Application Note AN-T-208

Nicotine in e-liquids

Reliable and affordable determination by potentiometric titration

The vaping and electronic cigarette industries have grown impressively in the past decade. Usage among youths has increased from around 1% in 2011 to 10.5–27.5% in 2019 (pre-teens vs. older teenagers) mainly due to the vast array of flavor options available (Truth Initiative, 2020). The mixtures used in these products are usually called «e-liquid», «e-fluid», or «e-juice». To ensure the quality of these e-liquids, testing the most important quality parameters is required. One important quality control parameter is the nicotine content available in these products.

Nicotine in tobacco is usually determined by gas chromatography or liquid chromatography. Aqueous acid base titration is a much more affordable alternative for this determination. As e-liquids do not contain other components which might interfere with the titration, the aqueous acid base titration presented in this Application Note can be applied for nicotine determination.

This method is an affordable and reliable way to determine the nicotine content in e-liquids and their nicotine starting material, ensuring the quality of these products.

SAMPLE AND SAMPLE PREPARATION

Nicotine starting material for e-liquids as well as e-liquids are analyzed. No sample preparation is required.

EXPERIMENTAL

The analyses are carried out on a 905 Titrando system with a rod stirrer and a Unitrode easyClean for indication of the equivalence point.

A suitable amount of sample is transferred into a disposable beaker and deionized water is added. The solution is stirred to ensure complete dissolution and mixing. Afterwards, the solution is titrated with standardized hydrochloric acid until after the first equivalence point is reached.

Figure 1. Titration system consisting of a 905 Titrando, a rod stirrer, and a Unitrode easyClean. The data are recorded and evaluated by tiamo.

RESULTS

Steep and smooth titration curves are obtained for all analyses. An example titration curve is displayed in Figure 2. The automated analysis leads to reproducible results with low RSDs as shown in Table 1.

Table 1. Results of the nicotine determination by aqueous titration in nicotine starting materials as well as in various e-liquids (n = 3).

	Mean value / g/L	SD(abs) / g/L	SD(rel) /%
Nicotine starting material	31.39	0.01	0.03
E-liquid 1	5.64	0.01	0.24
E-liquid 2	2.82	0.001	0.04
E-liquid 3	15.32	0.08	0.53
E-liquid 4	10.15	0.04	0.35

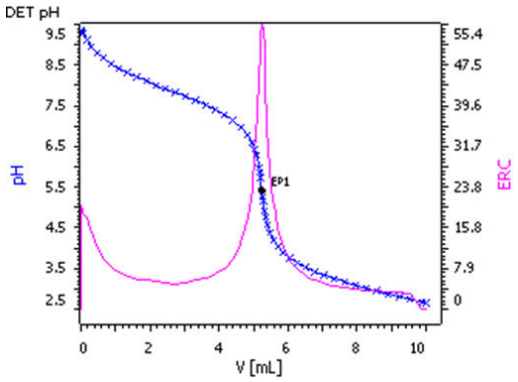

Figure 2. Example titration curve for the nicotine determination in an e-liquid.

CONCLUSION

This method is an affordable and reliable way to determine the nicotine content in e-liquids and their nicotine starting material, ensuring the quality of these products. Additionally, no harmful chemicals and no sample preparation are required for the determination.

Internal reference: AW TI US1-0073-092018

CONTACT

Metrohm AG
Ionenstrasse
9100 Herisau
info@metrohm.com

CONFIGURATION

905 Titrando

High-end titrator for potentiometric titration with one measuring interface for use with Dosino dosing systems.

- up to four dosing systems of the 800 Dosino type
- dynamic (DET), monotonic (MET), and endpoint titration (SET)
- Measurement with ion-selective electrodes (MEAS CONC)
- Dosing functions with monitoring, Liquid Handling
- four MSB connectors for additional stirrers or dosing systems
- "iTrode" intelligent electrodes
- USB connector
- For use with OMNIS Software, *tiamo* software, or Touch Control unit
- Compliance with GMP/GLP and FDA regulations such as 21 CFR Part 11, if required

802 Stirrer for 804 Ti Stand

Rod stirrer including 6.1909.010 stirring propeller.

804 Ti Stand with stand

Titration stand and controller for 802 Rod Stirrer. The 804 Ti Stand together with the optional 802 Rod Stirrer provides an alternative to the magnetic stirrer. Ti Stand with base plate, support rod and electrode holder.

Unitrode easyClean with Pt1000 (fixed cable 2 m)

Combined pH electrode with easyClean diaphragm, integrated Pt1000 temperature sensor, and fixed cable (2.0 m). This electrode is particularly suitable:

- for automated pH measurements and titrations in difficult, viscous, or alkaline samples
- at elevated temperatures
- for long-term measurements

The easyClean diaphragm can be easily cleaned even in the case of heavily contaminating samples.

Reference electrolyte: c(KCl) = 3 mol/L, storage in storage solution.
Alternatively: reference electrolyte for measurements at T>80°C: Idrolyte, storage in Idrolyte.