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Relative Color Strength of Dyes in Solution

Established in 1998 by AATCC Committee RR98; under jurisdiction of AATCC Committee RA36; reaffirmed 1999, 2005; editorially revised and reaffirmed 2000, 2011; editorially revised 2010; revised 2017. Technically equivalent to ISO 105-Z10.

1. Purpose and Scope

1.1 This is a test method to determine the color strength of a dye sample relative to a reference dye by means of spectrophotometric transmittance measurements on solutions of each. It is a comparison of the color strength of the dyes in a chosen solvent which may or may not correspond to strengths when applied to a textile substrate.

1.2 To be valid as a measurement of the relative color strength of a dye for a particular textile end-use, additional tests must be performed to demonstrate that the relative strength in solution is equal to the relative strength when applied to the textile substrate (see 5.4).

1.3 The test is often used by dye manufacturers and users because of its speed, repeatability and reproducibility.

2. Principle

2.1 Solutions of the test dye and the reference dye are prepared in known concentrations and their transmittance values are determined using a spectrophotometer. The relative color strength for the test dye is then calculated using absorbance and concentration values.

3. Terminology

3.1 **absorbance**, *n.*—the logarithm to the base 10 of the reciprocal of transmittance.

NOTE: Absorbance is proportional to the mass of absorbing material in the path length of a spectrophotometer cell (syn: *absorbance value*).

3.2 **color strength**, *n.*—a measure of the ability of a dye to impart color to other materials.

NOTE: Color strength is evaluated by light absorption in the visible region of the spectrum (see 13.1).

3.3 **relative color strength**, *n.*—*in spectrophotometric testing of dyes*, the percentage of the color strength of a sample relative to that of a reference dye assigned a color strength of 100% (see 10.2).

3.4 **transmittance**, *n.*—*of light*, that fraction of the incident light of a given wavelength which is not reflected or absorbed, but passes through a substance.

NOTE: In this test, the transmittance of the material is measured on a spectrophotometer, and corrected for that of pure solvent for the same path length.

4. Safety Precautions

NOTE: These safety precautions are for information purposes only. The precautions are ancillary to the testing procedures and are not intended to be all inclusive. It is the user's responsibility to use safe and proper techniques in handling materials in the test method. Manufacturers MUST be consulted for specific details such as material safety data sheets and other manufacturer's recommendations. All OSHA standards and rules must also be consulted and followed.

4.1 Good laboratory practices should be followed. Wear safety glasses in all laboratory areas.

4.2 All chemicals should be handled with care.

4.3 Use chemical goggles or face shield, impervious gloves, and an impervious apron during dispersing and mixing of acids, alkalis and organic solvents. Concentrated acids, alkalis and organic solvents should be handled in a well ventilated hood. CAUTION: Always add acid to water.

4.4 Acetone, methyl alcohol and ethyl alcohol are highly volatile liquids and should be stored in the laboratory only in small containers away from heat, open flames and sparks. These chemicals should not be used near an open flame.

4.5 Cellosolve (2-ethoxyethanol) is combustible and may be harmful or fatal if ingested or inhaled. It is also a reproductive hazard and should only be used when absolutely necessary.

4.6 An eyewash/safety shower should be located nearby and an organic vapor respirator and a self contained breathing apparatus should be readily available for emergency use.

4.7 Exposure to chemicals used in this procedure must be controlled at or below levels set by government authorities [e.g., Occupational Safety and Health Administration's (OSHA) permissible exposure limits (PEL) as found in 29 CFR 1910.1000; see web site: www.osha.gov for latest version]. In addition, the American Conference of Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) comprised of time weighted averages (TLV-TWA), short term exposure limits (TLV-STEL) and ceiling limits (TLV-C) are recommended as a general guide for air contaminant exposure which should

be met (see 14.1).

5. Uses and Limitations

5.1 This method is not applicable to all dyestuffs; e.g., pigments, due to solubility and/or other limitations. Dyes that are commonly measured include acid, basic, direct and disperse. Many reactive dyes are not easily measured using this procedure (see 5.4).

5.2 Basic requirements for this method are that the dye solutions do not scatter light and do obey the Lambert-Beer or Beer-Bouguer Laws as well as having identical or similar absorption curves of the samples and the reference dyes in the visible region of the spectrum (see 13.9).

5.3 Identical or similar absorption curves are usually obtained if the tests are carried out for the purpose of dye production control of batches/deliveries of the same dye. This method is not applicable for the evaluation of dyes with distinctly different hues or strengths greater than 20% or chemical compositions.

5.4 The method may be useful in the prediction of relative dye strength in process applications; e.g., dyeing. It is generally accepted that some reasonable correlation can be obtained between application and solution measurements. Exceptions occur where there is a significant difference in the relative amount of colored but non-exhausting or non-fixing impurities between the specimen under test and the reference dye; e.g., reactive dyes. Exceptions may also occur for some reactive dyes which exhibit shade differences between their hydrolyzed and unreacted forms (see additional caution for reactive dyes in 8.3.3).

5.5 As the relative color strength is determined by a comparison with a reference dye, the reference dye is assumed to remain constant. It is essential, therefore, to ensure careful storage and control of the reference dye. Many dyes are hygroscopic and sensitive to oxidation. Protect the reference dye from exposure to light in firmly sealed containers that are impervious to moisture.

6. Apparatus and Materials

6.1 Flasks, volumetric Class A, TC.

6.2 Pipettes, volumetric Class A, TD.

6.3 Analytical balance with accuracy of weighing to 0.0005 g.

6.4 Cells for spectrophotometers, 5 mm or 10 mm path length as needed, analytical grade or optical quality. May be cuvette or flow-through cell. (Note: the