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Bamboo-based activated carbon — General specifications

Charbon actif à base de bambou — Spécifications générales

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Foreword

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This document was prepared by Technical Committee ISO/TC 296, *Bamboo and Rattan.*

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

Activated carbon is a carbonaceous material with a complex porous structure, manufactured from materials such as coal, wood and coconut shell. It is highly valued for its various applications in the environment, industry, food, pharmaceutical, and agriculture. These applications include water treatment and filtration, air and gaseous purification, beverage, fuel storage, solvent recovery, and electroplating solutions. Bamboo is an alternative renewable source to produce activated carbons. The rapid growth and development of bamboo-based activated carbons make it necessary to establish an international standard to guide production, quality requirements, and international trade.

Bamboo-based activated carbon — General specifications

1 Scope

This document specifies general requirements and test methods for bamboo-based activated carbon.

2 Normative references

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

ISO 18122, *Solid biofuels — Determination of ash content*

ISO 18134-3, *Solid biofuels — Determination of moisture content — Oven dry method — Part 3: Moisture in general analysis sample*

ISO 18135, *Solid biofuels — Sampling*

ISO 1953, *Hard coal — Size analysis by sieving*

ISO 21625, *Vocabulary related to bamboo and bamboo products*

ISO 21626-1, *Bamboo charcoal — Part 1: Generalities*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21625, ISO 21626-1 and the following 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
bamboo-based activated carbon
BAC
carbonaceous material made from carbonization of bamboo materials and activation processing

3.2
granular bamboo-based activated carbon
GBAC
bamboo-based activated carbons with a particle size of >1,0 mm

3.3
powdered bamboo-based activated carbon
PBAC
small bamboo-based activated carbon particles with a size of ≤1,0 mm

3.4
formed bamboo-based activated carbon
FBAC
product made by mixing bamboo charcoal with or without a binder which is extruded at high pressure into a particular shape and further activation in a specific condition

3.5
abrasion
loss of material from particle surfaces of a solid material or from other surfaces in contact with steel balls under specified conditions, caused by friction between contacting surfaces

[SOURCE: ISO 1213-2: 2016, 3.1]

3.6
abrasion value
resistance to *abrasion* (3.5), measured as the percentage of a sample passing through a specified sieve after tumbling under conditions specified known as ball-pan hardness

[SOURCE: ISO 1213-2:2016, 3.3, modified — the definition has been generalized to apply to bamboo-based activated carbon]

4 Classification according to size and shape

Bamboo-based activated carbon (BAC) shall be classified as:

a) powdered bamboo-based activated carbon (PBAC);

b) granular bamboo-based activated carbon (GBAC);

c) formed bamboo-based activated carbon (FBAC).

FBAC can be further subdivided into cylinder BAC, bead BAC, cellular BAC, and other forms.

5 Requirements

5.1 Sensory inspection

The product shall appear black with no peculiar smell, contaminant, and foreign matter.

5.2 Requirements for physical and chemical properties of bamboo-based activated carbon

The bamboo-based activated carbon shall conform to the requirements specified in Table 1.

Table 1 — Requirements for physical and chemical properties of BAC

Entry	Item	Unit	Requirements
1	Moisture content	%	≤10,0
2	Ash content	%	≤15,0
3	Fixed carbon	%	≥70,0
4	Apparent density	g/cm^3	≥250,0
5	Abrasion value[a]	%	≥80,0
6	Iodine number	mg/g	≥500
[a] The item is used for GBAC.			

6 Sampling

Sampling of bamboo-based activated carbon shall be in accordance with ISO 18135. The sample for analysis shall be randomly chosen from a batch of bulk products with a minimum mass of 2,0 kg.

7 Test methods

7.1 Visual inspection

Put no less than 100 g of bamboo-based activated carbon on a piece of white paper, then observe and decide the sample by sense of sight.

7.2 Determination of moisture content

The moisture content shall be determined in accordance with ISO 18134-3.

7.3 Determination of ash content

The ash content shall be determined in accordance with ISO 18122.

7.4 Determination of fixed carbon

The fixed carbon shall be determined in accordance with ISO 21626-1.

7.5 Determination of apparent density

Bamboo-based activated carbon samples shall be oven-dried at (105 ± 2) °C for 3 h to remove moisture prior to the determination of apparent density. Ground bamboo-based activated carbon samples to powders or particles if necessary.

Load dry bamboo-based activated carbon samples into the funnel and allow to flow freely through the discharge orifice into the receiver with a given volume. Enough samples shall be used so that the samples spill evenly over the side of the receiver. The samples shall then be levelled off using a spatula. Tap the receiver lightly on the side to settle the samples, and remove any excess samples from its external wall. The filled receiver shall then be weighed to the nearest 0,01 g. The apparent density shall then be calculated in compliance with Formula (1):

$$\rho_a = (m_1 - m_0) / V \quad (1)$$

where

ρ_a is the apparent density of bamboo-based activated carbon, expressed in g/cm^3;

m_1 is the mass of bamboo-based activated carbon samples-filled receiver, expressed in grams;

m_0 is the mass of empty receiver, expressed in grams;

V is the volume of the receiver, expressed in cm^3; usually 100 cm^3 (see ISO 60).

