

# Ammonium and urea nitrogen in NPK fertilizers

Fast, simultaneous determination of both components by thermometric titration

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## Summary

Fertilizers are applied in the agricultural sector to provide more essential nutrients to growing plants. The so-called «NPK» fertilizers provide such nutrients to plants with its three main components (N – nitrogen, P – phosphorous, K – potassium). In fertilizers, nitrogen is mainly provided in three forms: as ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ), ammonia ( $\text{NH}_3$ ), and urea ( $\text{H}_2\text{NCONH}_2$ ). 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.

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## Configuration



### 2.859.1010 - 859 Titrotherm complete with tiamo™

Computer-controlled titrator for thermometric titration. Including complete accessories for the titration (10 mL buret, titration stand with rod stirrer, Thermoprobe, titration vessel and tiamo™ light).



### **2.846.0010 - 846 Dosing Interface**

USB-capable control unit for connecting a maximum of four 800 Dosinos or 805 Dosimats for dosing and Liquid Handling tasks. A Touch Control or the connection to a PC with OMNIS Software, tiamo™, MagIC Net, viva, or 797 VA Computrace is required for operation.



### **2.800.0010 - 800 Dosino**

Drive with write/read hardware for intelligent Dosing Units. With fixed cable (length 150 cm).



### **6.3032.150 - Dosing Unit 5 mL**

Dosing unit with integrated data chip with 5 mL glass cylinder and light protection, mountable on reagent bottle with ISO/DIN GL45 thread. FEP tubing connection, anti-diffusion buret tip.



### **6.3032.210 - Dosing Unit 10 mL**

Dosing unit with integrated data chip with 10 mL glass cylinder and light protection, mountable on reagent bottle with ISO/DIN GL45 thread. FEP tubing connection, anti-diffusion buret tip.



### **6.3032.250 - Dosing Unit 50 mL**

Dosing unit with integrated data chip with 50 mL glass cylinder and light protection, mountable on reagent bottle with ISO/DIN GL45 thread. FEP tubing connection, anti-diffusion buret tip.

## 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



Figure 1. 859 Titrotherm setup for the thermometric titration and the data evaluation performed with tiamo.

The analysis is carried out with an 859 Titrotherm equipped with a Thermoprobe. 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.

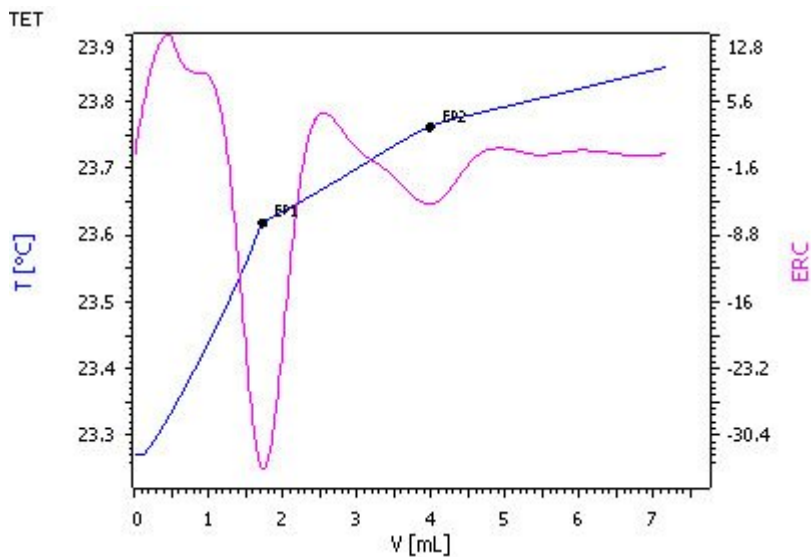
Prior to the titration, the sample is pipetted into the titration vessel. All required auxiliary solutions are dosed automatically, and the vessel is filled up with deionized water to a total volume of 50 mL. Afterwards, the solution is titrated until after the second exothermic endpoint with sodium 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
$w(N_{\text{Ammonia}}) / \%$	11.31	11.98
$s(\text{rel})_{\text{Ammonia}} / \%$	0.70	0.31
$w(N_{\text{Urea}}) / \%$	4.51	2.03
$s(\text{rel})_{\text{Urea}} / \%$	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**.

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