Application Note AN-T-247

Photometric titration of acid value in biodiesel according to EN 14104

Fast and reliable determination of acid value in fatty acid methyl ester (FAME) with the Optrode following EN 14104

Biodiesel, also known chemically as Fatty Acid Methyl Ester or FAME, is a fuel that is used just like mineral diesel. Biodiesel quality needs to be monitored for many reasons.

The acid value (or acid number) is a measurable quality parameter linked to a fuel's purity and stability. A high acid value suggests either prolonged storage or poor biodiesel production quality, both of which can lead to corrosion of engine parts. A low acid value indicates pure, stable biodiesel.

In this Application Note, an acid value determination of biodiesel was photometrically titrated with the Optrode. The method was performed according to EN 14104. The standard specifies the titrimetric determination of the acid value in lightly colored fatty acid methyl esters (FAME) in the range of 0.10 mg KOH/g sample to 1.00 mg KOH/g sample.

INTRODUCTION

FAME (biodiesel) is a type of fuel produced by transesterification of glycerides present in vegetable or animal fats and oils, as well as in organic waste with monohydric alcohols like methanol or ethanol. In simplified terms, the production process is based on the following reaction:

Oils/Fats + Alcohol → Biodiesel + Glycerine

Compared to petroleum-based diesel, biodiesel produces fewer emissions and is considered sustainable and climate-friendly. It is primarily made from renewable resources, is biodegradable, and has good lubricating properties.

The acid value in biodiesel should be determined as a quality control measure. Low values are associated with good quality biodiesel, while high values indicate poor quality and a higher likelihood of corrosion from the fuel.

SAMPLE AND SAMPLE PREPARATION

This application is demonstrated on 100% biodiesel (made from organic waste, e.g., waste cooking oil).

No sample preparation is required.

EXPERIMENTAL

The determinations are carried out on an OMNIS Professional Titrator equipped with OMNIS Dosing Modules (Figure 1) as well as an Optrode M2.

An appropriate amount of sample is weighed into the titration beaker, and pre-neutralized 2-propanol as well as phenolphthalein solution are added. The solution is titrated until after the first break point with standardized potassium hydroxide in 2-propanol.

Figure 1. When equipped with an Optrode M2, the OMNIS Professional Titrator with OMNIS Dosing Modules (shown here) are ideal for acid number determination in biodiesel.

RESULTS

This method offers reliable results that meet the standard's requirements for repeatability and reproducibility within the measurement series, as displayed in Table 1. An exemplary titration curve of acid number in biodiesel is given in Figure 2.

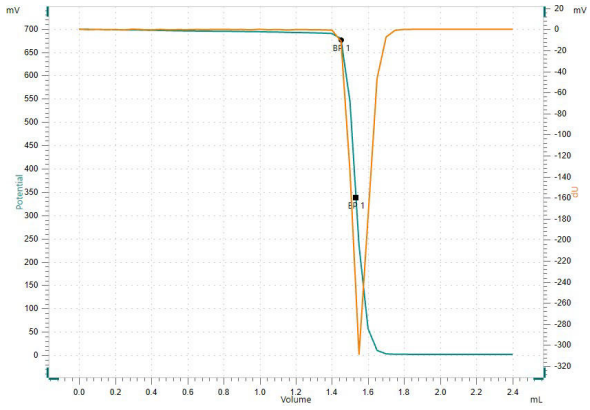

Figure 2. Biodiesel titration for acid value with potassium hydroxide in 2-propanol using the Optrode M2.

Table 1. Results of the photometric titration of acid number in biodiesel (n = 6).

Sample (n = 6)	Acid value in mg KOH/g sample
Mean value	0.41
SD(abs)	0.01
SD(rel) in %	1.8

CONCLUSION

Photometric titration is a fast and reliable test method for determining the acid value of fatty acid methyl ester (FAME). The glass coating of the Optrode is insensitive to chemicals and raw materials (e.g., biodiesel itself), making it ideal for this purpose.

Thanks to the individually adjustable wavelength of the Optrode and the reliable OMNIS Software, acid value determination according to EN 14104 can be achieved even in very low measuring ranges.

CONTACT

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CONFIGURATION

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.

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Optrode M2

Optical sensor for photometric titrations offering 8 different wavelengths. The wavelength can be switched using the software (tiamo 2.5 or higher) or with a magnet. The glass shaft is completely solvent-resistant and easy to clean. For example, this space-saving sensor is suitable for:

- Non-aqueous titrations in accordance with USP or EP
- Determinations of carboxyl end groups
- TAN/TBN in accordance with ASTM D974
- Sulfate determination
- Fe, Al, Ca in cement
- Water hardness
- Chondroitin sulfate in accordance with USP

The sensor is not suitable for determinations of concentrations via measurement of color intensity (colorimetry).