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REAL-TIME OPTICAL ABSORPTION ANALYZERS

APPLICATION NOTE

The Cloud Point of Diesel Using a NIR-O™ Spectrometer

The Problem

The Cloud Point of a diesel fuel is the temperature below which wax forms giving the fuel a cloudy appearance. This parameter is an important property of the fuel since the presence of solidified waxes can clog filters and negatively impact engine performance. The traditional laboratory methods for the measurement of Cloud Point are optical in nature, but rely on cooling the fuel for the wax formation to occur.

The Solution

Near-infrared (NIR) spectroscopy instrumentation can measure compositional changes in the fuel that will be directly related to the wax formation and hence the Cloud Point. NIR methods can be applied without fuel cooling, in real time, directly in process monitoring, or as a laboratory procedure. In either case NIR is a time and money saving alternative to traditional methods.

Measurement Background

The NIR region of the electromagnetic spectrum allows the use of the overtone and combination bands of the C-H, O-H, and N-H fundamentals. By measuring the NIR spectra of a series of fuel samples of known Cloud Point, a quantitative model can be developed which will allow the measurement of future samples based only on their NIR spectrum.

Experimental Set-up

The NIR spectra of a group of different process diesel fuel samples with known (laboratory measured) Cloud Point values were measured between 1100 and 1600 nm using our GUIDED WAVE™ NIR-O™ process analyzer spectrometer. Figure 1 shows the absorbance spectra of some representative diesel samples collected using an on-line process probe with a 1 cm pathlength.

