Application Note 83:
Determination of Alcohol in Liqueurs

Introduction: The NIT-38 Alcohol Analyser was originally designed to rapidly measure the alcohol content of both red and white wine with no sample preparation. The NIT-38 Alcohol Analyser has also been used to measure alcohol in beer, vinegar and gasoline. The O-H bonds in the alcohol absorb NIR light at approximately 905nm. The alcohol content is determined by passing light through a sample of wine, beer, vinegar, gasoline or liqueurs, and measuring the amount of light absorbed by the O-H bonds. A calibration model is developed by collecting the NIR spectra of many samples with know alcohol%. This model is downloaded into the NIT-38. To measure future samples, the calibration model is selected from the on screen menu and the instrument prompts the user to load the sample. Up to five scans are averaged to give the result, Alcohol%, in approximately 10 seconds.

Procedure: 19 samples of liqueurs were provided. The liqueurs are of different types, eg, green, yellow, caramel, raspberry, blue, advocaat yellow, chocolate and black. Each sample was labelled with a % alcohol ranging from 3.8 to 58.2% The majority of samples were clear, however there were four lime green samples which had different levels of turbidity. The advocaat sample was very dense(opaque) and two other samples were sufficiently dark that light would not pass through the sample bottle.

Each sample was scanned using a 20mm pathlength cuvette, across the spectral region, 720-1100nm. The integration time was set to 78useconds per pixel. This is the fastest scan time available on the NIT-38. However for the three samples which were not clear, the integration time was set at 1000useconds. This helps to smooth the spectral data since less energy is reaching the detector.

The spectral data and reference alcohol data were collected and uploaded into NTAS(NIR Technology Australia Software). A PLS calibration model was developed and then downloaded into the NIT-38 Alcohol Analyser. The samples were then analysed against this calibration model.

Results: Figure 1. shows the NIT spectra for the 19 samples. It is noted that the advocaat sample has a large baseline offset due to the opacity of the sample. The four lime green samples which are turbid, also show some baseline offset.

Figure 2. shows the first derivative spectra of the samples. Not that the baseline offsets are reduced and that the differences in spectra due to alcohol can now be seen.

The results of the calibration modelling are shown in figure 3 and 4. Figure 3 shows the calibration statistics and a plot of the NIR Alcohol vs the Reference Alcohol for all 19 samples. Figure 4. shows the statistics and plot for all samples excluding the advocaat sample(sample 17). It is considered that even though the spectral data for sample 17 is acceptable, the overall calibration would be improved if this type of sample were treated separately. Since the NIT-38 can store many calibrations, it is suggested that a separate calibration be developed for those samples which are opaque.

Table 1. presents the calibration and the prediction data for these samples.

Calibration Model	SEC	R^2	SEP	R^2
All samples	0.34%	0.9992	0.6%	0.998
Excluding Advocaat	0.14%	0.9999	0.14%	0.9999

Conclusion: The results presented above illustrate the ability of the NIT-38 to measure alcohol in liqueurs. These results are typical of other alcohol applications, ie, wine, beer and vinegar.

The range of alcohol is very broad across these samples and it may be possible to improve the SEC and SEP by narrowing the ranges and setting up calibrations for different types of liqueurs, eg, clear samples, 4-15%, clear samples 15-30%, turbid samples, opaque samples. Unfortunately there are not enough samples to make these separation, at this time.

