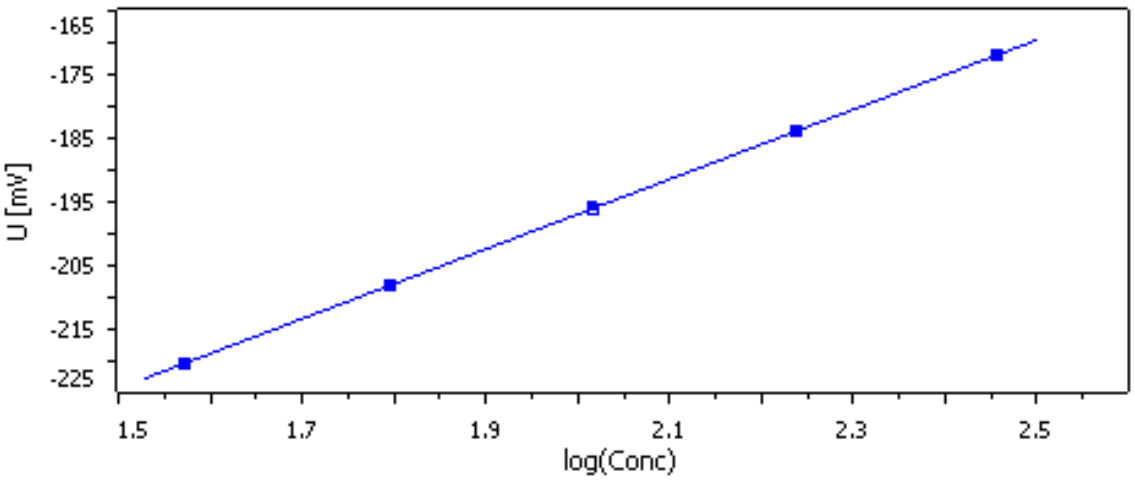
ISE Application Note I-021

Potassium in soil

Fast and inexpensive determination by standard addition



To assess the quality of a soil it is necessary to know its nutrients. For example, it is necessary that the level of bio-available ions is known as a deficiency might negatively affect plant growth. One of the most important ions is potassium which is directly absorbed in its ionic form by plants roots. It is an essential nutrient and required for proper growth and reproduction.

One commonly used method to assess the K content is the extraction of phosphorus and potassium from soil with an acidic, to pH 4.1 buffered solution of calcium acetate, calcium lactate, and glacial acetic acid. This test is called calcium acetate lactate test (CAL-test). Commonly, the extract is analyzed by flame photometric method. In this application note we present a fast and inexpensive alternative using the potassium ion selective electrode.

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Method description

Samples

Flower soil

Sample preparation

Approx. 5 g dried soil (2 h at 120 °C), a spatula of active carbon and 100 mL of CAL test solution are added into a glass beaker. The mixture is stirred at high stirring rate for 2 hours and afterwards the suspension is filtrated.

Configuration

814 USB sample processor (1T/2P)	2.814.0020
Titration head, 3x SGJ 14	6.1458.040
Sample rack 22 x 120 mL	6.2041.470
Sample beakers plastic (PP), 120 mL, 250 pieces	6.1459.300
Propeller for 120 mL beaker	6.1909.050
802 Rod stirrer	2.802.0020
tiamo 2.5 full	6.6056.252
867 pH module	2.867.0010
800 Dosino, 3x	2.800.0010
Dosing unit, 50 mL	6.3032.250
Dosing unit, 10 mL, 2x	6.3032.210
Cable USB A- mini DIN 8 pin	6.2151.000
Electrode cable 2 m / F	6.2104.030
Electrode cable 2 m, 2 x 2 mm	6.2104.150
Combined K-ISE	6.0510.110
Temperature sensor Pt1000	6.1110.100

Solutions

Standard solution for additions	$\beta(K^+)$ = 4'000 mg/L 7.46 g dried potassium chloride is weighed into a 1 L volumetric flask and filled up to the mark with deionized water.
ISA	c(NaCl) = 3 mol/L 175.3 g sodium chloride is weighed into a 1 L volumetric flask and filled up to the mark with deionized water.
CAL stock solution	7.7 g calcium lactate and 3.95 g calcium acetate are dissolved in approx. 50 mL deionized water. 5 mL glacial acetic acid is added and afterwards the pH is adjusted to 4.1 by adding dropwise glacial acetic acid. The solution is transferred into a 100 mL volumetric flask and filled up to the mark with deionized water.
CAL test solution	20 mL of CAL stock solution is pipetted into a 100 mL volumetric flask and filled up to the mark with deionized water.

Analysis of samples

5 mL of extracted sample is pipetted into a 120 mL beaker, 2 mL of ISA is dosed and then the solution is diluted with deionized water to 50 mL. The standard addition is carried out with $\beta(K^+)$ = 4'000 mg/L. In between each measurement the electrode is conditioned for 30 s in c(KCl) = 0.01 mol/L and then well rinsed with deion. water.

Parameters

Mode	STDADD auto
Number of additions	4
Volume auxiliary solution	45 mL
Stop volume	10 mL
Dosing rate	Medium
Delta U	12 mV
Signal drift	0.5 mV/min
Min. waiting time	10 s
Max. waiting time	300 s
Measuring interval	2.0 s
Stirring rate	8

Result

Sample	$\omega(K^+)$ in % (m/m)	s_{rel} / % (n = 5)
Soil	1.181	1.10

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