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Color Measurement Procedure for PET Resins

1. PRINCIPLE

The color of the sample is measured from crystallized chips by a reflection measurement using a spectrophotometer with a measuring geometry of $45^\circ/0^\circ$ (illumination at 45° /observer 0°) with standard illumination C/ 2° (daylight/standard observer 2°).

As result of the measurement, three coordinates X, Y, Z of a three-dimensional color space are obtained. From these values the color numbers L, a, b (Hunter) or L^* , a^* , b^* (CIELAB) or other color values can be calculated.

2. EQUIPMENT

Spectrophotometer for reflective measurements, measuring geometry: $45^\circ/0^\circ$
Glass plate, circular, fitted for the measuring field
Standard plate
Measuring cup, glass
General equipment for analytical work

3. PROCEDURE

Fill the ground material into a clean measuring cup. Remove possible hollow spaces by tapping the bottom of the cup against a cork or plastic pad.

Place the measuring cup with the sample on the measuring field of the spectrophotometer and start the measuring.

Measure the L, a, b (Hunter) values and read the results from the screen.

Turn the sample on the measuring field and measure again. Instead of this the sample can also be refilled into the measuring cup. Take at least five measurements from each sample.

When operating the instrument continuously the instrument calibration has to be repeated at least once a day. Otherwise the calibration has to be done before each series of measurements.

4. CALCULATION

Average the results of the single measurements and report the color values with one decimal.

The basic equations for the calculation of L, a, b colour values, Yellowness and Whiteness Indices are:

L, a, b (Hunter):

$$L = 10 \cdot \sqrt{Y}$$

$$a = \frac{17.5}{\sqrt{Y}} \cdot (1.02 \cdot X - Y)$$

$$b = \frac{7.0}{\sqrt{Y}} \cdot (Y - 0.8467 \cdot Z)$$

L*, a*, b* (CIELAB):

$$L^* = 116 \cdot \sqrt[3]{\frac{Y}{100}} - 16$$

$$a^* = 500 \cdot \left(\sqrt[3]{\frac{X}{98.07}} - \sqrt[3]{\frac{Y}{100}} \right)$$

$$b^* = 200 \cdot \left(\sqrt[3]{\frac{Y}{100}} - \sqrt[3]{\frac{Z}{118.22}} \right)$$

Yellowness Index according to ASTM D 1925:

$$YI = 100 \cdot \frac{1.277 \cdot X - 1.06 \cdot Z}{Y}$$

Whiteness Index according to ASTM E 313-73:

$$WI = 3.3877 \cdot Z - 3 \cdot Y$$

Please let me know if you have further questions.

Thank you,

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“Source of PET Resin to the Sheet Industry”