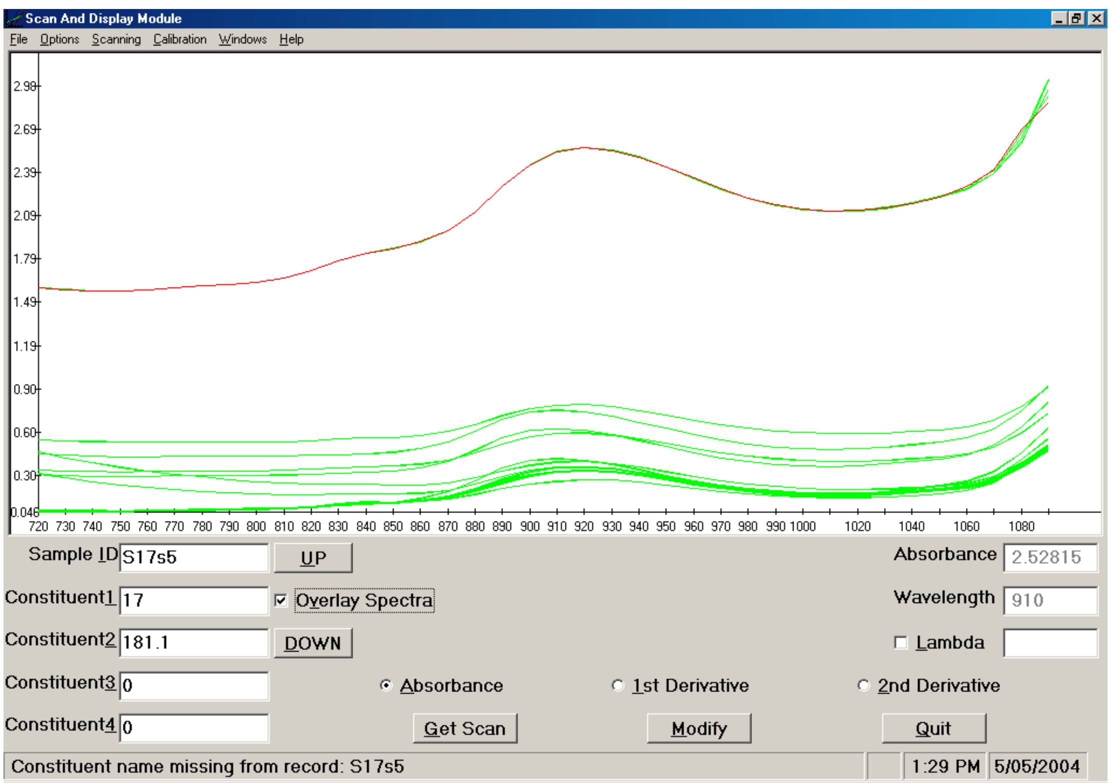

Figure 1. NIT Spectra of Liquor Samples.

Figure 2. First Derivative Spectra of Liquor Samples.

