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Prepared unshaped refractory materials (dense and insulating) — Classification

Matériaux réfractaires non façonnés préparés (denses et isolants) — Classification

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 1927 was prepared by Technical Committee ISO/TC 33, *Refractories*.

ISO 1927 was first published in 1975. This second edition cancels and replaces the first edition, of which it constitutes a technical revision.

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Prepared unshaped refractory materials (dense and insulating) — Classification

1 Scope and field of application

This International Standard establishes the definition, classification and designation of prepared unshaped refractory materials (dense and insulating).

It does not apply to refractory materials which have only been crushed or granulated.

2 References

ISO 565, *Test sieves — Woven metal wire cloth, perforated plate and electroformed sheet — Nominal sizes of openings.*

ISO/R 836, *Vocabulary for the refractories industry.*

3 Definitions

3.1 prepared unshaped refractory materials : Mixtures (see note) which consist of an aggregate and a bond or bonds, prepared ready for use either directly in the condition in which they are supplied or after the addition of one or more suitable liquids, and which satisfy the requirement on refractoriness given in ISO/R 836.

Certain prepared unshaped materials which do not correspond to the definition of refractory materials (i.e. pyrometric cone equivalent of at least 1 500 °C) but which nevertheless correspond to the criteria of this International Standard may be classified in accordance with it.

NOTE — These mixtures are either dense or insulating. Insulating mixtures are those whose true porosity is not less than 45 % when determined on a test specimen fired according to specified conditions.¹⁾

3.2 Nature of the bond

Depending on the hardening process of the different materials, the bond may be :

- a **ceramic bond** with hardening by sintering during firing;
- a **hydraulic bond** with setting and hydraulic hardening at ambient temperature;
- a **chemical bond** (inorganic or organic-inorganic) with hardening by chemical, but not hydraulic, reaction at

ambient temperature or at a temperature lower than that of a ceramic bond;

- **bonding by an organic product** with binding or hardening at ambient temperature or at higher temperatures.

When several bonds are used conjointly, the bond is designated according to the nature of that bond which plays the principal part during the hardening.

3.3 granulometric class : The mesh width of the finest sieve (ISO 565 series) through which at least 95 % by mass of the material passes.

3.4 yield by volume : The mass (expressed in tonnes, to the nearest hundredth) of material as delivered, necessary to place 1 m³ of material.

3.5 Type of use

Prepared unshaped refractory materials are subdivided according to type of use into

- materials for monolithic construction and for repairs (3.5.1);
- materials for placing and jointing (3.5.2);
- coatings (3.5.3);

In each of these subdivisions, a distinction is made between types of materials.

3.5.1 Materials for monolithic construction and for repairs

A distinction is made between four types :

3.5.1.1 refractory ramming materials : Materials which are non-coherent before use. They are made up of refractory aggregate, bond(s) and, if necessary, liquid(s).

According to the type of product, the main bond may be ceramic, chemical (inorganic, organic-inorganic), or organic. They are used as delivered or after the addition of liquid(s).

They are placed by ramming (manual or mechanical). They mostly harden under the action of heat above the ambient temperature.

1) ISO work in progress.

3.5.1.2 mouldable refractory materials : Materials which are ready for use, having a mouldable consistency, and made up of refractory aggregate, bond(s) and a liquid(s).

According to the type of product, the principal bond may be ceramic, chemical (inorganic, organic-inorganic) or organic. They are supplied in soft, pre-formed blocks or in an unshaped mass.

They are placed by ramming (manual or mechanical), by vibrating, by pressing or by "extrusion". They harden under the action of heat greater than ambient temperature.

3.5.1.3 refractory castables : Mixtures of refractory aggregate and bond(s).

They are supplied dry and used after the addition of water or another liquid, and mixing.

They are placed by casting and vibration, rodding or, where necessary, by tamping. The bond is formed and hardening takes place without heating.

According to the nature of the bond, a distinction is made between

- a) **hydraulic castables**, essentially containing a hydraulic bond;
- b) **chemical castables**, containing one or more chemicals which cause hardening.

3.5.1.4 refractory gunning materials : Mixtures of refractory aggregate and bond(s), specially prepared for placing by pneumatic or mechanical projection and which, by virtue of their other characteristics, may belong to one of the three preceding types (3.5.1.1, 3.5.1.2, 3.5.1.3).

3.5.2 materials for laying and jointing : Materials which may be applied either with a trowel or a similar instrument, or by grouting in the joints, or by dipping the piece to be bonded.

A distinction is made between three types :

3.5.2.1 refractory cements (ceramic bond) : Mixtures of fine refractory aggregate and bond(s) of a ceramic nature, supplied either in the dry state and made ready for application by the addition of water, or ready for use.

They harden at high temperature by ceramic bonding.

3.5.2.2 refractory cement (hydraulic bond) : Mixtures of fine refractory aggregate and bond(s) which are essentially hydraulic in nature.

They are supplied solely in the dry state and are made ready for application by the addition of water. They harden without heating.

3.5.2.3 refractory cements (chemical bond) : Mixtures of fine refractory aggregate and bond(s), which are essentially chemical (inorganic, organic-inorganic) or organic in nature.

They may be supplied either ready for use or in the dry state and, in the latter case, they are made ready for application by the addition of water or another liquid. They harden at temperatures lower than those required for ceramic bonding.

According to these temperatures, a distinction is made between air-setting cements and heat setting cements.

3.5.3 coatings : Mixtures of fine refractory aggregate and bond(s). According to the type of product, the principal bond may be either ceramic, or hydraulic or chemical (inorganic, organic-inorganic) or organic.

