SHIMADZU

Application News

Spectroscopy – UV

No. SCA-100-017

Wine bottle measurement with UV-2600 and MPC-2600 Quality control of color

The packaging of food is of mayor interest since the modern world is using modern materials as factor of design for food. Should it be new style in carton (since 1977) or classical in glass (since 17th century)? In case of wine it seems that the classical glass wine bottle is still the most favorite packaging.

Fig. 1: Red wine Bottles from the Shimadzu Wine Edition I at left and Edition II at right side.

The glass appears transparent and emphasize a feeling of being clean, and the wine should be less influenced by additives which can be result from the carton. The glass color can be blue, green, brown or white for liquids. It seems that glass which is not clear green or direct brown can be result of mixture caused by melting green and brown glass fraction in one or the adequate mixture of inorganic oxides causing such final color during the glass melting process. It is written in the literature that green glass can pick up to 15% of other colors. And brown glass add up to 8%. For the human eye it is still in the category green and brown glass.

Fig. 2: Typical colors of wine bottles, the green glass is easy to identify, at the right side the color is subjective more brown green

It is difficult to judge for the human eye if the right bottle from figure 1 is a dark green, brown, or? To overcome such handicap the UV-VIS spectroscopy can be a neutral instrument to characterize the color of the glasses. The application shown in this experiment is a measurement through wine bottles.

■ Experiment

The wine bottle in its appearance was completely set into the sample compartment of the MPC-2600. It was positioned so that the light energy could pass through the two wine bottle walls, without touching the paper prints on the glass bottle wall. The UV-VIS spectra were recorded for the two bottles. By the presence of two thick bottle walls the ground absorbance of the glass spectrum

resulted in a high baseline and high signal values. The measurement in this way was destroying free.

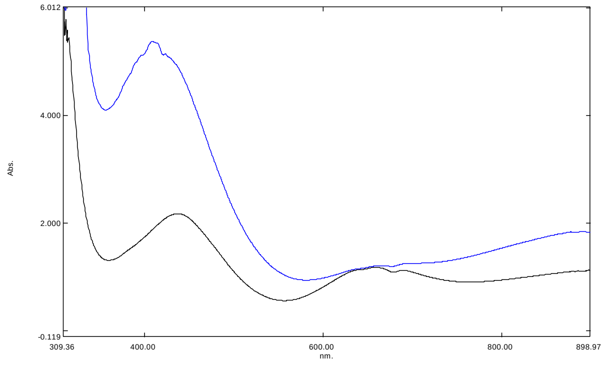

Fig. 3: blue line shows the UV-VIS spectrum from the brown-green glass and the black line is the spectrum from the green glass.

In figure 3 are shown two spectra from each sample. The range of interest is 310 to 890 nm. The green glass spectrum has two maxima ranges at around 650 and 440nm (black line). The blue lined spectrum has its maxima with a weak at 650nm and a very high at 410nm and a higher absorbance at >800nm. In detail it is at 650nm minimum a triplet signal or even a multiple which is saturated. With the help of the 2nd derivative spectroscopy it is possible to make this situation visible. The position of the maxima can be given as: 686.4, 669.9, 654.2, and 636 nm (Fig. 4). These absorbance maxima are typical signals belonging to Chromium 3^{+} in form as Chromium oxide Cr_2O_3 (1). This oxide is used to generate green color in glass ware. The same profile but less in height is visible in the green-brown glass spectrum, but the mayor signal in the range of 400 is shifted from 440 to 410. A broad signal with an internal maximum at 410nm. Brown color is result from the investigation of Manganese oxide (2). This is more present in the second sample because of less contents on Chromium oxide. A screening by Shimadzu EDX-7000 showed a factor of 3 lower contents of chromium in the brown-green sample.

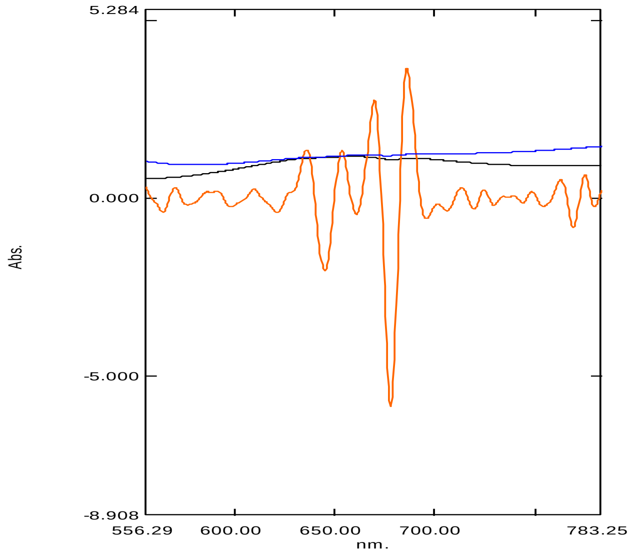

Fig. 4: 2nd derivative spectrum from the green glass spectrum (red), up to four signals can be separated at 650nm as characteristic for Cr_2O_3.

The manganese has influence on the redox process regards changes in the iron oxides under heat of melting. Absorption of yellow color falls into the visible spectrum. The presence of manganese oxide is also responsible for the more intense iron oxide signals at 380 to 430nm. The 2nd derivative spectrum extracts signals at. 420, 412, 400,390, 385 nm.

■ **Instrumentation**

UV-2600
MPC-2600 and Plane stage for a wine bottle

■ **Literature:**

(1) The effect of chromium oxide on optical spectroscopy of sodium silicate glasses, Bahman _Mirhadi, Behzad Mehdikhani, Journal of Optoelectronics and Advanced Materials, Vol. 13, No. 9, September 2011, p. 1067 -1070

(2) Effect on Manganese oxide on redox iron in sodium silicate glasses, Bahman _Mirhadi, Behzad Mehdikhani, Journal of Optoelectronics and Advanced Materials, Vol. 13, No. 10, October2011, p. 1309-1312