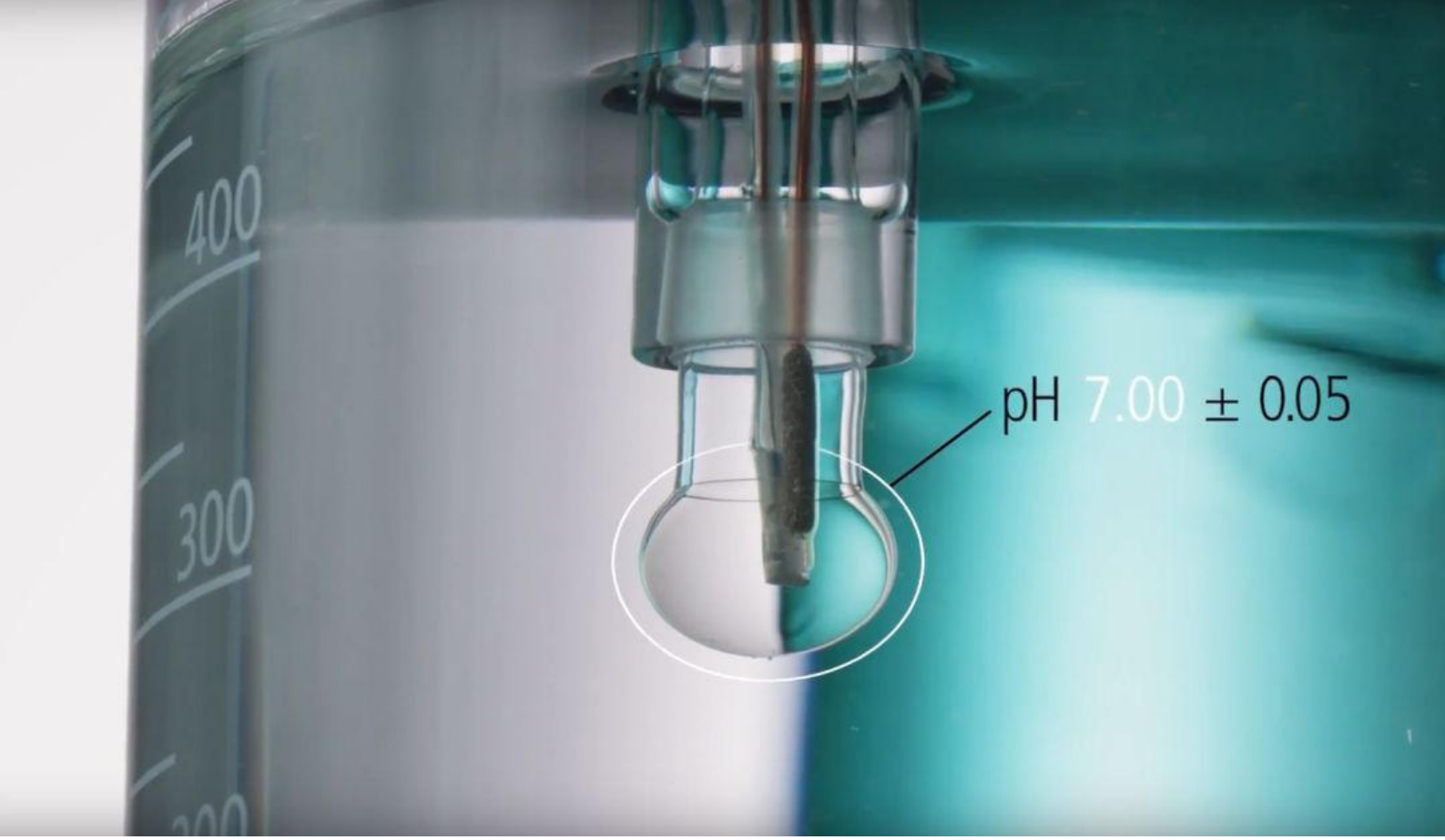

Application Note AN-T-236

Determination of hydrochloric acid with sodium hydroxide

Fast and reliable potentiometric titration of HCl with NaOH

Hydrochloric acid (HCl) is a strong inorganic acid also classified as a mineral acid. HCl is an essential solution with great significance in the chemical industry. Among other things, it is used in the processing of ores, serves as a cleaning agent, or is used during metal processing for pickling, etching, and soldering. Hydrochloric acid is also an important standard solution in the pharmaceutical industry.

The potentiometric titration of hydrochloric acid with sodium hydroxide is one of the most important and also most frequent analyses performed in the laboratory. Titration is best suited for this purpose. The method is very accurate, inexpensive, and fast.

In this Application Note, an acid-base titration is presented where the concentration of HCl is determined with sodium hydroxide (NaOH) using a pH electrode with an integrated Pt1000 temperature senor for the most accurate results.

SAMPLE AND SAMPLE PREPARATION

This application is demonstrated on c(HCl) = 1 mol/L.

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 acidic HCl reacts with a basic solution of NaOH via the following neutralization reaction mechanism:

$HCl + NaOH \rightarrow NaCl + H_2O$

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

Figure 1. The Eco Titrator from Metrohm equipped with a Unitrode with integrated Pt1000.

RESULTS

This method offers very accurate results, as displayed in Table 1. One exemplary titration curve of HCl is shown in Figure 2.

Table 1. Results of the potentiometric titration of HCl (n = 10).

Sample (n = 10)	NaOH in mL	HCl in mol/L	Recovery in %
Mean value	4.994	0.999	100.00
SD(abs)	0.00	0.00	0.05
SD(rel) in %	0.05	0.05	0.05

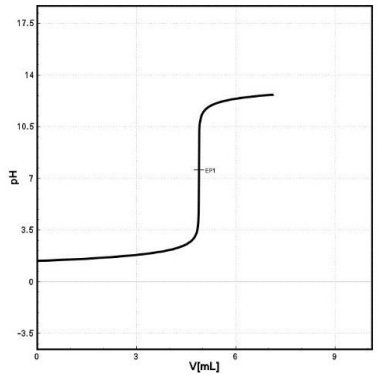

Figure 2. Titration curve of the potentiometric determination of hydrochloric acid. The equivalence point (EP) was found at approximately pH = 7.0.

CONCLUSION

HCl titration with NaOH is one of the absolute methods of routine laboratory analysis.

The compact Eco Titrator with integrated magnetic stirrer and touch-sensitive user interface is ideal for this kind of acid-base titration. The system is user-friendly and cost-effective. Pre-installed methods on the Eco Titrator make it easy for customers without laboratory experience to get started creating precise, fast, reliable, and GLP-compliant results. With a small footprint (approximately DIN A4), the Eco Titrator is suitable for laboratories even with space limitations.

CONTACT

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CONFIGURATION

Eco Titrator

The compact Eco Titrator with integrated magnetic stirrer and touch-sensitive User Interface is ideal for routine analysis. It provides GLP-compliant results with minimum space requirements at all times (approx. DIN A4).

Universally compatible with almost all potentiometric titrations, such as, for example, for

- Food products: Acid content, chloride, Vitamin C, iodine and peroxide number in fats
- Water analysis: Carbonate and Ca/Mg hardness, chloride, sulfate, permanganate index
- Petrochemistry: Acid/base number, sulfide & mercaptans, chloride, bromine number
- Electroplating: Total acid, metal content, chloride
- Surfactant analysis: Anionic, cationic and non-ionic surfactants
- Photometry with the Optrode: p and m value, metals, water hardness