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Diffuse opacity of paper (*d*/0 paper backing)

1. Scope

1.1 This method provides a measure of diffuse opacity (paper backing) of white and near-white papers, previously known as “printing opacity.”

1.2 The method may be employed for colored papers on condition that their reflectance (paper backing) is greater than 20% and their diffuse opacity (paper backing) is greater than 45% (1).

1.3 The method is not suitable for highly transparent papers such as glassine.

1.4 This method employs *d*/0 geometry, illuminant C, and paper backing whereas TAPPI T 425 “Opacity of Paper” employs 15/*d* geometry, illuminant A, both 89% reflectance backing and paper backing.

1.5 This method is similar to ISO 2471.

2. Summary

Diffuse opacity, expressed as a percentage, is given by the ratio of the diffuse luminous reflectance factor of a single sheet with black backing (Y_0) to that with a backing consisting of a pad of the same paper (Y_∞), multiplied by 100, i.e., $(100 \times Y_0 / Y_\infty)$.

NOTE 1: Light absorption coefficients K and light scattering coefficients S may also be determined from these reflectances if either the grammage of a sheet or its thickness is known (2,3).

3. Significance

3.1 This method indicates the extent to which a single sheet of paper hides (obscures) printed matter on underlying sheets of similar paper.

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3.2 This method should not be confused with the opacity, white backing (TAPPI T 425) method, which assesses different optical properties (see section 15.3).

4. Definitions

4.1 *Diffuse luminous reflectance factor.* The diffuse luminous reflectance factor is the ratio of the luminous flux from a body diffusely illuminated (and viewed by the CIE 1931 standard colorimetric observer) to the luminous flux from the perfect diffuse reflector, identically illuminated and viewed.

4.2 *Diffuse luminous reflectance factor, Y_0 .* The diffuse luminous reflectance of a single sheet backed with a black cavity.

4.3 *Diffuse luminous reflectance factor, Y_∞ .* The diffuse luminous reflectance factor of a pad thick enough such that doubling its thickness does not affect its reflectivity.

4.4 *Diffuse opacity (paper backing) of paper.* The diffuse opacity (paper backing) of paper is the ratio, expressed as a percentage, of the diffuse reflectance factor, Y_0 to the diffuse reflectance factor, Y_∞ , of the same paper, both values being measured with a reflectance meter or spectrophotometer in accordance with this method.

5. Apparatus

5.1 *Reflectance meter or spectrophotometer*¹, an instrument having the same geometric, photometric, and spectral characteristics described in Appendix A.1.

5.2 *Matched filters or equivalent device for modifying the spectral characteristics of the optical system,* providing the measuring instrument with an overall response equivalent to the CIE tristimulus value, Y , for CIE (1931) standard illuminant C, 2° standard observer.

5.3 *UV-cutoff filters,* required for instruments with strongly UV-emitting light source(s) to be interpositioned between the light sources and the d/0 integrating sphere to avoid the occurrence of UV-excited fluorescence in the $Y(\lambda)$ spectral region from papers treated with fluorescent agents.

5.4 *Standard black cavity,* consisting of a cylindrical hollow body lined with black velvet or similar material, having a luminous reflectance less than 0.5%.

5.5 *Reference Standard,* traceable to IR2 or IR3 as described in Appendix A.2.

5.6 *Two working standards,* one for control purposes and one for regular use, calibrated in advance for luminous reflectivity against a reference standard supplied by an approved laboratory, as described in Appendix A.2.

6. Sampling

Sample representative test specimens in accordance with TAPPI T 400 “Sampling and Accepting a Single Lot of Paper, Paperboard, Fiberboard, or Related Product.”

7. Preparation of test specimens

7.1 From each test unit, cut rectangular specimens about 75 × 150 mm, free of watermarks, creases, dirt, holes, or other imperfections.

7.2 Place specimens in a stack with top sides up. Form a pad (stack) of such thickness that doubling the number of sheets does not affect the reflectance factor of the pad. Condition all test specimens.

NOTE 2: If the top side can be distinguished from the wire side (TAPPI T 455 “Identification of Wire Side of Paper”), turn the top side uppermost. If this distinction cannot be made, as may be the case for papers manufactured on double wire machines or for papers coated on both sides, turn the same side of all sheets in the pad upwards to ensure that diffuse opacity values can be evaluated separately for each side of the paper.

7.3 Protect the pad with additional specimen sheets on the top and bottom.

7.4 Avoid contamination and exposure to light and heat of both specimens and pad (specimen stack).

¹ Names of suppliers of testing equipment and materials for this method may be found on the Test Equipment Suppliers list, available as part of the CD or printed set of Standards, or on the TAPPI website general Standards page.