INTERNATIONAL STANDARD

ISO 10086-2

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Coal — Methods for evaluating flocculants for use in coal preparation —

Part 2: Flocculants as filter aids in rotary vacuum filtration systems

Charbon — Méthodes d'évaluation des floculants utilisés dans la préparation des charbons —

Partie 2: Floculants comme aides à la filtration dans des systèmes rotatoires de filtration sous vide

Reference number
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Contents

Page

Foreword

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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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 10086-2 was prepared by Technical Committee ISO/TC 27, *Solid mineral fuels*, Subcommittee SC 1, *Coal preparation: Terminology and performance*.

ISO 10086 consists of the following parts, under the general title *Coal — Methods for evaluating flocculants for use in coal preparation*:

— *Part 1: Basic parameters*

— *Part 2: Flocculants as filter aids in rotary vacuum filtration systems*

Coal — Methods for evaluating flocculants for use in coal preparation —

Part 2:
Flocculants as filter aids in rotary vacuum filtration systems

1 Scope

This part of ISO 10086 specifies a method for the comparative evaluation of the performance of flocculants used as filter aids for rotary vacuum filtration applications on a given slurry.

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 10086-1:2000, *Coal — Methods for evaluating flocculants for use in coal preparation — Part 1: Basic parameters*

3 Principle

The performance of different flocculants on a given slurry is determined by measuring the cake yield and moisture content.

A flocculant solution is added to an aliquot of slurry in a beaker. A filter leaf is then applied to the flocculated sample and the cake thus produced on the apparatus is weighed wet, dried and reweighed. A measure of the efficiency of the flocculant is obtained from the cake yield and moisture content.

4 Apparatus

Ordinary laboratory apparatus and the following.

NOTE The apparatus is generally arranged as shown in Figure 1.

4.1 Laboratory vacuum pump or **piped vacuum system**, capable of producing a vacuum better than that proposed for the plant equipment.

4.2 Vacuum gauge

4.3 Two-way valves, of at least 2 mm to 3 mm bore, manufactured in glass or plastics.

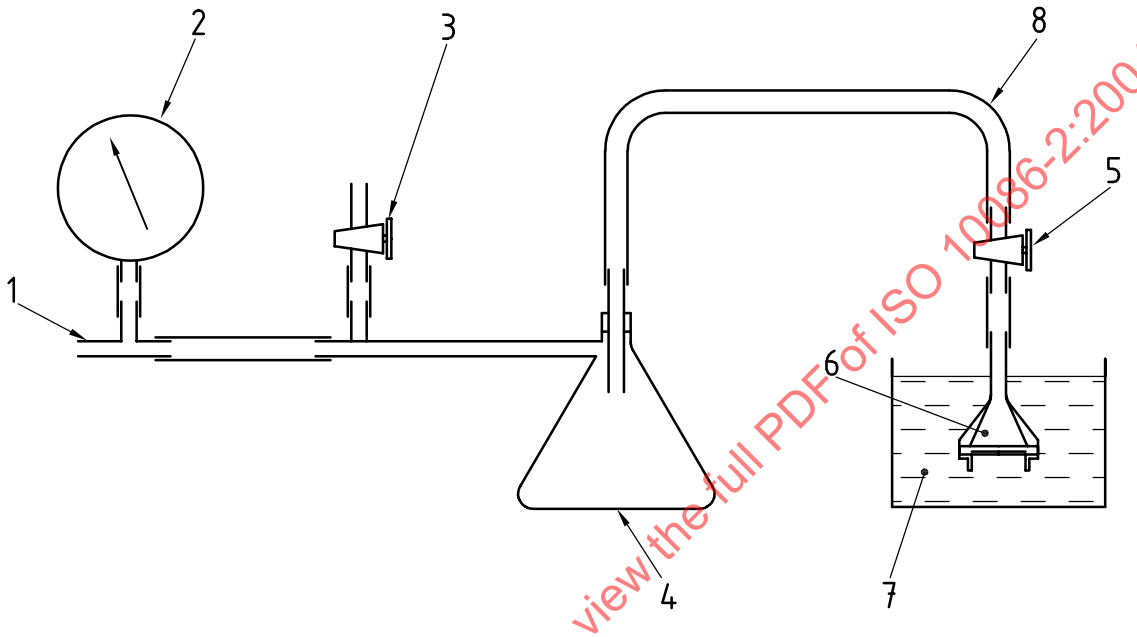
4.4 Buchner flask, with a minimum volume of 1 L.

