International Standard 5264/2

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Pulps — Laboratory beating — Part 2 : PFI mill method

Pâtes — Raffinage de laboratoire — Partie 2 : Méthode au moulin PFI

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FOREWORD

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 5264/2 was developed by Technical Committee ISO/TC 6, *Paper, board and pulps*, and was circulated to the member bodies in December 1977.

It has been approved by the member bodies of the following countries :

Belgium	Iran	South Africa, Rep. of
Canada	Ireland	Spain
Chile	Italy	Sweden
Czechoslovakia	Kenya	Switzerland
Finland	Mexico	Turkey
France	Netherlands	United Kingdom
Germany, F. R.	Norway	USA
Hungary	Poland	USSR
India	Romania	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Australia
New Zealand

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Pulps — Laboratory beating — Part 2 : PFI mill method

0 Introduction

It has been agreed that the ultimate aim of standardization of laboratory beating should be to develop one test method which is internationally acceptable and which, if possible, allows the energy consumption during beating to be measured. For practical reasons it has not proved possible to achieve this at present. Therefore, as an interim measure, in view of the widespread use of the following methods

— Valley beater,

— PFI mill,

— Jokro mill,

it has been decided to provide agreed guidance on the use of these equipments in order to achieve consistency of results with each instrument. While all three methods will show a similar trend in respect of the pulp tested, the actual results cannot be correlated between different types of beater[1]. The position will be kept under review, and the methods will be replaced by a single method as soon as practicable.

1 Scope

This International Standard specifies a method, using a PFI mill, for the laboratory beating of pulp. The description is limited to the furnishing and beating of the stock, the withdrawal and distribution of samples, and the beating equipment.

The beating is a preliminary step in testing the physical properties of pulp.

Part 1 specifies a method of laboratory beating using a Valley beater and Part 3 a method using a Jokro mill.

2 Field of application

In principle, this method is applicable to all kinds of pulp.

NOTE — In practice, the method may not give satisfactory results with certain extremely long-fibred pulps, such as cotton linters.

3 References

ISO 638, *Pulps — Determination of dry matter content.*

ISO 4119, *Pulps — Determination of stock concentration.*

ISO 5263, *Pulps — Laboratory wet disintegration.*[2]

4 Principle

A measured amount of pulp of specified stock concentration is beaten between a roll with bars and a smooth beater housing, both rotating in the same direction, but at different peripheral speeds.

5 Apparatus and auxiliary materials

Ordinary laboratory equipment and

5.1 PFI mill, as described in annex A

5.2 Standard disintegrator, as described in ISO 5263.

5.3 Balance, capable of weighing the sample to an error of less than 0,2 g.

5.4 Distilled water, or water of similar quality.

NOTE — Distilled water, or water of similar quality, is particularly recommended with a view to obviating any difficulties that might arise from the use of different qualities of water by the interested parties.

6 Preparation of sample

If the pulp is wet or air-dry, weigh out a sample for dry matter determination in accordance with ISO 638. If the pulp is in slush form, determine the dry matter content in accordance with ISO 4119.

Take an amount of the pulp corresponding to 30 ± 0,5 g of oven-dry pulp (do not cut the pulp, and avoid the use of cut

1) Should one of the three methods listed become the future standard method, that one of the methods should be chosen which works in the most economical way and yields the highest reproducibility of results obtained in different laboratories.

At present, some countries are of the opinion that the PFI mill described in ISO 5264/2 meets these requirements best of all.

2) At present at the stage of draft.

edges). If the sample is in the form of machine-dried sheets or flash-dried slabs, soak the pulp thoroughly in 0,5 litre of water (see 5.4) at room temperature for not less than 4 h. Tear the soaked pulp into pieces approximately 25 mm × 25 mm in size. It is essential that the pulp be thoroughly softened by soaking, to ensure that the preliminary disintegration results in a minimal beating effect. Wet pulps may be disintegrated without soaking.

7 Procedure

7.1 Disintegration

Transfer the wet-pulp sample, and the water used for disintegration, to the disintegrator (5.2). Add water at 20 ± 5 °C to give a total volume of 2 000 ± 25 ml; the pulp concentration will then be about 1,5 % (m/m). Set the revolution counter at zero. Switch the motor on and allow the disintegrator to run for a few seconds. Switch the motor off and, before the propeller stops, switch on again. For pulps having an initial dry matter content of 20 % (m/m) or more, have the propeller make 30 000 revolutions. For pulps having an initial dry matter content of less than 20 % (m/m), allow the propeller to make 10 000 revolutions.

