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Application News

Ion Chromatograph HIC-NS

Analysis of Anions Using Non-Suppressor Ion Chromatograph HIC-NS

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User Benefits

- Seven types of anion components that are commonly measured can be measured with high sensitivity.
- Simplified equipment configuration reduces maintenance and consumable costs.
- It can be applied to the analysis of a wide range of samples such as food and environmental water.

■ Introduction

Ion chromatography is used for the detection and quantification of ions in solutions, and is widely used for water quality analysis, food and medicine.

In this article, we introduce an example of anion analysis of tap water, food, and environmental water using the HIC-NS non-suppressor ion chromatograph and the Shim-pack™ IC-A3 anion analysis column.

■ Flow Path Diagram

Fig. 1 shows the flow path diagram of this system. The non-suppressor ion chromatograph has no suppressor unit, so maintenance and consumables costs can be reduced. Depending on the column used, a mixture of organic solvents can be used as the eluent.

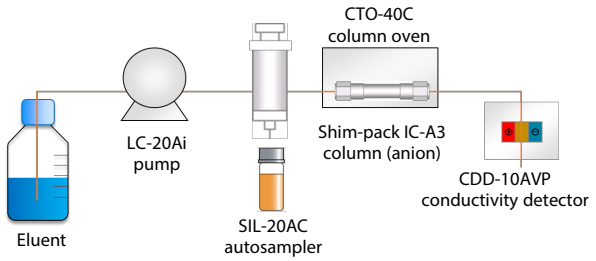
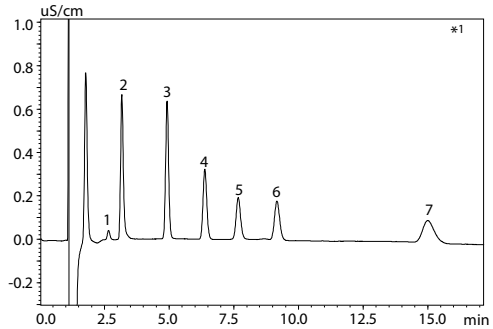


Fig. 1 Non-suppressor Ion Chromatograph Flow Path Diagram

■ Analysis of Standard Samples

Fig. 2 shows the analytical results for the composition of an anion standard mixture (F^-, Cl^-, NO_2^-, Br^-, NO_3^-, $H_2PO_4^-$, SO_4^{2-}) using the Shim-pack IC-A3 anion analysis column. The conditions shown in Table 1 were used in this analysis.



1. $H_2PO_4^-$ 1.0 mg/L
2. F^- 1.0 mg/L
3. Cl^- 1.0 mg/L
4. NO_2^- 1.0 mg/L
5. Br^- 1.0 mg/L
6. NO_3^- 1.0 mg/L
7. SO_4^{2-} 1.0 mg/L

Fig. 2 Chromatogram of Standard Mixture

*1 Under these analytical conditions, the eluent-derived system peak appears at around 18 min.

Table 1 Analytical Conditions

Column:	Shim-pack IC-A3*2 (250 mm × 4.6 mm I.D., 5 µm)
Guard Column:	Shim-pack IC-GA3*3 (10 mm × 4.6 mm I.D., 5 µm)
Mobile Phase:	8.0 mmol/L *p*-Hydroxybenzonic acid
	3.2 mmol/L Bis-Tris*4
	50 mmol/L Boric acid
Flowrate:	1.2 mL/min
Column Temp.:	40 °C
Injection Volume:	50 µL
Vial:	Shimadzu Vial, LC, 4 mL, Polypropylene*5
Detection:	Conductivity

*2 P/N: 228-31076-91 *3 P/N: 228-31076-92
*4 Bis-(2-hydroxyethyl)iminotris(hydroxymethyl)methane
*5 P/N: 228-31537-91

■ Linearity

5-point calibration curves were created for each ion. Table 2 shows the calibration ranges and the coefficients of determination of each calibration curve created by linear regression. All ions have good linearities.

