INTERNATIONAL STANDARD

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Third edition
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Dense shaped refractory products — Determination of bulk density, apparent porosity and true porosity

Produits réfractaires façonnés denses — Détermination de la masse volumique apparente, de la porosité ouverte et de la porosité totale

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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.

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 5017 was prepared by Technical Committee ISO/TC 33, *Refractories*.

This third edition cancels and replaces the second edition (ISO 5017:1998), which has been technically revised.

Dense shaped refractory products — Determination of bulk density, apparent porosity and true porosity

1 Scope

This International Standard specifies a method for the determination of the bulk density, apparent porosity and true porosity of dense shaped refractory products.

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 758, *Liquid chemical products for industrial use — Determination of density at 20 °C*

ISO 5018, *Refractory materials — Determination of true density*

3 Terms and definitions

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

3.1
bulk density
ρ_b
ratio of the mass of the dry material of a porous body to its bulk volume, expressed in grams per cubic centimetre or in kilograms per cubic metre

3.2
bulk volume
V_b
sum of the volumes of the solid material, the open pores and the closed pores in a porous body

Note 1 to entry: The roughness of the surface limits the accuracy of definition of the bulk volume and consequently, that of the bulk density. Also, the concept of bulk density becomes less precise when the volume of the sample diminishes below certain limits or when its texture (size of pores and grains) is too coarse.

3.3
true density
ρ_t
ratio of the mass of the dry material of a porous body to its true volume, expressed in grams per cubic centimetre or in kilograms per cubic metre, determined in accordance with ISO 5018

3.4
true volume
volume of the solid material in a porous body

3.5
open pores
those pores that are penetrated by the immersion liquid in the test described

Note 1 to entry: These pores are, in principle, all those that are connected with the atmosphere, either directly or via one another. Here also the roughness of the surface imposes a limit to the accuracy of the definition of the volume of the open pores.

3.6
closed pores
those pores that are not penetrated by the immersion liquid in the test described

3.7
apparent porosity
π_a
ratio of the total volume of the open pores in a porous body to its bulk volume, expressed as a percentage of the bulk volume

3.8
closed porosity
π_f
ratio of the total volume of the closed pores in a porous body to its bulk volume, expressed as a percentage of the bulk volume

3.9
true porosity
π_t
the ratio of the total volume of the open and closed pores to the bulk volume of the material, expressed as a percentage

Note 1 to entry: Consequently, the true porosity is the sum of the apparent porosity and the closed porosity.

3.10
dense shaped refractory product
product having a true porosity of less than 45 % (V/V)

4 Principle

4.1 The following are determined by weighing:

the mass of a dry test piece;

its apparent mass when immersed in a liquid with which it has been impregnated under vacuum;

its mass in air while still soaked with the liquid.

From these values and from the true density of the material, determined by the method specified in ISO 5018, the bulk density, apparent porosity and true porosity are determined by calculation.

4.2 The precision of the results does not require any correction to be made for the fact that weighings are carried out in air, not in a vacuum.

5 Apparatus and materials

5.1 Drying oven, capable of being controlled at 150 °C ± 10 °C.

NOTE A fan-assisted oven with ventilation would assist in attaining an even temperature distribution and efficient drying of the test pieces.

5.2 Balance, with an accuracy of ± 0,01 g, that can be arranged so that test pieces can be suspended in the immersion liquid (see Figure 1).

5.3 Beakers, of a suitable size for containing the samples during soaking (see 7.2) and when determining the apparent immersed mass (see 7.3).