Application Note AN-T-097

Base number in petroleum products with potentiometric titration

Potentiometric determination according to ISO 3771, ASTM D2896, and IP 276

Basic chemicals are added to petroleum products to prevent corrosion as they neutralize acidic components that form during the use and aging of these products. The base number (BN) gives an indication regarding the amount of these basic additives present, and it can be used as a measure for the degradation of the petroleum product.

The use of a pH electrode suitable for non-aqueous titrations ensures the reliable determination of the equivalence point. A flexible sleeve diaphragm facilitates its cleaning especially after use in heavily contaminated samples, such as used engine oils. Using the correct electrode greatly increases the precision and reliability of the results.

This Application Note describes the potentiometric determination of the base number according to ISO 3771, ASTM D2896, and IP 276 using the Metrohm Solvotrode easyClean and a fully automated OMNIS system.

SAMPLE AND SAMPLE PREPARATION

This application is demonstrated on lubricating oil and fresh motor oil.

Care should be taken to use a representative, well-homogenized sample portion. Otherwise, no sample preparation is necessary.

EXPERIMENTAL

The analysis is carried out on an automated system consisting of an OMNIS Sample Robot S and an OMNIS Advanced Titrator equipped with a Solvotrode easyClean.

Before the samples are measured, a blank determination is performed using the same amount of solvent as for the sample titration.

The sample is dissolved in a solvent mixture consisting of toluene, glacial acetic acid, and acetone. For the most efficient release of the basic constituents, these three solvents are added subsequently with a waiting time between the additions. Then the solution is titrated with standardized perchloric acid in glacial acetic acid until after the equivalence point is reached.

After each sample determination, the electrode needs to be rinsed with solvent solution, then isopropyl alcohol (IPA) followed by water. To rehydrate the glass membrane of the electrode, the glass membrane is placed into deionized water.

Figure 1. Sample Robot and OMNIS Titrator Advanced equipped with a Solvotrode easyClean for the determination of the base number of lubricating oil and motor oil.

RESULTS

For the tested samples, well-defined titration curves are obtained with acceptable results and low standard deviations. Results are summarized in Table 1. An example titration curve is displayed in Figure 2.

Table 1. Results for the acid number determination according to ASTM D2896 on a fully automated OMNIS system.

BN in mg KOH/g sample	lubricating oil (n = 3)	motor oil (n = 26)
Mean	0.397	7.2325
SD(abs)	0.0001	0.0727
SD(rel)	0.03	1.01

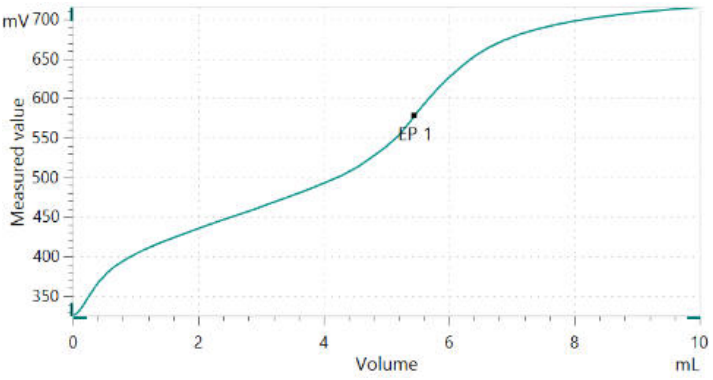

Figure 2. Example titration curve of the base number determination in fresh motor oil.

CONCLUSION

Fully automated determination of the base number of petroleum products according to ASTM D2896, ISO 3771, and IP 276 can be achieved using a Metrohm OMNIS system. Using an OMNIS Sample Robot allows the fully automated titration of up to four samples simultaneously, increasing throughput. The OMNIS platform offers the opportunity to customize your system according to your needs and expand it for other required titration applications.

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CONFIGURATION

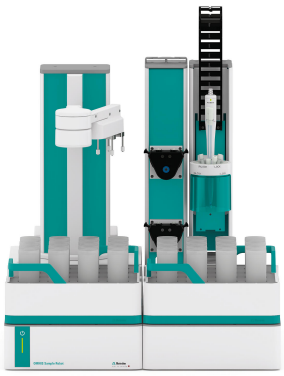
OMNIS Advanced Titrator without stirrer

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. If required, the OMNIS Advanced Titrator can be additionally equipped for parallel titration with a corresponding software function license.

- Control 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 parallel titration: "Professional" function license



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.

Measuring module digital

Digital measurement channel for one OMNIS Titrator or Titration Module for the connection of digital "dTrodes" electrodes.

dSolvotrode

Digital, combined pH electrode for OMNIS for all non-aqueous acid/base titrations. The glass membrane is optimized for poorly conducting solutions and thanks to the flexible ground-joint diaphragm, the electrode is suitable for contaminated samples.

This electrode can be used with non-aqueous reference electrolytes (lithium chloride or tetraethylammonium bromide).

Storage in corresponding reference electrolyte.
dTrodes can be used on OMNIS Titrators.