

Introduction of Haze value measurement system for UV/Vis spectrophotometer

Introduction

Haze value is an indicator to show fogged degree of samples and recently is often used to evaluate the transparency and diffuseness of touch panel and solar cell materials.

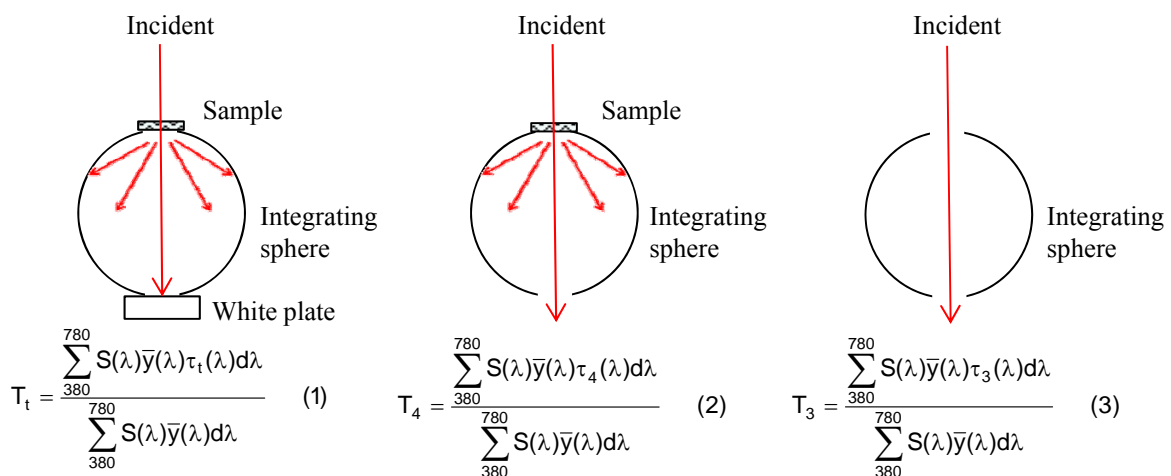
In this application note, the measurement method of Haze value and total light transmittance, and measurement of Haze value in diffuser panels are reported. Measurement methods on JIS, ISO, and ASTM applied to the UV-visible spectrometer in this application.

Keyword: Haze, Total transmittance, Diffuse transmittance, JIS K 7105, JIS K 7361-1, JIS K 7136, ISO 14782, ISO 13468-1, ISO 13468-2, ASTM D1003-11

Measurement Method

With using integrating sphere, total transmittance (T_t), sample diffusion rate (T_4) and scattering rate (T_3) which is required to calibrate the diffusion by instruments are measured in the wavelength range from 380 to 780 nm (figure 1). Using equation (4) provides the diffuse transmittance (T_d) of sample, and Haze value can be calculated by the ratio between T_t and T_d (equation (5)).

- (1) Total light transmittance (T_t) (2) Sample diffusion (T_4) (3) Instrument diffusion (T_3)



$$T_t = \frac{\sum_{380}^{780} S(\lambda)\bar{y}(\lambda)\tau_t(\lambda)d\lambda}{\sum_{380}^{780} S(\lambda)\bar{y}(\lambda)d\lambda} \quad (1)$$

$$T_4 = \frac{\sum_{380}^{780} S(\lambda)\bar{y}(\lambda)\tau_4(\lambda)d\lambda}{\sum_{380}^{780} S(\lambda)\bar{y}(\lambda)d\lambda} \quad (2)$$

$$T_3 = \frac{\sum_{380}^{780} S(\lambda)\bar{y}(\lambda)\tau_3(\lambda)d\lambda}{\sum_{380}^{780} S(\lambda)\bar{y}(\lambda)d\lambda} \quad (3)$$

$\tau_t(\lambda), \tau_3(\lambda), \tau_4(\lambda)$: Transmittance spectrum in each measurement

$S(\lambda)$: Spectral characteristics of light source

$\bar{y}(\lambda)$: Luminosity factor

Fig.1 Image of Haze value measurement

Diffuse transmittance (T_d):

$$T_d = T_4 - T_3 \left(\frac{T_t}{100} \right) \quad (4)$$

Haze value:

$$\text{Haze} = \frac{T_d}{T_t} \quad (5)$$

Sample

Six quartz diffuser panels.



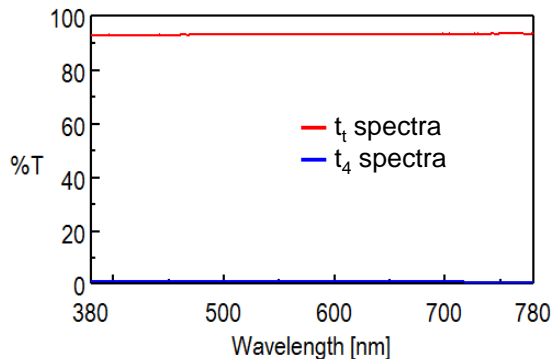
Measurement Results

The spectrum of total light transmittance (τ_t) and of sample diffusion rate (τ_d) are shown in figure 3. The calculated Haze value is shown in table 1.