4.5 Filter-leaf apparatus, consisting of a drainage plate and filter cloth in an assembly, as shown in Figure 4.

4.6 Vacuum tubing and glass/plastics tubing

4.7 Stirrers, motorized variable-speed stirrers, capable of speeds up to 1 000 r/min, one for flocculant preparation and one for sample homogenization.

4.8 Syringes, having capacities of 1 ml, 2 ml, 5 ml, 10 ml and 50 ml.



Key

1 vacuum pump/source
2 vacuum gauge
3 two-way valve
4 buchner flask
5 two-way valve
6 filter leaf
7 slurry in 800 mL beaker
8 vacuum tubing

Figure 1 — Laboratory vacuum filter-leaf apparatus

5 Materials

5.1 Slurry

The slurry for evaluation shall be collected and divided by the method described in ISO 10086-1. The contents of each test cylinder shall then be poured into an 800 ml beaker for evaluation.

5.2 Water

The water used for the preparation of flocculant solutions shall be collected by the method described in ISO 10086-1.

6 Sampling

The flocculant samples should be collected according to the recommendations described in ISO 10086-1.

7 Preparation of flocculant solutions

The flocculant, both powder and liquid grades, shall be prepared in accordance with the methods specified in ISO 10086-1.

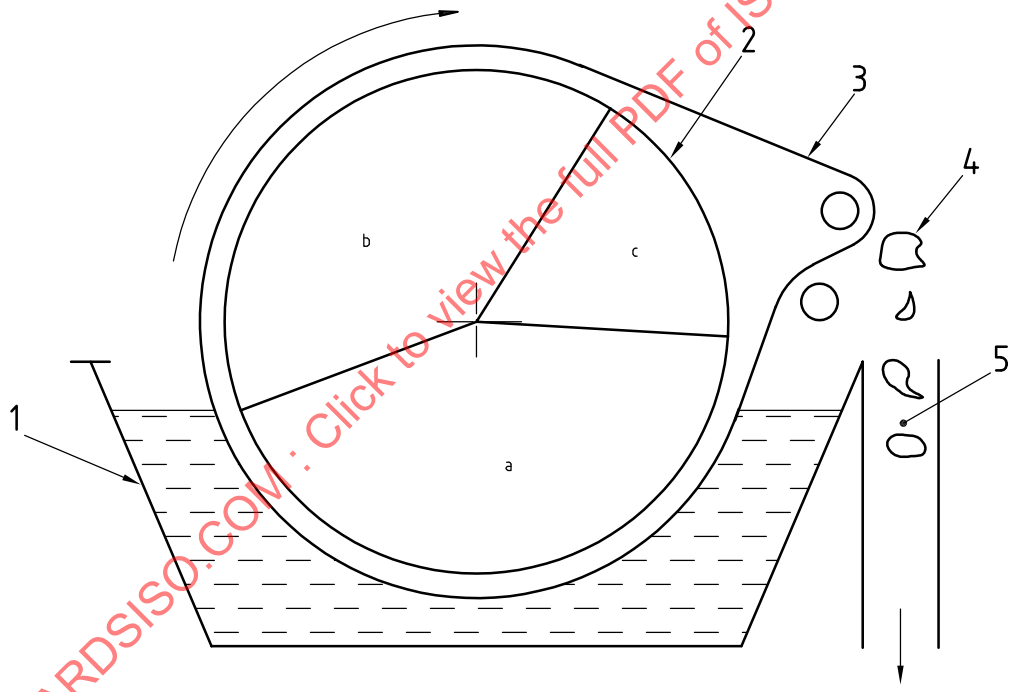
8 Test procedure

8.1 Preliminary

The test procedure shall simulate the operating conditions of a rotary vacuum filter on a plant (see Figures 2 and 3). Where the slurry is taken from a plant using such equipment, the immersion and drying times in the test procedure shall be the same as on the plant equipment. Where these times are not known, or where no vacuum filtration system exists, the following times shall apply:

— immersion time: 1 min 10 s;

— drying time: 2 min.



