



Application Note AN-T-098

# Total base number according to IP test method 400

## Base number of petroleum products determined following IP 400

Acids are formed in engines during the combustion process through oxidation of hydrocarbons and sulfur compounds. These acids can attack the engine surfaces, causing corrosion. The alkaline reserve of engine oil serves to neutralize these acids and thus protect the engine from damage. The alkaline reserve is the amount of alkaline additives in the oil that serve to neutralize harmful acids. The total base number (TBN) value determines the alkaline reserve of oil.

The TBN value is expressed in milligrams of potassium hydroxide (mg KOH) per gram of oil. A high TBN value means that the oil has a high alkaline reserve and therefore offers good protection against acids. It is recommended to have TBN values of at least 8 mg KOH/g for modern engines.

Some benefits of using conductometric titration for this analysis according to IP test method 400 include accuracy, speed, simplicity, sensitivity, and flexibility.

## SAMPLE

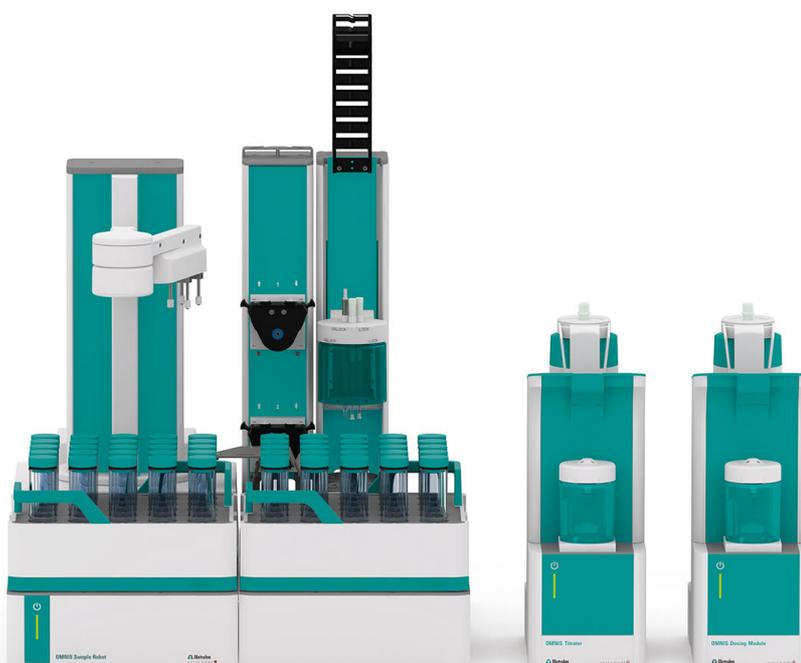
A new commercially available motor oil was used for

the analysis.

## EXPERIMENTAL

Hydrochloric acid in a 2-propanol solution was used to titrate the sample up to the first equivalence point. The conductivity was measured after each titrant addition.

A 5-ring conductivity cell was used as the measuring cell. **Figure 1** shows the system that could be used for this analysis.



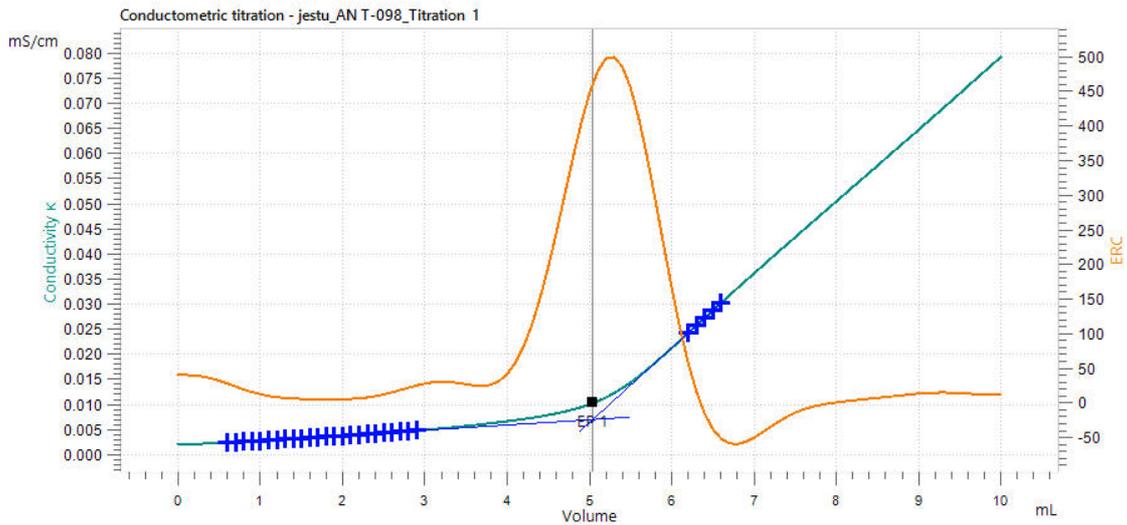
**Figure 1.** OMNIS Titration with an OMNIS Dosing Module and OMNIS Sample Robot.

