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Pulps — Determination of mass fraction of fines

Pâtes — Détermination de la fraction massique des fines

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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ISO 10376 was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*, Subcommittee SC 5, *Test methods and quality specifications for pulps*.

Introduction

This International Standard has been prepared to make it possible to determine the fines mass fraction of mechanical and chemical pulps. The greater tendency of the fines fraction to pass through the wire during sheet formation and to be recycled leads to an accumulation of fines in the headbox. The extent of this buildup is an indication of the retention performance of the machine and affects, for example, drainage, felt filling and save-all loading. The fines mass fraction in the pulp has also very often an effect on the properties of the end product, e.g. paper or board.

NOTE This International Standard involves a more precise determination, i.e. a lower coefficient of variation of repeated determinations is achieved (see Annex B), compared to the use of a McNett apparatus in which the fines mass fraction is obtained from the difference between the total mass and the sum of the fibre fractions (see Reference [3] in the Bibliography).

Pulps — Determination of mass fraction of fines

1 Scope

This International Standard describes the procedure for determining the fines mass fraction of all kinds of pulp by means of a perforated metal plate or a single-screen fibre classifier (Dynamic Drainage Jar or similar). The screening procedure is the same for all pulps, although the mass of the test portion and the total volume of water for screening are not the same.

NOTE The procedure is also applicable for most kinds of paper samples, provided that it is possible to fully disintegrate the sample.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4119, *Pulps — Determination of stock concentration*

ISO 5263-1, *Pulps — Laboratory wet disintegration — Part 1: Disintegration of chemical pulps*

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*

ISO 7213, *Pulps — Sampling for testing*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
fines
fraction of a pulp which passes a screen (nominal aperture of 76 µm) or a perforated plate (holes of 76 µm)

NOTE There is no significant difference in the results obtained using a perforated plate and a wire screen in the fibre classifier, see Annex B.

WARNING — If the sample contains mineral fillers, the filler particles will normally appear in the fines fraction.

4 Principle

The pulp sample is disintegrated using tap water.

The pulp suspension is screened through a plate with round holes, or through a wire screen. The material retained on the screen and that which passes the screen are dried and weighed separately. The fines mass fraction is calculated and reported as a percentage of the oven-dry mass of the test portion.

NOTE 1 The mass of the test portion and the volume of water are different for mechanical pulps and chemical pulps.

NOTE 2 The screening effect results from the turbulence and the pressure developed by a stirrer with a three-blade propeller.

NOTE 3 The mineral (fillers and pigment) content in the fines fraction can be calculated from the mass of the residue on ignition (the ash) of this fraction, provided that the ash content of the mineral and the pulp are known.

5 Apparatus

5.1 Disintegrator, as described in ISO 5263-1, ISO 5263-2 and ISO 5263-3, depending on which part of the standard is relevant.

5.2 Fibre classifier, of BDDJ type (Britt Dynamic Drainage Jar) or similar (an example of a suitable device is shown in Figures 1 and 2). A cylindrical sample holder with an internal diameter of (100 ± 10) mm, provided with 3 or 4 vanes on the inside, the vanes having a square section with (6,0 ± 1,0) mm sides, and equipped for the insertion of a bottom screen and a bottom chamber beneath the screen. The bottom chamber shall have an outlet located centrally in its base with a diameter of (6,5 ± 1) mm and the outlet shall be equipped with a device for closing the outlet.

NOTE The water flow rate has a minor influence on the result when determining the fines mass fraction.

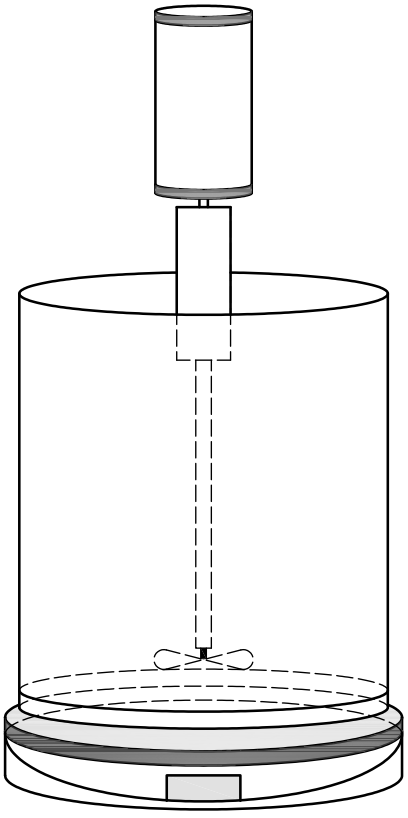
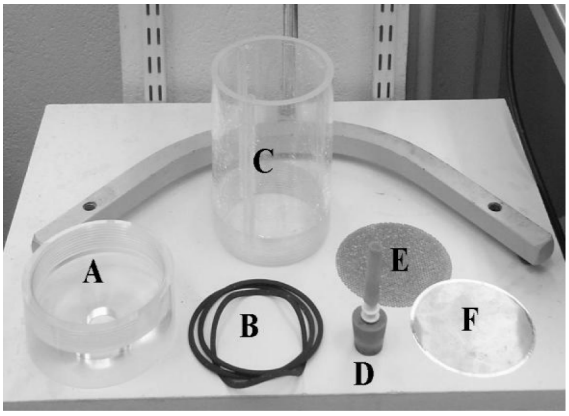


