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T 218

BALLOT NO. 02 SARG

DRAFT NO. 01

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WORKING GROUP CHAIR To Be Determined

SUBJECT CATEGORY Optical 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 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.

Forming handsheets for reflectance testing of pulp (Büchner funnel procedure)

(Five-year review of Standard Practice T 218 sp-18: Approval of T218 Draft 1)

1. Scope

1.1 This practice describes the procedure using a Büchner funnel for preparing specimen sheets for reflectance testing of bleached or unbleached pulp whose fibers are readily dispersed in water. The sheets are made at a pH of 6.5 ± 0.5. This practice permits the preparation of sheets having a smooth and reproducible surface for reflectance measurements with a minimum of washing or contamination of the sample.

1.2 This TAPPI Standard Practice differs from other practices used in world trade in the manner in which sheets are pressed and dried. See Appendix.

1.3 TAPPI Standard Practice T 272 describes a procedure for using a sheet forming machine for making handsheets for the application. The purpose for having two methods is discussed in sections 4.3 and 4.4.

1.4 See Appendix for consideration of slow draining pulps and recycled pulps.

2. Applicable documents

2.1 TAPPI Official Test Methods referred to for parts of this procedure include: T 400 "Sampling and Accepting a Single Lot of Paper, Paperboard, Containerboard, or Related Product;" T 205 "Forming Handsheets for Physical Tests of Pulp;" and T 402 "Standard Conditioning and Testing Atmospheres for Paper, Board, Pulp Handsheets, and Related Products."

2.2 Reflectance testing on handsheets prepared by this method can be performed using TAPPI T 452 "Brightness of Pulp, Paper, and Paperboard (Directional Reflectance at 457 nm)" or TAPPI T 525 "Diffuse brightness of paper, paperboard and pulp (d/0) – ultraviolet level C."

2.3 TAPPI Standard Practice T 272 "Forming Handsheets for Reflectance Testing of Pulp (Sheet Machine Procedure)" differs from this method in the manner in which the sheets are made.

3. Summary

A properly selected specimen of the pulp to be evaluated is dispersed in a small volume of water, the pH of the slurry is adjusted to 6.5 ± 0.5, and the slurry is formed into a sheet in a Büchner funnel. The sheet is pressed and dried under controlled conditions to make a reproducible surface for reflectance testing.

4. Significance

4.1 The reflectance of a sheet composed of fibers is dependent on the structure of the surface and orientation of the fibers. Industrially made pulp sheets have a variety of structures and surface textures and may contain impurities removable in water. The dispersion of the pulp and the forming of a uniform sheet in a repeatable manner are therefore necessary for accurate testing *(1)*.

4.2 It is well established that the reflectance of pulps, particularly unbleached, is affected by pH *(2)*. Accordingly, this practice establishes a pH which will be an optimum for most pulps. If, however, reflectance must be measured at a specific pH, all water used in preparation of the sheets shall be appropriately adjusted and the deviation from the practice reported.

4.3 The procedure described in this practice for forming the sheets and the sheet machine described in Standard Practice T 272 may not produce equivalent results. The 150 mesh stainless steel wire screen of the sheet machine may result in the loss of fines which are frequently defined as being able to pass a 200 mesh screen. Stone groundwood, which contains a large percentage of fines, is particularly affected by the sheet machine. Dilution factors are different between the two procedures, and opposite sides of the sheets are tested depending upon how the sheet is

formed. Contamination could occur if the sheet machine were not made of stainless steel. This method includes precautions to prevent contamination of the pulp with color-causing materials during preparation of the sheets.

4.4 In selecting which of the Standard Practices to use, (T 218 or T 272), consider the drainage characteristics of the pulp. For example, recycled or low freeness pulps may require an unreasonable time to remove the excess water from the funnel (T 218) and the fibers may not be distributed evenly. In that case, the sheet machine practice (T 272) would be preferred.

4.5 The reflectance of a sheet prepared according to this procedure may not be the same as that of a sheet made from the same pulp under industrial papermaking conditions since pulp fines retention is different and no heat is used to dry the sheet.

5. Apparatus and reagents

5.1 *Disintegrator*[1], as described in TAPPI T 205, or a *high-speed mixer*[1] with two fixed ripple-edge stainless steel mixing blades on a stainless steel shaft and fitted with a square-shaped 1000-mL stainless steel canister[1].

NOTE 1: A disintegrator with a stainless steel paddle and shaft and canister made of stainless steel or plastic is preferred. It is essential, if an old model bronze disintegrator is used, that the interior of the canister, the paddle, and the shaft be chromium-plated or plastic-coated to prevent discoloration of the pulp.