Table 2 Calibration Curve Range and Coefficient of Determination

	Range (mg/L)	Contribution Rate (r^2)
$H_2PO_4^-$	0.5 - 20	> 0.999
F^-	0.5 - 20	> 0.999
Cl^-	0.5 - 20	> 0.999
NO_2^-	0.5 - 20	> 0.999
Br^-	0.5 - 20	> 0.999
NO_3^-	0.5 - 20	> 0.999
SO_4^{2-}	0.5 - 20	> 0.999

■ Area Repeatability and Lower Limit of Quantification

Table 3 shows the area repeatabilities (%RSD) and the lower limits of quantification of 5 repeated analyses of each standard mixture. Each lower limit of quantification (LOQ, mg/L) was calculated as the concentration at which S/N ratio was 10. This value is a reference value calculated from the actual measured value and is not a guaranteed value.

Table 3 Area Repeatability (n = 5) and Lower Limit of Quantification

	Concentration (mg/L)	Retention time (%RSD)	Area repeatability (%RSD)	LOQ (mg/L)
$H_2PO_4^-$	1.0	0.03	1.85	0.15
F^-	1.0	0.01	0.34	0.01
Cl^-	1.0	0.01	0.19	0.01
NO_2^-	1.0	0.01	0.59	0.02
Br^-	1.0	0.01	0.61	0.04
NO_3^-	1.0	0.01	0.90	0.04
SO_4^{2-}	1.0	0.02	3.99	0.07

■ Analysis of Mineral Water

Commercial mineral water (soft water) was analyzed after filtration with a 0.2 µm filter followed by 5 times dilution with ultrapure water. The chromatogram is shown in Fig. 3.

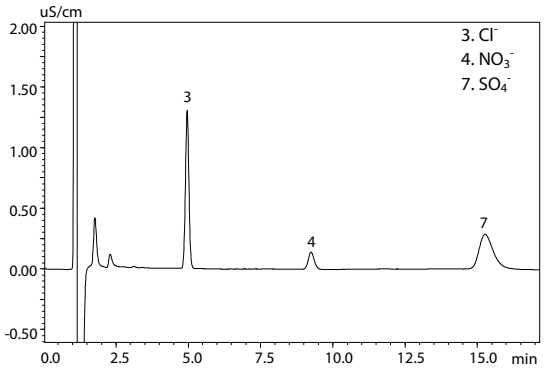


Fig. 3 Chromatogram of Mineral Water

■ Analysis of Plating Solution

Plating solution was analyzed after filtration with a 0.2 µm filter followed by 5000 times dilution with ultrapure water. The chromatogram is shown in Fig. 4.

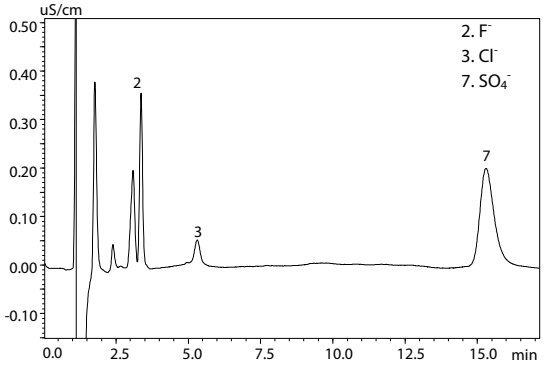


Fig. 4 Chromatogram of Plating Solution

■ Analysis of Energy Drink

Commercial energy drink was analyzed after filtration with a 0.2 µm filter followed by 100 times dilution with ultrapure water. The chromatogram is shown in Fig. 5.