Figure 1 — Sketch of the fibre classifier



Key

A	bottom chamber with outlet	D	plug for outlet
B	gaskets	E	supporting plate
C	sample holder	F	screen, hole diameter (76 ± 4) µm

Figure 2 — Key of the different parts of the classifier

5.3 Stirrer, a shaft that carries a three-bladed (5 mm ± 1 mm × 1 mm ± 0,1 mm) propeller. The blades shall be circular, (17,5 ± 2) mm in diameter with a pitch of (30 ± 3)°. The stirrer shall be well centred in the jar and the distance between the propeller and the screen shall be (3,5 ± 0,5) mm. The rotation direction of the motor shall be such that the pressure of the propeller blades is downward toward the screen and the speed of the propeller shall be (12,5 ± 0,8) s^{-1}.

5.4 Screen, a perforated metal plate with circular holes, each hole with a diameter of (76 ± 4) µm or a wire screen having a nominal aperture size of (76 ± 4) µm (see ISO 3310-1 [2]).

5.5 Filter paper, grammage about 90 g/m^2 [e.g. Whatman No. 4 [1)] or equivalent]. The recommended diameter is 120 mm for the fibre fraction and 90 mm for the fines.

5.6 Balance, accurate to 1 mg.

6 Reagents and material

6.1 Tap water.

7 Sampling

If the test is being made to evaluate a pulp lot, the sample shall be selected in accordance with ISO 7213. If the test is made on another type of sample, report the source of the sample and, if possible, the sampling procedure used.

Make sure that the test portions taken are representative of the pulp sample.

1) Whatman No. 4 is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

8 Procedure

8.1 Disintegration

Using tap water (6.1) and a disintegrator (5.1), disintegrate the pulp as described in the relevant part of ISO 5263. Use ISO 5263-3 for mechanical pulps exhibiting latency.

Determine the concentration of the pulp suspension as specified in ISO 4119.

8.2 Screening

Carry out the screening procedure in duplicate.

From the well-stirred, disintegrated pulp suspension, take a test portion having a mass as specified in Table 1. The total volume of screening water to be used is also specified in Table 1.

Table 1 — Mass of test portion and total volume of screening water to be used in the test

Pulp grade	Oven-dry mass of test portion g	Total volume of water ml
Sample with low fines mass fraction: $\leq$ 10 % (e.g. chemical pulp)	5,0 $\pm$ 0,5	5 000
Sample with high fines mass fraction: $>$ 10 % (e.g. mechanical pulp)	0,5 $\pm$ 0,1	2 500

NOTE 1 In this International Standard, chemi-thermo-mechanical pulps (CTMP) and pulps with a high fines mass fraction, such as semi-chemical pulps and recycled pulps, are regarded as mechanical pulp.

NOTE 2 For chemical pulps, a mass of 5 g has been chosen to guarantee good precision, even for pulps with low fines mass fraction.

NOTE 3 The content of dissolved and colloid substances can, for example, be obtained by determination of the total dry matter content of the sample, i.e. concentration by evaporation. Then calculate the difference between the total dry matter content and the concentration determined using a pre-weighed filter paper.

Dilute the weighed test portion with 1 000 ml of tap water (6.1) and transfer it to the sample holder (5.2) of the fibre classifier with the bottom outlet closed. Set the stirrer above the screen as described in 5.3 and start the stirrer. Open the outlet. Allow the contents of the jar to drain into a beaker. When the level in the jar is within 1 mm to 5 mm above the screen, add an additional portion of tap water (6.1), e.g. 1 000 ml, and allow the contents to drain into the beaker. Continue this procedure until the total volume of tap water (6.1) for screening, as specified in Table 1, has been used. Collect all that passes through the screen into the same beaker. After the final addition of screening water, continue until the water in the jar has disappeared.

Filter the fibre fraction and the fines fraction separately using pre-weighed filter papers (5.5). Dry and weigh the filter papers with the mat of fibres and the mat of fines. Calculate separately the oven-dry mass of the fibre fraction, m_2, and of the fines fraction, m_1.

