Application Note AN-T-179

Fully automated determination of TAN/TBN according to ASTM D664 and ASTM D2896

Fast and reliable analysis of non- and fully synthetic motor oil used in the automotive industry by potentiometric titration

Knowing the exact acid number and base number of an engine oil is important to determine its quality. Monitoring the total acid number (TAN) and total base number (TBN) of engine oils can also prevent damage to engine components. Both TAN and TBN can be accurately determined in fully synthetic and conventional engine oils used in the auto industry.

This Application Note presents the determination of TAN (ASTM D664) as well as TBN (ASTM D2896) in motor oil samples using potentiometric titration methods. Automated parallel titration is performed using the OMNIS Sample Robot S and the OMNIS Titrator equipped with dSolvotrodes.

SAMPLE AND SAMPLE PREPARATION

This application is demonstrated on fully synthetic motor oil SAE 5W/40 as well as non-synthetic (conventional) motor oil SAE 30, labelled as mineral oil.

No sample preparation is required.

EXPERIMENTAL

The determinations are carried out using an OMNIS Professional Titrator equipped with a dSolvotrode on an OMNIS Sample Robot S (Figure 1). To avoid manually handling chemicals, all solutions can be automatically added using an OMNIS Dosing Module. An appropriate amount of sample is weighed into the titration vessel and solvent is added. Afterwards, the solution is titrated until after the first endpoint with standardized potassium hydroxide for the total acid number, or with standardized perchloric acid in acetic acid for the total base number.

One exemplary titration curve of TBN with $HClO_4$ is shown in Figure 2.

Figure 1. OMNIS Sample Robot S equipped with an OMNIS Titrator, OMNIS Dosing Module, and dSolvotrode for the automated determination of TAN and TBN in motor oil samples.

RESULTS

This method offers very accurate results for TAN and TBN oil analysis as displayed in Tables 1 and 2.

Table 1. Results for the TAN oil analysis according to ASTM D664.

Motor oil (n = 6)	Mean in mg KOH/g sample	SD(rel) in %
SAE 5W/40	3.80	1.6
SAE 30	1.16	1.2

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SAE 30	1.16	1.2

Table 2. Results for the TBN determination according to ASTM D2896.

Motor oil (n = 6)	Mean in mg KOH/g sample	SD(rel) in %
SAE 5W/40	9.05	0.4
SAE 30	1.01	1.6

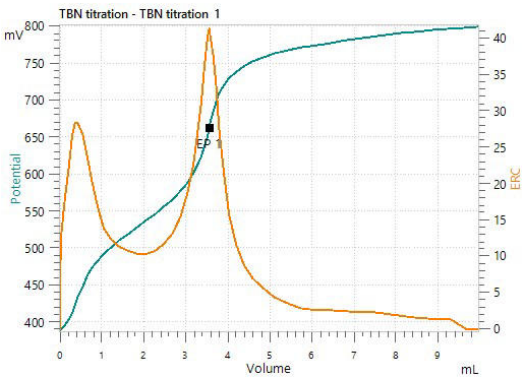

Figure 2. Titration curve of the TBN determination of SAE 5W/40.

CONCLUSION

Titration is a very fast and accurate method that can determine the total acid number and total base number of engine oil (both synthetic and conventional). The OMNIS Titrator equipped with a dSolvotrode delivers reliable determinations. This automated system offers flexible analyses combined with high-end software. Aside from improving the precision and speed of the determinations, OMNIS provides results that are on par with or better than other established titration systems.

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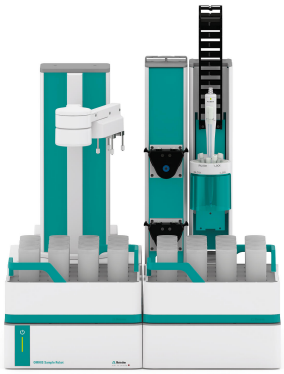
CONFIGURATION



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

OMNIS Dosing Module without stirrer

Dosing module for connection to an OMNIS Titrator for extending the system to include an additional buret for titration/dosing. Can be supplemented with one magnetic stirrer or rod stirrer for use as separate titration stand. Freely selectable cylinder unit with 5, 10, 20 or 50 mL.

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.