

The information and data contained in this document were prepared by a technical working group of the Association. The working group and the Association assume no liability or responsibility in connection with the use of such information or data, including but not limited to any liability under patent, copyright, or trade secret laws. The user is responsible for determining that this document is the most recent edition published.

PLEASE NOTE: A TAPPI Useful Method (UM) is a document written to describe a test, procedure, or practice which may be proposed by a Working Group of no fewer than three TAPPI members not employed by the same organization and written in the same general style as a TAPPI Standard Test Method, but with the inclusion or exclusion of certain sections as deemed appropriate by the Working Group, and with minimum precision requirements that may be expanded at the discretion of the Working Group. A UM is written with no less attention to proper use of the language to describe the procedure using essentially the same elements of a TAPPI Standard Test Method, but in a less rigorous manner. TAPPI Useful Methods do not receive the same review through a rigorous process of openness, voluntary review, and consensus as do the TAPPI Standard Test Methods, and as such, are not intended to be used as referee methods as the TAPPI Standard Test Methods are.

CAUTION:

This 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.

Bulk density of wood chips

Scope

This method is used to determine the weight on a moisture-free basis per unit volume of wet wood chips, the bulk density. For purposes of reference, a standard pressure of 11 kPa (225 lb/ft²) has been chosen. Of course, the principles of the test can be applied to the pressure of any digester or chip bin by making appropriate adjustments to the pressure of the test.

Safety precautions

There are no particular additional safety precautions for this method.

Significance

This method gives both bulk density under a pressure simulating that when chips are filled in a bin or digester. Thus, the bulk density can be used to calculate the weight of chips in a bin or digester when its volume is known. As a rule of thumb, a pressure is chosen to be equal to that exerted by the weight of a volume of chips equal to one half the height of the bin or digester, acting over the cross sectional area.

Apparatus

1. *Large chip can*, a galvanized metal cylindrical can or a fiber drum 553 ± 25 mm (21 ± 1 in.) inside diameter and about 600 mm (about 24 in.) deep with a line painted around the inside to indicate a volume of 110 L (4 ft³). The actual inside diameter, *D* in centimeters must be known in order to calculate the weight of chips needed to fill the small chip can to the required height.

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

2. *Small chip can*, a slightly conical cylindrical can having an average cross section of 310 cm^2 ($\frac{1}{3} \text{ ft}^2$) and a height equal to that of the 110-L volume mark on the larger can. The can has smooth interior with inside dimensions of 192 mm ($7\frac{5}{8}$ in.) diameter at the top and 203 mm (8 in.) diameter at the bottom and is made from 1.6-mm (16-gage), or thicker, sheet metal.
3. *Chip compressor disk*, a circular plate about 6 mm (about $\frac{1}{4}$ in.) or more thick, and about 190 mm (about $7\frac{1}{2}$ in.) diameter, so made as to slide freely, with only slight lateral play, within the small chip can.
4. *Pressure applicator*, a cylindrical weight about 180 mm (about $7\frac{1}{4}$ in.) in diameter, or a compressed-air, lever, or other system that will apply a known, steady force of 34 kg (75 lb) on the small chip can, which is about equivalent to the weight of a 7.63-m (25-ft) high column of dry uncompressed chips.

NOTE 1: A simple lever for applying the pressure is a 35 by 70 mm piece of lumber (a nominal 2×4), or metal I-beam or angle iron about 2 to 3 m (6 to 8 ft) long, hinged on its narrow face to a wall at a height of a little more than that of the small chip can. About 300 mm (about 1 ft) away from the hinge is a 15-mm (about $\frac{1}{2}$ in.) diameter threaded bolt about 250 mm (about 10 in.) long, with its nut embedded in, or attached to, the lower side of the lever, the lower end of the bolt bearing on the center of the chip compressor disk. The bolt is screwed up or down so as to keep the lever substantially horizontal when the load is applied. A weight, such as a bucket of water, is suspended from the lever. The weight and position of the bucket shall be determined such that the combined weight of the *chip compressor disk* and the force exerted by the threaded bolt attached to the lever equals 34 kg (75 lb). This force can be calculated or measured using a scale.

5. *Scales*, accurate to within 100 g (0.2 lb) or less and with a capacity of about 50 kg or sufficient for the large can plus chips.
6. *Drying oven*, capable of maintaining a temperature of $105 \pm 2^\circ\text{C}$, with chip baskets and/or suitable container for the determination of moisture content of wood chips.

Sampling and test specimen

Obtain a sample of the chips to be tested in accordance with T 257 "Sampling and Preparing Wood Chips for Analysis." The test specimen should be slightly larger than 110 L (4 ft^3).

Procedure

1. Weigh the large chip can and fill it with chips to slightly above the 110-L (4-ft^3) mark. Jar slightly three times by raising a side of the can 25 mm (1 in.) up from a concrete floor and releasing it once at each of three positions spaced equally around the can. Refill or reduce to the mark and obtain the net weight of the chips (total weight of large chip can and chips – weight of empty can) in grams (W).
2. Calculate the weight of the chips to be added to the small can to equal the height of the chips in the large can. This weight can be calculated by:

$$M = 39,500 W / D^2$$

where:

- M = mass of chips to be added to the small can
 W = mass of chips in large can from Step 1
 D = measured inside diameter of large can in cm

Dump out and mix the chips from the large can, reduce sample size by quartering (see T 605 "Reducing a gross sample of granular or aggregate material to testing size"), and weigh out the calculated weight. Save the remainder for further quartering for the moisture determination. Pour the calculated weight of chips into the small can and jar it until the chips are level with the top of its rim, that is, at the same height as in the large can.

3. Place the chip compressor disk on the chips in the small can and add the required weights (or apply the required pressure) which with the weight of the chip compressor disk and the effective force of the lever, if used, are part of the weight.

NOTE 2: Using the weight of the 110 L of chips in the large can as a basis, estimate the approximate weight of a column of chips 310 cm^2 in cross section and one-half the height of chips in the digester or chip bin.