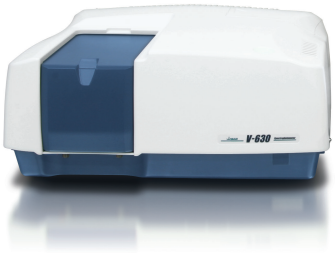
Application Note
UV-0014

Using a UV-Visible Spectrophotometer to Obtain Quantitative Chromaticity and Turbidity Measurements

Introduction

Chromaticity measurements are used to check the coloration degree of clean water and waste water by adding humic acid to the test solution and observing the absorption at 390 nm which shows the yellow color of the acid. The turbidity describes the relative clarity of a solution due to insoluble particles, microbe and organic substance in clean water and waste water. The degree of turbidity can be measured by the amount of light scattered from the materials in the solution using a UV/Vis spectrophotometer in transmission measurement method or an integrating sphere.



V-630
UV-Visible Spectrophotometer

This application note describes quantitative chromaticity and turbidity measurements using a UV/Vis spectrophotometer based on the clean water test method.

Keywords

V-630/650/660/670, UV-Visible/NIR, Materials, Chromaticity, Turbidity, LSE-701 Long pathlength cell holder, VWWQ-789 Chromaticity/turbidity measurement program, ISV-722/ISNN-723 Integrating sphere

Results

Chromaticity Measurements

Cobalt chloroplatinate has a color similar to the yellow-brown of humin and is used as a standard sample for the chromaticity measurements. 2.49 g of potassium chloroplatinate and 2.02 g of cobalt chloride are dissolved in 200 mL of hydrochloric acid. Purified water is then added to the solution to make a total volume of 1 L. This solution is the neat standard sample with a chromaticity of 1000 degree. The standard solutions used to create the absorbance calibration curve are prepared from the neat standard sample and diluted with purified water. Both the blank and water samples are filtering using a 0.2 µm membrane filter. Water samples can also be centrifuged with the supernatant used as the sample.

The absorption of the standard solutions at 390 nm were measured using a 50 mm pathlength cell. The calibration curve is shown in Figure 1 and the corresponding values and calculated chromaticity results are shown in Table 1.

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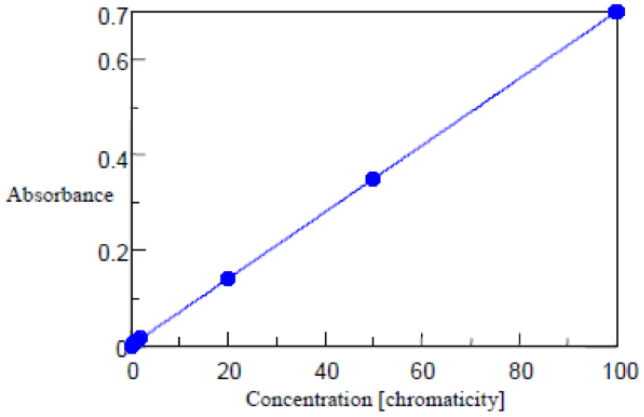

Figure 1. Chromaticity calibration curve.

Table 1. Chromaticity calibration curve results.

Concentration (Chromaticity)	Absorbance	Calculated Chromaticity
0	0.000	-0.06
0.5	0.004	0.51
1	0.007	0.97
2	0.015	2.04
20	0.141	20.07
50	0.350	49.99
100	0.699	99.99

From the above results, the standard deviation (σ) between the obtained quantitative value and actual chromaticity is 0.04(6) degree, the detection limit is 0.15, and the quantitation limit is 0.46 degree. The detection limit is calculated from 3.3σ while the quantitative limit is calculated from 10σ.

Turbidity Measurements

An immixture polystrenene suspension is used as the standard sample for the turbidity measurements. 5 neat solutions of polystyrene particles with a turbidity at 100 are shown in Table 2 along with their corresponding mixing ratios and diameters. To create the calibration curve, the neat sample solutions are diluted with purified water at 0, 5, 10, 50, and 100 degrees and measured in transmission mode using a 20 mm pathlength cell. Purified water filtered using a 0.2 µm membrane is used as the blank solution. The calibration curve and corresponding results are shown in Figure 2 and Table 3. The standard deviation is also calculated as 0.36 degree, the detection limit as 1.18, and the quantitation limit as 3.6 degrees.

