

APPLICATION NOTE

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Cold Filter Plugging Point on Diesel

Industry: Oil and Gas
Product: NR800

INFORMATION

ASTM 6371-99 describes the method for measuring Cold Filter Plugging Point (CFPP) of diesel and domestic heating fuels. CFPP measures the formation of waxy solids at low temperatures, similar in concept to Cloud Point. Cloud Point is readily predicted from NIR spectra, so we are often asked if CFPP can also be measured using on-line FT-NIR.

CFPP can be measured by FT-NIR if there are no additives to lower the CFPP or otherwise improve the flow characteristics of the sample. Thus, the CFPP of straight run diesels and heating oils can be measured on-line using FT-NIR. If an additive to lower CFPP is present, FT-NIR will probably not accurately measure the CFPP.

-5.759e-02 0.670 1.398 2.126 2.854 3.582

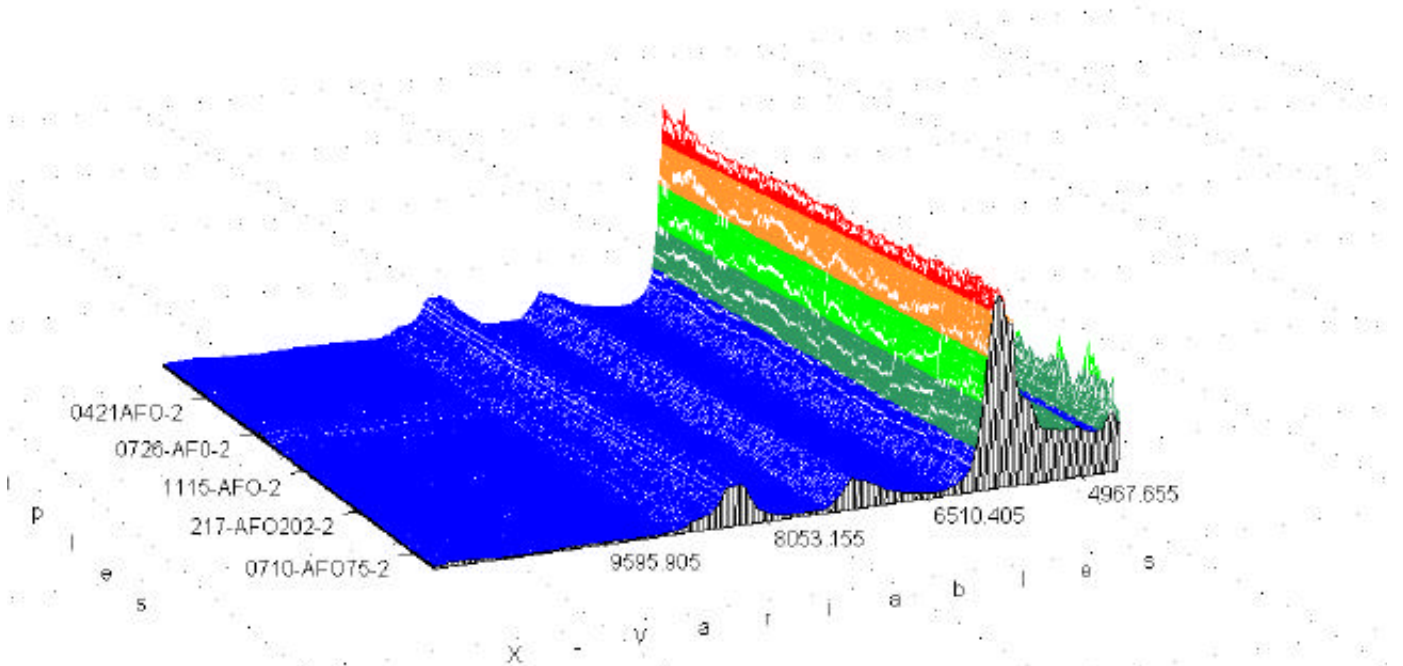


Figure 1: Spectra of Heater Oil Samples

The reason for this relates to how FT-NIR performs any measurement. All any NIR spectrometer does is measure the amount of light absorbed by the sample at each frequency across the NIR spectrum. Different chemical compounds absorb light differently at different frequencies. The waxy substances in diesel or heater oils which contribute to cloud point and CFPP are mainly higher molecular weight paraffins and aromatic compounds. As the concentration of these compounds changes, the shape of the spectrum changes in specific regions. The changes in the shape of the spectrum can be correlated with CFPP using a multivariate calibration model. The underlying assumption is that samples with similar NIR spectra have similar properties, and this is generally true. Figure 2 below shows a typical calibration for CFPP. The Root Mean Square Error of Prediction (RMSEP) is +/-1.74 °C which compares well with the ASTM Repeatability of +/- 1.76 °C and Reproducibility of +/- 2.55°C at 0 °C.

