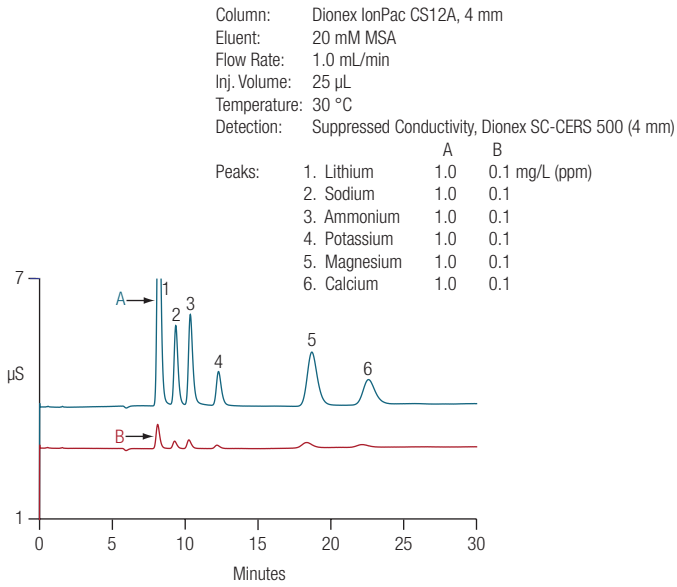

Figure 4. Overlays of 0.1 ppm and 1 ppm standards for ammonia and Group I and Group II cations.

The Dionex SC-CERS 500 suppressor improves the analyte response to the conductivity detector because the analytes are detected as fully dissociated methanesulfonic acid, which has an equivalent conductance of 399 $S \cdot cm^2 \cdot mol^{-1}$. In contrast, sodium detected as Na^+OH^- has an equivalent conductance of only 249 $S \cdot cm^2 \cdot mol^{-1}$. Ammonium detected as NH_4^+ OH^- has an equivalent conductance of only 273 $S \cdot cm^2 \cdot mol^{-1}$.

Figure 5 is a comparison of separations of inorganic cations, ammonium, and amines using a Dionex SC-CERS* suppressor. The concentrations in Figure 5A are 1 ppm for each analyte and the concentrations in Figure 5B are 0.1 ppm. The Dionex SC-CERS 500 suppressor increases ionization and therefore has a larger effect at higher concentrations. Method detection limits using the Dionex SC-CERS 500 suppressor are equivalent to those achieved using the Dionex CERS 500 suppressor.

** Data were collected using the Dionex SC-CSRS suppressor. Performance for the Dionex SC-CERS 500 suppressor is equivalent or superior.*

Dionex SC-CERS 500 suppressor background and noise

The Dionex SC-CERS 500 suppressor effluent contains a low background concentration of methanesulfonic acid. Due to this low background concentration of methanesulfonic acid, the expected background is slightly higher than when using a Dionex CERS 500 suppressor. The expected noise is also slightly higher due to the increased background. For a 20 mM MSA eluent suppressed using the Dionex SC-CERS 500 suppressor, the typical background conductance is 5 µS and the typical noise is less than 3 nS.

Ammonium and amine peak efficiency

When using the Dionex SC-CERS 500 suppressor, analyte peak efficiency is equivalent to that obtained from the Dionex CERS 500 suppressor. The Dionex SC-CERS 500 suppressor is available in both 4 mm and 2 mm formats to further ensure peak efficiency. The 2 mm Dionex SC-CERS 500 suppressor should be used with 3 mm and 2 mm i.d. columns.

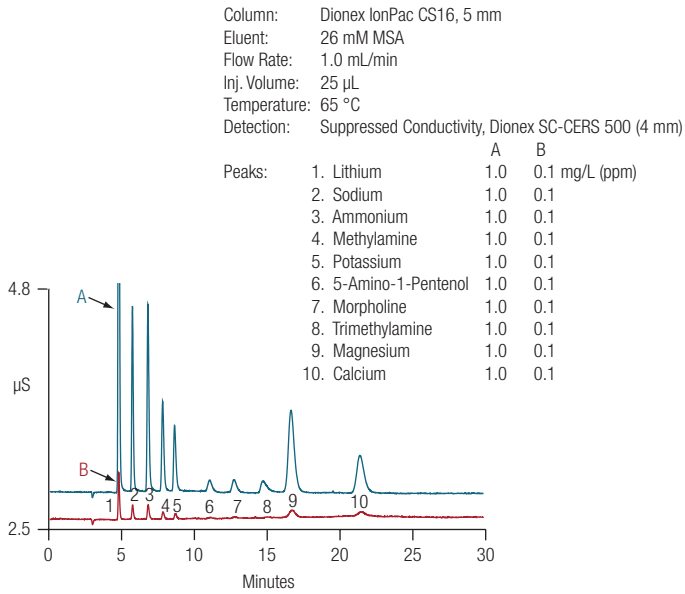

Figure 5. Overlays of 0.1 ppm and 1 ppm standards for ammonia and morpholine amines.

Dionex SC-CERS 500 suppressor operation recommendations

MSA eluents:

The Dionex SC-CERS 500 suppressor must be used with methanesulfonic acid eluents only. Sulfuric acid eluents are not compatible with the Dionex SC-CERS 500 suppressor.

Isocratic operation:

The Dionex SC-CERS 500 suppressor can be used for isocratic separations only. Gradient operation is not supported.

HPLC solvents:

The Dionex SC-CERS 500 suppressor is compatible with typical HPLC solvents up to 40%. The external water mode must be used for eluents containing solvents.

High temperature:

The Dionex SC-CERS 500 suppressor should be placed outside the oven for temperatures greater than 40 °C.

Dionex SC-CERS 500 Suppressor Specifications			
Suppressor Component	Dimensions	Void Volume	Weight
Eluent Suppressor Component (ES)	12.1 × 4.5 × 4.8 cm (4.25 × 1.8 × 1.9 in)	4 mm: <50 µL 2 mm: <15 µL	295 g (0.65 lb)
Analyte Converter* Component (AC)	14.0 × 4.5 × 4.8 cm (5.5 × 1.8 × 1.9 in)	4 mm: <50 µL 2 mm: <15 µL	370 g (0.82 lb)

*Low dispersion design used for both 4 mm and 2 mm Dionex SC-CERS 500 suppressor.

Ordering information

Description	Part Number
Dionex SC-CERS 500 Salt Converter-Cation Electrolytically Regenerated Suppressor	
Dionex SC-CERS 500 suppressor (4 mm)	083547
Dionex SC-CERS 500 suppressor (2 mm)	083549
Dionex SC-CERS 500 Suppressor Spare Parts	
Syringe, 1.0 mL, disposable. For flushing the Dionex SC-CERS 500 suppressor at start-up.	016388
Syringe Adapter, female Luer lock, 1/4-28 threads	024305
External Regenerant Installation Kit For Dionex SC-CERS 500 suppressor operation in the external water mode when up to 40% HPLC solvents are used in the eluent. Contains one pressure regulator (0–30 psi/0–210 kPa), and all tubing and fittings required to install the Dionex SC-CERS 500 suppressor.	038018
Dionex RFC-10 Reagent-Free Controller For systems without built-in control for electrolytic suppressors, the Dionex SC-CERS 500 suppressor can be controlled using the Dionex RFC-10 (DX-120, DX-320, DX-500)	060335

Find out more at **www.thermofisher.com/chromatography**

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