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Basic density and moisture content of pulpwood

1. Scope and summary

1.1 This method describes the measurement of the basic density (bone-dry weight per unit of maximum volume) of pulpwood in the form of chips or disks from the cross section of logs. The method also gives procedures for determining the moisture content of wood in either form.

1.2 For moisture content of wood in the form of sawdust see TAPPI T 264 “Preparation of Wood for Chemical Analysis (Including Procedures for Removal of Extractives and Determination of Moisture Content).”

1.3 Moisture content is determined by the difference in weight as received and after drying at $105 \pm 3^\circ\text{C}$.

1.4 Volume is determined by the amount of water displaced by the test specimen of wood.

1.5 Because wood swells or shrinks, respectively, with absorption or loss of water, it is necessary to express the density at a specified moisture content and corresponding volume. The usual conditions are the minimum (oven-dry or moisture-free) weight and the maximum (green) or the minimum (oven-dry or moisture-free) volume. For most purposes, the maximum volume basis is sufficient. In the present method the specimen is considered to have swollen to its maximum volume when its moisture content exceeds the “fiber-saturation point,” which lies between 18 and 26% by weight (wet basis) for most species. Procedures for obtaining the volume, both green and oven-dry, are described in this method.

NOTE 1: Many wood technologists consider the density of wood is best expressed only on the basis of oven-dry weight and maximum volume, because at moisture contents above the fiber-saturation point the maximum volume is essentially constant.

2. Significance

Pulpwood, as logs or chips, is often purchased on a volume basis. It is also normally charged to the digester by volume. The moisture content and density of the wood are significant values for comparative pulpwood costs, for inventory control, and for proper processing such as digester load and alkali charge.

Approved by the Standard Specific Interest Group for this Test Method



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3. Definitions

3.1 *Density* is the ratio of the mass of a quantity of a substance to its volume and is expressed in terms of weight per unit volume.

3.2 The density of the wood portion of pulpwood and chips may be expressed as:

3.2.1 *As-received density*, obtained by dividing the as-received weight by the as-received volume.

3.2.2 *Green density*, obtained by dividing the green (maximum swollen) weight by the green (maximum swollen) volume.

3.2.3 *Basic density*, obtained by dividing the oven-dry weight by the green (maximum swollen) volume.

3.2.4 *Oven-dry density*, obtained by dividing the oven-dry weight by the oven-dry volume.

3.2.5 *Bulk density*, obtained by dividing the weight (at specified conditions) of the specimen (chips) by the bulk volume at the conditions indicated. It can be expressed in the same terms as basic density (see TAPPI UM 23 "Bulk Density of Wood Chips").

NOTE 2: At initial moisture contents above the fiber saturation concentration (18-26% moisture), as-received and green densities will be identical.

TEST PROCEDURES FOR DISKS

4. Apparatus

4.1 *Balance*, capacity 1 kg, sensitivity 0.1 g.

4.2 *Balance*, minimum capacity 500 g, sensitivity 0.05 g. This balance has a weighted hook substituting for the left balance pan and hanger, and so mounted on a support that the hook will be suspended above an open 114-L (30-gal) container (see Fig. 1). Electronic balances equipped with a hanger to permit below-the-balance weighting are also suitable when mounted in an appropriate manner above the 114-L container. The weighted hook should be exactly the weight of the pan and hanger which has been replaced or sufficiently close to the same weight so that it can be counterbalanced by the adjusting screws.

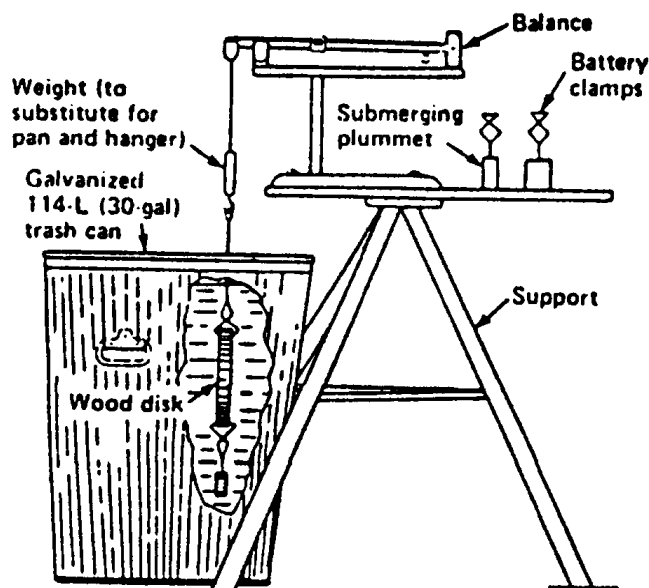


Fig. 1. Apparatus for suspended submergences method for volume determination of disks.

