Potassium, atomic absorption spectrometric, direct

Parameters and Codes:

Potassium, dissolved, I-1630-85 (mg/L as K): 00935
Potassium, total recoverable, I-3630-85 (mg/L as K): none assigned
Potassium, recoverable-from-bottom-material, dry wt, I-5830-85 (mg/kg as K): 00938

1. Application

1.1 This method may be used to analyze atmospheric precipitation, water, brines, and water-suspended sediment.

1.2 Two analytical ranges for potassium are included: from 0.01 to 1.0 mg/L and from 0.10 to 10.0 mg/L. Sample solutions containing potassium concentrations greater than 10 mgIL need to be diluted.

1.3 This method may be used to analyze bottom material containing at least 10 mg/kg of potassium.

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

2. Summary of method

2.1 Potassium 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.

3. Interferences

3.1 Of the substances commonly occurring in water, only sodium has been found to interfere, and its interference is greatly minimized if a reducing flame is used and the burner is raised to approximately 0.05 cm below the optical light path. The following data are indicative of the magnitude of sodium interference under these conditions:

Potassium added (mg/L)	Sodium added (mg/L)	Potassium found (mg/L)
1.00	0.0	1.00
1.00	100	1.03
1.00	500	1.05
1.00	1,000	1.07

3.2 Alternatively, an excess of sodium or cesium may be added to all samples and standards. Such additions essentially eliminate the effects of the then comparatively minor contributions of sodium present in the samples.

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	766.5 nm
Source (hollow-cathode lamp)	Potassium
Oxidant	Air
Fuel	Acetylene
Type of flame	Slightly reducing

4.3 The 50-mm (2-in.), flathead, single-slot burner allows working ranges of 0.01 to 1.0 mg/L and 0.1 to 10 mg/L. The burner, rotated 90°, extends the range to 100 mg/L. Different burners may be used according to manufacturers' instructions.

5. Reagents

5.1 *Potassium standard solution I,* 1.00 mL = 0.100 mg K: Dissolve 0.1907 g KCl, dried at 180°C for 1 h, in demineralized water and dilute to 1,000 mL.

5.2 *Potassium working standards:* Prepare a series of at least six working standards containing either from 0.01 to 1.0 mg/L or from 0.1 to 10.0 mg/L of potassium by appropriate dilution of potassium standard solution I.

6. Procedure

While aspirating the blank use the automatic zero control to set the digital display to read zero concentration. While aspirating standards use the automatic concentration control to set the digital display to read the concentration 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 milligrams per liter of dissolved or total recoverable potassium in each sample from the digital display or printer while aspirating each sample. Dilute those samples containing potassium concentrations that exceed the working range of the method and multiply by the proper dilution factors.

7.2 To determine milligrams per kilogram of potassium in bottom-material samples, first determine the milligrams per liter of potassium as in paragraph 7.1; then:

$$\text{K (mg/kg)} = \frac{\text{mg/L K} \times \dfrac{\text{mL original digest}}{1000}}{\text{wt of sample (kg)}}$$

8. Report

8.1 Report potassium, dissolved (00935), and total recoverable (none assigned), concentrations as follows: less than 1.0 mg/L, two decimals; 1.0 to 10 mg/L, one decimal; 10 mg/L and above, two significant figures.

8.2 Report potassium, recoverable-from-bottom-material (00938), concentrations as follows: less than 1,000 mg/kg, nearest 10 mg/kg; 1,000 mg/kg and above, two significant figures.

9. Precision

9.1 Precision for dissolved potassium for 36 samples within the range of 0.09 to 26.1 mg/L may be expressed as follows:

$$S_T = 0.113X - 0.050$$

where

S_T = overall precision, milligrams per liter, and

X = concentration of potassium, milligrams per liter.

The correlation coefficient is 0.9350.

9.2 Precision for dissolved potassium for five of the 36 samples expressed in terms of the percent relative standard deviation is as follows:

Number of laboratories	Mean (mg/L)	Relative standard deviation (percent)
24	0.09	55
17	2.48	10
32	5.20	11
23	11.7	8
19	26.1	13

9.3 Precision for dissolved potassium within the range of 0.01 to 1.0 mgIL in terms of the percent relative standard deviation by a single operator is as follows:

Number of replicates	Mean (Mg/L)	Relative standard deviation (percent)
18	0.023	38.9
12	.078	9.7
11	.358	2.7
10	.585	1.8
11	1.02	4.6

9.4 It is estimated that percent relative standard deviation for total recoverable potassium and for recoverable potassium from bottom material will be greater than that reported for dissolved potassium.

Reference

Fishman, M. J., and Downs, S. C., 1966, Method for analysis of selected metals in water by atomic absorption: U.S. Geological Survey Water-Supply Paper 1540-C, p. 36-8.