Diesel and Jet Fuel Analysis by NIR Spectroscopy

The Portable Fuel Property Analyzer (PFPA) provides rapid fuel quality assessment using Near-Infrared Spectroscopy combined with advanced Chemometric methods. Key physical and chemical fuel properties that dictate engine performance are obtained in seconds with only a 2-mL sample of fuel.

Near-Infrared Spectroscopy (NIR) measures the molecular bonds and hence the organic chemicals that determination the overall composition of the fuel. The composition of the fuel in turn dictates the physical and chemical properties of the fuel. With a training set of over 800 Diesel and Jet samples from around the world, multivariate correlation models that conform to ASTM E1655 are used to predict many desired physical and chemical properties.
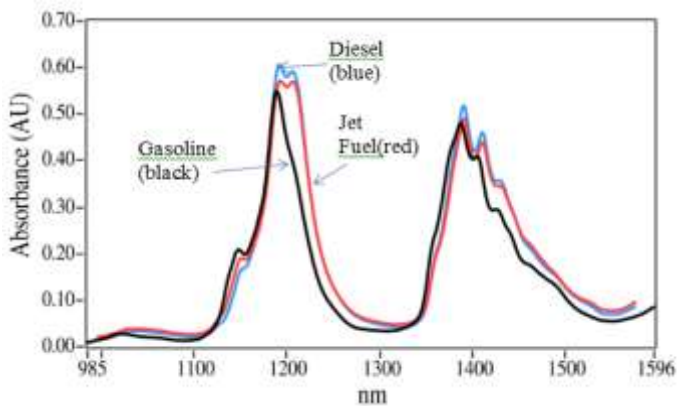

Figure 1. NIR spectra of various fuel types: Diesel, Jet, and Gasoline
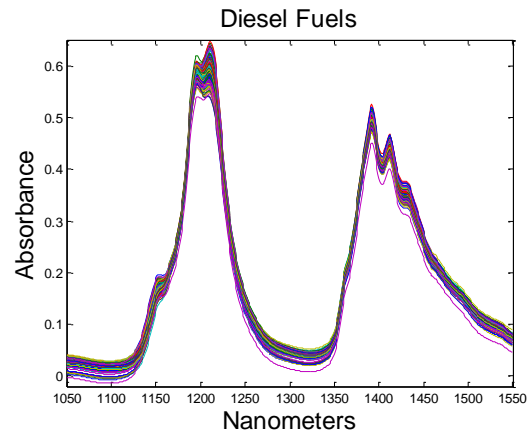

Figure 2. Calibration set of 200 Diesel fuels

The NIR spectra in Figure 1 show differences in fuel types, and Figure 2 shows the raw spectra of 200 diesel samples. Despite the overlapping similarity of the NIR spectra, multivariate analysis partial least squares (PLS) regression allows the prediction of multiple fuel properties. Figures 3 and 4 show the Predicted vs Measured correlations of the Cetane Index of Diesel and the Density of Jet Fuel. Both calibrations exhibit good correlations, with R^2 greater than 0.90 and an error of prediction less than 5.0%.
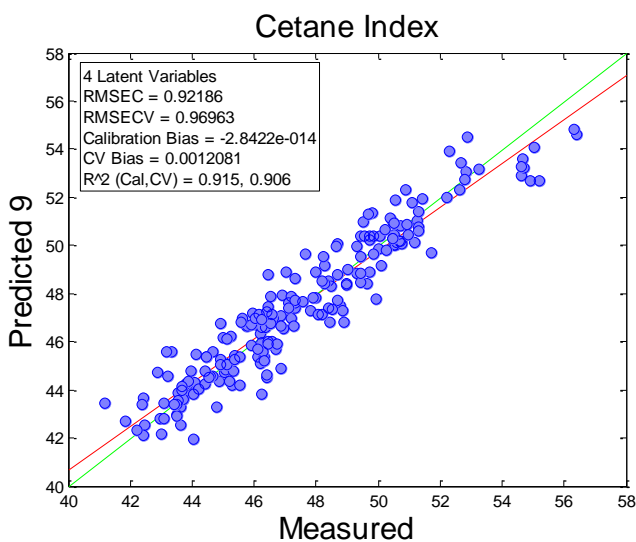