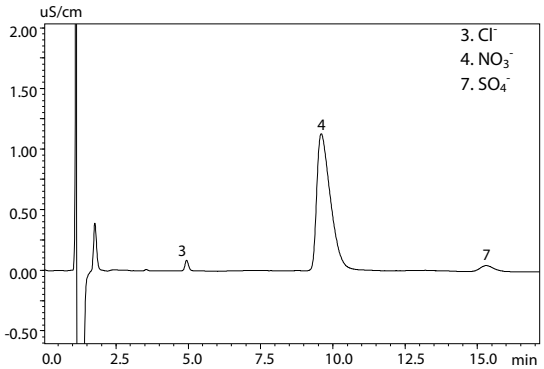
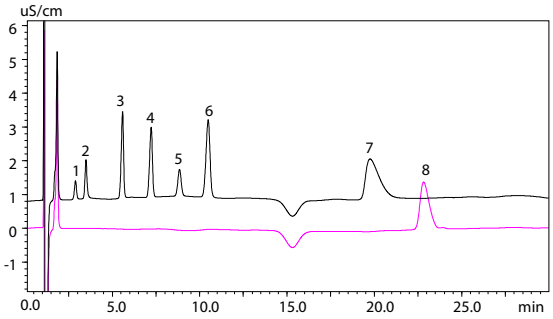


Fig. 5 Chromatogram of Energy Drink

■ Analysis of Iodide Ion

The elution position of highly hydrophobic ion species can be adjusted by adding an organic solvent to the eluent. An example of the analysis of iodide ion in a mouthwash by adding acetonitrile to the eluent is presented. Fig. 6 shows the analysis results of the standard solution of the seven anions and iodine, and Fig. 7 shows the analysis results of the mouthwash.

5 % acetonitrile was added to the eluent to shorten the analysis time for iodide ion, which elutes slowly. Table 4 shows the analysis conditions. A commercially available mouthwash was analyzed after filtration with a 0.2 µm filter followed by 1000 times dilution with ultrapure water, iodide ion equivalent to 1.7 mg/L was detected (1.7 g/L in stock solution). Under these conditions, the eluent-derived system peak, which usually appears at about 18 minutes, appeared at about 15 minutes.



1.	$H_2PO_4^-$	40 mg/L	5.	Br^-	10 mg/L
2.	F^-	5.0 mg/L	6.	NO_3^-	30 mg/L
3.	Cl^-	10 mg/L	7.	SO_4^{2-}	40 mg/L
4.	NO_2^-	15 mg/L	8.	I^-	40 mg/L

Fig. 6 Chromatograms of Standard Mixture (Acetonitrile Added)

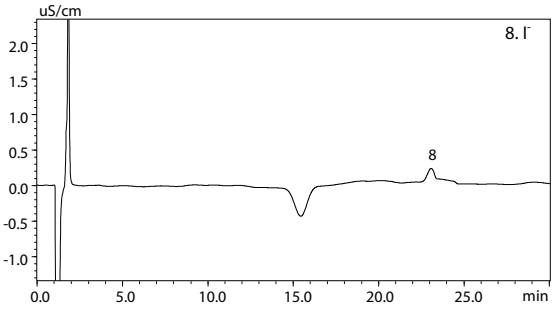


Fig. 7 Chromatogram of Mouthwash

Table 4 Analytical Conditions

Column:	Shim-pack IC-A3 (250 mm × 4.6 mm I.D., 5 µm)
Guard Column:	Shim-pack IC-GA3*3 (10 mm × 4.6 mm I.D., 5 µm)
Mobile Phase:	8.0 mmol/L *p*-Hydroxybenzonic acid, 3.2 mmol/L Bis-Tris, 50 mmol/L Boric acid/Acetonitrile = 95:5
Flowrate:	1.2 mL/min
Column Temp.:	40 °C
Injection Volume:	50 µL
Vial:	Shimadzu Vial, LC, 4 mL, Polypropylene
Detection:	Conductivity

■ Conclusion

The HIC-NS non-suppressor ion chromatograph and its applications are introduced in this article. By using Shim-pack IC-A3, anion components can be analyzed in food and environmental water. Furthermore, by adding organic solvents to the mobile phase, the analysis time for highly hydrophobic ion species can be shortened.

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