Biodiesel in diesel fuel using the Agilent 5500t FTIR by EN14078 method

Application Note

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Objective

Determine concentration of biodiesel in diesel fuel from 1% to 6% (v/v) per EN14078 procedure.

Samples

Two stock solutions in the concentrations of 20% (v/v) and 4% (v/v) of biodiesel in standard U.S. automotive diesel were made. These solutions were diluted to yield solutions of 0.8, 1.2, 3, 4, 6, 8 and 10% (v/v) biodiesel in diesel.

Experiment

Each of the above concentrations of biodiesel in diesel was measured using an Agilent 5500t FTIR spectrometer with a 100 µm pathlength Tumbler transmission cell; 32 scans were collected at 4 cm^{-1} resolution yielding a 15 second sample measurement time. Measurements were made in triplicate. A calibration curve was made according to the EN14078 procedure "Liquid petroleum products — Determination of fatty acid methyl esters (FAME) in middle distillates — Infrared spectroscopy method". The maximum absorbance at 1745 cm^{-1} was plotted versus volume percent of biodiesel.

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Results

The average absorbance measured from the lowest concentration (0.8%) was 0.15 Abs. The highest concentration (10%) produced an absorbance of 1.6 Abs. The FAME absorbances at 1745 cm^{-1} for all concentrations are shown in Figure 1. Note that all three replicates are shown in that figure.

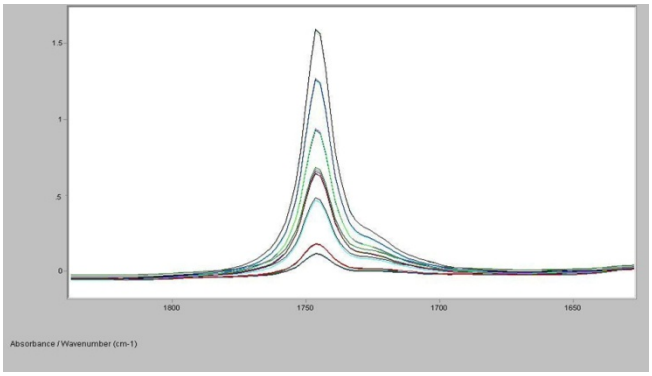

Figure 1. Absorbance at 1745 cm^{-1} of biodiesel in diesel fuel at 0.8, 1.2, 3, 4, 6, 8 and 10% (v/v)

The absorbance at 1745 cm^{-1} was measured on each of the samples using a two-point baseline at 1820 cm^{-1} and 1670 cm^{-1}. A calibration plot was drawn using two measurements at each concentration; it is shown in Figure 2. A simple linear regression yielded a correlation of 0.999.

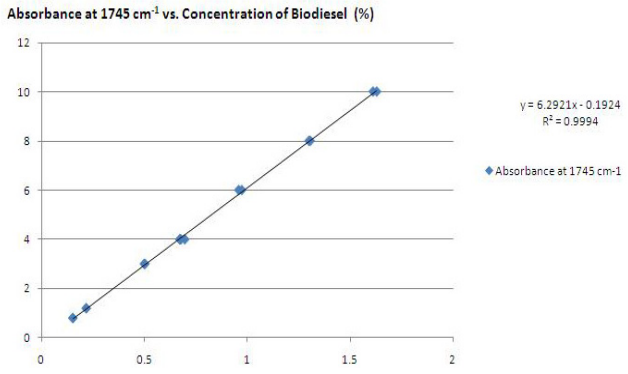

Figure 2. Calibration plot of biodiesel in diesel fuel showing linear fit of absorbance from 0.8 to 10% (v/v)

The data from the calibration was used to generate a method in the MicroLab software. Note that the concentrations are formatted at % x 10 in order to display the calculated value to 0.1%. The method is shown in Figure 3.

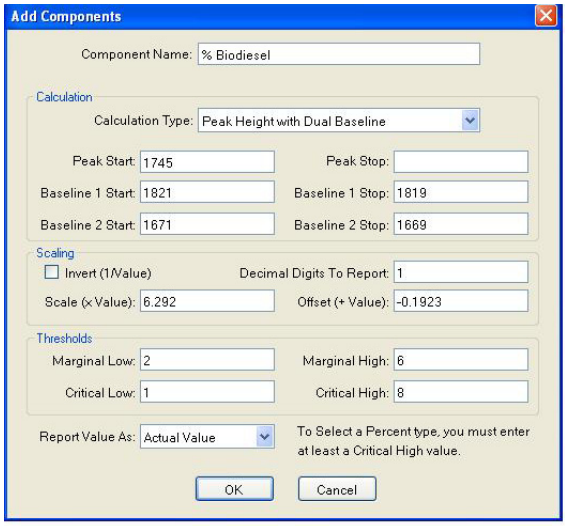

Figure 3. Biodiesel method in MicroLab software

This method was used in the MicroLab software to predict the concentration of the remaining samples. The average error was 0.129% (v/v) with a maximum error of 0.2% (v/v). The results are shown in Table 1, and an example of the MicroLab software results screen is shown in Figure 4.

Table 1. Results from samples measured with the biodiesel method in the MicroLab software

Actual %	Abs at 1745 cm^{-1}	Predicted %	Error (%)
0.8	0.154	0.8	0
1.2	0.219	1.1	0.1
3	0.504	2.90	0.1
4	0.696	3.9	0.1
6	0.971	5.8	0.2
8	1.3	7.8	0.2
10	1.631	9.8	0.2
		Average error:	0.13
		Maximum error:	0.20

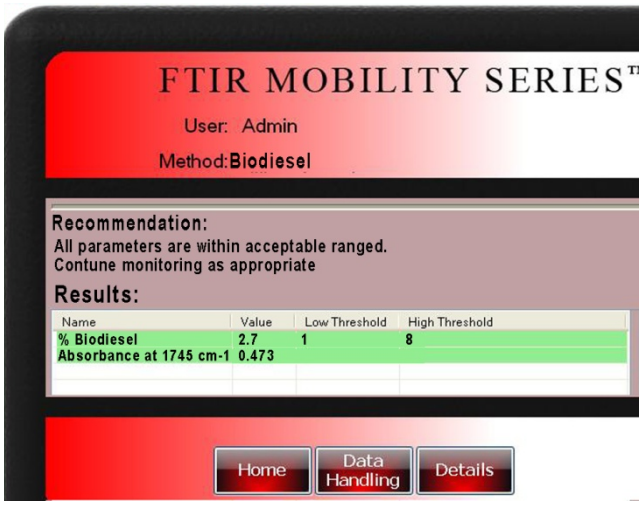

Figure 4. MicroLab results screen for a 3.0% sample of biodiesel in diesel

Conclusion

This experiment shows the ability of the Agilent 5500t FTIR spectrometer with the Tumbler transmission cell to quantify the amount of biodiesel in diesel fuel per the European Standard EN14078. The system using a 100 µm liquid cell produced ideal absorbances in the concentration range of interest (1.0 to 6.0% (v/v)). The MicroLab software can be easily configured to calculate the percent biodiesel in diesel fuel and presents the data in an easily understandable format.

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