Figure 3. Cetane Index calibration of Diesel Fuel
(Predicted vs Measured)

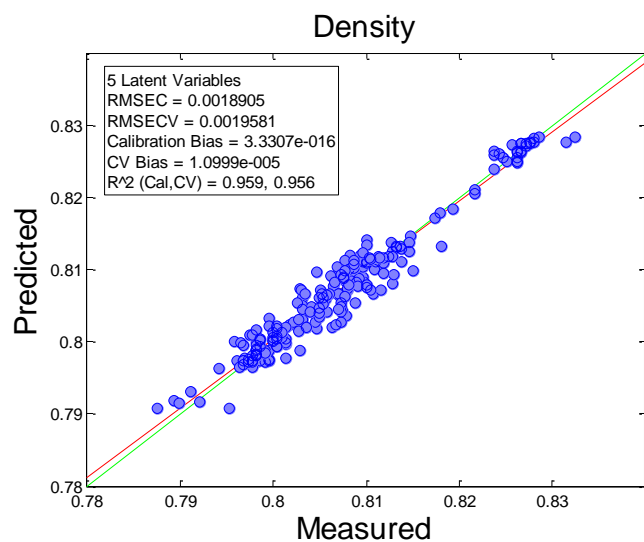Figure 4. Density calibration of Jet Fuel
(Predicted vs Measured)

RTA is located at 362 Industrial Park Rd (#8) / Middletown, CT 06457
www.rta.biz, Phone: 860-635-9800, Facsimile: 860-635-9804

Providing Chemical Information When & Where You Need It

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The use of NIR to predict chemical and physical properties in the petroleum industry has successfully been used for many years. Because the size and cost of spectrometers have come down in recent years, the ability to measure fuel properties now extends to places outside the laboratory. Figure 5 shows benchtop and field-portable versions of the multi-property fuel analyzer. Figure 6 shows the graphical user interface for the easy-to-use software.

9.63 x 8 x 3.75"

5.2 lbs

Figure 5. Benchtop and Portable versions of the Fuel Property Analyzer

Advantages

- ❖ *Only 2 mL of Fuel Required*
- ❖ *No Sample Preparation Required*
- ❖ *Analyzer Warm-Up takes <1 Minute*
- ❖ *Complete Analysis in 10 Seconds*
- ❖ *Permanently Aligned and Calibrated*
- ❖ *Easy To Use*
- ❖ *Rugged Design, No Moving Parts*
- ❖ *Analysis Based on ASTM Data, Developed and Validated According to ASTM E1655 using Eigenvector PLS Toolbox*
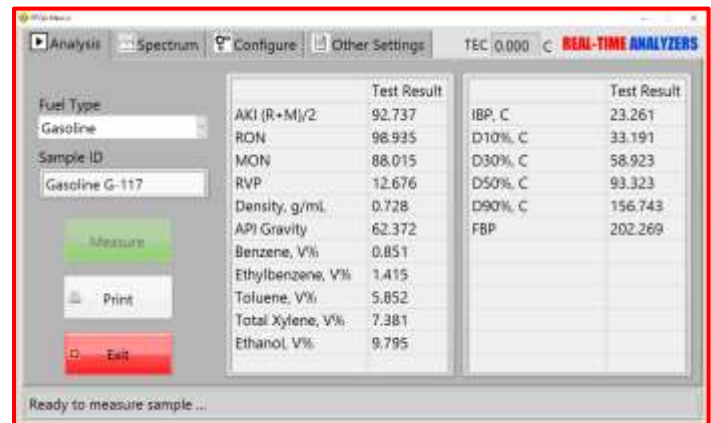- ❖ *Economically Priced!*

Figure 6. User Interface of Software showing predicted results

The Portable Fuel Analyzer is used as follows:

1) The unit is turned *On* (warm-up takes 1 minute).
2) A Reference Vial is placed in the analyzer for background scan (measurements take 10 seconds).
3) The Sample is placed in a disposable 2-mL vial and placed in the analyzer.
4) The Results are displayed in 10 seconds, and can be printed.

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