Lithium, atomic absorption spectrometric, direct

Parameters and Codes:
Lithium, dissolved, I-1425-85 (µg/L as Li): 01130
Lithium, total recoverable, I-3425-85 (µg/L as Li): 01132
Lithium, suspended recoverable, I-7425-85 (µg/L as Li): 01131
Lithium, recoverable-from-bottom-material, dry wt, I-5425-85 (µg/g as Li): 01133

1. Application

1.1 This method may be used to analyze water and water-suspended sediment containing at least 10 µg/L of lithium. Sample solutions containing more than 1,000 µg/L need either to be diluted or to be read on a less expanded scale.

1.2 Brines need to be diluted to eliminate interference from other elements. (See section 3, "Interferences.") If the lithium concentrations in the diluted samples are below detection, the undiluted samples need to be analyzed by the standard-addition method.

1.3 Suspended recoverable lithium is calculated by subtracting dissolved lithium from total recoverable lithium.

1.4 This method may be used to analyze bottom material containing at least 1 µg/g of lithium. Prepared sample solutions containing more than 1,000 µg/L need either to be diluted or to be read on a less expanded scale.

1.5 Total recoverable lithium in water-suspended sediment needs to undergo preliminary digestion-solubilization by method I-3485, and recoverable lithium in bottom material needs to undergo preliminary digestion-solubilization by method I-5485 before being determined.

2. Summary of method

2.1 Lithium is determined by atomic absorption spectrometry by direct aspiration of the sample solution into an air-acetylene flame (Fishman and Downs, 1966).

2.2 The procedure may be automated by the addition of a sampler and either a strip-chart recorder or a printer or both.

3. Interferences

The following elements interfere when the indicated concentrations are exceeded: sodium, 1,000 mg/L; potassium, 100 mg/L; magnesium, 200 mg/L; calcium, 200 mg/L; chloride, 1,000 mg/L; sulfate, 2,000 mg/L; nitrate, 100 mg/L; and strontium, 5,000 µg/L.

4. Apparatus

4.1 *Atomic absorption spectrometer,* equipped with electronic digital readout and automatic zero and concentration controls.

4.2 Refer to the manufacturer's manual to optimize instrument for the following:

Grating -------------------------- Visible
Wavelength --------------------- 670.8 nm
Source (hollow-cathode
        lamp) -------------------- Lithium
Oxidant -------------------------- Air
Fuel ------------------------------ Acetylene
Type of flame ------------------ Oxidizing

4.3 The 50-mm (2-in.), flathead, single-slot burner allows a working range of 10 to 1,000 µg/L. Different burners may be used according to manufacturer's instructions.

5. Reagents

5.1 *Lithium standard solution I,* 1.00 mL = 1,000 µg Li: Dissolve 9.936 g $LiNO_3$ in demineralized water and dilute to 1,000 mL.

5.2 *Lithium standard solution II,* 1.00 = 10.0 µg Li: Dilute 10.0 mL lithium standard solution I to 1,000 mL with demineralized water. This solution is used to prepare working standards at time of analysis.

5.3 *Lithium working standards:* Prepare a series of at least six working standards containing from 10 to 1,000 μg/L of lithium by appropriate dilution of lithium standard solution II. Prepare fresh daily.

6. Procedure

Aspirate the blank (demineralized water) to set the automatic zero control. Use the automatic concentration control to set the concentrations of standards. Use at least six standards. Calibrate the instrument each time a set of samples is analyzed and check calibration at reasonable intervals.

7. Calculations

7.1 Determine the micrograms per liter of dissolved or total recoverable lithium in each sample solution from the digital display or printer while aspirating each sample. Dilute those samples containing lithium concentrations that exceed working range of the method and multiply by the proper dilution factors.

7.2 To determine micrograms per liter suspended recoverable lithium, subtract dissolved lithium concentration from total-recoverable-lithium concentration.

7.3 To determine micrograms per gram of lithium in bottom-material samples, first determine micrograms per liter of lithium as in paragraph 7.1; then

$$Li\ (\mu g/g) = \frac{\mu g/L\ Li \times \dfrac{mL\ of\ original\ digest}{1,000}}{wt\ of\ sample\ (g)}$$

8. Report

8.1 Report lithium, dissolved (01130), total-recoverable (01132), and suspended-recoverable (01131), concentrations as follows: less than 100 μg/L, nearest 10 μg/L; 100 μg/L and above, two significant figures.

8.2 Report lithium, recoverable-from-bottom-material (01133), concentrations as follows: less than 10 μg/g, nearest microgram per gram; 10 μg/g and above, two significant figures.

9. Precision

9.1 Precision for dissolved lithium for 19 samples within the range of 32 to 632 μg/L may be expressed as follows:

$$S_T = 0.080X + 1.13$$

where

S_T = overall precision, micrograms per liter, and

X = concentration of lithium, micrograms per liter.

The correlation coefficient is 0.8270.

9.2 Precision for dissolved lithium for five of the 19 samples expressed in terms of the percent relative standard deviation is as follows:

Number of laboratories	Mean (μg/L)	Relative standard deviation (percent)
13	32	12
10	113	9
12	215	7
10	395	4
12	632	7

9.3 It is estimated that the percent relative standard deviation for total recoverable and suspended recoverable lithium and for recoverable lithium in bottom material will be greater than that reported for dissolved lithium.

9.4 Precision for total recoverable lithium expressed in terms of percent relative standard deviation for one water-suspended sediment is as follows:

Number of laboratories	Mean (μg/L)	Relative standard deviation (percent)
7	116	17
6	222	9

Reference

Fishman, M. J., and Downs, S. C., 1966, Methods for analysis of selected metals in water by atomic absorption: U.S. Geological Survey Water-Supply Paper 1540-C, p. 30-5.