



Application Note AN-T-237

用氢氧化钠测定磷酸

Fast and accurate potentiometric titration with NaOH

Phosphoric acid (H_3PO_4) is one of the most important inorganic acids in use today. This strong acid is triprotic, meaning it has three dissociable protons. It can be used for many purposes, e.g., as a raw material for the production of phosphate fertilizers, in detergents and rust removers, as an electrolyte in phosphoric acid fuel cells, and for the passivation of iron and zinc to protect against corrosion. In the food and beverage industry, phosphoric acid is used in diluted form as a

preservative, acidifier in soda, as an acidity regulator in general, and as an antioxidant in sausages and other meats.

Since H_3PO_4 is also used to produce buffer solutions (phosphate buffers) in various laboratories, its accurate analysis is indispensable.

This Application Note presents an acid-base titration where the concentration of phosphoric acid is determined over all three of its dissociable protons by titrating it with sodium hydroxide.

SAMPLE AND SAMPLE PREPARATION

This application is demonstrated on phosphoric

acid. Sample preparation is not required.

EXPERIMENTAL

The determinations are carried out on an Eco Titrator equipped with a Unitrode with integrated Pt1000 (**Figure 1**). The H_3PO_4 (acid solution) reacts with NaOH (strong base) via the following neutralization reaction mechanism:

$$\text{H}_3\text{PO}_4 + 3 \text{NaOH} \rightarrow \text{Na}_3\text{PO}_4 + 3 \text{H}_2\text{O}$$

An appropriate amount of sample is pipetted into the titration beaker and then deionized water and sodium chloride are added. Afterwards, the solution is titrated until after the third endpoint with standardized sodium hydroxide.



Figure 1. Eco Titrator equipped with a Unitrode with integrated Pt1000.

RESULTS

This method offers very accurate results, as displayed in **Table 1**. One exemplary H_3PO_4

titration curve with NaOH is shown in **Figure 2**.

Table 1. Results of the potentiometric titration of H_3PO_4 calculated via the second endpoint ($n = 10$).

Sample ($n = 10$)	NaOH in mL	H_3PO_4 in mol/L	Recovery in %
Mean value	3.998	0.999	99.99
SD(abs)	0.00	0.00	0.10
SD(rel) in %	0.07	0.05	0.10

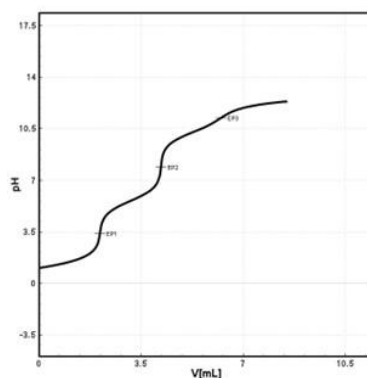


Figure 2. Phosphoric acid titration curve with three equivalence points (EP) shown.

CONCLUSION

The potentiometric titration of phosphoric acid with sodium hydroxide solution is routine in many laboratories.

It is normally only possible to titrate the first two protons of phosphoric acid in aqueous solution. By increasing the ionic strength, H_3PO_4 can completely dissociate. Thanks to the special properties of the Unitrode from Metrohm, it is possible to detect the third proton for the most accurate results.

This kind of acid-base titration is perfect for the

Eco Titrator with its integrated magnetic stirrer and touch-sensitive user interface. This system offers customers low-priced, simple handling within a compact footprint (approximately DIN A4). Pre-installed methods on the Eco Titrator enable users without laboratory experience to get right to work without complications. The Eco Titrator gives fast, reliable, precise, and GLP-compliant results in a small user-friendly package.

CONTACT

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CONFIGURATION



Eco Titrator

紧凑型 Eco Titrator 具有内置磁力搅拌器和触摸感应式用户界面,可以满足日常分析需求。其始终提供符合 GLP 标准的结果。

普遍适用于几乎所有电位分析式滴定,例如:

- 食品:脂肪的酸度、氯化物、维生素 C、碘和过氧化物值
- 水分析:碳酸盐和 Ca/Mg 硬度、氯化物、硫酸盐、高锰酸盐指数
- 石化:酸/碱值、硫化物和硫醇、氯化物、溴值
- 电镀:总酸度、金属含量、氯化物
- 表面活性剂分析:阴离子、阳离子和非离子表面活性剂
- 光度计与光度电极:p 和 m 值、金属、水硬度