

MC2750 EP-NIR: Accurately Measuring Biodiesel % vol. in B0 – B100 Blends.

SUMMARY: An Aspectrics MC2750 EP-NIR spectrometer equipped with a dip probe (2-mm pathlength) was used to develop a calibration for the measurement of the % volume of biodiesel in various (B0 – B100) diesel blends. Focus was on the most common blending ranges, B0-B20 and B90-B100. Validation of these calibration equations showed an accuracy of RMSEP = 0.09% vol. in predicting biodiesel % vol. in blends of finished product.



Fig. 1: EP-NIR MC2750 with dip probe and various samples (methanol, glycerin and actual ASTM 6751 compliant biodiesel samples.)

An Aspectrics MC2750 Encoded Photometrics Near Infrared (EP-NIR) spectrometer covering the 1375-2750 nm spectral range for access to combination bands information was equipped with a highly stable, industrial halogen NIR source and a dip probe with a 2-mm pathlength (See figure 1).

Samples of B0, B10, B20, B90, B95 and B100 were gathered and analyzed in several replicates. The resulting spectra were randomly split into 2 groups, one used to develop a calibration model, the other one to validate the equations created for accuracy. Both Principal Components Regression (PCR) and Partial Least Squares (PLS) chemometrics methods were used to develop calibration equations.

Biodiesel is composed of methyl esters of fatty acids, whereas diesel fuels predominantly contain a mixture of C10 through C19 hydrocarbons, including approximately 64% aliphatic hydrocarbons, 1-2% olefinic hydrocarbons, and 35% aromatic hydrocarbons. As seen on figure 2, the measurement of biodiesel % vol. in the final blend can be easily done using chemical information characteristic of and specific to the biodiesel product only: the ester carbonyl organic functional group.

As shown on figures 3 and 4, the PLS model performed marginally better than the PCR model, allowing for a validated Standard Error of Prediction for the measurement of biodiesel in blend of RMSEP = 0.09% volume. This guarantees, at a 99.9% confidence level, measurement of biodiesel % volume in blended finished product with an accuracy of ± 0.27 % volume.

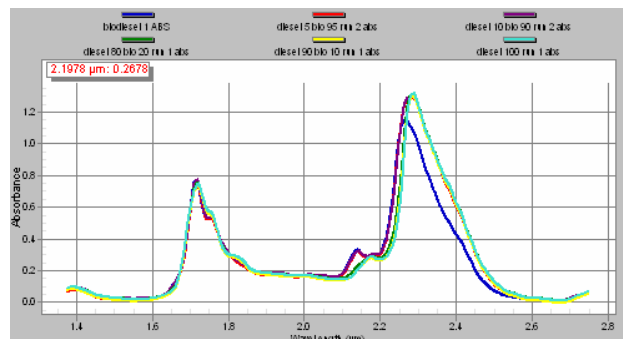


Fig. 2: EP-NIR MC2750 spectra of B0, B10, B20, B90, B95 and B100.

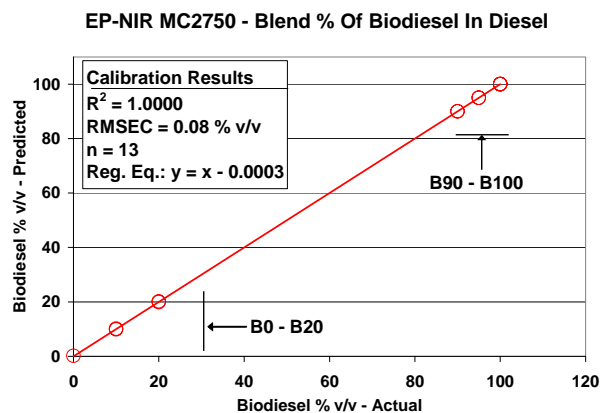


Fig. 3: Measurement of Biodiesel % vol in blend - Calibration Results

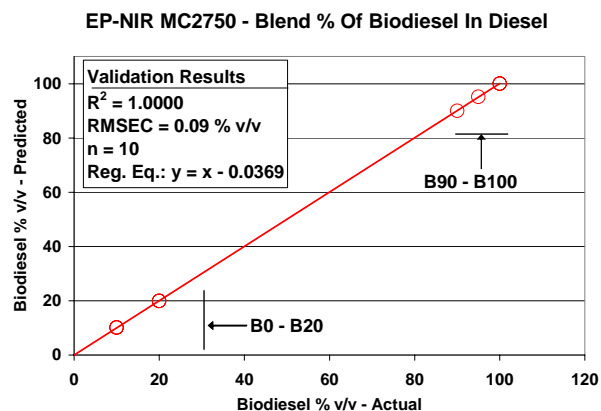


Fig. 4: Measurement of Biodiesel % vol in blend - Validation Results