

Application Note AN-H-146

Ammonium and urea nitrogen in NPK fertilizers

Fast, simultaneous determination of both components by thermometric titration

Fertilizers are applied in the agricultural sector to provide more essential nutrients for growing plants. So-called «NPK» fertilizers provide nutrients to plants with their three main components: N – nitrogen, P – phosphorus, and K – potassium. In fertilizers, nitrogen is mainly provided in three forms: as ammonium nitrate (NH_4NO_3), ammonia (NH_3), and urea (H_2NCONH_2). Due to the different physical and chemical properties, uptake and release kinetics, mixtures of the nitrogen-providing compounds are used. Using such mixtures reduces the problem of fertilizer burns on plants, caused by an excess of nitrogen.

Determination of the individual nitrogen-contributing components is often laborious work. Thermometric titration offers the possibility to rapidly determine the amount of ammoniacal nitrogen and urea nitrogen in a single titration using sodium hypochlorite as titrant.

SAMPLE AND SAMPLE PREPARATION

This application is demonstrated on two different solid NPK fertilizers. For the analysis, stock solutions of the solid fertilizers are prepared. The solid fertilizers are weighed accurately into a volumetric flask and dissolved in warm water.

EXPERIMENTAL

The analysis is carried out with an OMNIS Titrator equipped with a dThermoprobe (Figure 1). To avoid handling chemicals manually, all solutions are automatically dosed using an 846 Dosing Interface.
The titration is based on the reaction between sodium hypochlorite and ammonium nitrogen and urea, respectively. Bromide is used as a catalyst for the reaction. As urea reacts more slowly with hypochlorite than ammoniacal nitrogen, two endpoints are obtained.



Figure 1. OMNIS Titrator setup for the thermometric titration. The data evaluation is performed with the OMNIS software.

Prior to the titration, the sample is pipetted into the titration vessel. All required auxiliary solutions are dosed automatically, and the vessel is filled up with deionized water to a total volume of 50 mL. Afterwards, the solution is titrated until after the second exothermic endpoint with sodium hypochlorite.

RESULTS

Titration curves with two endpoints are obtained if the sample includes ammonium and urea. One exemplary titration curve is shown in Figure 2. Depending on the urea amount in the sample, additional spiking of the sample can improve the detection of urea and ensures that a second endpoint is found.

Table 1. Results of the thermometric titration of solid NPK fertilizers containing urea and ammonium (n = 6).

	NPK 17-8-10	NPK 15-15-15
$w(N_{Ammonia})$ / %	11.31	11.98
$s(rel)_{Ammonia}$ / %	0.70	0.31
$w(N_{Urea})$ / %	4.51	2.03
$s(rel)_{Urea}$ / %	0.69	2.35

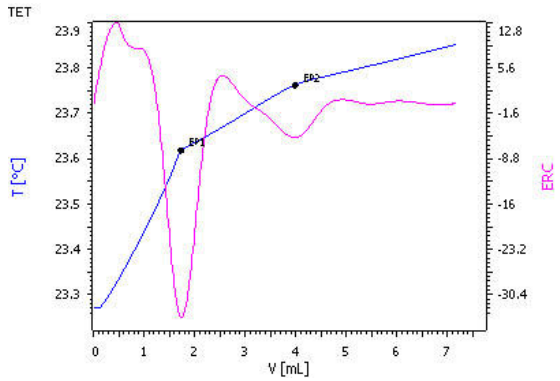


Figure 2. Titration curve of thermometric determination of ammonium (EP1) and urea (EP2) in NPK 17-8-10 fertilizer.

CONCLUSION

Thermometric titration is a very fast and accurate method to determine the ammonium and urea content in fertilizers in one titration. The method allows a differentiation of these two components with a determination time of less than 3 minutes.

Internal reference: AW TI CH1-1299-112019

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CONFIGURATION



OMNIS Titrator with magnetic stirrer, without function license

Innovative, modular potentiometric OMNIS Titrator for stand-alone operation or as the core of an OMNIS titration system. Thanks to 3S Liquid Adapter technology, handling chemicals is more secure than ever before. The titrator can be freely configured with measuring modules and cylinder units and can have a stirrer added as needed. Thanks to various software function licenses, various measuring modes and functionalities are possible.

- Control via PC or local network
- Connection option for up to four additional titration or dosing modules for additional applications or auxiliary solutions
- Connection option for one rod stirrer
- Various cylinder sizes available: 5, 10, 20 or 50 mL
- Liquid Adapter with 3S technology: Secure handling of chemicals, automatic transfer of the original reagent data of the manufacturer

Measuring modes and software options:

- Endpoint titration: "Basic" function license
- Endpoint and equivalence point titration (monotonic/dynamic): "Advanced" function license
- Endpoint and equivalence point titration (monotonic/dynamic) with parallel titration: "Professional" function license



dThermoprobe

High-sensitivity digital temperature sensor for thermometric titration with OMNIS.

The Thermoprobe has a short response time and a high resolution, which enables precise recording of even the smallest temperature changes.

This sensor can be used in aqueous and nonaqueous solutions which do not contain any HF, for determinations such as:

- Acid number (TAN) in accordance with ASTM D8045
- Total base number (TBN)
- Free fatty acids
- Ca/Mg determination
- Phosphate



Cylinder unit OMNIS special, 10 mL

Intelligent 10 mL cylinder unit for one OMNIS Titrator, Titration Module or Dosing Module. This cylinder unit is especially recommended for the following solutions:

- Aqueous alkaline solutions
- Titrant 5
- Silver nitrate solutions
- Nonaqueous alkaline solutions
- Permanganate solutions
- EDTA solutions

Includes dosing tubing and antidiffusion tip.

OMNIS

A WHOLE NEW LEVEL OF PERFORMANCE

Function license Thermometric Titrator

Function license "Thermometric Titrator" for the OMNIS Titrator

Contains the function modes

- Thermometric Titration (TET)
- MEAS U/T/pH
- Liquid Handling
- Titration only with internal buret of an OMNIS Titrator