These materials generally have a higher water or other liquid content than do materials for placing and jointing. They may be applied manually (with a brush or trowel) or by pneumatic or mechanical projection.

4 Classification

Prepared unshaped refractory materials are classified according to

- their chemical composition determined on the whole mixture. The appropriate treatment must be stated (e.g. drying and calcination);

- the nature of the principal material(s) in proportion and/or properties of the aggregate which confer special properties on the mixture (e.g. corundum, bauxite, synthetic mullite, fireclay, magnesia, carbon, carbides, zircon).

This classification corresponds to the principal classes in the following table :

Class	Denomination or limiting content of principal oxides
I	Materials with content of $Al_2O_3 \geq 45\%$
II	Materials with content of $10\% \leq Al_2O_3 < 45\%$
III	Materials with content of $SiO_2 \geq 85\%$; $Al_2O_3 < 10\%$
IV	Basic materials (magnesia, chrome ore, spinel, forsterite, dolomite, other alkaline earth oxides) and mixtures of these
V	Special materials (carbon, carbide, nitrides, zircon, etc.) and mixtures of these
VI	Mixed materials : Mixtures of those materials which are the constituents of classes I to V, the essential materials being constituents of classes I to IV
VII	Special mixed materials : Mixtures of those materials which are the constituents of classes I to V, but in which the essential materials are constituents of class V except the mixtures of the class V

5 Designation

The complete designation of a prepared unshaped refractory material includes the following information :

- the type (see 3.5);
- the class (see clause 4);
- the principal material(s) and/or properties of the aggregate (see clause 4);

- the nature of the bond (see 3.2);
- the condition in which it is delivered (see 3.5);
- the method of placing (see 3.5);
- the granulometric class (see 3.3);
- the yield by volume (see 3.4).

Examples :

Class I : Mouldable refractory material, class I, corundum based, with ceramic bond, ready for use, to be placed by ramming, granulometric class 6 mm, yield by volume 2,80 t/m³.

Refractory castable, class II, chamotte based, with hydraulic bond, supplied dry, to be placed by casting and vibration, granulometric class 5 mm, yield by volume 2,30 t/m³.

Class II { Refractory castable, class II, insulating chamotte based, with hydraulic bond, supplied dry, to be placed by pneumatic projection, granulometric class 3 mm, yield by volume 0,80 t/m³.

Class III : Refractory ramming siliceous material, class III, quartzite based, with ceramic bond, ready for use, to be placed by mechanical projection, granulometric class 3 mm, yield by volume 2,20 t/m³ (e.g. slinger mass).

Class IV : Refractory ramming material, class IV, magnesia based, containing chromite, with chemical bond, supplied dry to be placed by ramming, granulometric class 5 mm, yield by volume 2,70 t/m³.

Class V { Mouldable refractory material, class V, carbon based, containing silicon carbide, with organic bond, supplied in an unshaped mass, to be placed by ramming, granulometric class 15 mm, yield by volume 2,10 t/m³.

Refractory ramming material, class V, zircon based, with chemical bond, supplied dry to be placed, after the addition of the bond, by ramming, granulometric class 1 mm, yield by volume 3,40 t/m³ (e.g. masses for glass work).

Class VI : Mixed refractory castable, class VI, corundum based, containing chromite, with hydraulic bond, supplied dry, to be placed by casting, vibration and ramming, granulometric class 5 mm, yield by volume 2,80 t/m³.

Class VII : Special mixed mouldable refractory material, class VII, silicon carbide, silicon nitride and carbon based, containing corundum, with ceramic bond, supplied in an unshaped mass, to be placed by ramming, granulometric class 10 mm, yield by volume 2,30 t/m³.

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6 Terminology

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English	French	German	Spanish	Italian	Portuguese
Refractory cement ¹⁾ (ceramic bond)	Coulis réfractaire	keramischer Feuermörtel	Mortero refractario	Malta refrattaria	Cimento refractário para assentamento de presa ²⁾ cerâmica
Refractory cement ¹⁾ (hydraulic bond)	Ciment réfractaire à liant hydraulique	hydraulischer Feuermörtel	Cemento refractario de fraguado hidráulico	Cemento refrattario (a legante idraulico)	Cimento refractário para assentamento de presa hidráulica
Refractory cement ¹⁾ (chemical bond)	Ciment réfractaire à liant chimique	chem. gebundener Feuermörtel	Cemento refractario de fraguado químico	Cemento refrattario (a legante chimico)	Cimento refractário para assentamento de presa química
Coating	Matériau pour enduit Matériau pour revêtement de surface	Anstrichmaterial Verputze Spachtel	Recubrimiento refractario Revestimiento refractario superficial	Intonaco Rivestimento di superficie	Induto Revestimento de superficie
Ramming material	Pisé	Rammasse (Stampfmasse)	Masa para apisonar	Pigiata	Mistura de apiloamento
Mouldable material	Mélange plastique	plastische Masse	Masa plástica	Massa plastica	Mistura plástica
Refractory castable	Béton réfractaire	Feuerbeton	Hormigón refractario	Calcestruzzo refrattario	Betão ²⁾ refractário
Gunning material	Mélange projetable	Spritzmasse, Schleudermasse	Masa proyectable	Massa da spruzzo	Mistura projectável

1) In some countries, the term "mortar" is used instead of "cement" (Australia, USA) and in India the term "cement" is used only for hydraulic bonding, other types being called "mortar".

2) In Brazil, the terms "pega" and "concreto" are used instead of the terms "presa" and "betão" respectively.