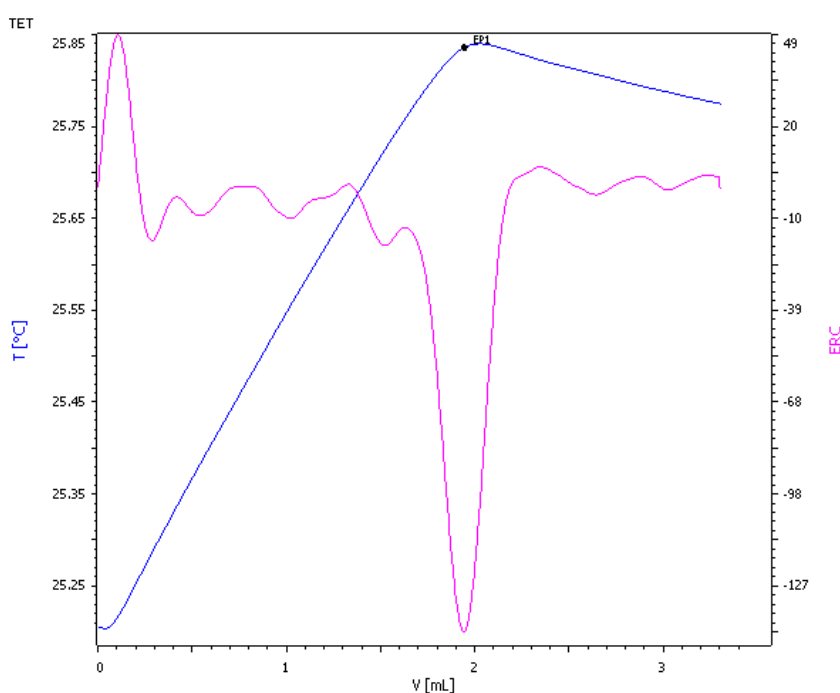


Phosphate in fertilizers

Rapid and reliable determination by thermometric titration



Phosphorus is a primary macronutrient for plants and is a constituent of DNA and adenosine triphosphate (ATP), which is involved in many biological processes requiring energy. In fertilizers, phosphorus is present in the form of phosphate, as the most accessible form of phosphorus for plants is dihydrogen phosphate. Knowledge of the phosphorus content helps to select the right fertilizer for the plants.

Traditionally, phosphate is determined gravimetrically (a time consuming procedure) or spectrophotometrically (expensive instrumentation). In this Application Note, an alternative method is presented, where phosphate is determined by a precipitation titration with magnesium. Various solid and liquid NPK fertilizers with phosphorus contents between 6.5 and 17% were analyzed. The analysis by thermometric titration requires no sample preparation in case of liquid NPK fertilizers and only minimal sample preparation in case of solid NPK fertilizers. One determination takes about 5 minutes.

Method description

Sample

Three liquid NPK fertilizers

One solid NPK fertilizer

Sample preparation

Liquid fertilizers

No sample preparation is required for liquid fertilizers.

Solid fertilizers

Approximately 5 g sample is weighed into a 100 mL Erlenmeyer flask and dissolved in about 75 mL deionized water. The flask is placed into a heated ultrasonic bath at about 40 °C for 30 min. The solution is then filtrated into a 100 mL volumetric flask and the filter paper is rinsed with deionized water. The flask is then filled to the mark with deionized water.

Configuration

859 Titrotherm	2.859.1010
800 Dosino, 3x	2.800.0010
Dosing unit 5 mL	6.3032.150
Dosing unit 50 mL	6.3032.250
Thermoprobe	6.9011.020

Solutions

Titrant $c(\text{Mg}(\text{NO}_3)_2) = 1 \text{ mol/L}$	256.4 g $\text{Mg}(\text{NO}_3)_2$ is weighed into a 1 L volumetric flask and dissolved in approximately 500 mL deionized water. The flask is then filled to the mark with deionized water.
Precipitant $\beta(\text{K}_2\text{C}_2\text{O}_4) = 300 \text{ g/L}$	332.5 g $\text{K}_2\text{C}_2\text{O}_4$ is weighed into a 1 L volumetric flask and dissolved in approximately 500 mL deionized water. The flask is then filled to the mark with deionized water.
Buffer $\text{NH}_4\text{Cl}/\text{NH}_3$	87.54 g NH_4Cl is weighed into a 1 L bottle and dissolved in 568 mL $\omega(\text{NH}_3, \text{aq}) \sim 25\%$.

Analysis

Liquid fertilizers

1 to 10 g liquid sample is weighed directly into the titration vessels. 5 mL buffer and 5 mL precipitant are dosed to the solution, which is then made up to a total volume of approximately 30 mL with deionized water. Then the sample is titrated with $c(\text{Mg}(\text{NO}_3)_2) = 1 \text{ mol/L}$ until after the exothermic endpoint.

Solid fertilizers

5 to 20 mL of the solid sample solution is pipetted into the titration vessels. 5 mL buffer and 5 mL precipitant are dosed to the solution, which is then made up to a total volume of approximately 30 mL with deionized water. Then the sample is titrated with $c(\text{Mg}(\text{NO}_3)_2) = 1 \text{ mol/L}$ until after the exothermic endpoint.

Parameters

Mode	TET
Start volume	0 mL
Pause	10 s
Stirrer	15
Dosing rate	2 mL/min
Filter factor	40
Damping until	0.5 mL
Stop volume	10 mL
Evaluation start	0.5 mL
Reaction type	Exothermic
EP criterion	-40

Result

Sample no.	n	$\text{P}_2\text{O}_5 / \%$	$s(\text{abs}) / \%$
Liquid NPK fertilizer 1	5	9.18	0.02
Liquid NPK fertilizer 2	5	7.16	0.02
Liquid NPK fertilizer 3	5	6.64	0.01
Solid NPK fertilizer 1	4	17.24	0.03