

APPLICATION OF THE THERMATIC TITRATOR FOR FAST ANALYSIS

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ABSTRACT

A new instrument for thermometric titration has been developed at ALUTERV-FKI. This instrument called Thermatic titrator uses the heat effect of the reaction to indicate the end point of the titration. A typical application is demonstrated /discussed/ by the analysis the process liquor of alumina plants. Other possibilities are also mentioned.

INTRODUCTION

The automatic THERMATIC titrator consists of an automatic burette connected with an electronic unit. A stirrer, temperature detector, titration cell, calorifer together with calculator and printer make the instrument complete.

There are two ways of titrating with the THERMATIC titrator:

- automatic end point detection is used for reactions of large heat effect;
- graphic evaluation is used, by means of a recorder for titration with a small heat effect, that is, when either the reaction heat is small, or the amount of the material to be analysed is small.

MEASURING METHODS

Thermometric titration involves the continuous detection of the heat of reaction evolving during titration. A titrant is injected at a constant speed to the solution of the material to be analyzed. A temperature change can be detected in the solution until all the material has been consumed in the reaction and the titration is over. The end point of the titration can be detected by the $T = f /t/$ function as shown in Fig.1.

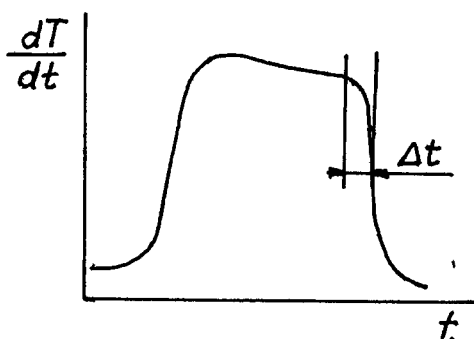
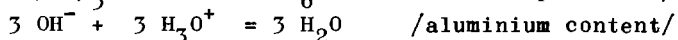
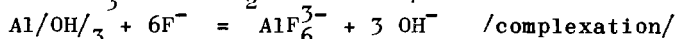


Fig.1.

The automatic detection of the end point takes place with a delay of Δt , with respect to the real end point. This overtitration can be corrected by calibration. Automatic end point detection can be used whenever the heat effect of the reaction is sufficiently large. The heat effect is directly proportional with the heat of reaction, the concentration of titrant and the speed of titrant injection and inversely proportional with the thermal capacity of the titration cell. Graphic evaluation is used for the determination of materials of low concentration and titration with a reaction of small heat effect.

RESULTS AND DISCUSSIONS

A typical application is the analysis of sodium aluminate solutions. Both the caustic soda and the aluminium content of the solution can be determined in one sample according to the following reactions:



The alkali content of the sample is analysed first, using a tartarate salt as complexing agent and hydrochloric acid as titrant. For the second titration a fluoride salt solution is added to the sample. The resulting amount of hydroxyl ions is equivalent to the aluminium content of the sample and can be titrated with hydrochloric acid. Connected with a calculator and a printer the THERMATIC titrator evaluates the titration data and print the results.

The time necessary to analyse both components is two to five minutes. The error of the analysis varies with the concentration of the species titrated and is between 0.3 - 0.8 relative percent. This instrument and the method mentioned are used /applied/ in the alumina plants of GDR, Hungary, Roumania and Yugoslavia, for fast analysis of process liquors. The THERMATIC titrator was successfully used to determine the concentrations in various solutions of the following materials:

- chloride, sulphate and hypochlorite ions;
- silicon dioxide;
- lead, barium, aluminium, ferrous and ferric ions;
- products and intermediates of pharmaceutical industry.

Furthermore, reaction kinetic tests as well as measurements of the heat of reaction can also be made with the instrument. For reaction heat measurement it is necessary to calibrate the instrument with a calorifer or with standard chemical reactions.

CONCLUSIONS

The THERMATIC titrator has been proved a suitable new means for fast analysis of process liquor and also for the quality control of different materials, with a very good reproducibility and accuracy.

REFERENCE

1. P. Gadó, I. Szalay, F. Farkas, I. Fehér: Instrumental Process Control in Bauxit Mining and Processing. Light Metals 1983 /Proc. of AIME Annual Meeting/ pp. 313-323.