SHIMADZU
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Application News

No. L552

Ion Chromatography

Analysis of Tap Water Using ICDS™-40A Suppressor Unit

The ion chromatograph is an outstanding instrument for high-sensitivity measurement of the ionic contents in solutions. Because of this feature, it is used in many fields, including the environment, chemicals, pharmaceuticals, and foods. In the field of tap water quality analysis, use of the ion chromatograph in measurements of multiple drinking water quality standards items is specified in "Method Determined by the Minister of Health, Labour and Welfare on the Basis of the Ordinance Provisions Relating to Water Quality Standards" (Notification No. 261 issued by the MHLW in 2003, sequential revision).

This article introduces an example of anion analysis of tap water based on the above-mentioned Ministerial Notification using a Shimadzu ICDS-40A suppressor unit.

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ICDS-40A Suppressor Unit

In ion chromatography, a suppressor is a device that removes sodium ions from the column eluent. Use of a suppressor reduces background noise and increases the signal intensity of the analyte in anion analysis.

The Shimadzu ICDS-40A suppressor unit is an electrodialysis-type suppressor (Fig. 1), in which an ion exchange membrane in the suppressor removes the sodium ions in the column eluent, and the hydrogen ions necessary to regenerate the membrane are formed by electrolyzing the eluent after it passes through the detector. Fig. 2 shows the flow diagram.

With conventional cartridge-type suppressors, waiting time is required for cartridge switching. The Shimadzu ICDS-40A doesn't need to set this waiting time because the suppression operation and regeneration operation are conducted simultaneously, thereby shortening the total analysis time.

Fig. 1 ICDS™-40A Suppressor Unit

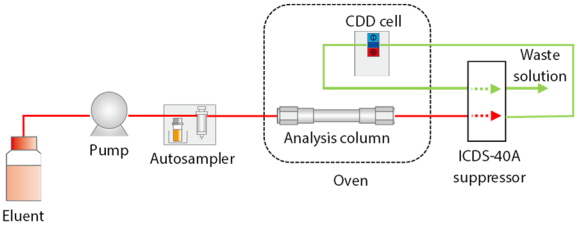

Fig. 2 Flow Diagram

Analysis of Standard Solution

Fig. 3 shows the chromatogram obtained by injecting 50 µL of a standard solution of the 5 anions (F, Cl, NO_2, ClO_3, NO_3) included in the water quality standard items. Table 1 shows the analyticalconditions.

Table 1 AnalyticalConditions

Column	:	Shim-pack™ IC-SA4 (150 mmL. × 4.6 mmI.D.)
Mobile phase	:	1.7 mmol/L Sodium Carbonate 5.0 mmol/L Sodium Hydrogen Carbonate
Flow rate	:	0.8 mL/min
Column temp.	:	50 °C
Injection volume	:	50 µL
Detection	:	Electro conductivity detector UV-VIS detector at 210 nm

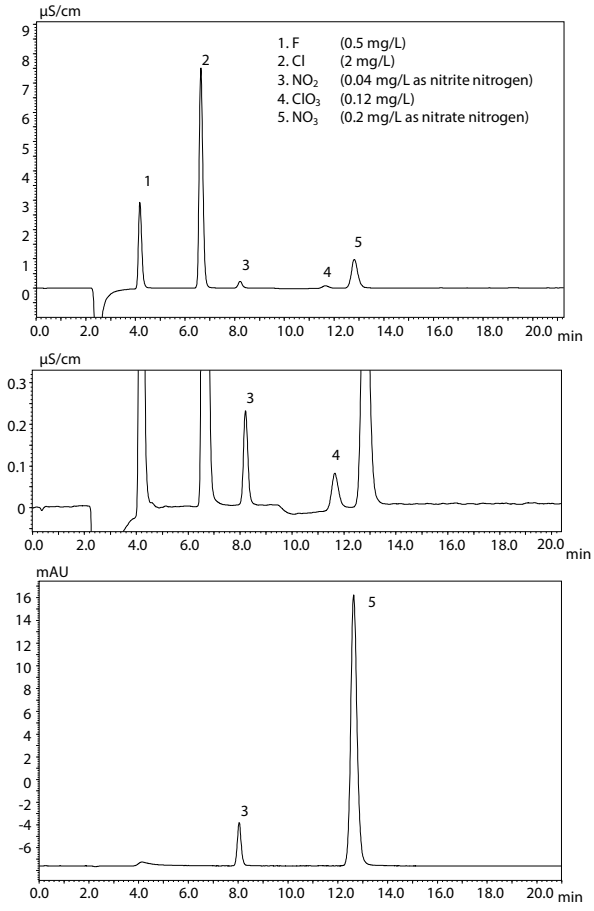

Fig. 3 Chromatograms of Anion Standard Solution (Top: Conductivity Detector, Middle: Conductivity Detector (Enlargement), Bottom: UV-VIS Detector)

Nitrite Nitrogen

As introduced in Application News No. L493, measurement of the standard value of 0.04 mg/L and measurement of the lowest point on the calibration curve of 0.004 mg/L are specified for nitrite nitrogen. Use of a UV-VIS detector is recommended to avoid the influence of chlorides which are detected just before nitrite in electro conductivity detection.

