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Fiber length of pulp and paper by automated optical analyzer using polarized light

1. Scope

1.1 This is an automated method by which the numerical and weighted average fiber lengths and fiber length distributions of pulp and paper can be measured using light polarizing optics in the range of 0.1 mm to 7.2 mm.

1.2 The fiber length can also be measured using the following methods: TAPPI T 232 “Fiber Length of Pulp by Projection” and TAPPI T 233 “Fiber Length of Pulp by Classification.”

2. Summary

2.1 The measuring principle of this method is optical and is based on the ability of the fiber to change the direction of light polarization.

2.1.1 The fibers suspended in water are routed through a fiber orienting channel (F.O.C.) where the image lengths of individual fibers are measured.

2.1.2 A F.O.C. is placed between a light source and a photosensor matrix. The elements of the matrix detect the length of the fiber from the projected image of the fiber.

2.2 On either side of the F.O.C., crossed polarizers are positioned to eliminate the effect of objects other than fibers, e.g., non-optically active fillers and air bubbles, which are not able to change the direction of polarization.

3. Significance

3.1 Pulp and paper made from wood consists of fibers and fiber fragments. The length distribution of different fibers in the pulp can contribute to various properties of the final product.

4. Apparatus

4.1 The apparatus (Fig. 1) consists of a sample transport system and a measurement section:

4.2 A *transport system* of a F.O.C. (1), through which fibers dispersed in a liquid are drawn. [Numbers in parentheses refer to numbers on Fig. 1.] The F.O.C. orients the fibers into a plane, or tube, normal to the light path and

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no thicker than a nominal 0.5 mm or less in the direction of the light path.

4.3 Measurement system:

4.3.1 A light source (2) is located on one side of the F.O.C. and a photosensor matrix (3) on the opposite side of the F.O.C. The photosensor matrix indicates the fiber length from the image of the fiber passing by. The wavelength of light for the light source and the photosensor matrix must be spectrally matched.

4.3.2 Crossed polarizers (4, 5) are located between the light source and the photosensor matrix.

4.3.3 An analyzer with resolution equal to, or better than, 100 μm (see Note 1).

NOTE 1: Measuring cellulosic particles between 0.1 mm and 0.2 mm will require an analyzer to have a resolution of 50 μm or smaller.

5. Test specimen

5.1 If the pulp or paper is being tested to evaluate a pulp or paper lot, obtain a sample in accordance with TAPPI T 400 "Sampling and Accepting a Single Lot of Paper, Paperboard, Containerboard or Related Product." It is essential that the test specimens of dry pulp or paper do not contain any cut edges.

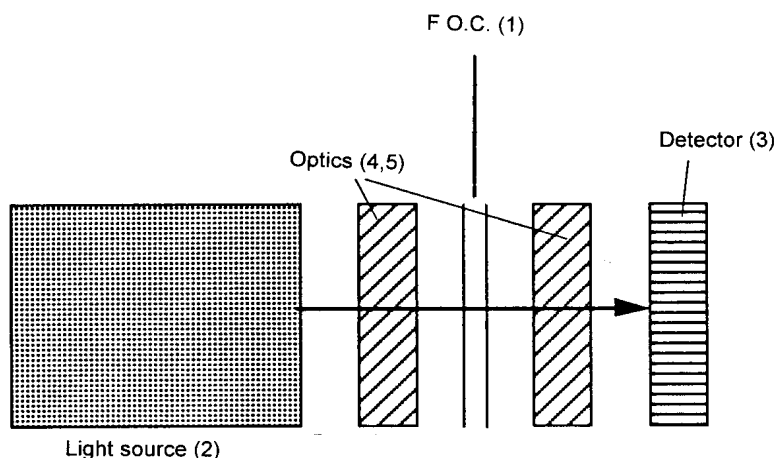


Fig. 1. The apparatus/measurement principle.

6. Procedures

6.1 Disintegration.

6.1.1 *Dry pulp samples.* Disperse the sample as described in TAPPI T 205 or disintegrate it in a manual disintegrator (Fig. 2). For good fiber dispersion of the disintegrated sample, one method is to use the manual disintegrator as follows: Put the sample (0.8 - 1.3 g for long-fibered softwood pulps and 0.3 - 0.5g for hardwood pulps) and 150 mL of distilled water in the disintegrator, and move the piston up and down until the sample has been disintegrated completely. Presoaking is to be preferred for pulps difficult to disperse. Fibers must be properly separated, with no fiber bundles or fiber-to-fiber bonds remaining in the test specimen. When the sample is completely dispersed, dilute with distilled water to a consistency of $0.02 \pm 0.005\%$ for softwood, and $0.0075 \pm 0.0025\%$ for hardwood. The sample volume after dilution should be at least 5L to insure a homogenous mixture. Treat mixed furnish pulps as softwood pulps for determining final consistency.

6.1.2 *Wet pulp samples.* Dilute to approximate consistency per manufacturers recommendations to give accurate measurements.

6.1.3 *Ordinary papers.* Disintegrate the paper according to method A as described in TAPPI T 401 "Fiber Analysis of Paper and Paperboard." Treat paper samples as softwood pulps for determining final consistency.

6.2 *Test sample concentration.* Dilute to the suspension concentration recommended by the instrument's manufacturer, or to that determined by tests over a range of concentrations to give accurate measurements.