Application Note AN-T-242

Acidity in aviation turbine fuel according to ASTM D3242

Automatic photometric titration with the Optrode

Aviation turbine fuels may contain acids, either from naturally occurring organic compounds or introduced through acid treatment during refining processes. These acids are detrimental even in trace amounts as they can corrode metal components within fuel systems and negatively impact the fuel's ability to effectively separate from water.

The standard method ASTM D3242 determines acidity in aviation turbine fuel with titration, using *p*-naphtholbenzein as a color indicator. The sample is purged with nitrogen gas for three minutes before analysis and the flow is maintained during the titration. Precision may be challenging for inexperienced users due to the small volume of titrant needed and gradual color change close to the endpoint of titration.

This study presents how to fully automate ASTM D3242 using an automatic titrator and the Optrode. The titrator controls a degas box to facilitate the gas to flow and then close the valve at the end of each titration. The results obtained statistically meet the precision criteria defined in the ASTM standard.

SAMPLE AND SAMPLE PREPARATION

To the nearest 0.5 g, weigh 100 g ± 5 g of jet fuel into a 400 mL tall form beaker. Add 100 mL of the titration solvent according to ASTM D3242 and 0.1 mL of the *p*-naphtholbenzein indicator solution. Begin purging the sample with dry-type, carbon dioxide-free nitrogen gas (N_2) at a rate of 400 to 450 mL/min. Purge the solution while continuously mixing for 3 min ± 30 s to remove any carbon dioxide.

EXPERIMENTAL

Start the titration and continue purging the sample with N_2 until the end of the analysis. The monotonic endpoint titration mode – MET U is used.

The titrator adds alcoholic KOH titrant (prepared as per ASTM D3242) to the sample in fixed volume increments—each time waiting for the sensor reading to stabilize before adding the next volume. The equivalence point is indicated by the first derivative of the titration curve (Figure 1).

At the end of the titration, the result is displayed, and the gas flow is stopped.

Table 1. Results of the determination of acidity in jet fuel samples according to ASTM D3242.

No. (n = 5)	Mean value in mg KOH/g	s(abs) in mg KOH/g	s(rel) in %
1	0.0219	0.0001	0.6
2	0.0478	0.0003	0.6
3	0.0839	0.0005	0.6

RESULTS

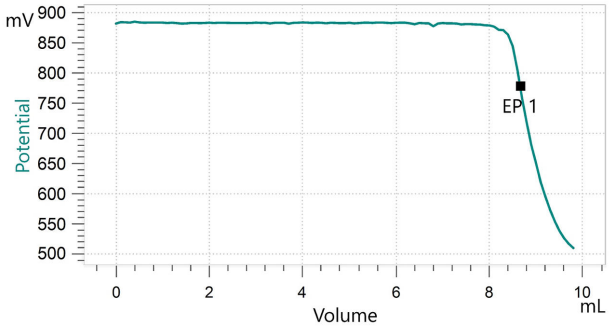

Figure 1. Exemplary titration curve of acidity in jet fuel according to ASTM D3242 using the Optrode at 610 nm for unambiguous endpoint detection.

CONCLUSION

It was possible to fully automate the determination of acidity in aviation fuel by automatic titration, including a sample degassing system that purges the sample with nitrogen before and during the analysis. The results meet the accuracy specifications of ASTM D3242.

CONTACT

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CONFIGURATION

OMNIS Professional Titrator with magnetic stirrer

Innovative, modular potentiometric OMNIS Titrator for stand-alone operation or as the core of an OMNIS titration system for endpoint titration and equivalence point titration (monotonic/dynamic). 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 rod 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
- Connection option for one 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

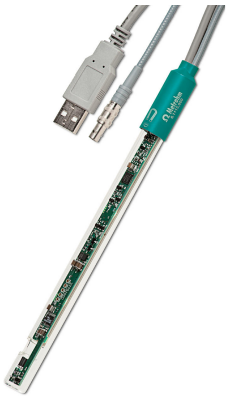
Dosing module for connection to an OMNIS Titrator for extending the system to include an additional buret for titration/dosing. Can be supplemented with one magnetic stirrer or rod stirrer for use as separate titration stand. Freely selectable cylinder unit with 5, 10, 20 or 50 mL.

Cylinder unit OMNIS special, 20 mL

Intelligent 20 mL cylinder unit for one OMNIS Titrator, Titration Module or Dosing Module. This cylinder unit is especially recommended for the following solutions:

- Aqueous alkaline solutions
- Titrant 5
- Silver nitrate solutions
- Nonaqueous alkaline solutions
- Permanganate solutions
- EDTA solutions

Includes dosing tubing and antidiffusion tip.



Optrode

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).

OMNIS

A WHOLE NEW LEVEL OF PERFORMANCE

OMNIS Stand-Alone license

Enables stand-alone operation of the OMNIS software on a WindowsTM computer.

Features:

- The license already includes one OMNIS instrument license.
- Must be activated via the Metrohm licensing portal.