The results of an analysis of a 0.004 mg/L of nitrite nitrogen using a new type of suppressor were summarized. Fig. 4 shows the chromatogram for this concentration level, and Fig. 5 shows the calibration curve prepared for the concentration range between 0.004 and 0.040 mg/L using a UV-VIS detector. The coefficient of determination (r^2) was satisfactory at 0.999 or higher. Table 2 shows the relative standard deviations (RSD%) of the retention time and area in 6 continuous repeated analyses of the 0.004 mg/L of nitrite nitrogen, and Table 3 shows the relative errors when the standard solutions were determined by using the obtained calibration curve in Fig. 5.

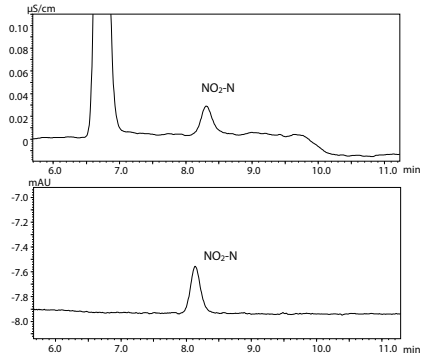

Fig. 4 Chromatograms of 0.004 mg/L of Nitrite Nitrogen (Top: Conductivity Detector, Bottom: UV-VIS Detector)

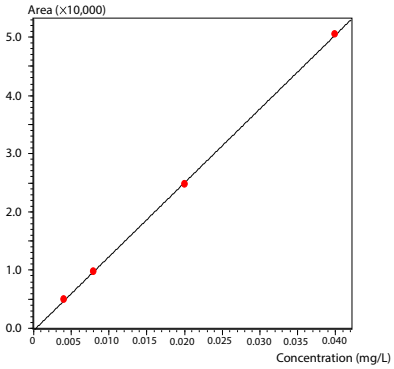

Fig. 5 Calibration Curve

Table 2 Repeatability for 0.004 mg/L of Nitrite Nitrogen

Detector	Retention time (%RSD)	Area (%RSD)
CDD	0.12	3.07
UV-VIS	0.11	1.10

Table 3 Relative Error of Nitrite Nitrogen

Prepared concentration (mg/L)	Relative error (%)
0.004	3.87
0.010	-0.42
0.020	-1.13
0.040	0.26

Analysis of Tap Water

Fig 6 shows the results of the analysis of tap water.

The sample for the analysis was prepared by adding nitrite nitrogen to tap water so as to obtain a concentration of 0.004 mg/L. Based on the MHLW Ministerial Ordinance, 1 mL of ethylenediamine (50 mg/mL) was added per 1 L of tap water. All components were lower than the standard values.

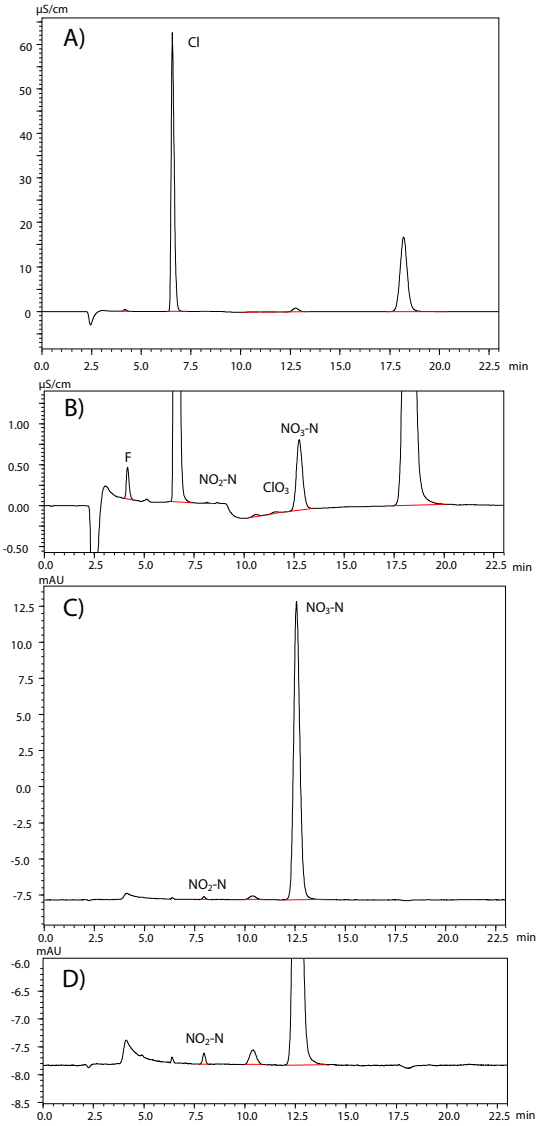

Fig. 6 Chromatograms of Tap Water (A: Conductivity Detector, B: Conductivity Detector (Enlargement), C: UV-VIS Detector, D: UV-VIS Detector (Enlargement))

Conclusion

Anions in tap water were analyzed based on the MHLW Ministerial Ordinance using a Shimadzu ICDS-40A suppressor unit and Shim-pack IC-SA4. Although the ordinance requires measurement of nitrite nitrogen at a low concentration level (0.004 mg/L), an analysis with high accuracy was possible by using the ICDS-40A suppressor unit.

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