New Analyzer Provides Measurement of % Biodiesel (% FAME) in Petrodiesel from 0.025% to 20% Range

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Summary

A2 Technologies has developed a new FTIR analyzer and a new sampling methodology which enables the measurement of % FAME present in diesel fuel in the analytical range from 0.025% to 20%. This new technology is fast, easy-to-use and exceptionally reliable for on-site measurement of % FAME in blended fuels, as well as a highly accurate meter for determining ppm levels of FAME contamination in petrodiesel. The analyzer can also be configured to measure % FAME in diesel fuel from 1% to 100%, for applications that require that range.

Introduction

Biodiesel has become an important diesel fuel component over the past several years and an entire industry has developed to produce, blend, transport and store biodiesel for virtually every application in which diesel fuel is used.

The advantages of biodiesel are profound in that it can be produced relatively inexpensively from a wide range of readily available starting materials including used vegetable oil and algae. It is environmentally friendly compound, is biodegradable and non-polluting. When blended with diesel at appropriate and specified levels, it offers transparent performance to unblended diesel fuel. Blended petrodiesel is an important component to reducing dependence on foreign energy sources.

There are some properties of biodiesel that also must be considered. Biodiesel tends to absorb water efficiently and thus can contribute to more rapid oxidation of stored diesel fuel. At higher percentages it is an excellent solvent and can solubilise compounds that may cause clogging of fuel lines and filters in engines. Also, it tends to promote the growth of biologics such as bacteria, which can lead to increased oxidation of the diesel fuel as well as contribute to clogging of lines and filters. To minimise the negative attributes of biodiesel, additives are added, the amount defined by the concentration of biodiesel in the blend.

In certain applications, biodiesel provides necessary and important value to the economics of the industry. Other industries, however view biodiesel as a potential contaminant that can negatively affect the performance of their high value equipment. In either scenario, it is crucial to know the level of biodiesel present. In the former case, producers and users of blended fuels, as well as manufacturers of machinery that use blended fuels, must know that the diesel supply is properly formulated, labeled and stored. In the latter case, industries that view biodiesel as a potential contaminate must be able to ensure that the levels present are acceptable with respect to equipment manufacturers specifications and/or federal regulations.

Spectroscopic Analysis of % FAME in petrodiesel

There are a number of analytical techniques that are employed to measure the % FAME level in diesel fuel. Classical methods such as gas chromatography are used, and techniques such as near infrared or mid infrared (FTIR) spectroscopy have been used for years for this determination. In the latter case of spectroscopic analysis, international standards ASTM 7371-07 and EN14078 specify the use of mid infrared FTIR spectroscopy for measuring % FAME in diesel fuel in the 1%-20% (B1-B20) range. In the former case this is accomplished via FTIR employing an internal reflection (ATR) sampling interface. In the latter case, this is carried out using a FTIR spectrometer incorporating a standard transmission liquid cell. The typical FTIR spectrometer is a bench-top unit that is used in a lab or lab-like setting by analysts with training in spectroscopy.

Infrared spectrometers that incorporate ATR sampling interfaces are calibrated to enable measurement of FAME in the 1-20% range. They do not have the sensitivity to accurately measure levels of FAME below approximately 1%. Infrared spectrometers equipped with transmission liquid cells that have pathlengths of 100 micron can be calibrated to accurately analyse FAME at lower levels, but the liquid cells are difficult to fill and clean or require a liquid pumping system to introduce sample, adding cost and complexity.

A2 Technologies has developed a new FTIR analyzer and a new sampling methodology which enables the measurement of % FAME in the analytical range from 0.025% to 20%. This new technology is fast, easy-to-use and exceptionally reliable for on-site %FAME determination.

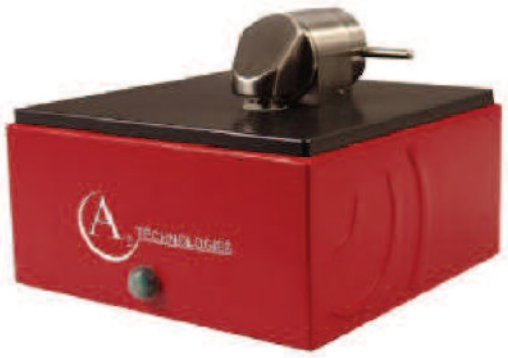

Figure 1: A2 Technologies' PAL FTIR analyzer equipped with TumblIR transmission infrared sampling interface. This system is ideal for table top measurement of % FAME in biodiesel fuel from 0.025% to 20%. The PAL system is 8 pounds and measures 8" x 8". It can be equipped with PDA or computer control.

A2 Technologies' PAL FTIR Analyzers Measure 0.025% to 20% FAME in petrodiesel.

PAL Series FTIR analyzers were conceptualised and engineered to be used in non-laboratory and on-site field applications that are far more demanding environments than typically experienced by traditional laboratory spectrometers. Also, PAL analyzers are employed by users who are not necessarily trained in either chemistry or spectroscopy. For this reason, ease of use and ruggedness is a paramount attribute of these systems. The PAL systems have two basic configurations – an extremely compact table-top system (figure 1) and a portable, battery powered analyzer (figure 2). Both systems use the same optical engine, designed to deliver the accuracy and sensitivity required for these measurements.