NOTE 2: The high-speed mixer recommended is of the "malted-milk" type, not the "blender" type. For ease of cleaning, it should have fixed, ripple-edged blades rather than hinged blades. The canister is specially made to fit the mixer but is square because this shape is more efficient than the common round "malted-milk" can (Fig. 1).

5.2 *Balance*, capable of weighing to the nearest 0.2 g.

5.3 *Graduated vessels*, two calibrated 1000-mL glass cylinders or stainless steel cups.

5.4 *Filter paper*, sheets of smooth, rapid-draining, 150-mm white filter paper, free from soluble impurities; and any type of 185-mm white filter paper so long as it is free from water soluble impurities.

5.5 *Büchner funnel*, nominally 150 mm inside diameter with a smooth, coarse, fritted glass filtering disk.

NOTE 3: The use of a Büchner funnel with a perforated plate should be avoided because it can result in thin spots or pinholes, especially with fast-draining pulps.

5.6 *Suction flask*, 1500-mL or larger. For improved safety and convenience, a steel vacuum chamber with funnel ports is desirable.

5.7 *Water*, distilled or deionized, preferably at pH 6.0–7.0. The water should be tested for purity as follows:

5.7.1 Adjust 2000 mL of the water to pH 4.5 with alum and allow it to stand for 10 min.

[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.

5.7.2 Dip one piece of 150-mm filter paper into the water and remove it at once. Lay it on a blotter in the press referred to in 5.8.

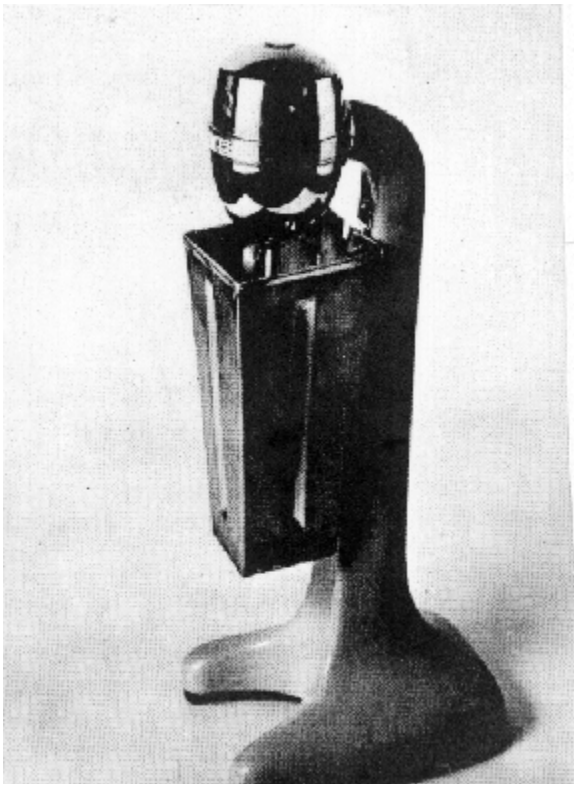

Fig. 1. High-speed mixer (alternate to disintegrator) showing special canister fitted to the mixer.

5.7.3 Using the Büchner funnel, filter the 2000 mL of water through another piece of the filter paper. Transfer this paper to another blotter.

5.7.4 Press and dry both filter papers as described in 8.3 and 8.4.

5.7.5 Determine brightness of both filter papers. The paper used to filter the water should not be more than 0.2% lower in brightness than the one merely dipped in the water.

5.7.6 Since colloidal particles may pass through a deionizing bed, deionized water should be filtered through a high-quality filter just before use. A vessel 100-150 mm in diameter packed to a depth of 50-80 mm with slurried high-brightness pulp* meets this requirement. If the vessel is transparent, the need for pulp replacement can be checked visually. * Verify that any pulp used to filter the deionized water contains no Optical Brightening Agents (OBAs).

5.8 *Pump and press with pressure gage*, as described in TAPPI T 205.

5.9 *Press template* (see T 205), for centering the sheets in the press.

5.10 *Drying rings* (see T 205), with rubber seatings for holding the sheets during drying.

5.11 *Drying plates* (see T 205), highly-polished chromium-plated sheet metal disks, 159 mm (6.25-in.)

diameter, and about 0.5 mm (0.020-in.) thick.

5.12 *Blotting paper* (see T 205), sheets of standard white non-fluorescent blotting paper. For pulp brighter than the blotters, sheets of similar pulp are useable as insurance against color transfer.

NOTE 4: Some blotters contain fluorescent material. The blotters used should be checked with an ultraviolet lamp to ascertain that such material either is absent or is not transferred to the test sheets.

5.13 *Acetic acid 10%.*

5.14 *Sodium hydroxide* (NaOH) approximately 0.1 *M*.

5.15 *pH meter*.

