# TBN determination in lubricants

## Quality control of total base number without toxic chemicals

Alkaline additives in engine lubricants are used to prevent the build-up of acids and as a result, they inhibit corrosion. The total base number (TBN) indicates the amount of basic additives present in samples and thus can be used as a measure for the degradation of the lubricant. Depending on the application, the TBN value varies from 7 mg KOH/g in lubricants for combustion engines up to 80 mg KOH/g for marine grade lubricants.

The standard test method for TBN in lubricants is potentiometric titration according to ASTM D2896. This method requires the use of toxic reagents (e.g., tetraethylammonium bromide) and the cleaning procedure is labor-intensive. In contrast to the primary method, near-infrared spectroscopy (NIRS) is a fast analytical technique which does not produce any chemical waste and completes the TBN analysis in less than one minute.

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## EXPERIMENTAL EQUIPMENT

23 marine cylinder lubricants and 37 engine lubricants were analyzed on a Metrohm DS2500 Liquid Analyzer equipped with 2.5 mm flow cell. All measurements were performed in transmission mode from 400 nm to 2500 nm. In this feasibility study, a flow cell was used to automate the sample handling and measurement. Data acquisition and prediction model development was performed with the software package Vision Air complete.



**Figure 1.** DS2500 Liquid Analyzer.

**Table 1.** Hardware and software equipment overview

| Equipment | Metrohm number |
|---|---|
| DS2500 Liquid Analyzer | 2.929.0010 |
| DS2500 Holder for flow cells | 6.7493.000 |
| Vision Air 2.0 Complete | 6.6072.208 |

## RESULTS

The obtained Vis-NIR spectra (**Figure 2**) were used to create a prediction model for the TBN determination. To verify the quality of the prediction model, correlation diagrams were created which display the correlation between Vis-NIR prediction and primary method values. The respective figures of merit (FOM) display the expected precision of a prediction during routine analysis (**Figure 3**).
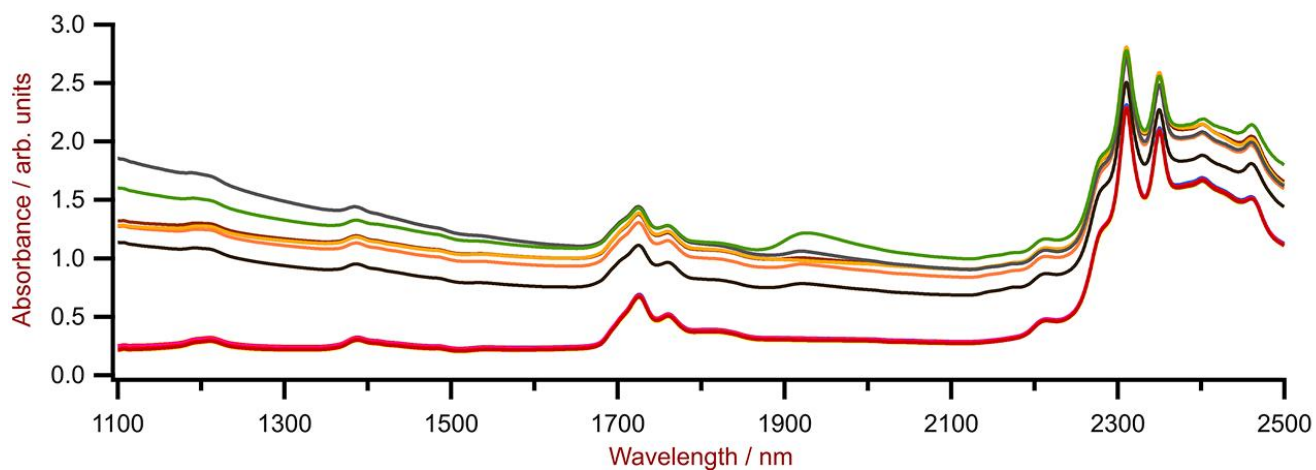
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**Figure 2.** Selection of Vis-NIR spectra of marine cylinder lubricants and engine lubricants obtained using a DS2500 Liquid Analyzer with a 2.5 mm flow cell.
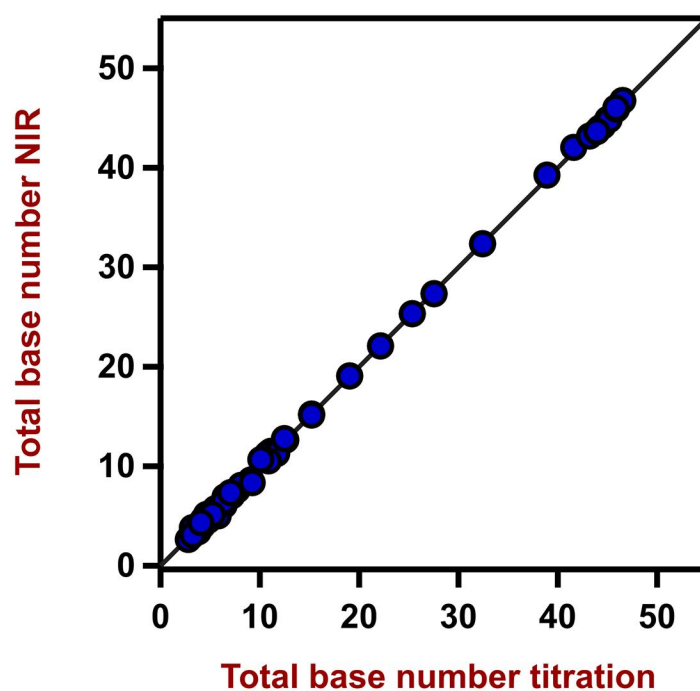


