SCAN-CM 43:95
Revised 1995

SCANDINAVIAN PULP, PAPER AND BOARD
TESTING COMMITTEE

Wood chips for pulp production

Basic density

0 Introduction

This SCAN-test Method replaces SCAN-CM 43:89, from which it differs mainly with regard to editorial changes. In addition, precision data are available in this revised Method.

1 Scope

This Method describes the equipment and procedure for determining the basic density of wood chips for the production of chemical and mechanical pulps. An Annex also furnishes instructions for determining the basic density of wood disks cut from logs and representing their cross section.

2 References

SCAN-CM 39 Wood chips for pulp production – Dry matter content
SCAN-CM 40 Wood chips for pulp production – Size distribution
SCAN-CM 41 Wood chips for pulp production – Sampling

3 Definitions

For the purpose of this Method the following definitions apply:

3.1 *Basic density* – The oven-dry mass of a wood sample divided by its green volume.

3.2 *Green volume* – The solid volume of a wood sample when it is in equilibrium with surrounding water.

3.3 *Bulk density* – The oven-dry mass of a sample of chips divided by the bulk volume of the sample, when packed without compression.

4 Principle

Bark-free wood chips are soaked in water. By centrifugation, excess water adhering to the chips is removed, but not water present in the voids inside the chips. The chips are soaked again in a vessel containing water and placed on a balance. The apparent mass of the immersed chips is taken as a measure of their green volume. The chips are dried and their oven-dry mass is determined. The basic density is calculated.

5 Apparatus

5.1 *Container*, of aluminium foil, for weighing the chips.

5.2 *Chip classifier* as described in SCAN-CM 40.

5.3 *Soaking vessel* for complete soaking of the sample. The vessel is provided with a device for keeping the sample completely immersed.

5.4 *Drum centrifuge*, with a vertical axis and a variable speed control, capable of generating a centrifugal force of about 100 *g* at the periphery of the centrifuge drum (*g* = *9,806* m/s^2, the acceleration of free fall).

> *Note* – The required rotational frequency *n* of the centrifuge (expressed in revolutions per minute) may be calculated from the expression:

$$n = 29{,}905(F/r)^{1/2} \quad [1]$$

where
F is the centrifugal force at the periphery of the centrifuge drum, expressed as a multiple of the acceleration of free fall, (*g*);
r is the radius of the drum, in metres.

5.5 *Cylinder* of inert material, to be placed in the centre of the centrifuge drum when loading it with chips. Its function is to concentrate the chips close to the periphery of the drum.

5.6 *Sample basket*, cylindrical, with cover, capacity at least 3 litres, of stainless steel wire cloth, mesh opening 2 × 2 mm. A diameter of 170 mm and a height of 200 mm are recommended.

5.7 *Water container*, preferably of a transparent material, large enough to accommodate the sample basket. It must be possible to suspend the basket in the container so that it is completely immersed in water and does not come into contact with the walls of the container.

5.8 *Support* to be used when weighing the immersed basket.

5.9 *Drying oven*, capable of being controlled at (105 ± 2) °C, and suitably ventilated.

5.10 *Balance*, with a capacity of about 15 kg and accurate and readable to 0,5 g.

6 Sampling and preparation of sample

The sampling procedure is not covered by this Method. A suitable procedure is described in SCAN-CM 41.
Prepare the sample as follows: Screen 8 to 10 litres of chips as described in SCAN-CM 40. Discard the fractions 1 and 5 (oversize chips and fines). From the remaining fractions (2, 3 and 4), remove any bark particles and any bark attached to the chips. Thoroughly mix the bark-free fractions.

> *Note* – If, for some reason, this procedure for preparing the sample has not been followed, this fact must be explicitly stated in the test report.

7 Procedure

Fill the water container (5.7) with water at room temperature, but not exceeding 25 °C, and place it on the balance (5.10). Attach the empty sample basket (5.6) to the support (5.8). An example of the apparatus is presented in *Figure 1*. Adjust the sample basket so that it is entirely immersed, as indicated by a mark on the support. Record the balance reading, or, if the balance has a taring device, adjust this so that the balance reads zero.

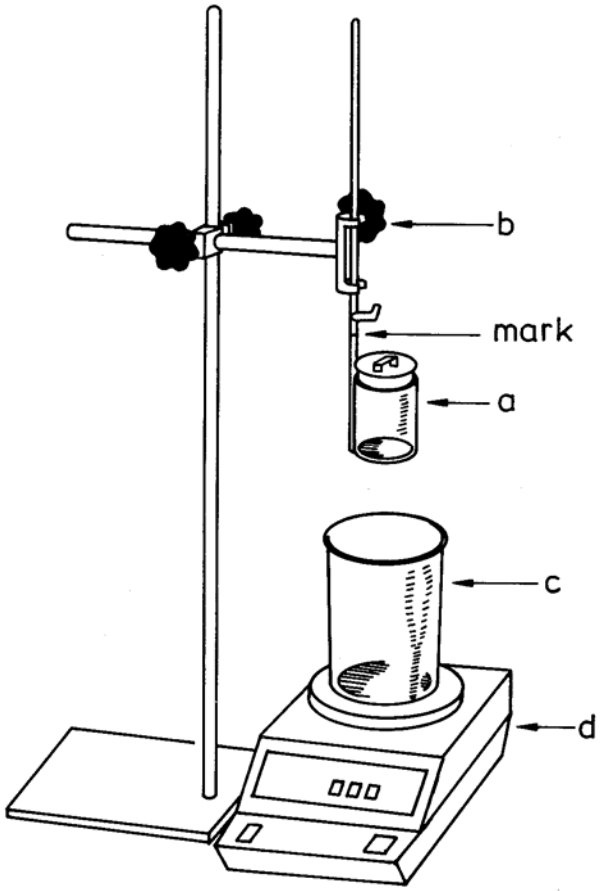

Figure 1. Example of equipment for determining the green volume of chips:
(a) sample basket for the chips (5.6);
(b) support (5.8);
(c) water container (5.7);
(d) balance (5.10).