The test shall be repeated three times using fresh samples for each test, and an average result obtained and rounded to the nearest 0,01 g/cm^3 for reporting, with an error less than 2,0 %. Otherwise, it shall be re-determined.

7.6 Determination of abrasion value

The abrasion value shall be determined in accordance with Annex A of this document.

7.7 Determination of iodine number

The iodine number shall be determined in accordance with Annex B of this document.

8 Marking and labelling

8.1 The following information shall appear on the face of the containers:

a) name and address of the manufacturer;

b) a reference to this document, i.e. ISO 5946;

c) date of production and batch identification;

d) net mass;

e) grade of the bamboo-based activated carbon.

8.2 A product's use instructions shall be printed on the back of the containers. The information shall include the name of the product, method of usage, storage, and usage precautions.

9 Packaging, transport and storage

9.1 The BAC products shall be handled with utmost care during transportation and shipping to avoid damage, moisture, and exposure to sunlight.

9.2 The products shall be stored in a cool, ventilated, dry place (ambient temperature). Exposure to sunlight, moisture, and ignition shall be avoided.

Annex A
(normative)

Determination of abrasion value

A.1 Apparatus and materials

A.1.1 **Hardness pan** (see Figure A.1)

Dimensions in mm

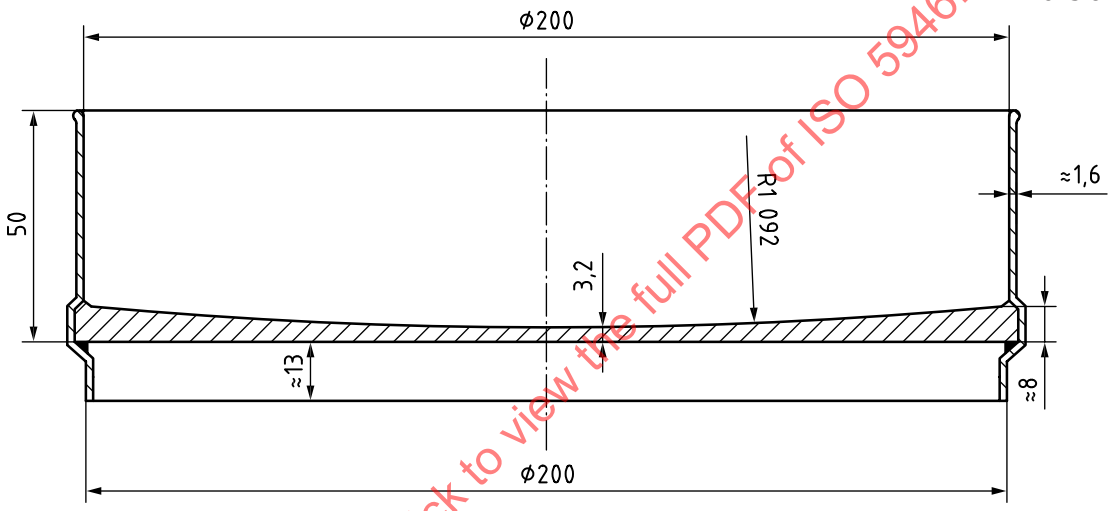

Figure A.1 — Hardness pan for abrasion resistance test

Material is plate, of one of the following alloys: (1) Cartridge brass, CuZn30, half-hard temper, hardness 60 HRB or greater; or (2) Aluminium bronze, CuAl8Fe3, soft temper, hardness 140 HB or greater. The pan is recommended to be solder-jointed.

A.1.2 **Mechanical sieve shaker**

The mechanical sieve shaker is designed to produce from 140 to 160 taps and from 280 to 320 rotating motions per min in a stack of standard sieves. Adjust the sieve shaker to accommodate the desired number of sieves, receiver pan, and sieve cover. Adjust the bottom stops to give a clearance of approximately 1,6 mm between the bottom plate and the sieves so that the sieves are free to rotate. Fit the cover plate with a cork stopper which extends from 3,2 to 9,5 mm above the metal recess.

A.1.3 **Sieves**, in accordance with ISO 565.

A.1.4 **Bottom receiver pan and top sieve cover** (see A.1.2).

A.1.5 **Timer**, with a precision of at least ±5 s, duration of at least 600 s (10 min).

A.1.6 **Sample splitter**, single-stage riffle type.

A.1.7 **Balance**, capable of weighing to the nearest 0,1 g.

A.1.8 Soft brass-wire brush.

A.1.9 Steel balls, 15 balls of diameter (12,7 ± 0,1) mm and/or 15 balls of diameter (9,5 ± 0,1) mm.

A.2 Procedure of determination

A.2.1 Determine the nominal particle size of the sample in accordance with ISO 1953 and its moisture content in accordance with ISO 18134-3.