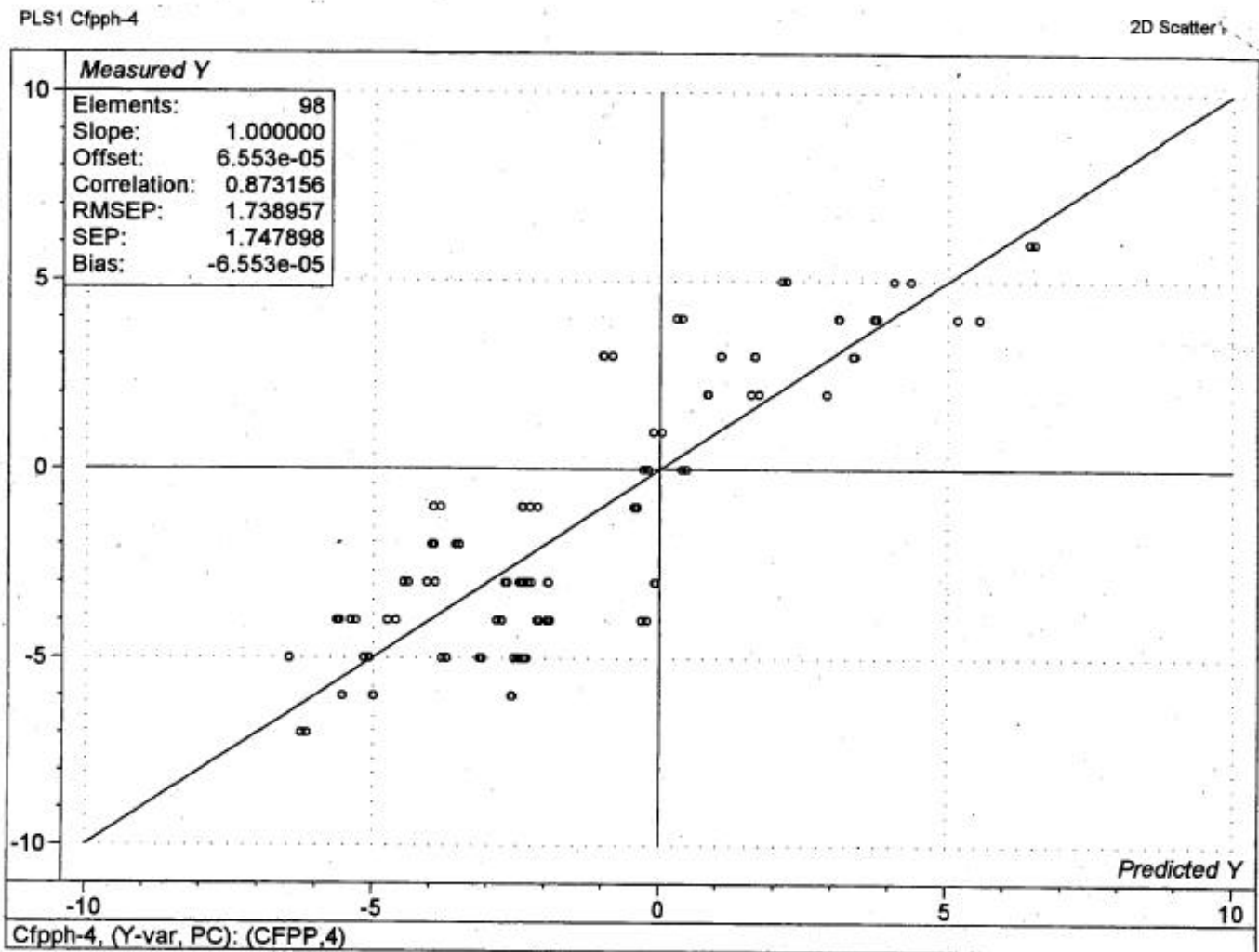


Figure 2: Predicted vs. Measured Plot for CFPP in Diesel

If additives are present at low concentrations (typically in the ppm range) to change the CFPP, these additives are not present in sufficient concentration to change the NIR spectrum. Thus, the correlation between the spectra and the measured property (CFPP in this case) breaks down and the measurement cannot be made using NIR. Figure 3 shows the error of prediction for two sets of samples, some with additives to lower CFPP and some with not additive. Note that the error on samples with no additive is relatively small, but samples with additive show a much larger negative error.

