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Carbonaceous materials used in the production of aluminium — Cold and tepid ramming pastes — Preparation of unbaked test specimens and determination of apparent density after compaction

Produits carbonés utilisés pour la production de l'aluminium — Pâtes de brasquage froides et tièdes — Préparation d'éprouvettes non cuites et détermination de la densité apparente après compactage

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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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This document was prepared by Technical Committee ISO/TC *226*, *Materials for the production of primary aluminium*.

This second edition cancels and replaces the first edition (ISO 14427:2004), which has been technically revised.

The main changes are as follows:

— the mass of the falling weight and the ramming rate have been corrected.

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

The bottom of aluminium electrolysis cells is lined with cathode blocks that are sealed with a ramming paste to avoid any leakage. When lining a cell, the green paste is directly rammed between the cathode blocks and baked in situ during the start-up of the pot by the process heat. The quality of the paste is of primary importance as to ensure long operation without disturbance.

Carbonaceous materials used in the production of aluminium — Cold and tepid ramming pastes — Preparation of unbaked test specimens and determination of apparent density after compaction

1 Scope

This document describes the preparation of unbaked test specimens made by compacting carbonaceous ramming pastes. This document also includes a method for determination of the apparent density after compaction.

Unbaked test specimens of ramming paste are not only prepared for determination of the apparent density of the paste after compaction, but also for the determination of the dimensional change during baking and for the subsequent determination of properties of baked test specimens.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 5725-2, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*

ISO 14422, *Carbonaceous materials used in the production of aluminium — Cold-ramming pastes — Methods of sampling*

3 Terms and definitions

No terms and definitions are listed in this document.

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/

4 Principle

The carbonaceous ramming paste is compacted in a cylindrical mould by a defined number of impacts at a specified force in a ramming apparatus. The bulk density is calculated from the mass and the dimensions of the resulting compacted test specimen. The test specimen may subsequently be baked, if desired, for further testing.

5 Apparatus and materials

5.1 General. An example of a rammer mould is shown in Figure 1.

5.2 Rammer cylinder. The rammer cylinder is made of steel, with an inner diameter of 50 mm.

5.3 Rammer base. The rammer base is made of steel. The rammer base shall fit into the rammer cylinder and act as the bottom of the cylinder.

5.4 Rammer. The rammer consists of a steel piston, a falling weight mounted so that it can be dropped onto the top of the piston, and a height-measuring device accurate to 0,1 mm. The mass of the falling weight shall be 6,7 kg ± 0,1 kg and the weight shall travel a constant distance to impact of (50 ± 0,1) mm.

5.5 Box (with lid). The box is capable of containing the amount of ramming paste needed to produce one test specimen. The free space over the paste shall not be more than 50 % of the volume of the paste.

5.6 Heating/cooling cabinet. The heating/cooling is capable of being maintained at a constant temperature ±0,5 °C in the range 5 °C to 100 °C.

5.7 Insulation layer. The insulation layer (for example, 1-cm-thick polystyrene), for insulation of the rammer cylinder, or thermostatically controlled surround (see Figure 1).

5.8 Balance, accurate to 0,1 g.

6 Sampling

Sample the paste in accordance with ISO 14422.

NOTE Experience has shown that 150 g to 200 g of ramming paste is necessary for each test specimen.

7 Procedure

Ensure the cylinder, the ram base and the piston are clean.

Weigh the necessary amount of ramming paste (to the nearest 0,1 g) into a suitable box (5.5). If the amount of ramming paste to be used is not known, determine the required mass by preliminary tests [the height of the test specimen after compaction has to be (50 ± 5) mm (see below)]. Seal the box. Heat or cool the box together with the rammer cylinder (5.2), the rammer base (5.3) and the insulation/surround (5.7) to the test temperature (agreed between the interested parties) in the heating/cooling cabinet (5.6) for 2 h to 3 h.

Transfer the paste to the cylinder. Protect the cylinder with the insulation or surround (5.7). Place the cylinder in the rammer (5.4) and lower the piston until it is resting on the paste. Compact the ramming paste with 100 impacts at a rate of about 50 ± 5 impacts per minute.

Read the height h of the test specimen (to the nearest 0,1 mm) from the scale on the ramming apparatus, with the piston head resting on the specimen. If the height of the compacted test specimen is not equal to (50 ± 5) mm, discard the result and repeat the test with another sample mass.

Remove the test specimen. Clean the cylinder, the ram base and the piston carefully after each test.

8 Expression of results

8.1 Apparent density of unbaked paste

Calculate the apparent density ρ, in g/cm^3, of the unbaked test specimen using Formula (1):

$$\rho = \frac{m}{\pi r^2 h} \quad (1)$$

where

m is the mass, in g, of the ramming paste placed in the cylinder, accurate to 0,1 g;

r is the inner radius of the ramming cylinder, in cm, accurate to 0,01 cm;

h is the height of the unbaked test specimen as read from the rammer scale, in cm, accurate to 0,01 cm.

Round the result to the nearest 0,001 g/cm^3.

8.2 Precision

The precision is determined in accordance with ISO 5725-2.

Repeatability, r = 0,023 in g/cm^3

Reproducibility, R = 0,042 in g/cm^3

The number of degrees of freedom is, the number of laboratories (6) × number of samples (4) × analysed in duplicate (2), which is 48.

9 Test report

The test report shall include the following information:

a) an identification of the sample;

b) the document version used, i.e. ISO 14427:2024;

c) the method used (if the standard includes several);

d) the date of the test;

e) the result(s), including a reference to the clause which explains how the results were calculated;

f) any deviations from the procedure;

g) any unusual features observed:

1) details of any unusual features noted during the determination;

2) details of any operation not included in this document or regarded as optional.