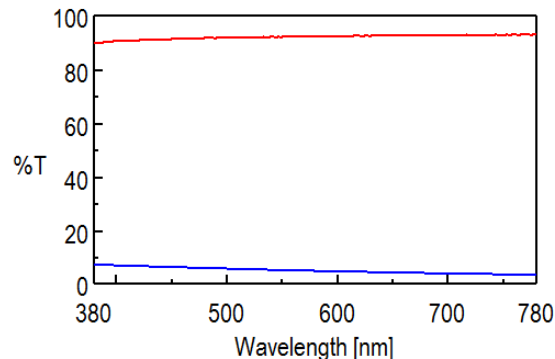
As shown in the figure and the table, the difference of fog degree between 3 and 4, 5 and 6 are distinguish clearly.

As result, in this system, the fogged degree of samples which is difficult to be detected by visual observation can be evaluated by numerical value.

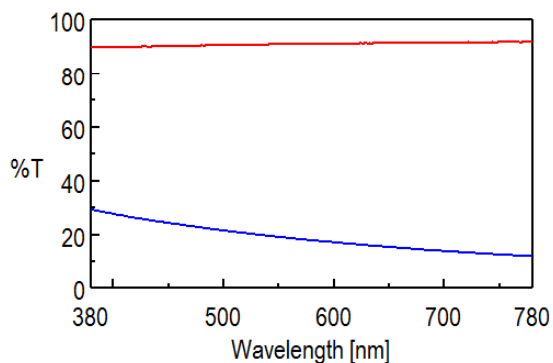
So, this system can be effective to comparison of products or control of quality.



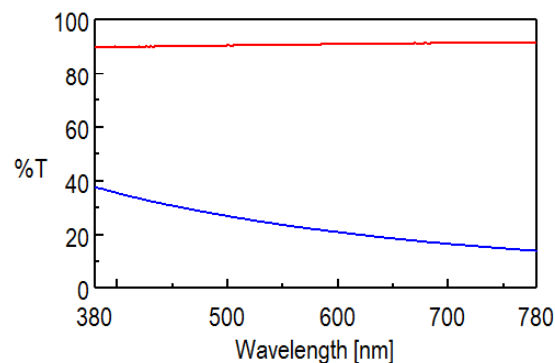
Sample 1



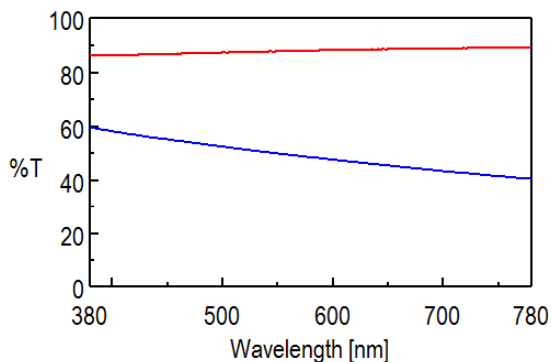
Sample 2



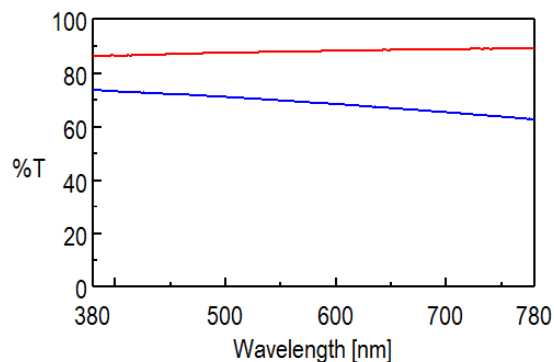
Sample 3



Sample 4



Sample 5



Sample 6

Fig.3 Transmittance spectrum of six plate samples

Table1 Calculation results of Haze value

No.	T ₃ [%]	T _t [%]	T ₄ [%]	T _d [%]	Haze[%]
1	0.08	93.06	0.71	0.63	0.7
2	0.08	92.13	4.94	4.86	5.3
3	0.08	90.88	18.7	18.62	20.5
4	0.08	90.7	23.12	23.04	25.4
5	0.08	87.75	69.34	69.27	78.9
6	0.08	85.46	70.56	70.49	82.5

Measurement Condition

Band width 5.0 nm
Response 0.24 sec

Scan speed 400 nm/min
Data interval 1 nm

Calculation Condition

Light source D65
View angle 2°

Color-matching function JIS Z 8781-1