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Carbonaceous materials for the production of aluminium — Cathode block materials —

Part 1: Determination of the expansion due to sodium penetration with application of pressure

Produits carbonés utilisés pour la production de l'aluminium — Blocs cathodiques —

Partie 1: Détermination de l'expansion due à la pénétration du sodium avec application de pression

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Contents

Page

Foreword ..... **iv**
Introduction ..... **v**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Principle **1**
5 Apparatus **1**
6 Reagents **3**
7 Samples **3**
8 Procedure **3**
9 Results **4**
9.1 Calculation 4
9.2 Precision 4
10 Test report **4**
Bibliography **6**

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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.

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 documents 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 226, *Materials for the production of primary aluminium*.

This third edition cancels and replaces the second edition (ISO 15379-1:2015), which has been technically revised. The main changes to the previous edition are as follows:

— ASTM E 220 has been removed from Clause 2 and 5.3;

— minor changes have been made in 6.2, 6.3, 6.4 and 6.5;

— Clause 10 has been aligned with test reports in other ISO/TC 226 standards.

A list of all parts in the ISO 15379 series can be found on the ISO website.

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.

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Introduction

Expansion due to sodium penetration is an important property of carbon cathode blocks. As soon as alumina electrolysis starts, sodium penetrates into the carbon cathode blocks causing swelling of these blocks. This increase in volume creates mechanical stresses within the blocks and/or bulging of the bottom block plate. This can lead to cracks through which liquid aluminium and/or liquid electrolyte can flow, reaching the thermal insulation beneath the blocks and destroying these ceramic materials. In such cases, the electrolysis cell has to be relined, resulting in loss of aluminium production and high expenses. Therefore, cathode blocks produced with materials allowing only low sodium penetration and with the lowest possible expansion due to sodium penetration are preferred.

The study can be supplemented by measuring electrical resistivity (see ISO 11713) before and after the test.

Due to thermal and sodium expansion when heating up the cathode blocks in the electrolysis cells to operational temperature, the block will be subject to pressure from the steel shell; therefore, in the present method, 5 MPa is chosen as a realistic maximum pressure.

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Carbonaceous materials for the production of aluminium — Cathode block materials —

Part 1: Determination of the expansion due to sodium penetration with application of pressure

1 Scope

This document specifies a method that covers the determination of linear expansion under external pressure due to sodium penetration in cathode-block materials used in the production of aluminium.

The linear expansion of the blocks depends on the sampling direction due to anisotropy.

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 8007-1, *Carbonaceous materials used in the production of aluminium — Sampling plans and sampling from individual units — Part 1: Cathode blocks*

3 Terms and definitions

No terms and definitions are listed in this document.

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

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

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

4 Principle

An anodic graphite crucible containing a cryolitic bath with an initial cryolite ratio of 4,0 and with a cathode carbon sample placed in the crucible, as shown in Figure 1, is used for this experiment. The whole sample is immersed in a cryolitic bath with a graphite cylinder fitted as an extension from the sample. The crucible is placed in a crucible support, which is connected to a hydraulic power cylinder. A constant pressure of 5 MPa is applied to the sample by pressing the graphite cylinder against a stop rod in the top of the furnace by the hydraulic power cylinder. The whole assembly is heated in a tubular furnace to (980 ± 5) °C and is then electrolyzed for 2 h with a current density of approximately 0,7 A/cm^2 (see Clause 7 for precise setting). The expansion is measured by a probe, which is fastened to the frame of the furnace and measures the position of the crucible support.

5 Apparatus

The principle of the apparatus for measuring sodium expansion is shown in Figure 1.

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