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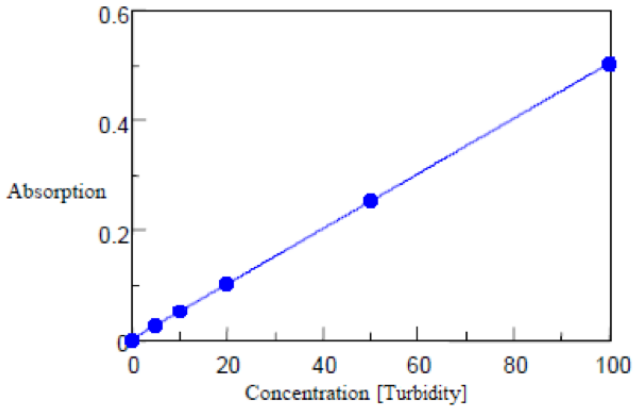

Figure 2. Turbidity calibration curve.

Table 2. Turbidity calibration curve results.

Concentration (Turbidity)	Absorbance	Calculated Chromaticity
0	0.000	-0.27
5	0.026	4.81
10	0.052	10.07
20	0.102	20.09
50	0.256	50.64
100	0.502	99.67

The blank and standard solutions were then diluted in purified water to the final concentrations listed in Table 4 and measured using a 20 mm pathlength cell and an integrating sphere to obtain the diffuse transmittance. A standard white diffuser plate was first mounted in the integrating sphere and the total light (T_t) at 660 nm was measured. The plate was then removed and the diffuse transmittance (T_d) of the sample can then be measured.

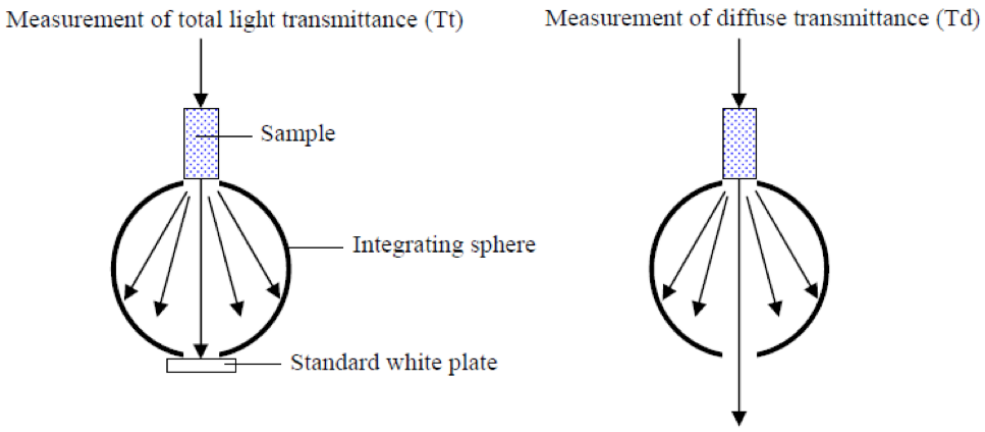

Figure 3. Diffuse transmittance measurement using the integrating sphere.

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The turbidity is calculated from the diffuse transmittance results and are shown in Table 4, along with the calibration curve shown in Figure 4. The standard deviation is calculated as 0.08 degree, the detection limit as 0.28, and the quantitation limit as 0.86 degree. A 50 mm light pathlength rectangular cell is recommend to be used for the analysis of low turbidity samples with concentrations close to or less than the quantitation limit.

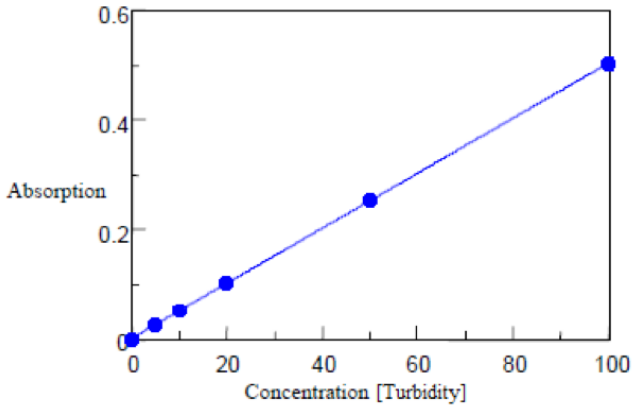

Figure 4. Turbidity calibration curve from diffuse transmittance measurements.

Table 4. Turbidity calibration curve results.

Concentration (Turbidity)	T_d/T_t x 100	Quantitative Value (Turbidity)
0	0.004	-0.05
0.5	0.389	0.50
1	0.726	0.98
2	1.435	1.99
5	3.666	5.17
10	7.003	9.92

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