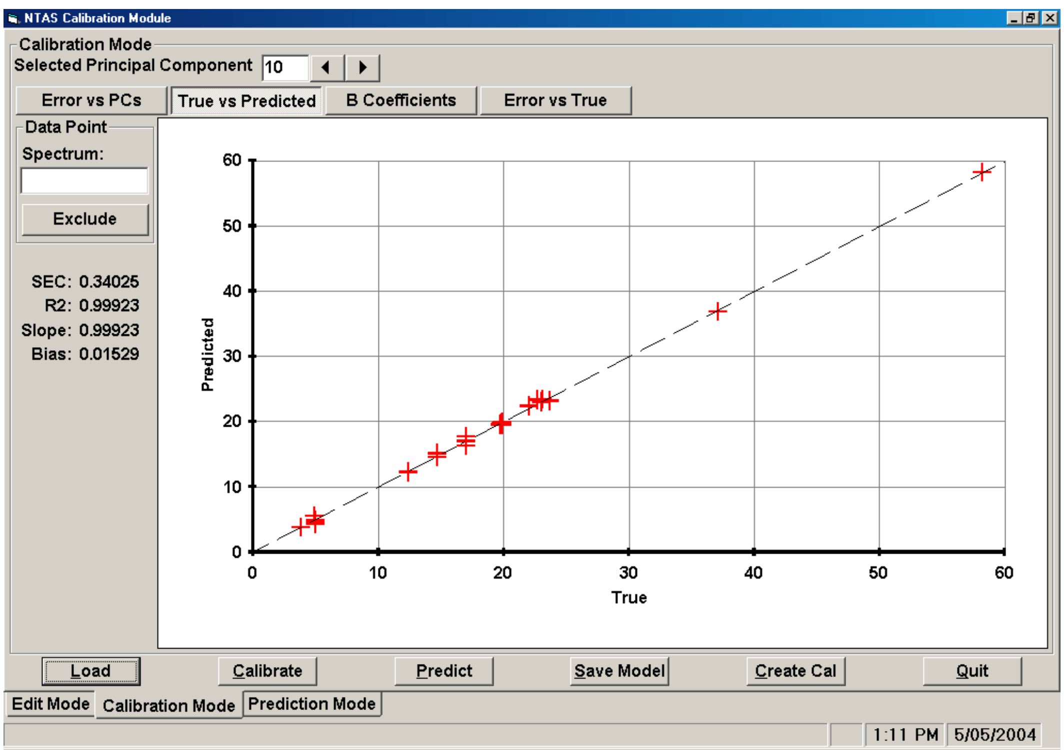

Figure 3. Calibration Statistics and Plot for All Samples

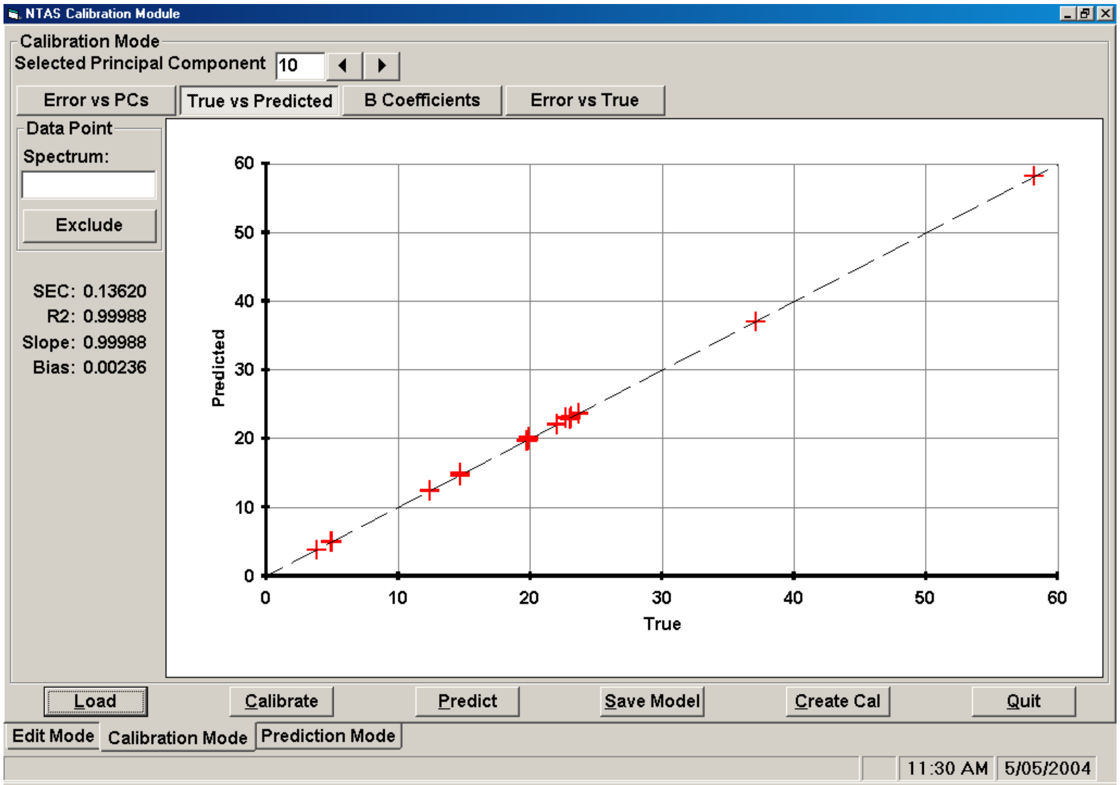

Figure 4. Calibration Statistics and plot for All Samples excluding Advocaat

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