

## Chromaticity and turbidity quantitative measurement

In this Application Note, the method for measurement of chromaticity and turbidity using UV/Vis spectrophotometer based on clean water test method will be described.

### <Chromaticity>

Chromaticity measurement is to check the coloration degree of clean water and wastewater using humic acid. This test is applied by observing the absorption at 390 nm which shows the yellow color of humic acid by using UV/Vis spectrophotometer.

### Measurement/analysis system

- V-630/650/660/670                      UV/Vis spectrophotometer
- LSE-701                                      Long path cell holder
- VWWQ-789                                  Chromaticity/turbidity measurement program
- Rectangular cell, 50 mm or 100 mm



### Standard sample

Cobalt chloroplatinate which has a color similar to yellow-brown of humin is used as standard sample for chromaticity. 2.49 g of Potassium chloroplatinate and 2.02 g of cobalt chloride are dissolved in 200 mL of hydrochloric acid, and then purified water is added to make the solution of total volume 1 L. This solution is neat standard sample with chromaticity 1000 degree.

### Test method

Measuring the absorbance of sample in cell of 50 mm or 100 mm pathlength at the wavelength of 390 nm

### Procedure

1. Standard solution is prepared from neat standard sample diluted by purified water. Blank sample is purified water filtrated using 0.2 μm membrane filter.
2. Chromaticity calibration curve is created from the measurement results of blank sample and standard solution prepared in 1.
3. Sample water is filtrated using membrane filter or centrifuged and the supernatant is used as sample.
4. The absorption of sample prepared in 3 at 390 nm is measured, and chromaticity is calculated from the results and calibration curve.

### Calibration curve

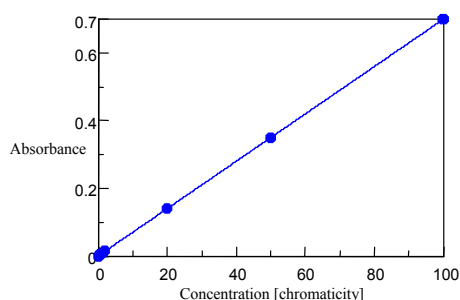


Figure 1. Chromaticity calibration curve

Table 1. Chromaticity calibration curve

| Concentration [chromaticity] | Absorbance | Quantitative value [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                             |

Standard solutions with chromaticity at 0, 0.5, 1, 2, 20, 50, 100 degree were measured using 50 mm light pathlength cell and these results are shown in the center column of Table 1. Measured absorbance values are input to the calibration curve and the calculated quantitative values of chromaticity are shown in the right column of Table 1. From the above results, the standard deviation ( $\sigma$ ) between the obtained quantitative value and actual chromaticity is 0.04(6) degree, detection limit, 0.15 and quantitation limit, 0.46 degree. <sup>\*1)</sup>

<sup>\*1)</sup> Detection limit is calculated from  $3.3\sigma$  and quantitative limit is calculated from  $10\sigma$ .

Calibration curve information:  $y = 0.0070x + 0.0004(5)$

$R^2 = 1.0000$

## <Turbidity>

In turbidity measurement, the turbidity degree due to insoluble particles, microbe and organic substance in clean water and wastewater is tested. Scattering light at 660 nm is measured using UV/Vis spectrophotometer in transmission measurement method or integrating sphere photoelectric spectrophotometry.

### Standard sample

Immixture polystyrene suspension is used as standard sample of turbidity. Mixture of 5 kinds of polystyrene particles shown in the Table 2 is stated as neat solution of turbidity at 100 degree, which is commercially available.

Table 2. Polystyrene standard particle of turbidity at 100

| Category | Normal diameter (μm) | Mixture ratio (%) |
|----------|----------------------|-------------------|
| No. 6    | 0.5                  | 6                 |
| No. 7    | 1                    | 17                |
| No. 8    | 2                    | 36                |
| No. 9    | 5                    | 29                |
| No. 10   | 10                   | 12                |

### [Transmission measurement method]

#### Measurement/analysis system

- V-630/650/660/670 UV/Vis spectrophotometer
- LSE-701 Long path cell holder
- Quantitative measurement program
- Rectangular cell, 20 mm 50 mm and 100 mm

### Procedure

1. Neat sample solution is diluted by purified water and prepared as standard solution. Purified water filtrated using 0.2 μm membrane filter is used as blank sample.
2. Turbidity calibration curve is created from the measurement results of blank sample and standard solution prepared in 1.
3. The absorbance of sample water at 660 nm is measured, and turbidity is calculated from the results and calibration curve.

