SCANDINAVIAN PULP, PAPER AND BOARD
TESTING COMMITTEE

SCAN-M 13:83
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Mechanical pulp

Shives content

PFI Mini-shive fractionator

0 Introduction

In the process of making mechanical pulp, the wood is split into fibres, fibre fragments and wood fragments, also called shives. The latter are undesirable and several apparatuses have been constructed in order to determine the content of shives by screening a pulp suspension through slits. A slit width of 150 µm has commonly been used, but increasing requirements for the quality of printing papers mean that particles passing through a 150 µm slit may also cause trouble and may need to be quantified. This experience has led to the construction of the PFI Mini-shive fractionator, with a slit width of 80 µm, described in this Method.

1 Scope

This SCAN-test Method specifies a procedure for determining the mini-shives content of mechanical pulps which are primarily intended for use in high grade printing papers.

2 References

ISO 4119 Pulps – Determination of stock concentration
ISO 5263-2 Pulps – Laboratory wet disintegration – Part 2: Disintegration of mechanical pulps at 20 °C
ISO 5263-3 Pulps – Laboratory wet disintegration – Part 3: Disintegration of mechanical pulps at >85 °C

Note – SCAN-test has withdrawn a number of test methods and refers instead to the corresponding ISO and/or EN Standards.

3 Definition

For the purpose of this Method, the following definition applies:

3.1 *Mini-shives* – Material retained when a pulp suspension is screened through a 80 µm wide slit, according to this SCAN-test Method.

4 Principle

A pulp suspension is screened through an annular slit, 80 µm wide, situated in the bottom of a screen. The screening effect results from the oscillation of a membrane acting on water added to a chamber below the slit. The material retained by the screen is dried and weighed and the mini-shives content is reported as a percentage of the oven dry mass of the pulp added.

5 Apparatus

5.1 *Disintegrator* as described in ISO 5263-2.

5.2 *PFI Mini-shive fractionator,* as described in Annex A.

5.3 *Water supply*, capable of delivering tap water of (20 ± 1) °C at a flow rate of (2,0 ± 0,2) l/min.

5.4 *Filter crucibles,* having sintered filter discs of medium coarseness (pore diameter 90–150 µm).

5.5 *Drying oven,* capable of maintaining a temperature of (105 ± 2) °C.

6 Preparation of sample

Disintegrate the sample as described in ISO 5263-2 or ISO 5263-3 and dilute the suspension so obtained to a pulp concentration of approximately 3 g/l ensuring that the temperature is about 20 °C. Determine the stock concentration in accordance with ISO 4119 to an accuracy of 0,02 g/l.

7 Procedure

Carry out this procedure in duplicate.

Pre-set the timer at 30 min. Close the drainage tube of the basin, and place the screen in its lower position. Connect the dilution water hose to the pipe in the centre of the screen and turn on the water. The water flow shall be (2,0 ± 0,2) l/min and the temperature of the water shall be (20 ± 1) °C (5.3).

As soon as overflow through the overflow tube commences, add water to the screen until the water level reaches 30–40 mm above the slit.

Start the motor to remove any air in the chamber below the screen. From the pulp suspension, measure a sample containing (2,00 ± 0,02) g of oven-dry pulp and pour it into the screen in the course of 10 s. Start the timer immediately after the pulp sample has been added. After a screening time of 30 min ± 10 s, when the timer has stopped the motor, stop the water supply and disconnect the hose from the fractionator. Empty the basin by opening the drainage tube and lift the screen to its upper position.

> *Note* – For pulps with a high content of shives or of long fibres, the level of the suspension in the screen may increase so that overflowing occurs. In such cases the screen may be charged with (1,00 ± 0,02) g of pulp only and this must be stated in the report.

Place the crucible in the holder, *Figure 2*. Before the water has run out of the screen, suck the shives into the crucible and simultaneously wash down the inner walls of the screen with a small jet of water to ensure that no shives are lost.

In order to remove the shives which may be stuck in the slit, proceed as follows:

1. Rotate the screen through an angle of 90°.
2. Place the bowl in the basin beneath the screen.
3. Rotate the screen a further 90° (bottom-up position).
4. Place the suction hose from the crucible in the holder of the bowl, *Figure 3*.
5. Guide the tip of the special water jet pipe (Annex A) along the slit thus rinsing the slit by means of the strong jet of water. During this cleaning operation the rinsing water together with shives are sucked from the bowl into the crucible.
6. After the rinsing, remove the bowl from the basin and return the screen to its normal position.

When all the shives are collected remove the stopper from the filter crucible and wash down the shives from its walls to the bottom so that they form a pad. Remove the crucible from the filter disc.

Dry the shives to constant weight at a temperature of (105 ± 2) °C. After drying, cool the crucible and the shives in a desiccator and weigh to the nearest 0,1 mg. Wash out the shives, dry the crucible as before and weigh the empty crucible to the nearest 0,1 mg.