9 Calculations

Calculate the fines mass fraction, as a percentage, using Equation 1:

$$w = \frac{100 \times m_1}{m_1 + m_2} \quad (1)$$

where

w is the fines mass fraction , expressed as a percentage;

m_1 is the oven-dry mass of the fines fraction, in milligrams;

m_2 is the oven-dry mass of the fibre fraction, in milligrams.

Calculate and report the mean fines mass fraction as a percentage with three significant figures.

10 Test report

The test report shall include the following information:

a) a reference to this International Standard;

b) all information for complete identification of the sample;

c) date and place of testing;

d) the fines mass fraction, as a percentage;

e) any departure from this International Standard or any circumstances or influences regarded as optional that could have affected the results.

Annex A
(informative)

Precision

A.1 Repeatability

Seven pulp samples were tested in one laboratory according to this International Standard. Five parallel determinations were made in each case. The results are shown in Table A.1.

Table A.1 — Repeatability

Parameter	Bleached CTMP	Bleached kraft hardwood	Bleached kraft softwood	Bleached bagasse	TMP	Bleached kraft softwood, unrefined	Bleached kraft softwood, refined
Fines mass fraction, %	18,7	5,80	2,53	7,68	22,6	2,89	4,99
Standard deviation, s_r	0,72	0,19	0,23	0,10	0,22	0,09	0,12
Repeatability, r	2,0	0,52	0,64	0,28	0,61	0,25	0,32
Coefficient of variation, %	3,9	3,2	9,1	1,3	0,98	3,1	2,3

A.2 Reproducibility

Four pulp samples were tested in five different laboratories according to this International Standard. The results are shown in Table A.2.

Table A.2 — Reproducibility

Parameter	Bleached CTMP	Bleached kraft hardwood	Bleached kraft softwood	Bleached bagasse
Fines mass fraction, %	18,9	6,92	3,03	9,41
Standard deviation, s_R	2,8	1,3	0,38	1,1
Repeatability, R	7,9	3,5	1,04	3,0
Coefficient of variation, %	15,0	18,3	12,4	11,6

Annex B
(informative)

Comparison between McNett classifier and fibre classifier (BDDJ)

This comparision study is based on the work published as SCAN-method in SCAN-CM 66:05 [4].

In a laboratory study, results from the determination of the fines content (mass fraction) using the fibre classifier (BDDJ-type) and the McNett classifier were compared.

Four different pulp samples were included: a bleached softwood kraft, a bleached hardwood kraft, an unbleached softwood kraft and a CTMP. In this comparison study, the mass of the test portion was 0,5 g when testing in accordance with the fibre classifier, irrespective of whether the pulp was a chemical or a mechanical pulp. The sample size when testing in accordance with the McNett classifier was, as stated, 10 g.

In the determination of the fines mass fraction using the McNett classifier, the fines mass fraction is obtained as the difference between 100 % and the sum of the added contents of the fibre fractions, which has the consequence that any error in the determination of the contents of the fibre fractions will influence the value of the fines mass fraction. For that reason, the coefficient of variation is normally higher in the determination of the fines mass fraction using the McNett classifier than when using the fibre classifier.

Table B.1 — Comparison between McNett classifier and fibre classifier (BDDJ)

	Bleached softwood kraft			**Bleached hardwood kraft**			**Unbleached softwood kraft**			**CTMP**		
	Fines mass fraction, %			**Fines mass fraction, %**			**Fines mass fraction, %**			**Fines mass fraction, %**		
	Fibre classifier		McNett classifier	Fibre classifier		McNett classifier	Fibre classifier		McNett classifier	Fibre classifier		McNett classifier
	Wire	Plate		Wire	Plate		Wire	Plate		Wire	Plate	
	7,7	6,8	7,6	8,1	7,7	8,8	12,7	12,3	12,2	20,8	20,1	22,2
	6,7	7,2	6,2	8,7	8,2	10,6	12	12,6	10,9	20,4	20,3	20,2
	6,7	7,5	6	7,5	8,8	8,7	12,4	13,3	12,5	20,9	21,2	19,8
Mean	7,03	7,17	6,60	8,10	8,23	9,37	12,4	12,7	11,9	20,7	20,5	20,7
C_V [a], %	8,2	4,9	13,2	7,4	6,7	11,4	2,8	4,0	7,2	1,3	2,9	6,2

[a] C_V is the coefficient of variation.

Bibliography

[1] ISO 638, *Paper, board and pulps — Determination of dry matter content — Oven-drying method*

[2] ISO 3310-1 *Test sieves — Technical requirements and testing — Part 1: Test sieves of metal wire cloth*

[3] SCAN-CM 6, *Mechanical and chemical pulps — Fibre fractionation in the McNett classifier*

[4] SCAN-CM 66:05, *Mechanical and chemical pulps — Fines content*

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