### Calibration curve

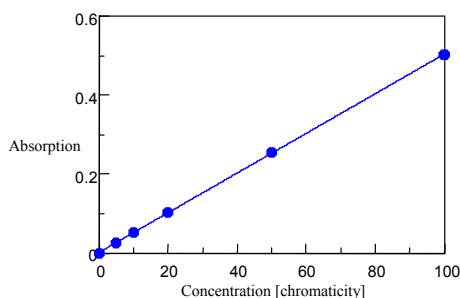


Figure 2. Turbidity calibration curve (Transmission measurement method)

Table 3. Turbidity calibration curve (transmission measurement method)

| Concentration [turbidity] | Absorbance | Quantitative value [turbidity] |
|---------------------------|------------|--------------------------------|
| 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                          |

Standard solutions with turbidity at 0, 5, 10, 50, 100 degree were measured using 20 mm light pathlength cell and the results are shown in Table 3. By the same method as chromaticity, the standard deviation is calculated as 0.36 degree, detection limit as 1.18 and quantitation limit as 3.6 degree.

Calibration curve information:  $y = 0.0050x + 0.0014$

$R^2 = 1.0000$

## [Integrating sphere photoelectric spectroscopy]

### Measurement/analysis system

V-650/660/670                      UV/Vis spectrophotometer  
 ISV-722/ISN-723                  Integrating sphere unit  
 VWWQ-789                          Chromaticity/turbidity measurement program  
 Rectangular cell, 10 mm, 20 mm, 30 mm and 50 mm



ISV-722/ISN-723 Integrating sphere unit

### Procedure

1. Standard solution is prepared from neat standard sample diluted by purified water. Blank sample is purified water filtrated using 0.2 μm membrane filter.
2. Turbidity calibration curve is created from the measurement results of blank sample and standard solution prepared in 1. Firstly, standard white plate is mounted in integrating sphere and total light transmittance (Tt) is measured, and then the plate is removed and diffuse transmittance (Td) is measured.
3. Tt and Td of sample water at 660 nm is measured, and turbidity is calculated from the results and calibration curve.

(1). Measurement of total light transmittance (Tt)      (2). Measurement of diffuse transmittance (Td)

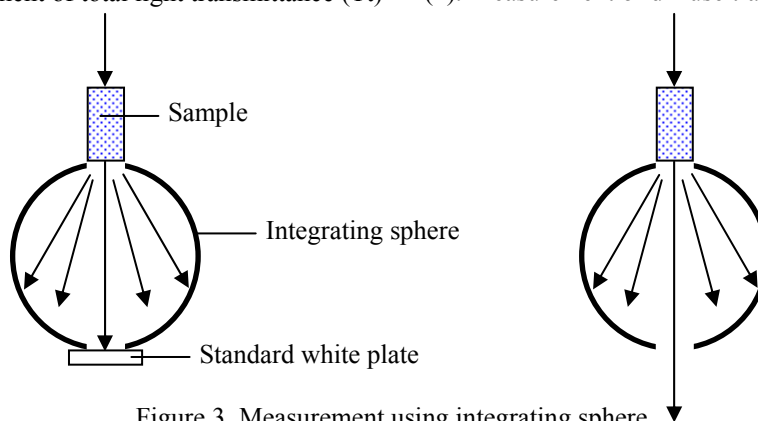


Figure 3. Measurement using integrating sphere

### Calibration curve

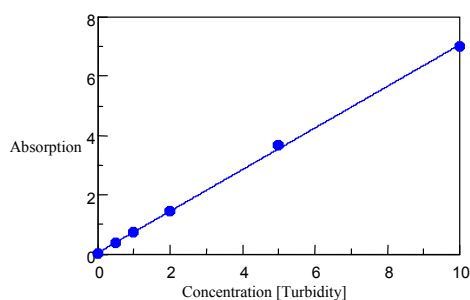

 Figure 4. Turbidity calibration curve  
 (integrating sphere photoelectric spectroscopy)

 Table 4. Turbidity calibration curve  
 (Integrating sphere photoelectric spectroscopy)

| Concentration<br>[turbidity] | Td/Tt x 100 | Quantitative value<br>[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                              |

Standard solutions with turbidity at 0, 0.5, 1, 2, 5, 10 degree were measured using 20 mm light pathlength cell and the results are shown in Table 4. From the calibration curve, the standard deviation is calculated as 0.08(6) degree, detection limit as 0.28 and quantitation limit as 0.86 degree. <sup>\*2)</sup>

<sup>\*2)</sup> 50 mm light pathlength rectangular cell is recommend to be used for the analysis of low turbidity sample with concentration close to or less than quantitation limit .

Calibration curve information:  $y = 0.7018x + 0.0397$        $R^2 = 0.9997$

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