TECHNICAL SPECIFICATION

ISO/TS 11371

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Pulps — Guidelines for using laboratory refiners to simulate industrial low consistency refining

Pâtes — Lignes directrices relatives à l'utilisation de raffineurs de laboratoire pour simuler le raffinage basse consistance industriel

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*.

This first edition of ISO/TS 11371 cancels and replaces ISO/TR 11371:2013, which has been technically revised.

The main changes are as follows:

— the focus lies exclusively on simulating industrial refining with laboratory refining;

— the basics of refining are further elaborated;

— Clause 3 has been updated;

— the refining procedures have been reviewed and detailed;

— the clause on pulp preparation and the two annexes have been removed.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

It is well known that the current standardized method (PFI mill method) for beating has only limited value in the evaluation of pulps. It was originally developed for quality control purposes and has no counterpart in real mill operations since the fibre property development is based on a different principle.

The biggest shortcomings are the following:

— The refining principle is different from mill-scale refining processes (controlled by energy consumption, refining intensity);

— No possibility to adjust refining parameters for specific pulps;

— No direct measure for specific energy consumption;

— Not consistent and correct usage of terms.

This well-known standardized method has good reproducibility and repeatability and the equipment is easy to handle. Nevertheless, many laboratories have replaced this method by the use of refiners enabling them to simulate industrial refining and to allow the evaluation of pulps for various mill-scale refining applications.

The objective of this document is to address the related topics by providing a common basis with regard to refining parameters, definitions, and procedures.

Pulps — Guidelines for using laboratory refiners to simulate industrial low consistency refining

1 Scope

This document provides guidelines for the laboratory refining of various pulps intended for paper production including:

— Harmonization of terms and parameters for the simulation of industrial refining processes by laboratory refiners;

— Treatment of pulp samples in a (semi) continuous operation in contrast to the batch operation of laboratory beating equipment such as the PFI mill;

— Evaluation of fibres for papermaking, in particular chemical market pulps, under close-to-reality conditions in terms of refining intensity and refining energy consumption.

This document only considers refiners operating at low stock concentration, i.e. 3 % to 5 %.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 Machine parameters

3.1.1
total load power
P_{tot}
power provided to the refiner during refining of a fibre suspension to modify fibre properties and overcome friction and the pumping effect

Note 1 to entry: It is expressed in kW.

3.1.2
no-load power
P_0
power required to overcome friction and the pumping effect measured in water or fibre suspension (at refining stock concentration) in defined conditions for flow and open gap

Note 1 to entry: It is expressed in kW.

3.1.3
net refining power
P_{net}
difference between total load power and no-load power

Note 1 to entry: It is expressed in kW.

3.1.4
refiner rotational speed
n
revolutions of the refiner rotor per minute or per second

Note 1 to entry: It is expressed in 1/min or 1/s.

3.1.5
tangential speed
v
speed of the rotor at the outer diameter of the refining zones of the refining elements at a defined refiner rotational speed

Note 1 to entry: It is expressed in m/s.

3.1.6
average tangential speed
$\bar{v}$
tangential speed of a point at half-length of the refining zones of the refining elements at a defined refiner rotational speed

Note 1 to entry: It is expressed in m/s.

3.2 Refiner fillings parameters

3.2.1
filling
exchangeable plates used for fibre treatment (refining), including a stationary element (stator) and a rotating element (rotor) in the form of a disk, cone or cylinder with bars and grooves

3.2.2
rotor
motor-driven (rotating) refiner filling

3.2.3
stator
stationary refiner filling

3.2.4
bar
one of a number of structures of rectangular cross-section on the active surface of the rotor and stator filling

Note 1 to entry: It may be cast, fabricated or machined into the surface of an element. The bars cause the refining of fibres (see Figure 1) and transport of the fibre suspension.

3.2.5
bar width
$b_{r,s}$
width of a single bar at the bar surface (rotor or stator)

Note 1 to entry: It is expressed in mm.

3.2.6
number of stator bars
z_s
total number of stator bars on the refiner filling

3.2.7
number of rotor bars
z_r
total number of rotor bars on the refiner filling

3.2.8
average rotor bar angle
α_r
angle formed between the rotor bars and the radius for disc fillings

Note 1 to entry: It is expressed in °.

3.2.9
average stator bar angle
α_s
angle formed between the stator bars and the radius for disc fillings

Note 1 to entry: It is expressed in °.