The determination of the TBN value in motor oil gave accurate results (**Table 1**). An example determination

is shown in **Figure 2**.

**Table 1.** Results of the motor oil determination by conductometric titration according to IP 400.

Sample	Result TBN	RSD in %
Motor oil (n=6)	7.85 mg KOH/g	0.4



**Figure 2.** Example titration curve to determine the total base number in motor oil according to IP test method 400.

## CONCLUSION

This analysis method does not require indicators or complicated instruments. Compared to other titration methods, it is highly sensitive, giving users precise results.

The measurement is easy to perform and is applicable to a variety of sample types. Measuring suspensions, slurries, and cloudy or colored solutions (e.g., diesel fuels or oil samples) is straightforward.

The robust design of the conductivity measuring cell

makes it easy to clean. Unlike a potentiometric sensor, the cell does not require any rehydration time between measurements.

It is possible to use conductivity titration to titrate highly diluted solutions, nonaqueous solutions, strong acids, and weak acids or bases. The endpoint of this titration method is sharp and precise compared to other titration methods.

## CONTACT

Metrohm AG  
Ionenstrasse  
9100 Herisau

[info@metrohm.com](mailto:info@metrohm.com)

## CONFIGURATION



### OMNIS Titrator with magnetic stirrer, without function license

Innovative, modular potentiometric OMNIS Titrator for stand-alone operation or as the core of an OMNIS titration system. Thanks to 3S Liquid Adapter technology, handling chemicals is more secure than ever before. The titrator can be freely configured with measuring modules and cylinder units and can have a stirrer added as needed. Thanks to various software function licenses, various measuring modes and functionalities are possible.

- Control via PC or local network
- Connection option for up to four additional titration or dosing modules for additional applications or auxiliary solutions
- Connection option for one rod stirrer
- Various cylinder sizes available: 5, 10, 20 or 50 mL
- Liquid Adapter with 3S technology: Secure handling of chemicals, automatic transfer of the original reagent data of 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

### Function license Conductometric titrator

Function license "Conductometric titrator" for the OMNIS Titrator

Contains the function modes

- MET COND
- MEAS U/T/pH/COND
- Liquid Handling
- Titration only with internal buret of an OMNIS Titrator

# OMNIS

A WHOLE NEW LEVEL OF PERFORMANCE



### Measuring module conductivity

Measurement channel for one OMNIS Titrator or Titration Module for the connection of conductivity measuring cells.



### 5-ring conductivity measuring cell $c = 0.7 \text{ cm}^{-1}$ with Pt1000 (fixed cable 0.65 m)

5-ring conductivity measuring cell with cell constant  $c = 0.7 \text{ cm}^{-1}$  (guide value), with integrated Pt1000 temperature sensor and with fixed cable (0.65 m) for connecting to the OMNIS Measuring Module Conductivity.

This sensor is suitable for measurements of medium conductivities ( $5 \mu\text{S}/\text{cm}$  to  $20 \text{ mS}/\text{cm}$ ), e.g., in:

- Drinking water
- Surface water
- Waste water