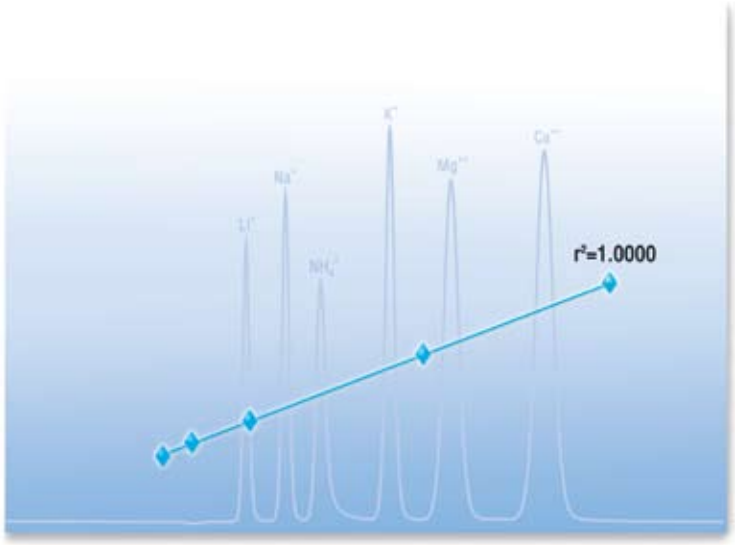
suppressors

Salt Converter-Cation Self-Regenerating Suppressor 300



The Salt Converter-Cation Self-Regenerating Suppressor (SC-CSRS™) 300 provides extended linearity and increased sensitivity for the determination of ammonium and amines using conductivity detection. The SC-CSRS 300 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 SC-CSRS 300 is used as a replacement for the CSRS® 300 in cation-exchange applications where extended linearity or increased sensitivity for ammonium and amines is required.

Now sold under the Thermo Scientific brand

Thermo SCIENTIFIC

Features

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

Applications

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

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 SC-CSRS 300 suppressor is designed to make this conversion.

DIONEX

Passion. Power. Productivity.

When to use CAES or CSRS 300

For most applications, the non-linear 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, either a Cation Atlas® Electrolytic Suppressor (CAES) or a CSRS 300 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 comparison of correlation coefficients for a broad range of aliphatic amines and ammonium using the SC-CSRS and CSRS* suppressors. Note the excellent correlation coefficient for the weak base, triethanolamine, over the concentration range of 0.1–100 mg/L, when using the SC-CSRS 300 suppressor.

Table 1. Linearity Comparison for Amines Using CSRS and SC-CSRS

Amine Concentration Range 0.1–100 mg/L	pKa	Correlation Coefficients[a]		
			CSRS	SC-CSRS
		Quadriatic 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	10.7	0.9999	0.9960	1.0000
Diethylamine	11.09	1.0000	0.9990	1.0000

[a]Chromatography conditions: IonPac® CS16, 5 × 250 mm, 30 mM methanesulfonic acid, 1.0 mL/min.

When to use SC-CSRS 300

Dionex has developed the SC-CSRS 300 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 through put for industries with high sample work loads such as the power generation industry. The SC-CSRS 300 should be used in industries where regulated methods require a linear response; for example, Boiler Industrial Furnace Compliance Monitoring. The SC-CSRS 300 may also be beneficial for amine determinations where the increased conductivity response improves sensitivity for these analytes.

*Data were collected using the SC-CSRS and CSRS ULTRA suppressors. Performance for the SC-CSRS 300 and CSRS 300 suppressors is equivalent or superior.

Eluent Suppression and Analyte Conversion Using the SC-CSRS 300

When using the SC-CSRS 300, 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 SC-CSRS 300 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.

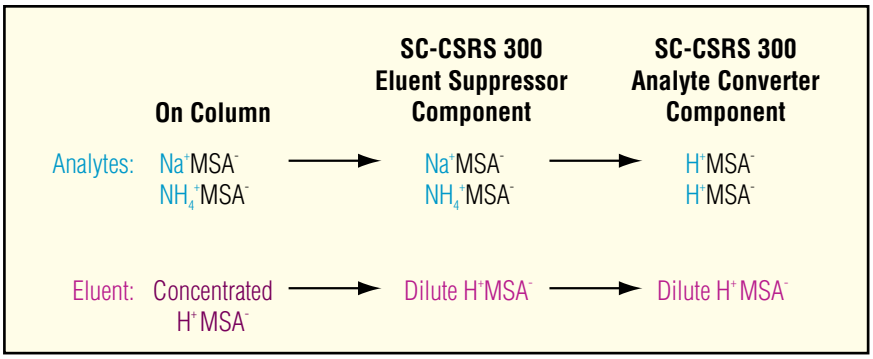


Figure 1. Salt Converter-Cation Self-Regenerating Suppressor Mechanism.