**Figure 3.** Correlation diagram for the prediction of TBN in lubricants using a DS2500 Liquid Analyzer. The lab values were determined using titration.

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**Table 2.** Figures of merit for the prediction of TBN in lubricants using a DS2500 Liquid Analyzer.

| Figures of merit | Value |
|---|---|
| $R^2$ | 0.998 |
| Standard error of calibration | 1.1 |
| Standard error of cross-validation | 1.2 |

## CONCLUSION

This application note shows the feasibility of NIR spectroscopy for the analysis of total base number in marine cylinderand engine lubricants.

In comparison to the wet chemical method (Table 3), no sample preparation or chemicals are needed with NIR spectroscopy.

**Table 3.** Time to result with conventional titration method ASTM D2896

| Parameter | Method | Time to result |
|---|---|---|
| Total base number | Titration | ~5–10 minutes |

## CONTACT

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## DS2500 Liquid Analyzer
**固耐用的近外光,用于生境和室中的量。**

DS2500 Liquid Analyzer 是一成熟且活的解决方案,其用于在整个生中行液体常分析。其固耐用的使 DS2500 Liquid Analyzer 不受灰、潮湿、振的影,因此非常用于在劣的生境中使用。

DS2500 Liquid Analyzer 覆盖 400 至 2500 nm 的整个光范,将品加至 80°C 高温,并与各不同的一次性小瓶和石英比色皿兼容。因此,DS2500 Liquid Analyzer 可的个性化品要求,助在一分内得精和具有可重性的果。借助集成的品架装置和自的 Vision Air 件,保了用能松和安全地行操作。

如果是大的品量,可通将流通池与一个 Metrohm 机器人自器搭配使用的方法著提高生率。

## DS2500
12.5 mm 直通式比色皿用智能支架

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Vision Air 2.0 Complete

**Vision Air – 通用的光分析件。**

Vision Air Complete 是用于管范境的先易用的件解决方案。

Vision Air 点一:
- 独特的件用和配的用界面保了直的操作方式
- 操作程的建与方式
- SQL 数据,可安全且地管理数据

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- 方法用
- 常分析用

其它 Vision Air Complete 解决方案:
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- 66072209 (Vision Air Pharma Complete)
- 66072210 (Vision Air Pharma Network Complete)

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