5.16 *Silicone-treated wiping cloth*, prepared by applying silicone oil to a lint free cotton cloth.

6. Sampling

6.1 Select a sample of the pulp in accordance with a previously determined sampling procedure. If the pulp is in dry sheet form, T 400 is applicable and recommended.

6.2 Since the optical properties of many pulps change significantly during the first few hours after manufacture, optical readings for control purposes should be taken at some definite interval after processing, which should be stated in the report. In any event, store pulp samples so that they are not subject to any of the following: contamination, a marked change in moisture content, or a significant influence of heat or light.

7. Test specimens

7.1 If the pulp is so dry that it will not readily disperse using the procedure given below, tear about 25 g into small pieces, soak in prepared water (see section 5.7) for at least 4 hours, dilute to 2000 mL, and stir in the disintegrator until the fibers are well separated, as judged by examining a small quantity diluted with water in a beaker or graduated cylinder. Then handle the pulp as though it had been received as a slurry.

NOTE 5: Before adding pulp to the disintegrator, make sure the entire inside surface of the disintegrator and the propeller shaft are clean.

7.2 To provide the number of test pieces needed for reflectance measurements, prepare two handsheets, each weighing approximately 4 g.

7.2.1 Weigh out two separate portions of pulp equivalent to 4 ± 0.2 g of moisture-free fiber, or measure the corresponding volume of premixed slurry.

8. Procedure

8.1 *Dispersing*

8.1.1 If the disintegrator is used, dilute the 4 g of pulp to 1300 mL with prepared water at room temperature

and disintegrate for 15,000 revolutions (5 min). Measure pH and adjust to 6.5 ± 0.5 with acid or base (see Note 6).

NOTE 6: If a pH other than that specified is used, the control shall be ± 0.5 of the intended value. The deviation from the standard shall be reported.

8.1.2 If the high-speed mixer is used, add 4 g of torn pulp to 500 mL of prepared water (see section 5.7) and disintegrate at 13,000 rpm for 2 min. Measure pH and adjust to 6.5 ± 0.5 with acid or base. Transfer to a graduated container and dilute to 1000 mL using prepared water which has been adjusted to pH 6.5 ± 0.5. Use this dilution water to rinse out the mixer.

8.2 *Forming*

8.2.1 Insert and level the fritted glass Büchner funnel in the neck of the suction flask or chamber port. Place a sheet of the 150-mm filter paper in the funnel, wet it with prepared water from a wash bottle, and apply suction momentarily in order to seat it. Make certain that the funnel is level by pouring a little more water over the paper and noting that it disappears simultaneously over the entire area.

NOTE 7: To keep the funnel level, it is desirable to clamp it in position.

8.2.2 With no suction applied to the funnel, rapidly pour in 1000 mL of the disintegrated stock. Apply the suction and continue until the excess of water has been removed, then break the vacuum immediately. Avoid drawing any appreciable quantity of air through the pulp mat.

8.2.3 After transferring the sheet to the press (8.3.1 - 8.3.3), form the second sheet from the other 1000 mL of prepared stock.

8.3 *Pressing*

8.3.1 Lay a piece of blotter on the press to serve as a cushion. Lay a clean drying plate, polished surface uppermost, on the blotter and center it with the press template.

NOTE 8: If experience shows that finished sheets tend to stick to the plates, the plate surface may be wiped occasionally with a clean silicone-treated cloth. Check carefully that this has no effect on the brightness of the pulps being tested by making measurements with and without the oil.

8.3.2 Invert the Büchner funnel over the plate in the press and, by using an air stream to blow into the funnel stem to loosen the sheet, deposit the test sheet and its filter paper centrally upon the surface of the plate.

8.3.3 Cover with the two sheets of the blotting paper. The stack from bottom to top will then consist of one blotter, drying plate, test sheet, filter paper, and two blotters. Add a clean plate for the next sheet and center it.

8.3.4 Continue to assemble blotters, plates, and test sheets in the press until up to four sets have been accumulated. Cover the top sheet with two blotters.

8.3.5 Put on the cover of the press and hand-tighten two of the diagonally opposite, or all four, wing nuts. Raise the pressure as indicated by the gauge to 50 psig, equivalent to approximately 350 kPa on the sheet, in 30

seconds from the time the needle begins to move, and maintain this pressure for 90 seconds. At the end of that time, release the pressure and remove the press cover.

NOTE 9: The pressing procedure is similar to the second cycle of pressing in T 205. With a thick stack of blotters, take care that the press piston does not travel to the end of its stroke and give a false pressure reading.

8.4 *Drying*

8.4.1 Remove the stack of blotters, plates, and sheets from the press. As each plate with its attached test sheet and filter paper is removed from the stack, hold down the plate and test sheet at one edge and peel the 150-mm filter paper back from the test sheet at an acute angle.