3.2.10
average cutting angle
ϕ
sum of the average rotor bar angle and the average stator bar angle

Note 1 to entry: It is expressed in °.

3.2.11
cutting edge length
C_{EL}
CEL
total length of all bar edges at a defined refiner rotational speed

Note 1 to entry: It is expressed in km/s.

3.2.12
cutting length factor
C_{LF}
CLF
total length of all bar edges for one complete rotation of the rotor

Note 1 to entry: It is expressed in m·min/s.

3.2.13
grooves
channels between bars

3.2.14
groove width
g
distance between two bars (rotor or stator)

Note 1 to entry: It is expressed in mm.

3.3 Process parameters

3.3.1
refining gap
distance between the top surfaces of rotor and stator bars

Note 1 to entry: It is expressed in mm or µm.

3.3.2
refining time
period of time from the start of refining to sampling or interval between two samplings

Note 1 to entry: It is expressed in min or s.

3.3.3
stock concentration
c
ratio of the oven-dry fibre mass that can be filtered from a stock sample, to the mass of unfiltered sample

Note 1 to entry: It is expressed in %.

3.3.4
flow rate
f
fibre suspension flow rate through the refiner

Note 1 to entry: It is expressed in l/h, l/min, l/s or m^3/h.

3.3.5
mass flow rate
F
fibre mass flow rate through the refiner

Note 1 to entry: It is expressed in kg/s or t/h.

3.3.6
refining intensity
I
how force is transferred to the fibre

Note 1 to entry: See Clause 5.

3.3.7.1
net specific refining energy
S_{RE}
SRE
<continuous process> net refining power per oven-dry mass flow rate of fibre

Note 1 to entry: It is expressed in kWh/t or kJ/kg.

3.3.7.2
total specific refining energy
S_{RE}
SRE
<continuous process> total refining power per oven-dry mass flow rate of fibre

Note 1 to entry: It is expressed in kWh/t or kJ/kg.

3.3.7.3
net specific refining energy
S_{RE}
SRE
<batch process> product of the net refining power and the time for which it is applied per oven-dry mass of fibre

Note 1 to entry: It is expressed in kWh/t or kJ/kg.

3.3.7.4
total specific refining energy
S_{RE}
SRE
<batch process> product of the total refining power and the time for which it is applied per oven-dry mass of fibre

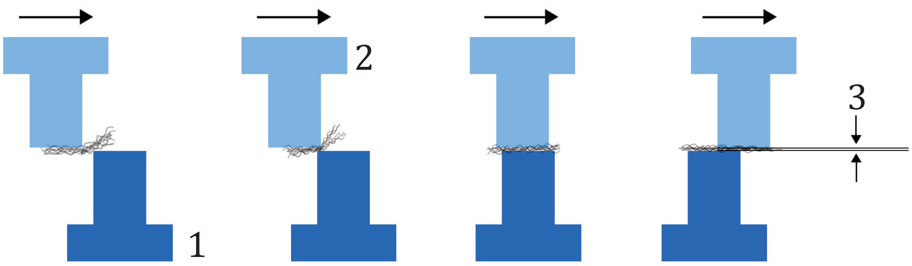
Note 1 to entry: It is expressed in kWh/t or kJ/kg.

4 Basics of pulp refining

Fibres usually need treatment to meet the required paper or board quality. Refining is the most important process step for achieving this, which it does by modifying the fibre properties.

The main purpose of refining is to improve the bonding ability of the fibres. Depending on the product, this is required to increase strength, enhance runnability, increase stiffness, improve printing properties, modify porosity or increase transparency, or a combination of these. It can also be used to improve sheet formation by reducing the length of fibres, which are too long, or to modify some other paper property.

The most common refining method for chemical pulps is to treat the pulp suspension at low stock concentrations using metallic bars according to the bar-to-bar principle (Figure 1). The bars are attached to elements knows as fillings, a stationary element (stator) and a rotary element (rotor). The pulp fibres pass through the gaps between the rotor and the stator bars receiving impacts, which can be varied in number and intensity. In industrial refiners, the refiner fillings can be disks, cones, or cylinders.



Key

1 stator

2 rotor

3 refining gap

Figure 1 — Bar-to-bar refining principle

Refining affects fibres in several ways. The most common effects are as follows:

— External fibrillation;

— Internal fibrillation (changes in the fibre walls, swelling, and delamination);