Dcgas0 - Histogram Plot

Histogram Plot

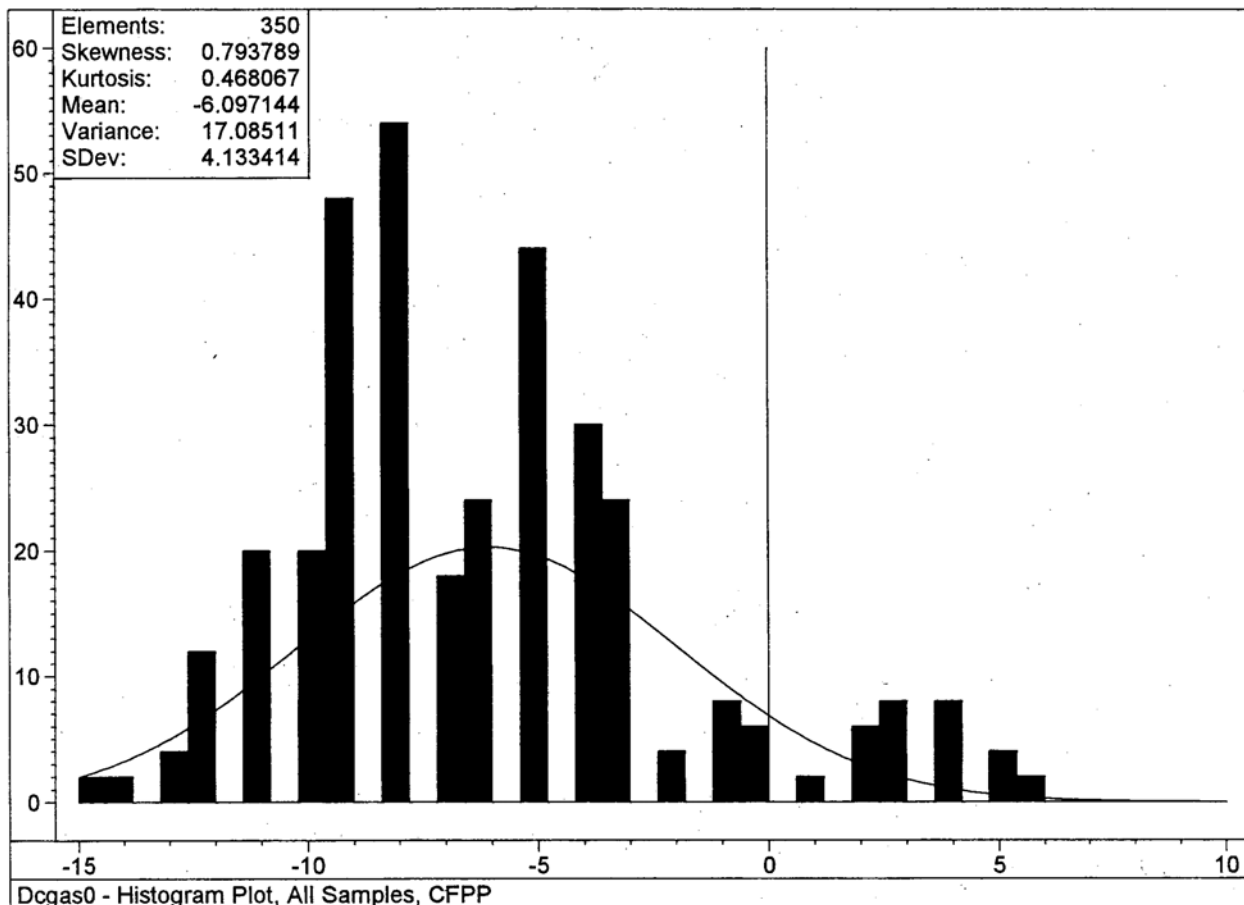


Figure 3: Errors in CFPP Measurement

CONCLUSION

FT-NIR is a viable approach to on-line measurements of Cold Filter Plugging Point for straight run diesel and heating oil samples which contain no additives to improve the flow characteristics of the product. Measurement repeatability and reproducibility compares well with ASTM standards.