8 Calculation and report

8.1 Calculation

Use the expression

$$X = \frac{100\,(a\,b)}{c} \qquad [1]$$

where

X is the content of mini-shives, as a percentage;
a is the weight of the crucible and shives after drying and cooling, in grams;
b is the weight of the emptied crucible after drying and cooling, in grams;
c is the weight (oven-dry basis) of the added pulp sample (standard 2,00 g), in grams.

8.2 Report

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

(a) date and place of testing;
(b) description and identification mark of the material tested;
(c) the number of replicates carried out;
(d) the test results as specified above;
(e) any departure from the procedure described in this Method or any other circumstances which may have affected the tests results.

8.3 Precision

Repeated measurements in the same apparatus normally give results with a coefficient of variation of about 5 %. When the same sample is analysed in different sets of apparatus, the coefficient of variation normally falls within the range of 10 % to 15 %.

9 Literature

9.1 Hauan, S. and Gaure, K. – The PFI Micro-Shive Fractionator, Norsk Skogindustri 22 (1968): 5, p 155–162

9.2 Høydahl, H. E. and Hauan, S. – Mini-shives in Mechanical Pulp, Norsk Skogindustri 26 (1972): 3, p 62–65.

Annex A
PFI Mini-shive fractionator

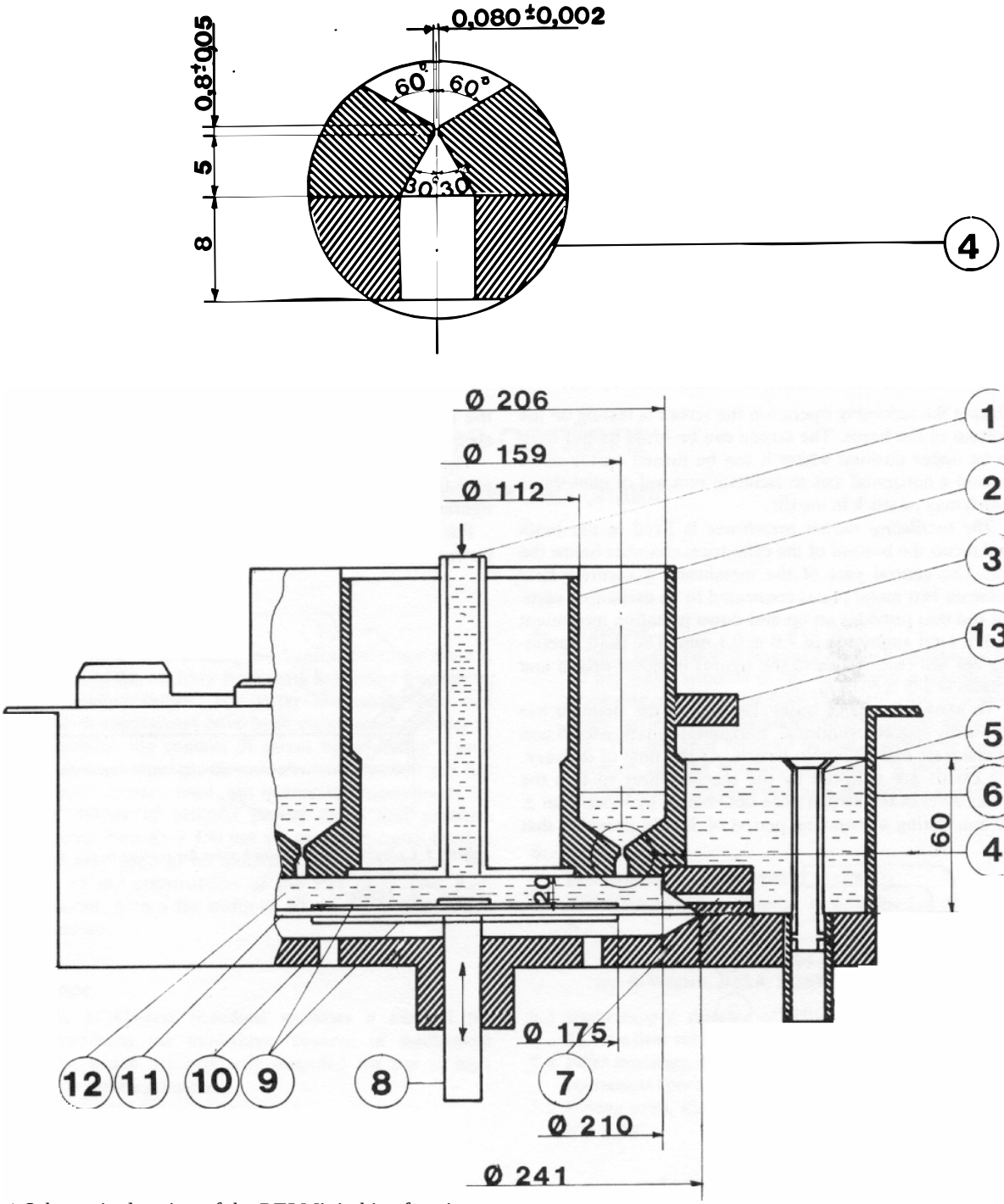

Figure 1 Schematic drawing of the PFI Mini-shive fractionator

1. *Pipe for dilution water*
2. *Inner part of screen*
3. *Outer part of screen*
4. *Slit*
5. *Overflow and drainage tube*
6. *Basin*
7. *Canal through chamber wall*
8. *Oscillating rod*
9. *Metal plates*
10. *Air opening*
11. *Oscillating rubber membrane*
12. *Chamber*
13. *Horizontal axis*

