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WORKING GROUP
CHAIRMAN _____ Dennis Crawshaw _____

SUBJECT
CATEGORY _____ Pulp Properties _____

RELATED
METHODS _____ See "Additional Information" _____

CAUTION:

This Test Method may include safety precautions which are believed to be appropriate at the time of publication of the method. The intent of these is to alert the user of the method to safety issues related to such use. The user is responsible for determining that the safety precautions are complete and are appropriate to their use of the method, and for ensuring that suitable safety practices have not changed since publication of the method. This method may require the use, disposal, or both, of chemicals which may present serious health hazards to humans. Procedures for the handling of such substances are set forth on Material Safety Data Sheets which must be developed by all manufacturers and importers of potentially hazardous chemicals and maintained by all distributors of potentially hazardous chemicals. Prior to the use of this method, the user must determine whether any of the chemicals to be used or disposed of are potentially hazardous and, if so, must follow strictly the procedures specified by both the manufacturer, as well as local, state, and federal authorities for safe use and disposal of these chemicals.

Dirt in pulp – chart method
(Five-year review of Official Method T 213 om-15)
(Suggested changes have been incorporated)

1. Scope

1.1 This method (1,2) is adapted to the numerical estimation of dirt in pulp and recycled pulp in terms of equivalent black area.

1.2 The results will differ from those obtained by TAPPI T 246 "Foreign Particulate Matter in Pulp by Transmitted Light" (now withdrawn) in that it is the contrasting color of foreign matter rather than its opaqueness that affects the result.

1.3 An automated procedure for dirt count can be found in TAPPI T 563 "Equivalent Black Area (EBA) and Count of Visible Dirt in Pulp, Paper, and Paperboard by Image Analysis." Both this procedure and T 563 are based on Equivalent Black Area (EBA) measurement.

2. Significance

2.1 This method provides a test for estimating the amount of dirt in pulp including recycled pulps to help the mill meet its needs for production of fine or other speck-free papers.

2.2 The estimated equivalent black area of a gray or colored speck is smaller than its actual area, in inverse proportion to the intensity of its color contrast with its background. Thus, the equivalent black area of a black spot in a nonbleached pulp would be considerably smaller than its actual area because its appearance would not be as pronounced as it would be if it were in a white pulp.

3. Definitions

3.1 *Dirt* is defined as foreign matter in a sheet which, when examined by reflected, not transmitted light, has a marked contrasting color to the rest of the sheet and has an equivalent black area (see 3.2) of 0.04 mm² or more.

3.2 *Equivalent black area (EBA)* of a dirt speck is defined as the area of a round black spot on a white background of the TAPPI Dirt Estimation Chart which makes the same visual impression on its background as does the dirt speck on the particular background in which it is embedded.

4. Apparatus

4.1 *Dirt Estimation Chart*¹ (see Fig. 1). The actual chart is a photograph approximately 3½ in. × 5 in. (89 mm × 127 mm) of a series of round black spots of various areas on a white background such that using an instrument and method in accordance with TAPPI T 452 “Brightness of Pulp, Paper, and Paperboard (Directional Reflectance at 457 nm)” the reflectance of the white background is 81.5 ± 1.0% and that of the black dots is 2.4 ± 0.4%. In accordance with Graff’s findings (2) all the round spots on the present chart, except those listed, are correct to within 10% or 0.005 mm², whichever is the larger. For special accuracy, these designated areas should be changed to those given in parentheses: 1.00 (1.08); 0.80 (0.76); 0.60 (0.58); 0.40 (0.42); 0.30 (0.31); 0.25 (0.26); 0.20 (0.21); 0.15 (0.16); 0.10 (0.11); 0.09 (0.10). It is the same as for TAPPI T 437 “Dirt in Paper and Paperboard.” Only the round spots are used for the analysis.

4.1.1 Only the photographic dirt charts specified in Section 4 shall be used when performing the procedure in this test method. The use of any other type chart made by a process other than photographic, including all printing techniques including but not limited to electrostatic copy, ink jet, or laser jet on paper, or transparent bases and/or plastic-covered charts, do not comply with the requirements of this method and shall not be used.

4.1.2 Only the round spots on the chart are used for the analysis.

4.1.3 For highly precise work, the spot sizes can be measured microscopically and correction factors can be developed and used as indicated by Graff (2).

¹ Available for purchase from TAPPI.