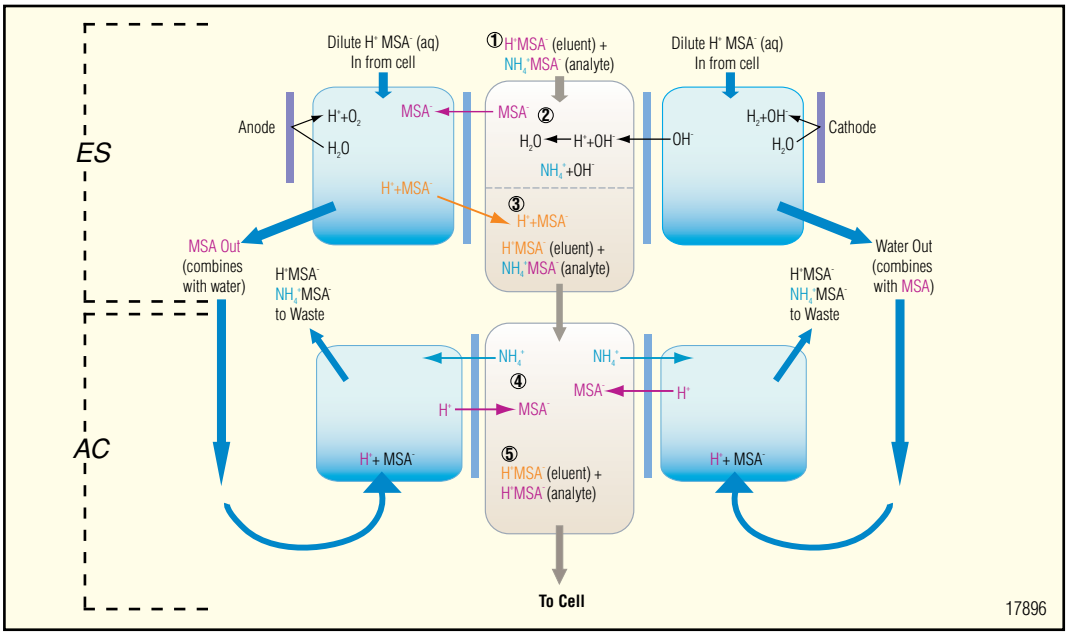


Figure 2. SC-CSRS 300 Operational Schematic.

Increased Linearity for Ammonium and Amines

When using the SC-CSRS 300, 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 SC-CSRS and the CSRS* over three orders of magnitude (0.1–100 mg/L). The SC-CSRS calibration will yield far more accurate data for samples with varying concentations of ammonium and amines.

