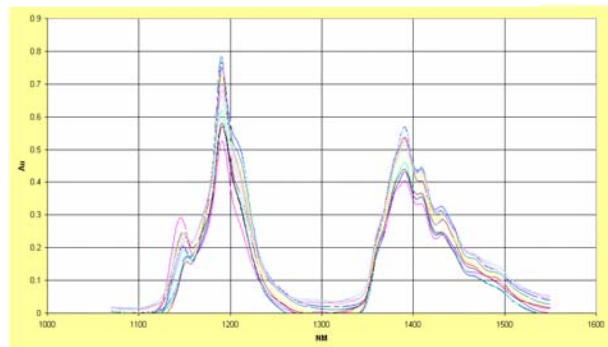
Guided Wave INCORPORATED

Process Analytical Systems

Application – Octane Number of Gasoline

The Octane number rating of a gasoline is an indication of how the gasoline will perform under various engine conditions. Two different ratings are included: Research Octane Number (RON) and Motor Octane Number (MON). Finished gasoline must meet certain Octane number specifications. Thus refineries control this parameter during production and must certify that a gasoline meets specification before it is released. The traditional laboratory method for Octane number determination is the knock engine method in which a gasoline is burned and its combustion characteristics compared to known standards. This method is time and labor intensive, and provides no ability for real time control of production. This note will discuss the use of Guided Wave hardware and software tools for the measurement of Octane number in gasoline using fiber optic-based, Near-Infrared (NIR) spectroscopy. NIR can be applied 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.

Figure 1 - NIR Spectra of Gasoline Samples



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 Octane number, a quantitative model can be developed allowing the measurement of future samples based only on their NIR spectrum. Guided Wave analyzer systems use fiber optics to allow the sample probe to be located in remote locations away from the spectrophotometer itself.

Experimental

The NIR spectra of a group of different process gasoline samples with known Octane numbers were measured between 1000 and 1600 nm using a Guided Wave Model 310 NIR Spectrophotometer. Figure 1 shows the absorbance spectra of some representative gasoline samples collected using an on-line process probe with a 1 cm pathlength. For this application, data preprocessing consisted of a simple 2-point baseline correction to remove any offset. The spectra and concentration data were submitted to the Unscrambler^tm software and a calibration model was developed using PLS regression methodology. For a discussion of PLS and other multivariate calibration techniques please see Martens & Naes [1] and ASTM E1655 [2].

Results

The model was used to predict the Octane number of gasoline (RON and MON) using an in-situ probe inserted in a process stream measuring in real time. The results for this are shown in Figure 2 for MON and Figure 3 for RON. Both parameters are in good agreement with the accepted laboratory method.

Conclusion

The measurement of the Octane number of gasoline using NIR spectroscopy is both fast and reliable utilizing Guided Wave 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. For more detailed information regarding system specifications please contact a Guided Wave sales or technical specialist.

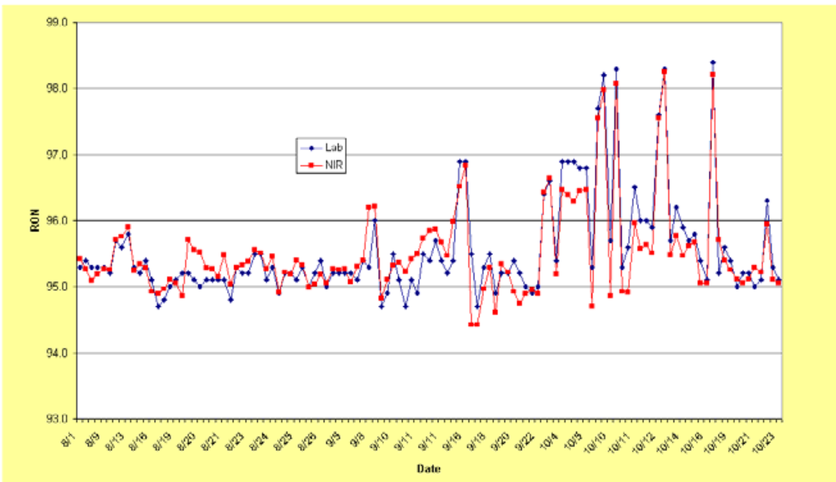


Figure 2 Trend Plot Lab vs NIR RON

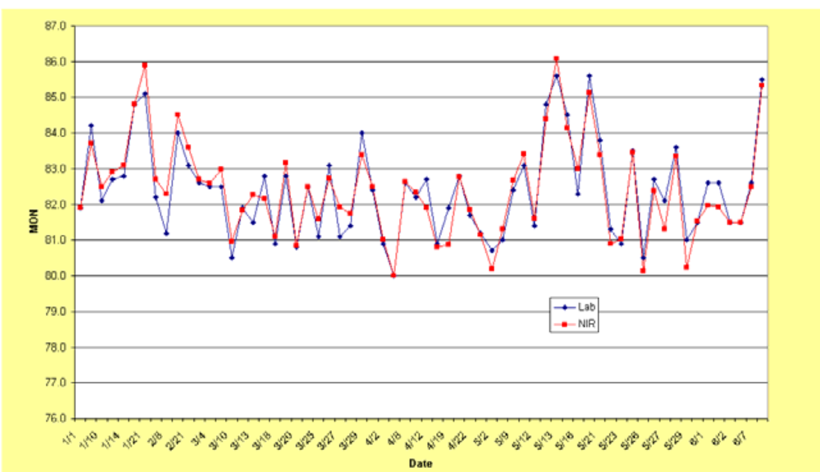


Figure 3 Trend Plot Lab vs NIR MON

References

1. H. Martens, T. Naes, Multivariate Calibration, John Wiley & Sons, 1989.
2. ASTM E1655 Standard Practices for Infrared, Multivariate, Quantitative Analysis.

Literature No. 3012-05-09 RevA1

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