4.2 *Illumination.* Lighting arrangements to give about 535 lm/m² (about 50 fc) of white or daylight light on the specimen. Since the light affects equally the appearance of both the dirt specks and the comparison spots on the charts, the intensity of illumination is not critical. For grooved pulp sheets, care should be taken to position the light source so that the pulp ridges do not cast shadows.

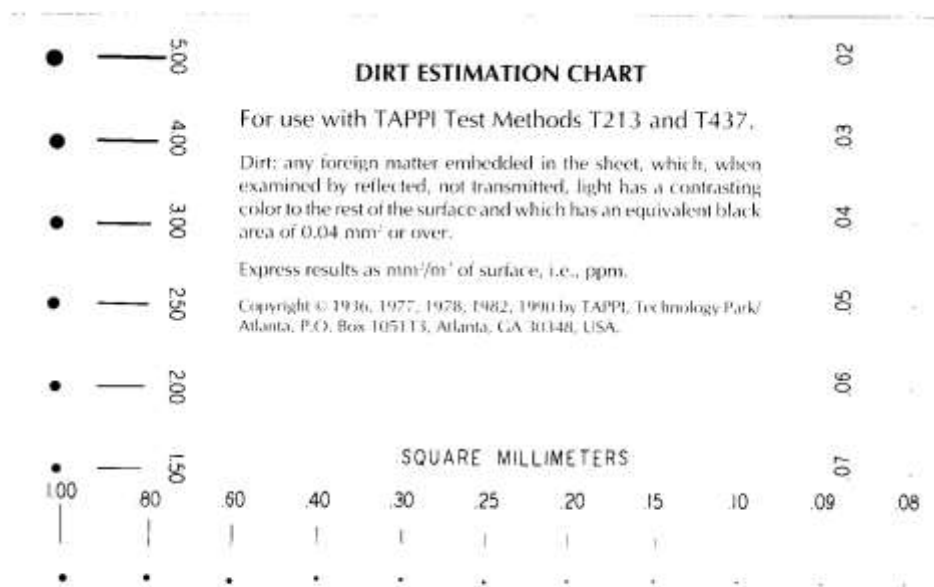


Fig. 1. Dirt Estimation Chart. ONLY use original printings of the chart provided by TAPPI for accurate results.

5. Sampling and test specimens

5.1 Obtain a sample selected in accordance with a predetermined sampling procedure.

5.1.1 *Sheets.* Select at least 10, preferably 20 or more, sheets; each sheet (specimen) having an exposed area on each side of a least 1500 cm². Sheets taken from the usual pulp bale are suitable.

5.1.2 *Disks.* Select a sufficient number of 75- or 100-mm (3- or 4-in.) diameter disks, one taken from each single bale of the shipment being tested for moisture with the boring method. Divide the disks into 10 groups, each group having a total exposed area of 570 or more cm². With disks, the lesser area is allowable because of more extensive sampling.

5.1.3 *Slush.* Take a sample and form into specimen sheets on a filter paper in a Büchner funnel or in a carefully cleaned sheet machine. Make a sufficient number of sheets with a grammage of at least 200g/m² so that they have an exposed area of at least 4000 cm² on both sides together. It is essential to take special care to clean thoroughly

all the sampling equipment and containers before use, and to use clean water. Dry the specimen sheets in any convenient manner, again taking great care to avoid contamination.

5.1.4 *Crumb*. Flash-dried or crumb-type pulp may be tested as slush pulp after slurring it with water. Provide just enough agitation to break up all stock lumps prior to forming sheets.

6. Procedure

6.1 *Clean pulp*

6.1.1 Examine both sides of the specimens in a dust-free place, preferably on a bench top covered with a large sheet of clean paper and after making sure that the hands are clean. View the pulp sheets at right angles to its general surface direction.

NOTE 1: This is particularly important for grooved pulp sheets since the sheet area is calculated by simple geometry and ignores the increased area of the sheets caused by the grooves. If the sheet and its dirt specks are viewed from an angle normal to the general surface direction of the sheet, the effect of the grooves tends to be canceled.

6.1.2 Carefully brush away any loose surface dirt specks. Check each remaining dirt speck that has an EBA of 0.04 mm^2 or larger. Record the EBA of each dirt speck in square millimeters. When estimating the EBA of a colored speck or a black speck on a white or colored sheet, proceed to select from the TAPPI Chart, with its white background, an appropriate black spot that is equally noticeable. If they have the noticeability or EBA, both the speck and the selected spot becomes indistinguishable at the same distance when moved away from the eyes or disappear together when observed through a film that scatters light slightly, that is, a film similar to a transparent glassine paper but more uniform.