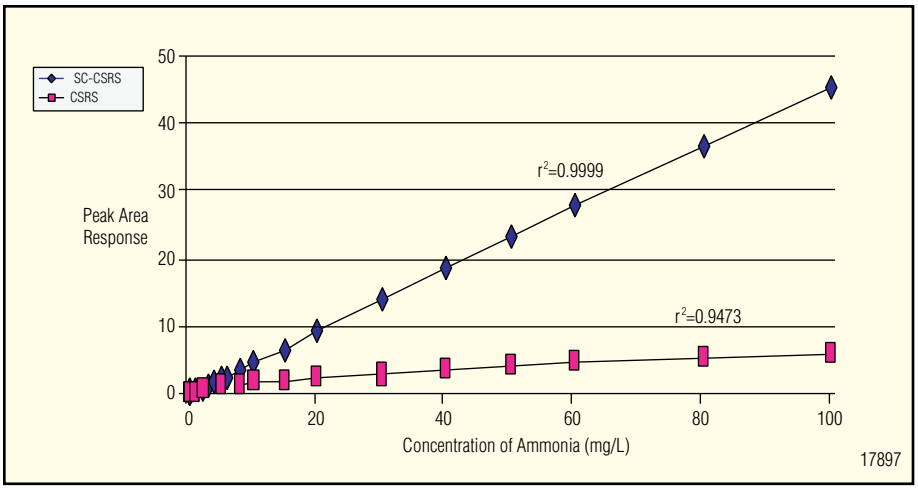


Figure 3. Comparison of response of ammonia using SC-CSRS and CSRS.*

Increased Sensitivity for Ammonium and Amines

The SC-CSRS 300 improves ammonium and amine response to the conductivity detector. Because the analytes are actually 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 SC-CSRS*. The concentrations in Figure 4A are 1 ppm for each analyte and the concentrations in Figure 4B are 0.1 ppm. The SC-CSRS 300 increases ionization and therefore has a larger effect at higher concentrations. Method detection limits for Group I & II cations, ammonium, and amines using the SC-CSRS 300 are equivalent to those achieved using the CSRS 300.

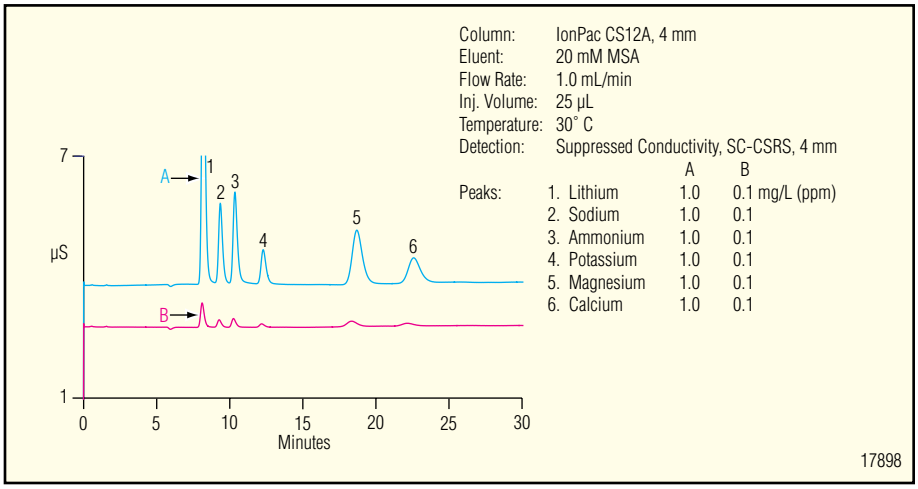


Figure 4. Overlays of 0.1 ppm and 1 ppm standards for ammonia and Group I and Group II cations.

*Data were collected using the SC-CSRS and CSRS ULTRA suppressors. Performance for the SC-CSRS 300 and CSRS 300 suppressors is equivalent or superior.

The SC-CSRS 300 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 equivalence 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 cm^2 mol^{-1}.

Figure 5 is a comparison of separations of inorganic cations, ammonium and amines using a SC-CSRS*. The concentrations in Figure 5A are 1 ppm for each analyte and the concentrations in Figure 5B are 0.1 ppm. The SC-CSRS 300 increases ionization and therefore has a larger effect at higher concentrations. Method detection limits using the SC-CSRS 300 are equivalent to those achieved using the CSRS 300.

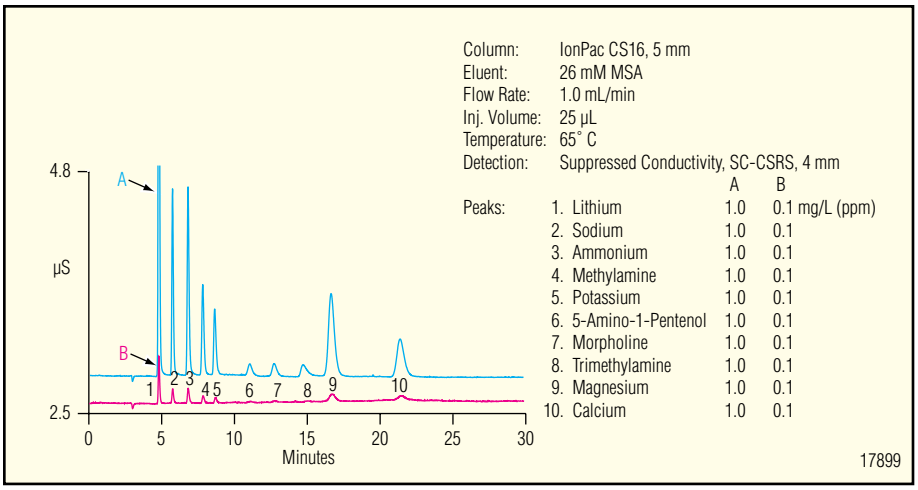


Figure 5. Overlays of 0.1 ppm and 1 ppm standards for ammonia and morpholine amines.