From the mixture of bark-free fractions (fraction 2, 3 and 4), take at least triplicate samples and carry out the following procedure:

Soak 2 to 3 litres of the prepared sample completely in water at room temperature for at least 4 h but not more than 3 days. Remove the chips from the water and place them in the centrifuge. Feed the chips into the centrifuge drum, packing them as close as possible to the periphery by means of the cylinder (5.5). Remove the cylinder and run the centrifuge at the predetermined speed for 2 min. (See Annex B.)

> *Note* – Avoid excessive centrifugation. This can cause air to replace the water in the voids inside the chips. The optimal rotational speed for a particular centrifuge may be determined by the procedure described in Annex B.

To determine the green volume, immediately transfer the chips to the sample basket (5.6) and immerse it completely in the water container (5.7). Rotate or rock the basket to ensure that all air adhering to the chips is removed.

Keep the sample basket immersed in the water while connecting it to the support (5.8). Adjust the support so that the water level is at the mark on the support and check that the basket does not touch the water container walls. Check that the temperature of the water does not exceed 25 °C. Record the balance reading.

Remove the basket from the water container and transfer the chips to one or more dishes of aluminium foil. Dry them in an oven at 105 °C as described in SCAN-CM 39 and determine their dry mass.

8 Calculation and report

Calculate the basic density separately for each of the triplicate samples from the expression

$$X = \frac{c\,\rho}{(b-a)} \qquad [2]$$

where

- X is the basic density, in kilograms per cubic metre;
- a is the balance reading, in grams, obtained with the basket empty;
- b is the balance reading, in grams, obtained with the basket full;
- c is the mass of the dried chips, in grams;
- ρ is the density of the water = 1000 kilograms per cubic metre.

Calculate the mean of the three results and report it to the nearest whole number.

The test report shall include reference to this SCAN-test Method and the following particulars:

(a) date and place of testing;
(b) identification mark of the sample tested and an indication as to whether or not sampling has taken place in accordance with SCAN-CM 41;
(c) the result;
(d) any departure from the standard procedure and any other circumstances that may have affected the results.

9 Precision

Two laboratories determined the basic density of chip samples from spruce, pine and birch with the following results:

Sample	Basic density, kg/m3		
	Lab 1	Lab 2	Between labs
Pine	361 362 364	363 359 366	
$\bar{x}$ CV*, %	362 0,4	363 1,0	363 0,7
Spruce	416 416 418	419 416 416	
$\bar{x}$ CV*, %	417 0,3	417 0,4	417 0,3
Birch	519 521 523	522 523 520	
$\bar{x}$ CV*, %	521 0,4	522 0,3	521 0,3

* CV is the coefficient of variation.

10 Literature

10.1 Grundelius, R.: Determining the basic density of wood chips. Tappi Journal *73*: 4, 183 - 189 (1990)

Annex A – Basic density determined on wood disks

The procedure described in this Method may, with the following slight modification, be applied to disks of wood:

After soaking the disks, remove excess water by wiping them carefully with a sorbent cloth. Do not use the centrifuge.

In the green volume determination, no sample basket is required if the support in *Figure 1* is replaced by that shown in *Figure 2* which allows the disk to be mounted with its axis horizontal.

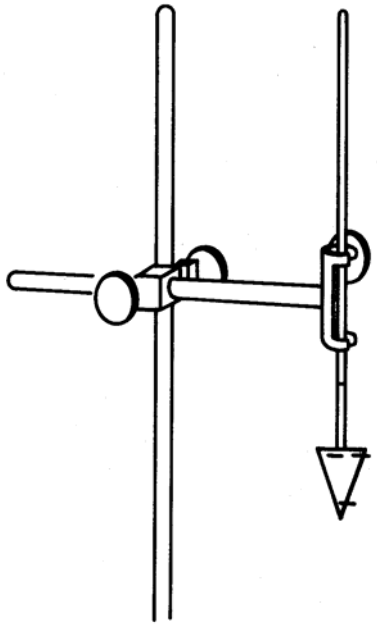

Figure 2. Example of a suitable support for the determination of the green volume of a wood disk.

Annex B – Check of procedure

Carry out the following procedure with at least two disks that are representative for the species of wood to be tested.

Soak the disks by submerging them completely in water at room temperature. Determine the green volume of each soaked disk as described in *Annex A.* Calculate the green volume of each disk.

Cut the disks manually into chips. Collect fines formed separately. Dry and weigh the fines.

For each disk, determine the basic density of the chips as described in Section 7.

Calculate the basic density of each disk. Use for the dry mass of the disk the total dry mass of the chips and the fines.

For each disk calculate the difference between the basic density determined on the chips and that determined on the disk. If the mean difference exceeds 4 kg/m^3, adjust the centrifuge speed and repeat the procedure until this value is not exceeded.

SCAN-test Methods are issued and recommended by KCL, PFI and STFI-Packforsk for the pulp, paper and board industries in Finland, Norway and Sweden.
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