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T 272

DRAFT NO. 03 - SARG

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WORKING GROUP CHAIRMAN N/A

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 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.

Forming handsheets for reflectance testing of pulp (sheet machine procedure) (Five-year review of Standard Practice T 272 sp-12) (No changes from previous drafts, minor editorial changes incorporated)

1. Scope

1.1 This practice describes the procedure using the TAPPI sheet machine for preparing reflectance-testing specimen sheets of bleached or unbleached pulp whose fibers are readily dispersed in water. 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 The pulp sample slurry is adjusted to a pH of 6.5 ± 0.5.

1.3 TAPPI Standard Practice T 218 describes a procedure for using the Büchner funnel for making handsheets for the same application. The purpose for having two practices is discussed in sections 4.3 and 4.4.

1.4 See Appendix for consideration of recycled pulps.

2. Applicable documents

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

2.2 Reflectance testing on handsheets prepared by this practice may be performed using TAPPI Official Test Methods 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 TAPPI T 218 "Forming Handsheets for Reflectance Testing of Pulp (Büchner Funnel Procedure)" differs from this practice in the manner in which the sheets are made.

3. Summary

3.1 A properly selected specimen of the pulp to be evaluated is dispersed in a small volume of water, the pH of the slurry and the water in the sheet machine is adjusted to a pH of 6.5 ± 0.5 and formed into a sheet on a sheet machine. The sheet is pressed and dried under controlled conditions to produce 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 is 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 actual pH reported.

4.3 The procedure described in this practice for forming the sheets and the Büchner funnel procedure described in Practice T 218 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, would be particularly affected by the sheet machine. Dilution factors between the two procedures are different, and opposite sides of the sheets are tested *(2)*.

4.4 In selecting which of the practices to use (T 218 or T 272), consideration should be given to 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.

4.4.1 Two of the advantages of the Büchner funnel practice (T 218) are that less water is involved so pH control is more convenient and the equipment is less expensive.

4.5 This practice includes precautions to prevent contamination of the pulp with color-causing materials during preparation of the sheets.

4.6 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 will probably be 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 2000-mL glass cylinders or stainless steel cups.

5.4 *Filter paper*, sheets of smooth, 185-mm white filter paper, free from water soluble impurities.

5.5 *Sheet machine,* the TAPPI 159-mm (6.25-in.) sheet machine (see T 205) provided that the sheet mold must meet the following conditions.

5.5.1 For bleached pulp the entire inner surface of the mold, grid plate, and water leg must be chromium- or nickel-plated. The forming surface should be of 150-mesh stainless steel wire backed by a 20-mesh stainless steel screen. Purified water must be piped in, using plastic or aluminum pipes, and special care must be taken so that it does not become contaminated.

[1] Names of suppliers of testing equipment and materials for this method may be found on the Test Equipment Suppliers list in the bound set of TAPPI Test Methods, or may be available from the TAPPI Quality and Standards Department.

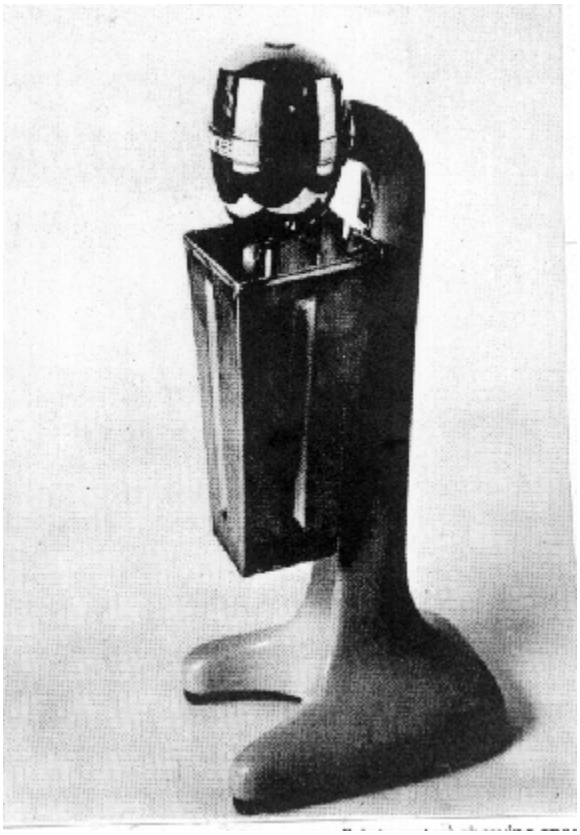

Fig. 1. High-speed mixer (same as T 218) (alternative to disintegrator) showing special canister fitted to the mixer.

