National Standards Authority of Ireland

IRISH STANDARD

I.S. CEN/TS 15418:2006

ICS 81.080

METHODS OF TEST FOR DENSE REFRACTORY PRODUCTS - GUIDELINES FOR TESTING THE CORROSION OF REFRACTORIES CAUSED BY LIQUIDS

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English Version

Methods of test for dense refractory products - Guidelines for testing the corrosion of refractories caused by liquids

Méthodes d'essai pour produits réfractaires denses - Lignes directrices pour la conduite sur réfractaires d'essais de corrosion provoquée par des liquides

Prüfverfahren für dichte feuerfeste Erzeugnisse - Leitlinien zur Prüfung von durch Flüssigkeiten hervorgerufene Korrosion an feuerfesten Erzeugnissen

This Technical Specification (CEN/TS) was approved by CEN on 25 March 2006 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

CEN members are required to announce the existence of this CEN/TS in the same way as for an EN and to make the CEN/TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the CEN/TS) until the final decision about the possible conversion of the CEN/TS into an EN is reached.

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Foreword

This Technical Specification (CEN/TS 15418:2006) has been prepared by Technical Committee CEN/TC 187 “Refractory products and materials”, the secretariat of which is held by BSI.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

These guidelines introduce the principles, testing and assessment of corrosion of refractories by liquids (molten metals, metallurgical slags, glasses, fluxes etc.) and describe four commonly used test methods.

— Method A: Corrosion testing by the crucible test;

— Method B: Corrosion testing by the finger-dip test;

— Method C: Corrosion testing by the rotary slag test;

— Method D: Corrosion testing by the induction crucible test.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 1402-5 *Unshaped refractory products — Preparation and treatment of test pieces*

EN ISO 12677 *Chemical analysis of refractory products by XRF— Fused cast bead method (ISO 12677:2003)*

ISO 3611 *Micrometer callipers for external measurement*

3 General

3.1 Principles

Industrial refractories are mainly used for the inner linings of operational units in combustion, chemical, metallurgical and materials manufacturing processes. Because of the thermal, chemical, mechanical and physical gradients encountered in these refractory linings, their service life is limited by corrosion phenomena, which often involve a combination of different mechanisms such as dissolution, invasive penetration, oxidation-reduction reactions, mass transport, acid-base reaction and spalling of reacted layers.

Because of the complexity of the phenomena, a simple, all-encompassing, general theory of corrosion of refractory materials does not exist, but some basic principles can be applied.

A fundamental and long considered principle is the acid-base relationship between the refractory and the corroding liquid so that an acid refractory such as silica is chosen for an acidic liquid and a basic refractory such as magnesia or doloma for a basic liquid. For example, commonly used acid-base ranking of various compounds are:

> most acidic < N_2O_5 (g) < SO_3 (g) < SO_2 (g)< CO_2 (g) < B_2O_3 (g or l) < V_2O_5 (g or l) < SiO_2 (s) <TiO_2 (s) < ZrO_2 (s) < Fe_2O_3 (s) < Cr_2O_3 (s) < Al_2O_3 (s) < FeO (s) < NiO (s) < MnO (s) < MgO (s) < CaO (s) < Na_2O (s or g) < K_2O (s or g) < most basic.

However, whilst this approach provides a starting point for refractory selection, it has limited value in comparing actual behaviour.

A second approach is to make appropriate thermodynamic calculations for the thermal stability of each constituent (free energy of formation); red-ox potentials and possible reactions (free energy change) between reactants (solid, liquid and gas) with the help of the Ellingham diagrams; and the volume changes caused by phase transformations inducing microcracks in the matrix.