8.4.2 Lay a sheet of 185-mm filter paper on the test sheet with light hand pressure and fit the assembled plate, test sheet, and filter into a set of drying rings. When the pile of rings is filled, place a heavy weight on top or clamp the pile together.

NOTE 10: Separating the 150-mm filter from the test sheet while wet prevents most of the bonding which has caused trouble in filter separation. Take care to minimize disturbance of the test sheet. Use the 185-mm paper thereafter to allow the drying rings to grip its edges and hold down the test sheet.

8.4.3 Dry the test sheets with the attached filter papers in the drying rings in an environment in accordance with T 402. The drying operation may be accelerated by circulating air through the drying rings by means of a fan, but do not use hot air.

8.4.4 After the sheets have been dried, remove them from the drying rings with the plates and filter papers attached and store in the conditioned room until tested. Do not remove the plates and attached filter papers until the test sheets are to be cut into specimen tabs for the reflectance readings. Then remove the filter papers without bending the test sheets. Cut the specimen tabs with the test surface (the smooth surface pressed next to the polished plate) uppermost. Be sure the surface of the cutter is clean.

8.4.5 Make the reflectance tests, using methods selected per 2.2, at least 2 but no more than 24 hours after forming the test sheets, as their optical properties may change with time.

9. Precision

Although the purpose of this standard practice is to make sheets with constant and reproducible surface characteristics, a statement of precision is not applicable in this case.

10. Keywords

Handsheets, Pulps, Reflectance, Disintegrators, Brightness

11. Additional information

11.1 Effective date of issue: To Be Assigned

11.2 Studies at the Pulp and Paper Research Institute of Canada (PAPRICAN) and the Finnish Pulp and Paper Institute (KCL) indicate that the pH of the slurry can have a significant effect on sheet brightness. The Canadian method, PAPTAC C-5, describes the use of a sheet machine and PAPTAC C 4U uses the Büchner funnel with pH control.

11.3 The classification has been changed from Official Method to Standard Practice. The pH of the water is specified at 6.5 ± 0.5, a change from the previous edition of the method of 5.0 ± 0.1. The weight of the sheet is specified at 4 g, a change from 3 g of the previous edition of the method. This is the same as T 272.

11.4 Related Methods: Scandinavian SCAN C-11; Canadian PAPTAC C-5 and PAPTAC / Useful method C 4U; ISO 3688.

11.5 Changes in the 2011 version were editorial.

Appendix

A.1 *Sheet pressing and drying procedure*

A.1.1 This TAPPI practice differs from other test methods used in world trade including SCAN, PAPTAC, and ISO in the manner in which the sheets are pressed and dried. In the TAPPI practice, the sheets are pressed in direct contact with the polished drying plate and dried in that condition. In the other methods, a filter paper is placed between the sheet and the plate before pressing and drying. Concern has been expressed that the difference in surface texture which may result from the different procedures may have an effect on the measured optical properties.

A.1.2 In the event that observed differences are suspected to be due to this difference in procedures, the user of the method may want to make an additional set of sheets with a filter paper inserted between the sheet and the plate prior to pressing and drying. Optical properties measured on the sheets produced by the two procedures will resolve these questions.

A.2 *Slow draining pulps*

A.2.1 Slow draining pulps may result in an uneven distribution of fibers with the fines on the top of the sheet. In the case of recycled pulps, brightness differences of as much as 5 points have been observed from one side of the sheet to the other. Slow drainage has been observed with mechanical pulps. Consideration should be given to the use of the sheet machine under these conditions (T 272) *(2).*

A.3 *Recycled pulps*

A.3.1 With recycled pulp, the dispersion and the subsequent sheet formation may result in rinsing that does not occur as effectively in the papermaking process. As a result, the brightness observed in actual use may be different from that determined by this handsheet procedure. In the event brightness-robbing contaminants are rinsed out, the sheet brightness could be higher than the brightness experienced in actual use. Conversely, components that enhance

brightness could be washed out resulting in a handsheet lower in brightness than experienced in actual use. Caution should be exercised in relating brightness values from laboratory tests to what might be experienced in the paper making process. Alternate procedures such as determination of brightness on the pulp sheets as received could be considered. However, these should not be considered as conforming with this TAPPI Standard Practice.

References

1. Koon, C. M., and Niemeyer, D. E., "The Influence of Certain Variables in Forming Brightness Handsheets," *Paper Trade J.* **114**(5):30 (1942).
2. Jousimaa, T., "KCL Y256-1, The Effect of Sheet Forming Conditions on Brightness," ISO/TC6/SC5 N 749.

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

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