Key

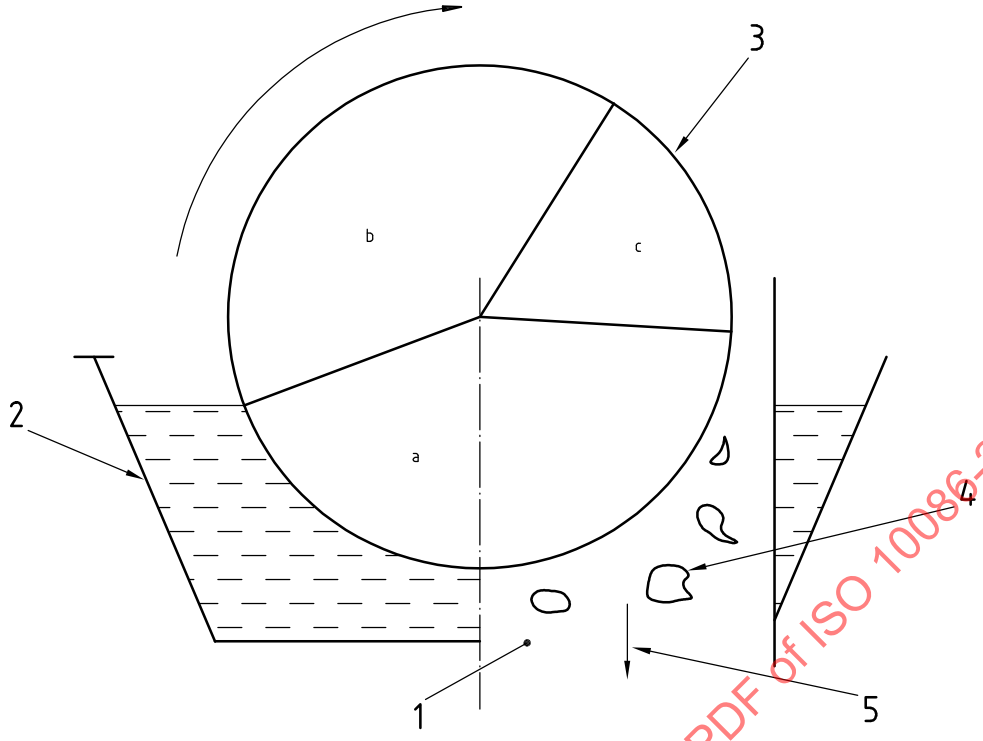
1 filter bowl
2 filter drum
3 filter cloth
4 filter cake
5 filter cake

a Filter leaf.

b Slurry in 800 mL beaker.

c Vacuum tubing.

Figure 2 — Diagram to show the immersion, drying and discharge sequences of a rotary vacuum drum filter



Key

1 filter cake discharge chute
2 filter bowl
3 disk filter
4 filter cake
5 cake discharge

a Immersion.
b Drying.
c Discharge.

Figure 3 — Diagram to show the immersion, drying and discharge sequences of a rotary vacuum disc filter

8.2 Procedure

Prepare a 500 ml subsample of the slurry as described in ISO 10086-1. Place one subsample in an 800 ml beaker and homogenize the slurry for 1 min using the laboratory stirrer at a speed sufficient to create a vortex.

Using a syringe, add the desired quantity of flocculant solution (see 8.3) to the surface of the slurry in the beaker and mix well by stirring until completely conditioned.

Record the conditioning time.

Excessive mixing should be avoided, to prevent degradation of the flocculant.

8.3 Calculation of flocculant dosage rate

8.3.1 Calculation of content of the flocculant solution

Mass of water in the beaker = m_W

Mass of flocculant dissolved in the water = m_F

Therefore, the content of the flocculant solution w_F is given by:

$$w_F = \frac{m_F}{m_W}, \text{ in grams of flocculant per gram of water}$$

For the purpose of this calculation, it is assumed that a volume of 1 ml of flocculant solution weighs 1 g.

8.3.2 Calculation of the quantity of solids in the test cylinder

Volume of slurry suspension used in the test cylinder (V_S) = 500 ml (= 0,5 L)

Solids concentration in the slurry, in g · L^{-1} (c_S) = c_S (g · L^{-1})

Therefore, the mass of the solids in 500 ml of slurry = $0{,}5 \times c_S$ (g)

= $0{,}5 \times 10^{-3}\ c_S$ kg of dry solids

8.3.3 Calculation of flocculant dosage rate

Volume of flocculant solution used to dose a slurry suspension in the cylinder = V_F ml

= V_F g

The mass of the flocculant used in the test cylinder = $\frac{m_F}{m_W} \times V_F$ g

NOTE It is approximated that 1 ml of flocculant weighs 1 g.

The flocculant dosage rate is given by:

Mass of flocculant used : Mass of solids in the cylinder

$$= \frac{m_F}{m_W} \times V_F : 0{,}5 \times 10^{-3}\ c_S$$

$$= 2\,000 \times \frac{m_F \times V_F}{m_W \times c_S} \text{ g of flocculant per kg of dry solids}$$

The units of the dosage rate may also be expressed as “kg of flocculant per tonne of dry solids”.

