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Opacity of paper using 45°/0° geometry reflectometer

Scope

The object of this method is to determine paper opacity by measuring the ratio of the reflectance of paper backed by black and white using an instrument equivalent to the geometry of the TAPPI brightness measurement instrument. Approximate TAPPI opacity is measured by contrast ratio of the specimen reflectance backed by a black cavity to white backing of 89%. The term “approximate” is used to differentiate the TAPPI opacity measured with this procedure to the TAPPI opacity measured using an instrument that conforms to the measurement of opacity as specified in the geometry in T 425 “Opacity of paper (15/d geometry, illuminant A/2o, 89% reflectance backing and paper backing).”

NOTE 1: Institute of Paper Chemistry (now Institute of Paper Science and Technology at Georgia Tech) Instrumentation Report 22, Part V, “Comparison of Printing Opacity Determined with Several Instruments [Tappi 53 (3): 436 (1970)] shows that the differences related to the changes in geometry are small in all cases; the differences related to the change in illuminant are small for white papers.

Safety precautions

There are no particular safety precautions for this method.

Definitions

1. *Approximate TAPPI opacity, C_W* , is defined for this Useful Method as 100 times the ratio of the diffuse reflectance, R_B , of a single sheet backed with black surface, or cavity, of not more than 0.005 reflectance, to the diffuse reflectance, R_W , of the same sheet backed by a standard white surface of diffuse absolute reflectance of 0.89; $C_W = 100 (R_B / R_W)$.

Approved by a Working Group of TAPPI in accordance with the Useful Method Guidelines

2. *Printing opacity*, C_p , is defined for this Useful Method as 100 times the ratio of the diffuse reflectance, R_B , of a single sheet backed with a black surface, or cavity, of not more than 0.0005 reflectance, to the diffuse reflectance, R_p , of the same sheet backed by a pad of the same paper; $C_p = 100 (R_B / R_p)$.

Apparatus

1. *Reflectometer*, 45°/0° geometry, in which the green tristimulus filter is at the photodetector. The y (green) spectral function must be spectrally adjusted to closely simulate the CIE y function with CIE illuminant C . Instruments meeting the requirements of T 542 “Color of Paper and Paperboard (45°/0° geometry)” when used with the green (y) filter meet the requirements of this UM.
2. *Standard black backing*, consisting of a cavity lined with black velvet or other material which will cause the reflectance of a 63.5-mm (2.5-in.) diameter window in the cavity to be not more than 0.005. The inside dimensions of the cavity are to be large enough to cover the measurement area of the instrument used.
3. *Standard white backing*, having an absolute reflectance equal to 0.89.

Test specimens

From each sample obtained in accordance with TAPPI T 400 “Sampling and Accepting a Single Lot of Paper, Paperboard, Containerboard, or Related Product,” cut test specimens, free from watermarks or blemishes and of sufficient size to completely cover the standard backings. Do not touch the test areas with the fingers, and keep these areas perfectly clean and free from fold or wrinkles.

Conditioning

Condition the specimens in an atmosphere in accordance with TAPPI T 402 “Standard Conditioning and Testing Atmospheres for Paper, Board, Pulp Handsheets, and Related Products.”

Calibration

Follow instrument manufacturer’s instructions for warmup and calibration.

Procedure

1. *Approximate TAPPI opacity*, $C_{0.89}$. Insert one specimen in front of the standard white backing, and measure the R_w value, then place the same specimen over the black surface and measure the R_E value. Calculate the approximate TAPPI opacity, repeat as required.
2. *Printing opacity*, C_p . Insert a pad of specimens so thick that adding additional pieces will not change observed reflectance. (Usually a pad of 10 sheets is thick enough.) Read reflectance of pad (R_p) by usual procedure. Then insert one sheet in front of the black cavity and read the reflectance (R_B) by the usual reflectometer procedure. Calculate the printing opacity, repeat as required.

Report

1. *Approximate TAPPI opacity*. Where separate results are desired for felt and wire sides, or for machine and cross-machine directions, the readings for these separate conditions should be so segregated. For average opacity, however, readings for both sides of the paper and both directions must be averaged. From these averages, compute $C_w = 100 (R_B / R_w)$. Report as approximate TAPPI opacity.
2. *Printing opacity*. Where separate results are desired for felt and wire sides, or for machine and cross-machine directions, segregate the readings for these separate conditions. For average opacity, however, results from