TITRATION APPLICATION NOTE 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.

**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.

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**.

## 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 |

**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 |

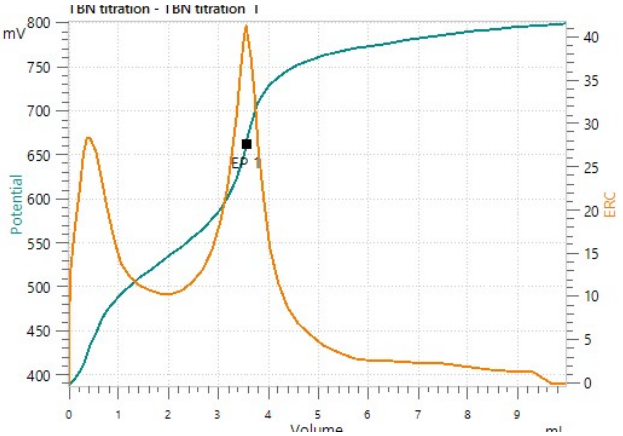


**Figure 2.** Titration curve of the TBN determination of SAE 5W/40.

## 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.

| | |
|---|---|
| **Analytes:** | **Acid number, TAN, base number, TBN** |
| **Matrix:** | **Mineral oils; Lubricants, coolants, cutting fluids** |
| **Method:** | **Titration** |
| **Industry:** | **Chemical; Petrochemicals & biofuels** |
| **Standards:** | **ASTM D664; ASTM D2896** |

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