8.3.4 Worked example

Mass of water (m_W) = 201,2 g

Mass of flocculant (m_F) = 0,23 g

Solids concentration in the slurry (c_S) = 50,6 g per litre

Volume of slurry used in the test = 500 ml

Volume of flocculant solution used (V_F) = 3,0 ml

Therefore, the flocculant dosage rate = $2\,000 \times \frac{m_F \times V_F}{m_W \times c_S}$

= $\frac{2\,000 \times 0{,}23 \times 3{,}0}{201{,}2 \times 50{,}6}$

= 0,136 g of flocculant per kg of dry solids

(or 0,136 kg of flocculant per tonne of dry solids, or 136 g of flocculant per tonne of dry solids)

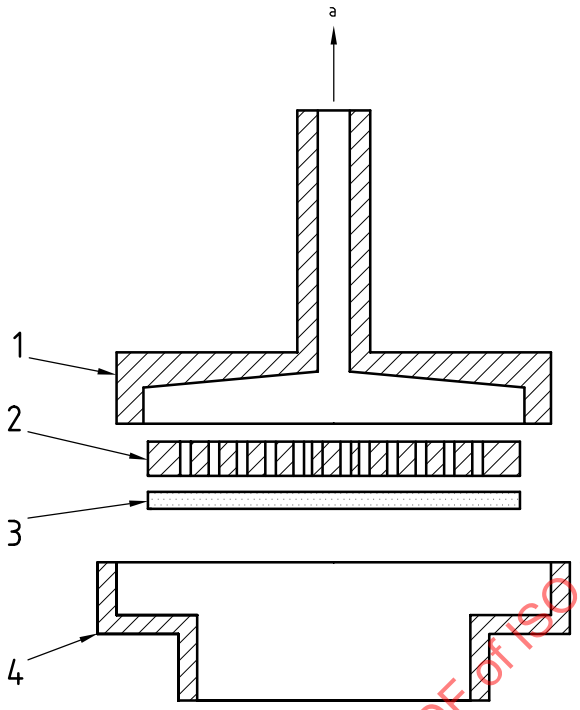
The procedure is repeated for other volumes of flocculant solution (V_F) used.

8.4 Filtration test

With reference to Figure 1, switch on the vacuum supply, close one two-way valve (5) and adjust the other two-way valve (3) to give the desired level of vacuum for the test. Insert the filter leaf (see Figure 4) with the appropriate filter cloth into the flocculated suspension and start the stop watch. At the same time, fully open the two-way valve (5). During the period of time that the filter leaf is immersed in the flocculated suspension (1 min 10 s or as per plant conditions), gently move the filter leaf up and down to maintain the flocculated pulp in suspension.

After the completion of the immersion time, remove the filter leaf from the flocculated suspension. Commence the drying time (2 min or plant time) with the filter leaf facing downwards. After half the drying time has elapsed, invert the filter leaf to face upwards for the remainder of the drying period.

After completion of the drying period, close one two-way valve (5) and vent the other two-way valve (3) to the atmosphere.



Key

1 filter leaf head
2 filtrate drainage plate
3 filter cloth
4 head to be placed in the slurry

a To vacuum pump/source.

Figure 4 — Exploded section of the filter leaf

8.5 Analysis of cake sample

Measure the thickness d, in millimetres, of the cake on the filter leaf at least three times across the diameter of the cake by inserting a millimetre-graduated steel ruler through the cake until it reaches the filter cloth. The cake thickness can be read from the lowest graduations visible on the steel ruler.

Remove the cake sample produced on the surface of the filter medium on the filter leaf and transfer to a pre-weighed Petri dish for weighing to determine the wet cake yield (wet cake mass = m_{wet}g). Place the Petri dish and sample in an oven at 105 °C until the mass of cake has decreased to a constant value, i.e. the cake has been dried (dry cake mass = m_{dry}g).

9 Clarity of the filtrate

Immediately after the cake thickness has been measured and the whole cake weighed, the clarity of the filtrate is evaluated according to ISO 10086–1. A turbidity-measuring instrument can also be employed for the evaluation of the clarity of filtrate.

10 Recording of results

Record the results for the cake yield on a data sheet (see Table B.1.). The characteristics of the slurry and filtrate shall also be recorded on this sheet.

Plot the cake yield (mass of dry solids produced) as a function of flocculant dosage for each flocculant, as illustrated in Figure A.1.

