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Laboratory processing of pulp (ball or pebble-mill method)

Scope

This method concerns the processing of pulp by means of a laboratory ball or pebble-mill prior to forming handsheets for determining pulp behavior when subjected to beating [see also TAPPI T 200 “Laboratory Processing of Pulp (Beater Method),” TAPPI T 248 “Laboratory Beating of Pulp (PFI Mill Method),” UM 221 “Laboratory Processing of Pulp (Plate Refiner),” and UM 258 “Laboratory Processing of Pulp (Kollergang Method)”. Only the furnishing and processing of the stock and the withdrawal and dilution of samples are described. The forming of sheets is described in TAPPI T 205 “Forming Handsheets for Physical Tests of Pulp,” their physical testing in TAPPI T 220 “Physical Testing of Pulp Handsheets,” and their classification in TAPPI T 233 “Fiber Length of Pulp by Classification.”

This method has the advantage of small specimen size and good reproducibility of beating action.

Safety precautions

There are no additional safety precautions for this method.

Apparatus

1. *Disintegrator*, TAPPI pulp disintegrator as described in T 205, or a higher capacity instrument to disintegrate a suspension containing 400 g of oven-dry pulp for four charges. A suitable disintegrator has a vertical shaft driven at about 1750 rpm, with an 8.5 cm (3.5 in.) diameter slotted disk or propeller at its lower end as described in T 200, and a container for holding the stock.

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

NOTE 1: Individual batches of 90 g of moisture-free pulp in 2000 mL of water may be discharged in the TAPPI disintegrator if the propeller is set 5 cm (2 in.) above the bottom of the container.

2. *Pebble-mills*, a reference standard pebble-mill (see Appendix) or an operating pebble-mill consisting of one or preferably two or more porcelain vessels each having dimensions of 25 ± 0.32 cm ($9\frac{7}{8} \pm \frac{1}{8}$ in.) internal diameter, by 32 ± 0.64 cm ($12\frac{3}{4} \pm \frac{1}{4}$ in.) internal depth, providing a volume of 16.5 ± 0.25 L, and mounted horizontally in a framework so as to rotate at 56 ± 2 rpm with an eccentricity of not over 9.5 mm ($\frac{1}{8}$ in.)

3. *Pebbles*. Each mill is charged with 120 ± 2 flint-type pebbles of two varieties, namely: (a) light colored and smooth, and (b) dark colored and slightly rough. The weight of the pebble-charge is 4500 ± 50 g, made up of nearly even numbers of the dark and light pebble, each varying in weight from 20 to 60 g.

NOTE 2: The roundness of the pebbles is not important, but the exact number and the weight are important: the weight and the number are maintained by exchanging a small pebble for a larger one, until both the pebble count and the weight are within the given tolerances.

4. *Centrifuge*, or equivalent, for dewatering the slushed pulp.

5. *Stop watch or electrical timer*, reading in seconds.

6. *Demineralized water*. Demineralized water is recommended, but distilled water or naturally soft tap water known to have a low mineral content may be used.

Storage of pulp samples

Store dry pulp samples away from heat and light. Moist samples should be protected to prevent evaporation during storage and kept in a cool place away from intense light. If prolonged storage of moist pulp is required, use a preservative such as cupric sulfate (crystal), at a level of 0.1 to 0.5 ppm based on dry pulp weight, will permit storage at 9°C for at least 18 months without changes in freeness, strength, and optical properties. The use of formaldehyde, glutaraldehyde, or similar preservatives is discouraged because of their potential carcinogenicity.

Test specimen

If not in slush form, prepare a representative sample by tearing off approximately equal portions from various parts of the lot. (Do not cut the pulp sheets, and use as few cuts edges as possible.) If the moisture content is known, weigh to the nearest gram a specimen from a representative sample equivalent to 90 g of moisture-free fiber.

If the pulp is dry, soak it in water for enough time to allow the pulp to be easily torn into small pieces. Disintegrate the specimen until it is just free from fiber aggregates as observed when a small portion is diluted with water in a graduated cylinder. If the moisture content is not known, defiber a quantity larger than 100 g so that it may be determined as follows:

Dewater the larger quantity of disintegrated pulp by means of a centrifuge or equivalent, using a cloth strainer to avoid loss of fines. Shred the pulp and place it in a closed container, determine its moisture content in duplicate (TAPPI T 210 "Weighing, Sampling, and Testing Pulp for Moisture") and weigh out a specimen of wet pulp equivalent to 90 g moisture-free.

Procedure

1. *Milling*. Use a single pebble-mill charge consisting of 90 g moisture-free pulp and 2000 mL of water (a total weight of approximately 2090 g, or 4.3% consistency). Add the wet pulp to the pebble-mill, then the charge of pebbles and next the required volume of water at 20–25°C (2000 mL less the quantity of water already in the pulp). Rotate the mill for the desired number of revolutions. Although the beating or milling time is often expressed in minutes, it is more precise and preferable to measure the amount of beating by the number of revolutions of the mill, for example, with an automatic counter. The amount of milling varies with the type of pulp being produced and usually extends from 750 (about 13 min) to 6000 revolutions (about 100 min), logarithmic increments such as 750, 1500, 3000, and 6000 revolutions being especially desirable.

2. *Clearing*. When the beating period for a mill is complete, dump the contents into a bucket, the top of which is fitted with a "pebble basket" or screen, to allow the fibers to pass through while retaining the pebbles, then