When the propeller has stopped, check that the pulp has been completely disintegrated.

NOTES

1 Where necessary for climatic reasons, a temperature of 25 ± 5 °C may be applied, provided that this is noted in the test report.

2 Ensure that the pulp is completely disintegrated. Pulps that are difficult to disintegrate, such as unbleached sulphate pulps, may require a time longer than that specified above.

7.2 Thickening

After disintegration, drain the pulp suspension on a Buchner funnel to a concentration of approximately 20 % (m/m). To avoid loss of any fibres, refilter the filtrate through the fibre mat, if necessary several times. Dilute the thickened pulp with water to a total mass of 300 ± 5 g, corresponding to a 10 % (m/m) stock concentration.

7.3 Beating

Beating conditions : Beating pressure : 3,33 ± 0,1 N per 1 mm of bar length, assuming that only one bar at a time makes contact with the housing (see note 1).

Rotational frequency of beater roll : 24,3 ± 0,5 s^{-1}

Difference in peripheral speed : 6,0 ± 0,2 m/s

Check that the beating specifications are correct. Bring the beating elements of the PFI mill (5.1) and the pulp suspension to a temperature of 20 ± 5 °C (see note 1 to 7.1). Transfer the pulp suspension, prepared in accordance with 7.2, to the beater housing, and distribute it as evenly as possible over the wall. Ensure that no pulp remains on the bottom of the beater housing within an area corresponding to the cross-section of the roll. Insert the roll in the beater housing, and press the cover correctly into position in the housing.

Set the beater housing in rotation, so that the pulp is flung against the housing, and then start the roll. When both elements of the beater have attained full speed, apply the required beating pressure, and simultaneously start the revolution counter (see note 3). After the required number of revolutions of the roll, discontinue the beating by removing the beating pressure. Switch off the motors, and stop the roll and beater housing. Remove the cover and the roll.

Transfer the stock to a measuring cylinder of capacity at least 2 litres. Rinse the mill with water, and add the rinsings to the cylinder. Dilute the stock with water to 2 000 ± 25 ml, and clear the pulp suspension by disintegrating it to 10 000 revolutions of the propeller in the standard disintegrator (5.2).

NOTES

1 For pulps that are very easily beaten (such as hardwood sulphites), a smaller load may be applied, giving a beating pressure of only 17,7 N per 10 mm of bar length, provided that this is noted in the test report.

2 After beating, clean the mill thoroughly with water and, if necessary, with a pitch solvent followed by water.

3 Apply the beating load at a constant rate over a period of 4 s. At the instant of full application of the load, release the revolution counter lever arm to engage the counter.

4 If the drainability is measured, this should be done with a minimum of delay.

8 Test report

The test report shall give the following particulars :

a) reference to this International Standard;

b) all indications necessary for complete identification of the sample;

c) the number of revolutions used for preliminary disintegration;

d) the time, or the number of revolutions used for beating;

e) the results obtained in the drainability test, if made (see note 4 to 7.3);

f) any unusual features observed in the course of the procedure;

g) any operations not specified in this International Standard or in the International Standards to which reference is made, or regarded as optional, which might have affected the results.

Annex A

PFI mill (see the figure)

The PFI mill consists of a roll, a beater housing with a cover and a loading device to provide the beating pressure. The roll and housing rotate on vertical shafts.

The roll has 33 bars, each 50 mm long and 5 mm wide. The bars are arranged radially and are parallel to the roll axis. The diameter of the roll, measured across the bars, is 200 mm and the depth of the cavities between the bars is 30 mm. The roll is driven by an approximately 1 kW motor and the rotational frequency when no pressure is applied shall be 24,3 ± 0,5 s^{-1}. The number of revolutions of the roll is indicated by the counter.

The beater housing has an internal diameter of 250 mm and is driven by an approximately 400 W motor. The speed of the housing shall be set so that the prescribed difference in peripheral speed of 6,0 ± 0,2 m/s between the beating elements is obtained at zero load and a rotational frequency of the roll of 24,3 ± 0,5 s^{-1}. Both the roll and the beater housing are driven by means of a belt transmission.

The beating pressure is obtained by means of a load, applied by means of a lever, that presses the roll against the wall of the beater housing. Futhermore, the mill is equipped with a device, including a distance screw, for regulating the distance between the roll and the housing when grinding-in and conditioning the mill. The beating elements are made of stainless steel.