SC-CSRS 300 Background and Noise

The SC-CSRS 300 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 CSRS 300. The expected noise is also slightly higher due to the increased background. For a 20 mM MSA eluent suppressed using the SC-CSRS 300, the typical background conductance is 5 µS and the typical noise is less than 3 nS.

Ammonium and Amine Peak Efficiency

When using the SC-CSRS 300, analyte peak efficiency is equivalent to that obtained from the CSRS 300. The SC-CSRS 300 is available in both 4-mm and 2-mm formats to further ensure peak efficiency. The 2-mm SC-CSRS 300 should be used with 3-mm and 2-mm i.d. columns.

SC-CSRS 300 Operation Recommendations

MSA eluents:

The SC-CSRS 300 must be used with methanesulfonic acid eluents only. Sulfuric acid eluents are not compatible with the SC-CSRS 300 suppressor.

Isocratic operation:

The SC-CSRS can be used for isocratic separations only. Gradient operation is not supported.

HPLC solvents:

The SC-CSRS 300 is compatible with typical HPLC solvents up to 40%. The external water mode must be used for eluents containing solvents.

High temperature:

When operating the SC-CSRS 300 at elevated temperatures, the LC30 chromatography module is recommended. The SC-SCRS 300 should be placed outside the oven for temperatures greater than 40 °C.

*Data were collected using the SC-CSRS suppressor. Performance for the SC-CSRS 300 suppressor is equivalent or superior.

SC-CSRS 300 Specifications			
Suppressor Component	**Dimensions**	**Void Volume**	**Weight**
Eluent Suppressor Component (ES)	16.8 × 4.5 × 5.2 cm (6.6 × 1.8 × 2.1 in)	4 mm: <50 µL 2 mm: <15 µL	630 g (1.4 lb)
Analyte Converter* Component (AC)	16.8 × 4.5 × 5.2 cm (6.6 × 1.8 × 2.1 in.)	4 mm: <50 µL 2 mm: <15 µL	630 g (1.4 lb)

*Low dispersion design used for both 4 mm and 2 mm SC-CSRS 300.

ORDERING INFORMATION

To order, using the following part numbers, contact your local Dionex office or distributor nearest you. In the U.S., call (800) 346-6390. In other regions, refer to the phone numbers below.

Description	Part Number
Salt Converter-Cation Self-Regenerating Suppressor 300	
SC-CSRS 300 4 mm	067530
SC-CSRS 300 2 mm	067529
SC-CSRS 300 Spare Parts	
Syringe, 1.0 mL, disposable For flushing the SC-CSRS at start-up.	016388
Syringe Adapter, female Luer lock, 1/4-28 threads	024305
Installation Kit for LC30 Metal bracket, spacers and screws required for mounting the SC-CSRS 300 Analyte Converter in a LC30.	060044
External Regenerant Installation Kit For SC-CSRS 300 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 SC-CSRS 300.	038018
RFC-10 Reagent-Free Controller For systems without built-in control for electrolytic suppressors, the SC-CSRS 300 suppressor can be controlled using the RFC-10 (DX-120, DX-320, DX-500, DX-600, and ICS-2500 systems)	060335

Passion. Power. Productivity.

DIONEX

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

North America
U.S. (847) 295-7500
Canada (905) 844-9650

South America
Brazil (55) 11 3731 5140

Europe
Austria (43) 1 616 51 25 Benelux (31) 20 683 9768; (32) 3 353 4294
Denmark (45) 36 36 90 90 France (33) 1 39 30 01 10 Germany (49) 6126 991 0
Ireland (353) 1 644 0064 Italy (39) 02 51 62 1267 Switzerland (41) 62 205 9966
United Kingdom (44) 1276 691722

Asia Pacific
Australia (61) 2 9420 5233 China (852) 2428 3282 India (91) 22 2764 2735
Japan (81) 6 6885 1213 Korea (82) 2 2653 2580 Singapore (65) 6289 1190
Taiwan (886) 2 8751 6655

www.dionex.com

LPN 1456-02 PDF 05/08