NOTE 2: During the count, if an odd piece of dirt is encountered, which is obviously unusual, e.g., crushed insect or a blotch of dirt which is definitely determined as not being representative of the shipment (ascertained by looking over additional sheets), ignore it.

NOTE 3: A shive can be defined here as a dirt speck having an aspect ratio of at least 3 to 1. Shives may be counted as dirt specks if they are visible when viewed at an angle normal to the general direction of the pulp sheet, or they may be recorded separately if this information is needed.

6.2 *Dirty pulp*

6.2.1 If pulp is dirty and a variety of dirt specks are visible on the specimen sheets, the specks may be numerous enough to render tedious the examination of the required area of the sample. In such a case select a particular reference spot on the TAPPI Chart that has an EBA such that there will be on the average at least one such sized speck, or larger, to be found on each 500 cm^2 of the exposed surface of the specimens. (The size of reference spots selected might vary from 0.08 mm^2 for fairly clean pulp to 0.25 mm^2 or more for a dirty pulp.) Make a mask for a sheet of the

pulp approximately the color and size of the specimen sheets, having an opening at its center, or a corner cut away, of one-fifth of its area.

6.2.2 Examine both sides of the specimen in a dust-free place. View the pulp sheet at right angles to its general surface direction. See Note 1.

6.2.3 Without using the mask, carefully brush away loose surface dirt. Then check each remaining dirt speck that has an EBA equal to or greater than that of the reference spot selected. Record the EBA of each speck in square millimeters.

6.2.4 Using the mask, check each dirt speck on the exposed pulp surface that is smaller than the reference spot and equal to or greater than 0.04 mm^2 . Record the EBA of each dirt speck in square millimeters.

7. Calculations

7.1 *Clean pulp*

7.1.1 Using simple geometry, measure the total area of both sides of the specimen sheet and record as square meters. Ignore the increased sheet area caused by grooves. Total the EBA of the dirt specks on both sides and record in square millimeters. Calculate the total square millimeters of dirt per square meter of surface examined.

7.2 *Dirty pulp*

7.2.1 Using simple geometry, measure the total area of both sides of the specimen sheet and record as square meters. Calculate EBA of the dirt specks on both sides by totaling the EBA of the larger specks on the entire area examined and adding 5 times the EBA of the smaller specks observed in 6.2.4. Calculate the total square millimeters of dirt per square meter of surface examined.

8. Report

Report the average dirt in terms of the square millimeters of equivalent black area of dirt per square meter of surface examined, i.e., in parts per million, for both sides of the pulp sheets, to two significant figures. State the area and the number of specimen sheets examined.

9. Precision

9.1 The following estimates of precision are based on limited experience with three lots of pulp that had dirt levels ranging between 1 and $5 \text{ mm}^2/\text{m}^2$. These lots were tested on pulp sheets in four different laboratories.

9.2 Repeatability (within a laboratory) = 15%.

9.3 Reproducibility (between laboratories) = 90%.

9.4 These data are for relatively clean pulps. The method rapidly loses precision as the dirt count increases. The precision is poor because of differences in operator judgement. The technique is useful in spite of the poor precision.

10. Keywords

Dirt, Equivalent black area, Pulp

11. Additional information

11.1 Effective date of issue: To be assigned.

11.2 This method was revised in 1939, 1943, 1965, and 1977 when a statement of precision was added. The 2010 version clarifies the use of the chart in 4.1.1.

11.3 This test will take about 1.5 h to check both sides of 20 fairly clean pulp sheets (dirt level about 3 mm²/m²) cut as in 5.1.1.

11.4 Related methods: TAPPI T 437, T 563, ISO 5350-3.

References

1. Clark, James d'A., Von Hazmberg, R. S., and Knoll, R. J., "The Estimation of Dirt and Shives in Pulp and Paper," *Paper Trade J.* **96** (5): 40 (1933).
2. Graff, J. H., and Nihlen, E. K., "A Chart for the Estimation of Dirt in Pulp and Paper," *Tech. Assoc. Papers* **25**: 331 (1942); *Paper Trade J.* **114** (21): 61 (1942).

Your comments and suggestions on this procedure are earnestly requested and should be sent to the TAPPI Standards Department. ■