

SOIL ALUMINUM

S - 16.10

KCl Extraction / Exchangeable ALuminum

Scope and Application

This method involves the semiquantitative extraction of aluminum from soils using 2.0 N KCl. Ammonium is determined by Inductively Coupled Plasma spectrometry (ICP-AES). The method doesn't quantitatively extract ammonium from mineral structures or bound to organic compounds. The procedure outlined follows that outlined by Bertsch and Bloom (1996) for determining nitrate nitrogen with a modification in which 25 mL of 1.0 M KCl and 5.0 g of soil are used instead of 100 mL and 10 g soil. Care must be taken to avoid contamination from filter paper and operator handling. Soil aluminum concentrations are generally low in mineral soils (< 1.0 mg kg⁻¹). The method detection limit is approximately 0.5 mg kg⁻¹ (on a dry soil basis) and is generally reproducible ± 10%.

Equipment

1. Analytical balance: 1000 g capacity, resolution ± 0.01 g.
2. Repipette dispenser, calibrated to 25.0 ± 0.2 mL.
3. Reciprocating horizontal mechanical shaker, 180 oscillations per minute (opm).
4. Extraction vessels and associated filtration vessel.
5. Whatman No. 42 or equivalent highly retentive filter paper.
6. Inductively Coupled Plasma spectrometry (ICP-AES).

Reagents

1. Deionized water, ASTM Type I grade.
2. Potassium chloride extracting solution, 1.0 N KCl: Dissolve 75 g of reagent grade KCl in 500 mL deionized water and dilute to a 1000 mL (See Comment #1).
3. Standard calibration solutions of NH₄⁺-N. Prepare five calibration standards ranging from 0.1 to 50.0 mg L⁻¹ concentration, diluted in 1.0 N KCl extraction solution prepared from 1000 mg L⁻¹ Al standard solution.

Procedure

1. Weigh 5.0 ± 0.05 g of air-dried soil pulverized to pass 10 mesh sieve (< 2.0 mm) into extraction vessel. Add 25.0 mL of 1.0 N KCl extraction reagent using repipette dispenser (See Comment #2). Include a method blank.
2. Place extraction vessel(s) on reciprocating mechanical shaker for thirty (30) minutes.
3. Filter extract (See Comment #3), refilter if filtrate is cloudy (comment #4).
4. Aluminum content of the extract is determined using an Inductively Coupled Plasma spectrometry (ICP-AES) (See Comment #4). Suggested wavelengths are: 309.271, 396.152 and 237.335 nm. Adjust and operate instrument in accordance with manufacturer's instructions. Determine aluminum concentration of a method blank reference checks and unknown samples.

Calculation

$$\text{Al mg kg}^{-1} \text{ in soil} = (\text{Al mg L}^{-1} \text{ in filtrate} - \text{method blank}) \times 5$$

Report soil Al concentration to the nearest 0.1 mg kg⁻¹ (See Comment #5)

Comments

1. Soils may be extracted with 1.0 N KCl for the simultaneous determination of nitrate (Method 3.10).
2. Check repipette dispensing volume calibration using an analytical balance.
3. Check filter papers supply for possible contamination of and Al. If contamination is greater than 0.2 mg L^{-1} on a solution basis, rinse filter paper with 1.0 N KCl.
4. It is recommended that soils extracted for ammonium be analyzed within two (2) hours after extraction.
5. Samples having ammonium concentrations exceeding the highest standard will require dilution and reanalysis.

Literature

Bertsch, P.M. and P.R. Bloom. 1996. Aluminum. p. 517-550. *In*: J.M. Bartel et al. (ed.) *Methods of soil analysis: Part 3 Chemical methods*. (3rd ed.) ASA and SSSA, Madison, WI. Book series no. 5

Keeney, D.R. and D.W. Nelson. 1982. Nitrogen-inorganic forms. *In* A.L. Page (eds.) *Methods of soil analysis, part 2. Agron. Monogr.* 9, 2nd ed. ASA and SSSA, Madison, WI. p. 643-698.