Plot the cake moisture content as a function of flocculant dosage for each flocculant, as illustrated in Figure A.1.

11 Repeatability

Duplicate results of tests should not differ by more than ± 1,0 % cake moisture and ± 1 mm cake thickness.

12 Test report

The test report shall include the following information:

a) date on which the test was carried out;

b) description of the flocculant under test;

c) details of slurry used;

d) reference to this part of ISO 10086;

e) the cake yield;

f) the clarity of the filtrate;

g) the cake moisture content;

h) the filter and dosage rate;

i) the vacuum used and the vacuum rate;

j) the filter cloth used;

k) the stirring time of the slurry after adding the flocculant.

l) the immersion time;

m) the drying time.

Annex A
(informative)

Worked example

A test was performed on a slurry with a commercial flocculant at a dosage of Y mg of flocculant per litre of slurry. The test procedure was carried out according to this part of ISO 10086 using fixed immersion and drying times of 1 min 10 s and 2 min, respectively.

A.1 Calculation

Mass of wet cake produced = m_w g

Mass of cake after drying = m_d g

Therefore

Moisture content of wet cake, in percentage by mass, $w_{wet} = 100 \times \frac{(m_{wet} - m_d)}{m_{wet}}$

and the solids content of the wet cake, in percentage by mass, $w_d = 100 \times \frac{m_d}{m_{wet}}$

The yield may be expressed as mass, in grams, of dry solids per unit area, in square centimetres, of the filter leaf to give a figure that is independent of the filtration area:

$$m_d / A \left(g \cdot cm^{-2} \right)$$

where A, in square centimetres, is the filtration area of the filter leaf.

The flocculant dosage rate is calculated 8.3

$$2\,000 \times \frac{m_F \times V_F}{m_W \times c_S}$$ g of flocculant per kg of dry solids

or

$$1000 \times 2\,000 \times \frac{m_F \times V_F}{m_W \times c_S}$$ g of flocculant per tonne of dry solids

where

m_F is the mass of flocculant dissolved in m_W g of water;

m_W is the mass of water used to prepare the flocculant;

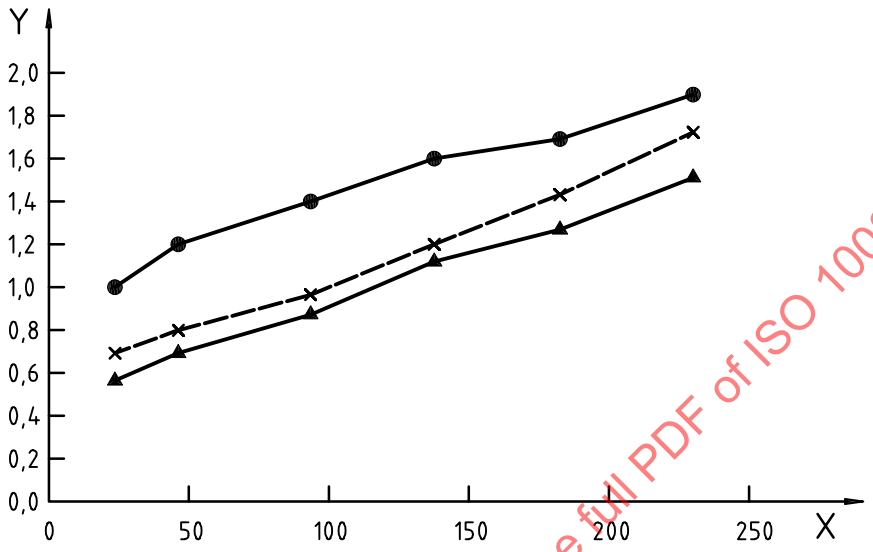
V_F is the volume of flocculant solution used in the test;

c_S is the solids concentration of the slurry used in the test.

A series of tests was carried out at different dosages, enabling the cake yield/dosage plot (Figure A.1) to be prepared. A further series of tests was then carried out with different flocculants.

In Figure A.1, for a desired cake (dry solids) yield of 1,5 g·cm^{-2}, this is achieved at a lower dosage with flocculant A than with flocculants B or C, at a dosage rate of approximately 2 mg/L of slurry.

Filtrate clarity and cake moisture content are taken into consideration where recirculation of the filtrate and product dryness are of importance.



Key

Flocculant A

Flocculant B

Flocculant C

X Flocculant dosage rate (kg/tonne of solids)

Y Yield (mass of dry solids per square centimetre of filtration area) (g/cm^2)

Figure A.1 — Effect of flocculant dosage rate for vacuum filtration