Application Note

260-DR-0190

NIR Measurement by Liquid Sampling using Hematocrit Capillary

<Introduction>

Light in the near-infrared region is widely employed for such purposes as quality control, receiving inspection, and process control using the diffuse reflection method. Furthermore, since light in the near-infrared region is not absorbed by glass, it can be easily used for measuring powder samples in test tubes and sample bottles. On the other hand, the measurement of liquid samples is normally performed using the transmission method rather than the diffuse reflection method, and the cell used is generally as thin as 1 to 3 mm thickness. This results in the problem of having to clean the cell each time for such applications as quality control, process control, and quantitation. The method introduced this time is an analysis technique using a commercially available hematocrit capillary tube (glass capillary tube). The capillary tube with the sample sucked in is placed as is on the sample holder and then measured using the transmission and reflection methods. Since hematocrit capillary tubes (Photo 1) enable measurements with only trace amount of sample and allow simple analysis without the trouble of having to clean cells, they can be widely used in such applications as receiving inspection, process management, and quantitation. Measurement results also have a similar level of precision when compared with ordinary square cells and ATR.

<Experimental>

1) Transmission

The transmission holder shown in Photo 2 was placed in the sample chamber of a near-infrared FT-IR system and then the hematocrit capillary tube was placed horizontally on the holder and measured. The slit mask was set to horizontal to match the capillary tube.

Photo 2. Holder for transmission measurement

2) Reflection

The diffuse reflection measurement attachment VIR-NRF-N shown in Photo 3 was placed in the VIR-9600 Fourier Transform Near-IR Spectrometer and then the hematocrit capillary tube was placed horizontally in line with the positioning groove and measured.

<Condition>

Accumulation:	32
Resolution:	8 cm^{-1}
Apodaization:	Cosine
Detector:	InGaAs

Photo 1. Hematocrit capillary

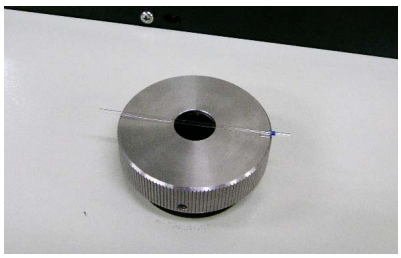

Photo 3. Holder for reflection measurement

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Figures 1 and 2 are the measurement results by the transmission method and diffuse reflection method, respectively. With the aqueous solution sample, there was strong absorption by OH in the 4500 cm^{-1} to 5500 cm^{-1} region. As compared with the transmission method, absorption is saturated with the diffuse reflection method.

<Quantitation>

To confirm the quantitative nature using the hematocrit capillary tube, a calibration curve of alcohol concentration within water was created. As shown in Figure 3 and 4, the results were extremely good with correlation coefficients between R = 0.998 and 0.999 for both the transmission method and the diffuse reflection method.

<Discussion>

Since this method using a hematocrit capillary tube enables measurement using both transmission and reflection method systems, it is useful for measuring not only general liquid samples, but also paste samples that are prevalent in the field of food analysis. It expands the field of applications to include fish paste products, fermented products, soybean paste, ketchup, jam, and yogurt.

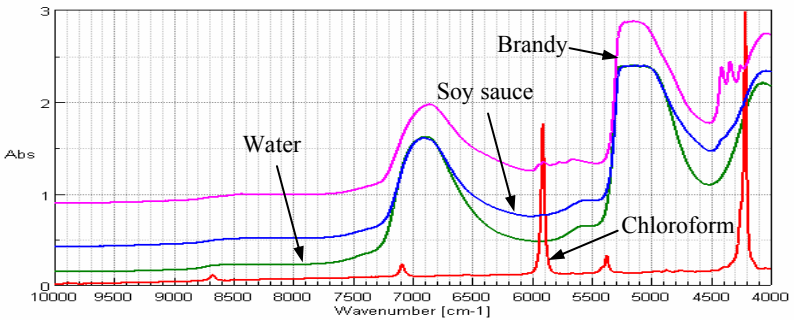

Figure 1. NIR transmission measurement spectra of liquid samples

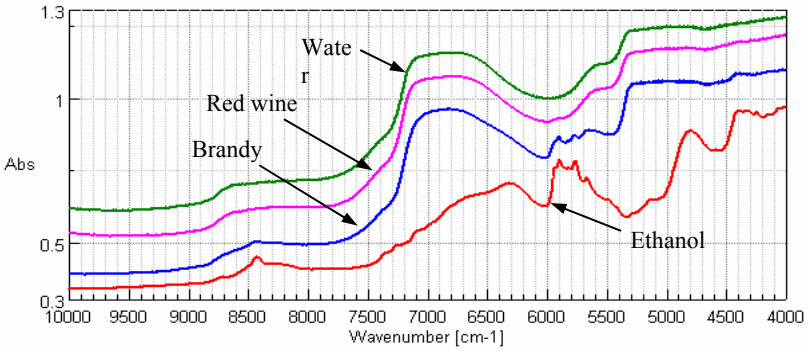

Figure 2. NIR reflection measurement spectra of liquid samples

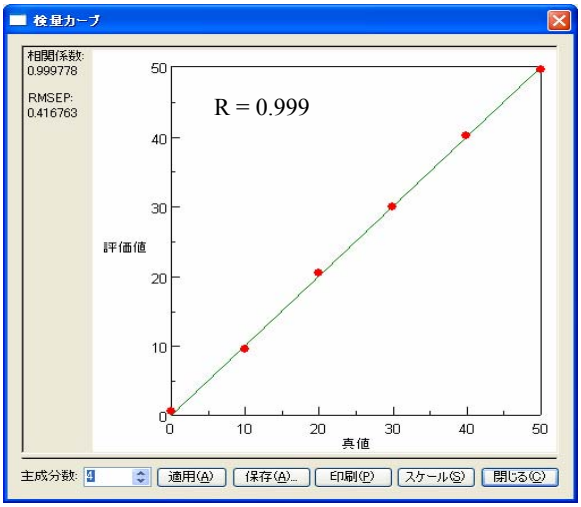

Figure 3. Calibration curve by transmission method

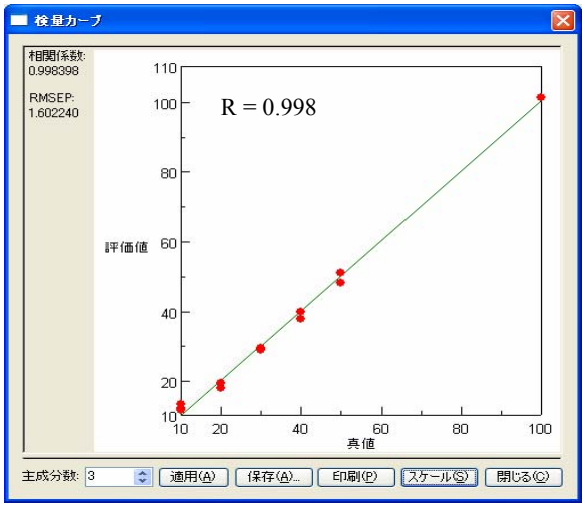

Figure 4. Calibration curve by reflection method

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