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

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

5.6.2 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

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

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

5.6.5 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.

5.6.6 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 may ~~can~~ be checked visually.

5.7 *Couch roll and plate* (see T 205) for transferring sheet from wire to blotter.

5.8 *Pump and press with pressure gage* (see 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 3: 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 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 (distilled or deionized, preferably at pH of 6.0 - 7.0) for at least 4 h, 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 4: 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 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 Use water as described in 5.6 in pulp disintegration and dispersing and handsheet forming.

8.1.2 If the disintegrator is used, dilute the pulp portion (7.2.1) to 1000 mL with water at room temperature and disintegrate for 15,000 revolutions (5 min) (see Note 4).

8.1.3 If the high speed mixer is used, add the pulp portion (7.2.1) to 500 mL of water and disintegrate at 13,000 rpm for 2 min. Transfer to a graduated cylinder and dilute to 1,000 mL using the dilution water to rinse out the mixer.

8.1.4 Using the pH meter, adjust the pH to 6.5 ± 0.5 with acetic acid or sodium hydroxide (5.13 and 5.14).

NOTE 5: Do not use additives including EDTA unless stated. If a pH other than that specified is used, the control shall be ± 0.5 of the intended value. Report any deviation from the standard.

8.2 *Forming*

8.2.1 Disperse the test portions as directed in 8.1, but dilute each disintegrated sample portion to 2000 mL in a graduated cylinder of that size. Close the drain valve of the sheet machine and fill it with water to about 150 mm above the wire. Mix the diluted sample portion by pouring it back and forth between two containers three times (or other equivalent mixing technique), then pour it into the sheet machine. Add distilled or deionized water until the depth is about 350 mm above the wire. Stir the pulp slurry with a stainless steel or plexiglass rod (do not use the standard mixing paddle), moving it back and forth across the deckle until the fibers are distributed uniformly. DO NOT STIR IN A CIRCLE. A figure 8 stirring motion is recommended for best distribution. After 3 s open the drain valve and drain off the water.

NOTE 6: The combined water and pulp slurry should be within the 6.5 ± 0.5 pH range. It may not be necessary to adjust the water in the sheet machine if the adjusted pulp stock results in the finished pH being within the specified range.

8.2.2 Couch the sheet from the wire using blotters of suitable quality, using the couch roll or air couching as described in T 205. Lay the sheet, on the attached blotter, in the press on an initial pad of two blotters, center a polished drying plate over the sheet and add two more blotters. Repeat procedure for second sheet.

NOTE 7: 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.

8.2.3 The stack from top to bottom will then consist of two blotters, drying plate, test sheet, and two blotters.

8.2.4 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 *Pressing*

8.3.1 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 gage to 50 psig, equivalent to approximately 350 kPa on the sheet in 30 s from the time the needle begins to move, and maintain this pressure for 90 s. At the end of that time, release the pressure and remove the press cover.

NOTE 8: 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.

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.

8.4.3 Dry the test sheets with the attached filter papers in the drying rings in an atmosphere 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 method selected per 2.2, at least 2 but no more than 24 h after forming the test sheets, as their optical properties may change with time.

9. Precision

The purpose of this Standard Practice is to make sheets with constant and reproducible surface characteristics. A statement of precision is not applicable.

10. Keywords

Handsheets, Pulp, Reflectance, Handsheet formers, Brightness, Formation

11. Additional information

11.1 Effective date of issue: To be assigned.

11.2 T 272 has been reclassified from an Official Method to a Standard Practice. Studies at the Pulp and Paper Research Institute of Canada (PAPRICAN) and the Finnish Pulp and Paper Institute (KCL) *(2)* indicate that the pH of the slurry can have a significant effect on sheet brightness. The pH of the water is specified at 6.5 ± 0.5 unless otherwise indicated.

11.3 Related Methods: Scandinavian Scan C-11; Canadian PAPTAC C-5; ISO 3688.

11.4 The only changes in the 2012 edition 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 procedural method, 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 that 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 those questions.

A.2 *Recycled pulps*

A.2.1 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.

Literature cited

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. ■