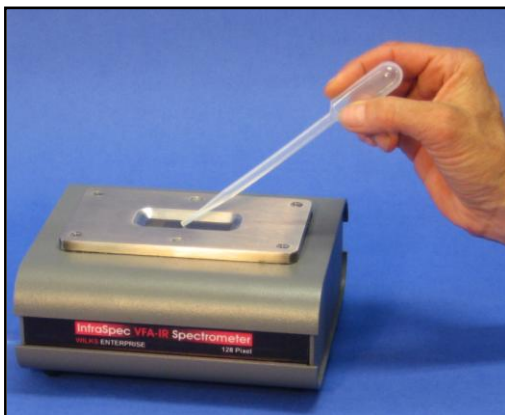


Free Fatty Acids (FFAs) in Biodiesel and Edible Oil

Introduction:



Fats and oils from a variety of sources are employed by the food industry and serve as feedstock for the rapidly developing biodiesel sector. Free fatty acids (FFAs), present in all vegetable oils, are detrimental to oil quality and functionality. Therefore determining the FFA content is an important parameter in edible oil refining and biodiesel production. In addition, FFAs are formed during prolonged frying operations and are a key determinant of frying oil quality. For all these reasons, simple, rapid and reliable means of determining FFA content are

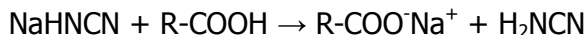
required. Mid infrared spectroscopy is an alternative to the traditional time-consuming titration procedures. The InfraSpec VFA-IR Spectrometer offers a simple and lower-cost alternative to large laboratory analyzers such as FTIR's.

Operating Principal:

The InfraSpec VFA-IR Spectrometer is a new concept in infrared instrumentation. It utilizes a patented design consisting of an Attenuated Total Reflection (ATR) sample plate with an electronically modulated source on one end and a linear variable filter (LVF) and combined with a 128 pixel detector array on the other. The result is an infrared analyzer that, unlike an FTIR spectrometer, has no moving parts and an insignificant optical air path. This makes for a portable, rugged analyzer suitable for use in a field environment. For multiple analysis capabilities, the InfraSpec VFA-IR Spectrometer is capable of other biofuels measurements such as water in oil, water in ethanol/methanol and can be used as a pass/fail test for total glycerides as glycerine. It is operated from a PC allowing for multiple calibrations, data storage and data transmission.

Methodology:

Measuring FFA involves adding a weak base to form a salt whose carbonyl absorption band is shifted away from that of the oil ester. This method was developed by Al Alawi et al ¹. The basic procedure involves the extraction of FFAs from the oil into methanol containing sodium hydrogen cyanamide and their stoichiometric conversion to sodium salts:

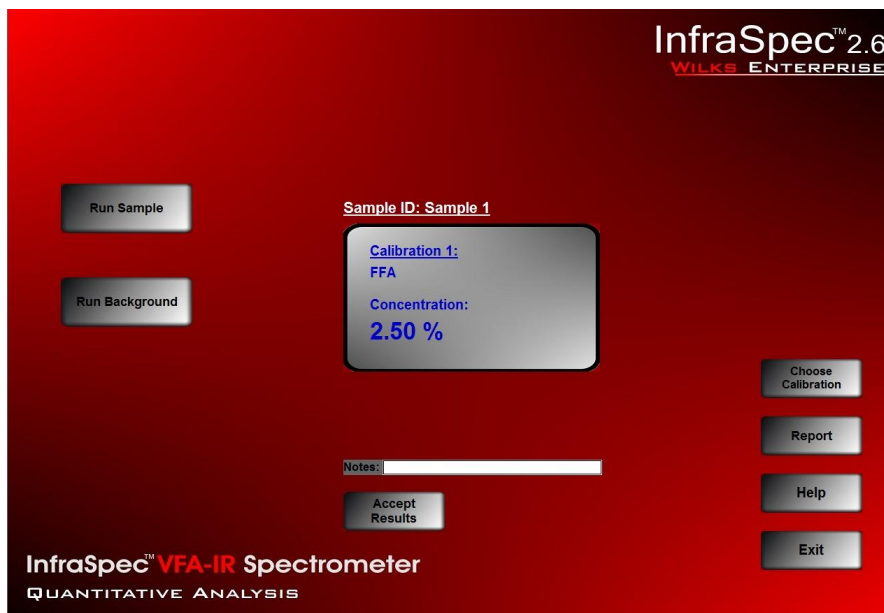


IR quantitation is based on measurement of the strong (COO⁻) absorption at ~1570 cm⁻¹ relative to a suitable baseline.

(1) Al-Alawi, A., van de Voort, F.R. and Sedman, J. 2005. A new FTIR method for the analysis of low levels of FFA in refined edible oils. *Spectrosc. Lett.* 38, 389-403.

Analysis:

FFA analysis is complete in four easy steps. First, methanol reagent is added to the vegetable oil in a vial. After shaking for one minute, the methanol will separate from the oil carrying the FFAs. A portion of the methanol layer is then placed on the exposed ATR crystal and after one minute the FFA concentration is displayed as shown in this screen shot. For a 0-10% FFA range the accuracy is +/-0.25% and for 10-50% the accuracy is +/- 1.0%.



Specifications:

Dimensions	6.5" x 4.25" x 1.6", 16.5 x 11 x 4 cm ³
Weight	3.5 lbs., 1.5 kg
P.C. Interface	RS 232, USB
Power Requirements	12V DC, 2.0 amps
Power Supply	Universal AC/DC converter type (supplied as standard)
Suggested Temperature Operating Range	15°C - 60°C
Humidity	0 – 98% relative humidity (non-condensing)
Detector Array	128 Pixel linear pyroelectric array
Array Responsivity	5.4·10 ⁵ V/W
Standard Spectral Range	5.4-10.8 μm (1850 – 925 cm ⁻¹)
For InfraSpec VFA-IR Spectrometer ATR Sample Plate	
ATR Crystal Material	Zinc Selenide
ATR Surface Size	50 x 16 mm
# of Reflections	12
Resolution	25 cm ⁻¹

Wilks Enterprise, Inc.

140 Water Street · South Norwalk, CT 06854 USA
Tel: 203-855-9136 · Fax: 203-838-9868

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E-Mail: info@wilksir.com

www.wilksir.com