NOTE — The mills first manufactured had beating elements made of bronze. However, the beating elements of stainless steel give the same results for beating as elements made of bronze.

To ensure reproducible beating, the following conditions must be fulfilled :

a) The roll and the housing shall run at the correct speeds.

b) The belts shall not slip. When pressure is applied, the rotational frequency of the roll will normally decrease by 0,3 to 0,6 s^{-1}, whereas the rotational frequency of the housing will increase slightly.

c) All parts shall move freely, so that the whole of the load applied is transmitted as beating pressure.

d) The distance screw shall be disengaged during beating.

e) The roll and the housing shall be clean and free from deposits. Pitch deposits should be removed with a non-corrosive solvent.

f) The general condition of the mill shall be checked from time to time by beating reference pulps kept for beating purposes, and stored sufficiently long to avoid further changes in the pulp. For preference, the reference pulp should be of the same type as that normally beaten in the beating equipment concerned. The drainage values obtained after beating the reference pulp to about 50 Schopper-Riegler number or 200 "Canadian Standard" freeness number shall be within ± 5 % of those established for the reference pulp concerned at the same number of revolutions.

Annex B

Maintenance of the PFI mill

Under normal conditions, the beating efficiency of the mill should remain constant. If the beating surfaces have been damaged, so that the mill gives incorrect results for reference pulps, the beating surfaces shall be ground and conditioned as follows :

B.1 Reverse the direction of rotation of the motor driving the beater housing.

B.2 Set the distance screw to bring about a gap of about 0,5 mm between the beating elements.

B.3 Charge the beater housing with 15 g of silicon carbide powder to pass 90 µm aperture suspended in 50 ml of soluble cutting-oil diluted with 50 ml of water.

B.4 Set the beater housing in rotation, so that the powder suspension is flung against the housing. Ensure that the cover is in position in the bracket and insert the roll in the beater housing.

Stop the housing, and press the cover into position. Start both beating elements, apply the load, and carefully reduce the gap between the elements by means of the distance screw until the sound of grinding can be heard. Run the mill until this sound has diminished appreciably, and then further reduce the gap, but by an amount not exceeding the equivalent of half a scale division (approximately 0,03 mm). Continue the grinding step by step in this way until the damage has been rectified.

B.5 Clean the beating elements and the cover with soap and water. Ensure that no silicon carbide powder is left.

B.6 After this rough grinding, carry out fine grinding with silicon carbide powder to pass 45 µm aperture, as described in B.3 and B.4.

B.7 Clean as described in B.5.

B.8 Apply a file to remove any rough edges that have appeared on the trailing edges of the bars.

B.9 Thoroughly clean the roll to remove filings.

B.10 Reverse the direction of rotation of the motor driving the beater housing. If, after grinding with silicon carbide powder to pass 45 µm aperture the beating surfaces are too coarse, smooth them to the required level by beating pulp in which approximately 15 g of silicon carbide powder to pass 45 µm aperture has been mixed. Set the distance between roll and housing, so that it slightly exceeds that required by the layer of fibres. (When, for example, bleached coniferous sulphite pulp is used for this purpose, a suitable gap could be 2 mm.)

B.11 Thoroughly clean the housing and the roll.

B.12 Disengage the distance screw.

B.13 To stabilize the beating surface, a series of beatings for periods corresponding to between 50 000 and 100 000 revolutions of the roll is recommended.

Dimensions in millimetres

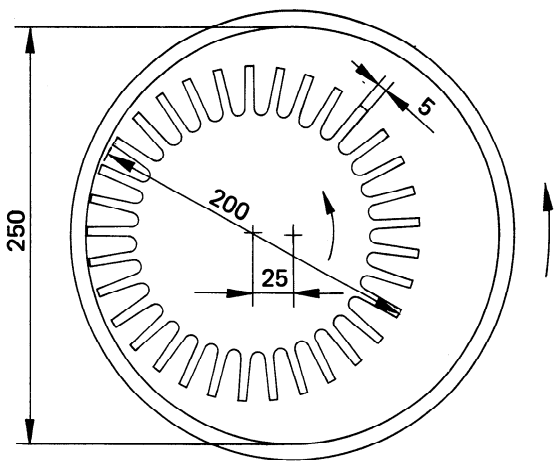

Figure — Principal elements of the PFI mill

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