A.2.2 Obtain an additional representative sample of approximately 125 ml of the sample.

A.2.3 Screen this sample to its nominal particle size distribution in accordance with ISO 1953. Discard the fractions above the larger and below the smaller nominal particle size. Obtain at least 100 ml of the sample within the nominal mesh size range. Use additional material obtained as in A.2.2, if necessary.

A.2.4 Measure out 100 ml of the screened sample into a tared, graduated cylinder, and weigh to the nearest 0,1 g.

A.2.5 Place the hardness pan (Figure A.1) on the standard bottom receiver pan. Pour the screened and weighed sample into the hardness pan and add the steel balls (A.1.9).

A.2.6 Complete the sieve stack by stacking five full-height sieves and the sieve cover on top of the hardness pan. The extra sieves, in this case, serve only to form a stack which fills the shaker, thus avoiding changes in tapping action and readjustment of the sieve stack retainer.

A.2.7 Place sieve stack in the sieve shaker and shake for 30 min ± 0,5 min, with tapping hammer operating.

A.2.8 At the end of the shaking period, remove the sieve stack from the sieve shaker and remove the hardness pan from the sieve stack. Place the test sieve on top of the receiving pan.

A.2.9 Remove the steel balls from the hardness pan and transfer the sample to the hardness test sieve, brushing adhering particles into the sieve. Stack the five full-height sieves and sieve cover on top of the hardness test sieve and receiving pan and replace the stack in the sieve shaker. Shake with the hammer operating for 10 min ± 10 s.

A.2.10 At the end of the shaking period, remove the sieve stack from the sieve shaker and transfer the remainder of the sample on the hardness test sieve to a tared weighing pan. Weigh to the nearest 0,1 g.

A.2.11 Sweep the pan catch into a tared weighing dish and weigh to the nearest 0,1 g.

A.3 Calculation

A.3.1 Calculate the abrasion value for abrasion resistance from the Formula (A.1):

$$H_0 = m_0/m \times 100\ \% \qquad \text{(A.1)}$$

where

H_0 is the abrasion value for abrasion resistance, expressed in percentage;

m_0 is the mass of sample retained on test sieve, expressed in grams;

m is the mass of sample loaded onto hardness pan, expressed in grams.

A.3.2 In order to check the accuracy of the test, calculate the abrasion value from the pan catch from the Formula (A.2):

$$H_1 = (1 - m_1/m) \times 100\ \% \quad \text{(A.2)}$$

where

H_1 is the abrasion value calculated from the pan catch, expressed in percentage;

m_1 is the mass of pan catch from A.2.11, expressed in grams.

If H_1 differs from H_0 by more than 2 %, it can be assumed that significant amounts of sample are not accounted for, and the run shall be rejected.

A.4 Report

The report shall include the following information:

a) name of the supplier;

b) grade designation of the sample;

c) nominal particle size range;

d) moisture content;

e) abrasion value for abrasion resistance;

f) name of the agency and technician making the test;

g) identification number;

h) date of the test;

i) lot number from which the sample was taken.

Annex B
(normative)

Determination of iodine number

B.1 General

The procedure applies to either powdered or granular activated carbon. When a granular sample shall be tested, grind a representative sample of bamboo-based activated carbon until 60 % of mass or more passes through a 325-mesh screen and 95 % or more passes through a 100-mesh screen. The sample received in the powdered form may need additional grinding to meet the particle size distribution requirement given above.

B.2 Reagents

B.2.1 Starch solution (1 g/1 000 ml)

B.2.2 Sodium thiosulfate solution (0,1 mol/l)

B.2.3 Standard iodine solution (0,100 mol/l)

B.2.4 Hydrochloric acid solution (5 % by mass)

B.2.5 Potassium iodate solution (0,100 0 mol/l)

B.2.6 Thermostatic dryer, capable of heating at (115 ± 5) °C and (130 ± 5) °C

B.2.7 Desiccator, with Type A silica gel desiccant

B.2.8 Balance, capable of weighing to the nearest 0,1 mg

B.2.9 Shaker, capable of reciprocal shaking 200 to 300 times per min, with 40 mm to 50 mm horizontal amplitude.

B.3 Procedure of determination

B.3.1 Place the sample which has been heated in a thermostatic dryer (B.2.6) at (115 ± 5) °C for approximately 3 h or longer, and then cooled in a desiccator (B.2.7) to room temperature.

B.3.2 The determination of the iodine number requires an estimation of three sample dosages. Formula (B.6) describes how to estimate the sample dosages to be used. After estimating sample dosages, weigh three appropriate amounts of dry sample to the nearest milligram. Transfer each weighed sample to a clean, dry 250-ml flask equipped with a ground glass stopper.

B.3.3 Pipet 10,0 ml of 5 % hydrochloric acid solution (B.2.4) into each flask containing the sample. Stopper each flask and swirl gently until the sample is completely wetted. Loosen the stoppers to vent the flasks, place on a hot plate in a fume hood, and bring the contents to a boil. Allow to boil gently for