



Application Note AN-T-233

Determination of pyrophosphates by titration

Fast and accurate potentiometric determination of pyrophosphates in aqueous samples

Pyrophosphates, also known as diphosphates, are mainly used in food chemistry applications as emulsifiers. They also have other useful properties as preservatives, antioxidants, release agents, and leavening agents. Pyrophosphates can also act as complexing agents and acidity regulators and therefore have a wide range of uses.

However, pyrophosphates should only be used in limited quantities as they can cause severe allergic

reactions as well as lead to the onset of osteoporosis. The determination of pyrophosphate content in food and beverage products is therefore of interest.

In this Application Note, the pyrophosphate content in aqueous samples is accurately and reliably analyzed by automated titration using the OMNIS Sample Robot S and the OMNIS Titrator equipped with a dUnitrode.

SAMPLES AND SAMPLE PREPARATION

This application is demonstrated on different samples from potato processing baths. Sample preparation is

An appropriate amount of sample is weighed into the titration beaker and deionized water is added. The pH is measured and then adjusted to between pH 3 and 6 if necessary.

In the first step after adding zinc sulfate, a pyrophosphate-complex and sulfuric acid are formed via the following reaction mechanism:

not required.

$$\text{Na}_2\text{H}_2\text{P}_2\text{O}_7 + 2 \text{ZnSO}_4 \rightarrow \text{Zn}_2\text{P}_2\text{O}_7 + \text{Na}_2\text{SO}_4 + \text{H}_2\text{SO}_4$$

In the second step, the formed sulfuric acid is titrated with sodium hydroxide to determine the pyrophosphate content in the sample.

The determination is carried out with an OMNIS Titrator equipped with a dUnitrode on an OMNIS Sample Robot S (Figure 1).



Figure 1. OMNIS Sample Robot S equipped with an OMNIS Titrator, Dosing module, and dUnitrode electrode for the automated determination of pyrophosphate in aqueous samples.

RESULTS

This method offers very accurate results, as displayed

in Table 1 and Table 2.

Table 1. Results of pyrophosphate determination in different aqueous samples.

Sample (n = 3)	Pyrophosphate in %	SD(rel) in %
1	7.48	0.0
2	5.32	0.1
3	9.84	0.1
4	8.48	0.1
5	15.87	0.3

Table 2. Results of pyrophosphate determination in the samples from Table 1 – each spiked with 5.0 g/L Na₂H₂P₂O₇.

Sample with spike (n = 3)	Expected value in %	Recovery in %
1	12.48	99.2
2	10.32	100.0
3	14.84	98.6
4	13.48	97.8
5	20.87	101.4

Titration is an accurate and precise method that can be used to determine the pyrophosphate content in aqueous products. The OMNIS Titrator equipped with

a dUnitrode delivers reliable determinations. This automated system offers flexible analyses combined with high-end software.

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CONFIGURATION



OMNIS Sample Robot S Pick and Place

OMNIS Sample Robot S with a "Peristaltic" (2-channel) pump module and a Pick&Place module in addition to extensive accessories for the direct transition to fully automatic titration. The system provides space in two sample racks for 32 sample beakers of 120 mL each. This modular system is supplied completely installed and can thus be put into operation in a very short time.

The system can also be extended upon request to include two additional peristaltic pumps and another Pick&Place module, thus doubling the throughput. If additional workstations are required, then this Sample Robot is already able to be expanded to become an L-sized OMNIS Sample Robot, thus enabling samples from seven racks to be processed in parallel on up to four Pick&Place modules and quadrupling the sample throughput.



OMNIS Professional Titrator without stirrer

Innovative, modular potentiometric OMNIS Titrator for endpoint titration and equivalence point titration (monotonic/dynamic). Thanks to 3S Liquid Adapter technology, handling chemicals is safer than ever before. The titrator can be freely configured with measuring modules and cylinder units and can have a stirrer added as needed. Including "Professional" function license for parallel titration with additional titration or dosing modules.

- Actuation via PC or local network
- Connection option for up to four additional titration or dosing modules for additional applications or auxiliary solutions
- Can be supplemented with magnetic stirrer and/or rod stirrer
- Various cylinder sizes available: 5, 10, 20 or 50 mL
- Liquid Adapter with 3S technology: Safe handling of chemicals, automatic transfer of the original reagent data from 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 5-way parallel titration: "Professional" function license