4.3 *Container*, for holding water for submerging disks. A 114-L (30-gal) galvanized or plastic trash container is satisfactory for the purpose.

4.4 *Holding clamp.* This clamp, such as a 200-A battery clamp, should be attached to a fine wire or thread, which, in turn, is attached to an eye for hanging the clamp from the weighted hook on the balance. The wire or thread must be long enough that the clamp and the eye to which the wire is attached are completely submerged in the water held in the container.

4.5 *Submerging plummets* (3 or 4), in the range of 50 to 500 g (as for example 50, 100, 200 and 500 g). Each of these plummets must be attached to a clamp (200-A battery clamps are suitable).

4.6 *Drying oven,* forced air, constant temperature $105 \pm 3^\circ\text{C}$, with drying rack of wire, so constructed that the disks can be placed on edge in the oven, and several thus held without touching one another.

4.7 *Saw,* circular or chain.

5. Materials

Paraffin wax, commercial grade.

6. Sampling

Select a number of sample logs according to TAPPI T 257 "Sampling and Preparing Wood for Analysis."

7. Test specimens

7.1 From each sample log, with a sharp saw, cut a specimen disk of solid wood 20-25 mm (3/4-1 in.) thick from an undamaged, sound, and knot-free section. Preferably cut the disks from the center or at least 300 mm (at least 12 in.) from the end of each log so as to avoid end checks. Quickly remove any bark, adhering splinters, and sawdust from each disk. Reduce the size of any disks too large for the available vessel used for obtaining the submerged weight by cutting a wedge or half disk section and mark the pieces for identification.

NOTE 3: The volume of the specimen required is the outside boundary, exclusive of surface depressions; therefore, cleanly cut the disks.

7.2 Place the specimen disks in a covered container as soon as cut to prevent loss of moisture.

8. Procedures

8.1 *Moisture content.*

8.1.1 Determine the moisture content from the as-received weight and the oven-dry (or moisture-free) weight. If the moisture content alone is desired, it is necessary only to determine the as-received weight as described in Section 8.1.2 and then immediately proceed to the measurement of oven-dry weight in Section 8.2.4.

8.1.2 *As-received weight of disks.* Brush off sawdust and dirt from surfaces of disk and weigh disk promptly. If the disk is too large in diameter to be weighed readily, cut it into pie-shaped segments, weigh each segment and total the weights of the segments. Record as-received weight of disk in grams.

8.2 *Basic density.*

8.2.1 *Soaking.* Unless the wood is green, submerge the disk in water at $23 \pm 2^\circ\text{C}$ for a minimum of 1 h.

NOTE 4: The purpose of soaking the wood is two-fold: first, to ensure that the specimen is swelled to its green volume, with its internal cavities filled, and second, to eliminate an error resulting from the wood absorbing water while being weighed to obtain its volume. If the moisture content is above the fiber-saturation point, a 1-h soaking period is usually sufficient to accomplish both these conditions; otherwise the soaking should be prolonged until 1 h after checks, if any, are closed.

8.2.2 *Green weight.* Drain the free water from the soaked disks by patting them lightly with a cloth or piece of blotting paper and allowing them to stand 5 min prior to weighing. Brush off sawdust and dirt from surfaces of disk and weigh each disk promptly. If a disk is too large in diameter to be weighed readily, cut it into pie-shaped segments, weigh each segment and total the weights of the segments. Record green (water-soaked) weight of disk in grams. While draining, do not expose the disks to a draft, fan, or direct heat. Return to the soaking vessel those disks whose surfaces show signs of drying out before the weighings can be completed.

8.2.3 *Green volume.* As shown in Fig. 1, set the scales on the left end of a table so constructed that specimens can be suspended in place of the left-hand pan. Place a vessel of sufficient size containing water at room temperature below the scales directly under the left side of the balance. Hang on the left-hand arm a stirrup and chain or other