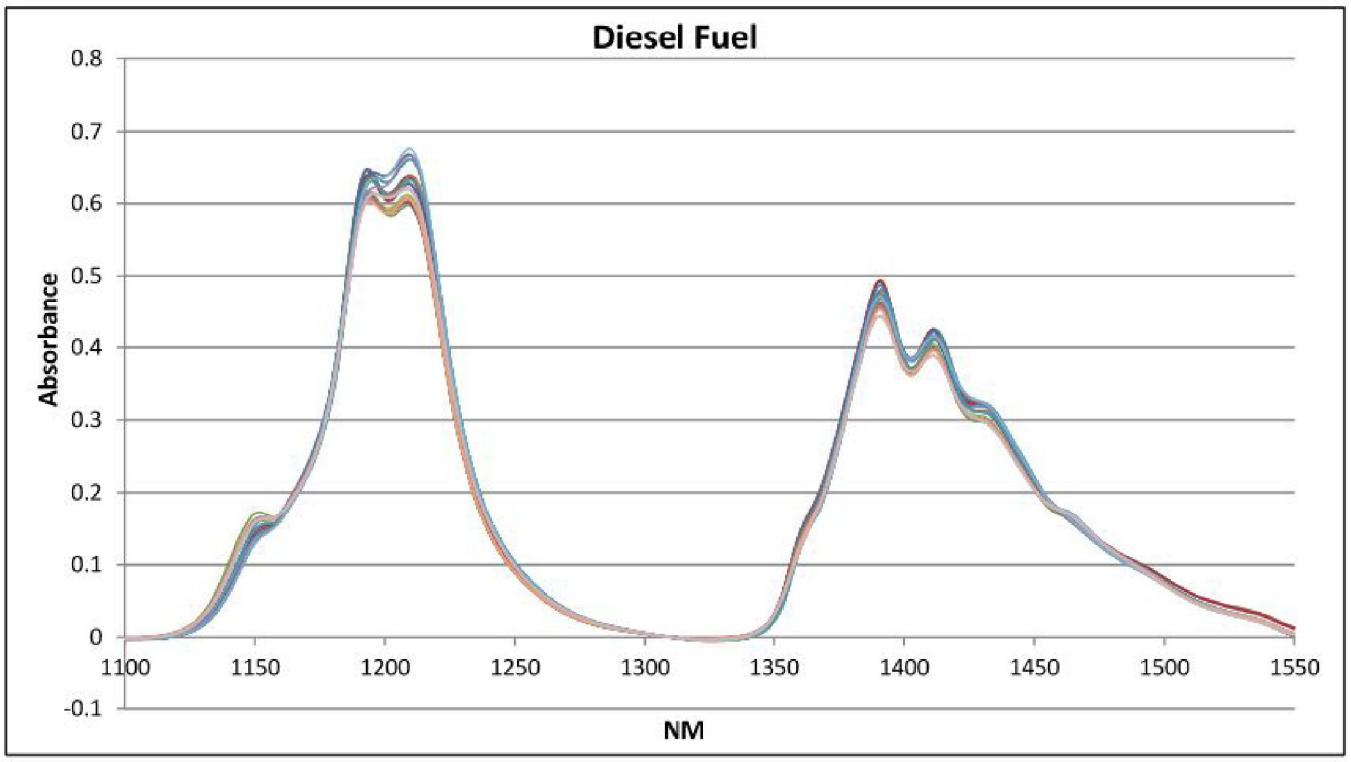

Figure 1: Diesel Fuel NIR Spectra

Results

Simple pre-processing methods were applied to each data set followed by Partial Least Squares (PLS) Regression analysis. The prediction results from the calibration model are shown in Figure 2. The calibration model produced an RMSEP (root mean square error of prediction) of 1.8 degrees. The RMSEP can be compared with the laboratory reference method error. In this case the ASTM method reproducibility for Cloud Point ranges from 2.5 to 4 degrees. The NIR method compares favorably with those results.

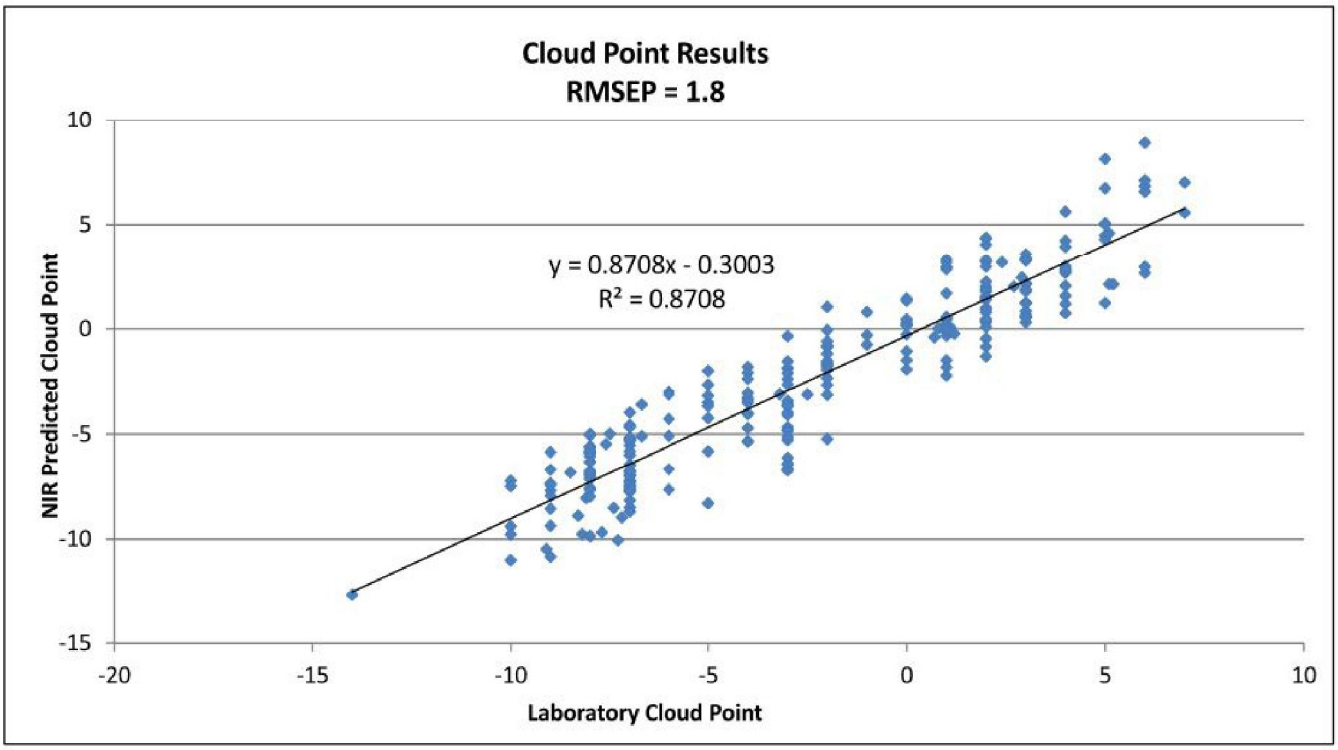

Figure 2: Cloud Point Results

Conclusion

The measurement of the Cloud Point of diesel fuel using NIR spectroscopy is both fast and reliable utilizing the hardware and software tools as described here. This method minimizes the need for laboratory sample collection. Results are available in real-time (seconds) for multiple parameters in complex streams. The NIR-O process analyzer system uses fiber optics to allow the NIR-O to be located in a remote (safe) location away from the sample points themselves. It is well suited for measuring many chemical and physical properties of diesel fuel. For more detailed information regarding system specifications please contact a Process Insights sales or technical specialist.

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