The PFI Mini-shive fractionator, *Figure 1,* consists of a screen, mounted in a basin. In the bottom of the basin there is an oscillating rubber membrane which gives rise to the screening effect.

The Screen is made of bronze and consists of two cylindrical parts fitted together concentrically to form an annular vessel.

The maximum external diameter of the specially shaped lower end of the inner part is 160 µm less than the minimum inner diameter of the lower end of the outer part, and a circular slit 80 µm wide is thus formed in the bottom of the vessel.

Precision machining and assembly shall ensure that the width of the slit is (80 ± 2) µm at any point along the slit, which shall have a length of 500 mm. Check the slit width using shims with a thickness of (80 ± 2) µm Take care to avoid damage to the slit.

> *Note* – In the course of time, the slit may become narrower due to deposits of calcium carbonate if the water used has high calcium content. Wash with dilute acetic acid to remove such deposits.

During the screening operation the screen is resting on the bottom of the basin. The screen can be lifted to and fixed in an upper position where it can be turned upside-down around a horizontal axis to facilitate removal of mini-shives which may be stuck in the slit.

The oscillating rubber membrane is fixed in the basin and forms the bottom of the cylindrical chamber below the slit. The central part of the membrane is securely held between two metal plates connected to an oscillating vertical rod that provides an up-and-down pulsation movement with a total amplitude of (7,0 ± 0,1) mm. The shaft operating the rod (not shown in the figure) is motor-driven and rotates at (375 ± 5) rpm.

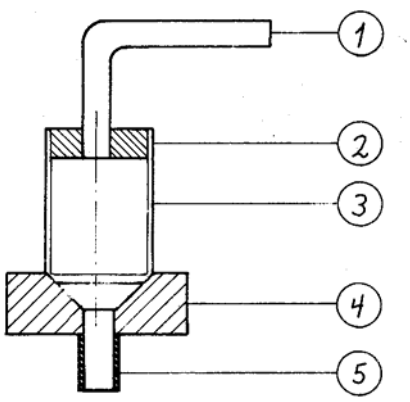

Figure 2 Holder with filter crucible and suction hose
1. *Suction hose*
2. *Stopper*
3. *Filter crucible*
4. *Holder*
5. *To vacuum source*

To allow passage of water, the wall of the chamber has 15 evenly spaced cylindrical, horizontal canals, each 8 mm in diameter and 32 mm in length. At the time of delivery, the canals are adjusted by the manufacturer so that the water level in the screen does not change by more than ± 10 mm during a screening period of 30 min provided that the screen, at the start of the screening period, is filled with tap water, up to a level 30 mm above the slit.

When the apparatus is operating, dilution water from the special water supply (5.3) is allowed to pass into the chamber below the screen. It is fed to the apparatus through a hose, connected to the vertical central tube leading to the chamber below the screen.

A combined overflow and drainage tube is situated in the basin and can be placed in an upper and a lower position. In the lower position the tube serves as a weir to keep a constant water level of 60 mm above the bottom of the basin. In the upper position the tube allows the basin to be emptied.

An adjustable timer terminates the pulsation after the desired screening time. The pulsation can also be interrupted manually.

The fractionator is equipped with a holder, *Figur 2,* into which a filter crucible is placed when the shives are to be collected. The holder must be connected to a vacuum source. A suction hose is attached to the top of the crucible when the water containing the shives is to be sucked into the filter.

A special facility is a cylindrical bowl, with a holder for the suction hose, to be put under the screen during the cleaning operation described in the procedure, *Figure 3*.

The fractionator is also equipped with a special water jet pipe to be used when cleaning the slit (not shown in the figures).

For further detailed information see the manufacturer's instruction for the PFI Mini-shive fractionator.

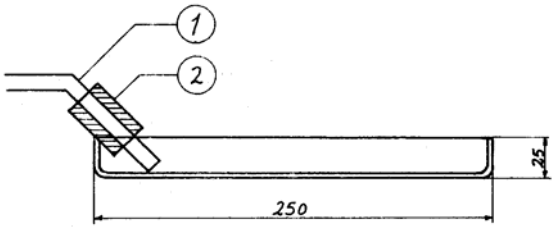

Figure 3 Cylindrical bowl, with holder for suction hose
1. *Suction hose*
2. *Holder.*

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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