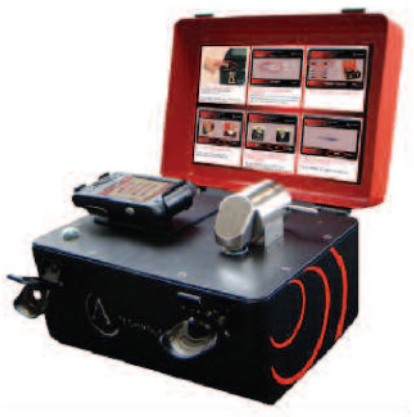

Figure 2: A2 Technologies IPAL FTIR analyzer equipped with TumblIR transmission infrared sampling interface and PDA control. This system is ideal for table top measurement of % FAME in biodiesel fuel from 0.025% to 20%. The iPAL FTIR analyzer weighs 15 pounds and is battery powered for portable use in field applications.

To meet the design specifications, an equally rugged and easy-to-use transmission IR sampling interface was developed. The TumblIR (patent pending) sample interface, provides the sensitivity necessary for lower level % FAME analysis, the analytical linearity to handle FAME levels to 20%, and is far easier to use than conventional IR liquid transmission cells.

The TumblIR system consists of two opposing windows; one is stationary and contained in the top surface of the PAL spectrometer and the other is mounted in a rotating arm. When the top window is rotated over the fixed window, a 100 micron gap between the two windows is created. This provides the pathlength necessary to carry out low level determination of % FAME in petrodiesel and permits the analytical dynamic range to permit up to B20 to be analysed.

In operation (figure 3), a drop of the diesel fuel sample is placed on the fixed window. The top window is rotated into place, and then the operator initiates the analysis of the diesel sample with a simple mouse click. The infrared spectrum of the diesel sample is recorded in less than 20 seconds, analysed by a previously developed on-board calibration, and the % FAME results are displayed on a PDA or computer. Cleaning the TumblIR apparatus is as simple as rotating the top window out of the way and then cleaning both the rotatable window and the fixed window. The PAL FTIR analyzer equipped with the TumblIR

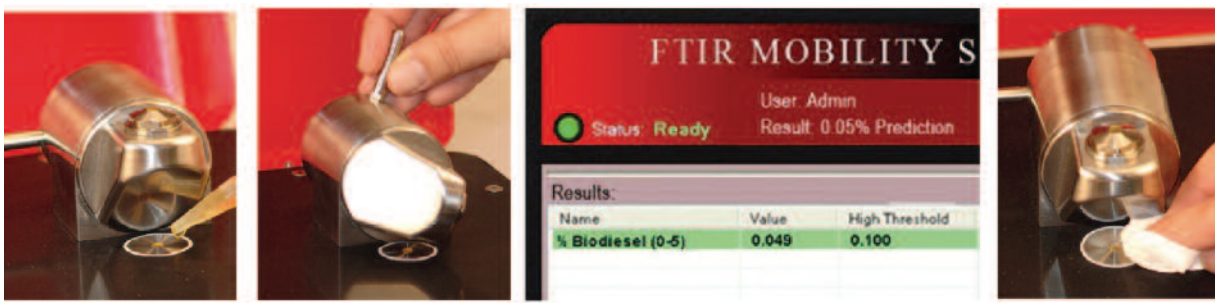

Figure 3: The TumblIR liquid sample transmission interface is ideal for biodiesel analysis. Just place a drop of the diesel fuel on the lower window, rotate the upper window into place forming the 100 micron pathlength, and start the measurement with a mouse click. The % FAME is shown in the display screen and if the reading is in the correct range, the reading appears in a green stripe. Out of spec readings may appear in yellow (marginal) or red (warning) depending on set thresholds. Once the analysis is made, the upper window is rotated back into its resting position and both windows are cleaned. The entire measurement from sample introduction to sample clean-up, takes under 1 minute.

interface can analyse a diesel samples in about one minute from the time the sample is placed on the window through clean-up in preparation for the next sample.

For those companies or industries that require conformation with the ASTM 7371-07 standard, the PAL series instrument can also be configured with an internal reflection (ATR) sampling system. This measurement is executed by placing a few drops of diesel on the internally reflecting crystalline window - the spectrum is recorded and the analysis is carried out as easily as with the TumblIR system. The ATR equipped PAL system readily measures up to B100 FAME, and like other commercial analyzers equipped with ATR devices, its lower useful range is limited to approximately B1. The PAL equipped with the TumblIR transmission interface handles the lowest levels of FAME (250 ppm) up to 20% (B20) and meets the requirements of EN14078 specifications.

Conclusion

Currently, industries such as the nuclear power industry require that % FAME in diesel fuel are kept at levels less than 0.1% in the stored diesel used for back-up power generators. For this industry, and for other applications where the levels of FAME must be well controlled, the PAL analyzer equipped with the TumblIR transmission sampling interface makes that analysis extremely fast, accurate and reliable. For industries or applications involved in producing, blending or using biodiesel blended petrodiesel fuel, the PAL system enables % FAME levels to be determined in seconds thus ensuring quality control of the diesel fuel supply.