THE FIRST STATE STANDARD FOR REFRACTORY CONCRETE


Refractory concrete is replacing blocks on an increasing scale in various branches of industry, the reasons being that with concrete industrial methods can be employed for constructing and repairing kilns and furnaces so that labor productivity is higher, the construction time of furnaces and kilns and downtime for repairs are shorter, and overall costs are lower (K. K. Strelov, D. S. Rutman, and P. N. Dyakov [1, pp. 6-24]; S. S. Serebrennikov [1, pp. 25-31]; A. V. Kudryavtsev [1, pp. 39-40]; A. S. Freidenberg, I. N. Sorokin, N. P. Zaryalova, et al. [1, pp. 259-262]) [2, 3].

The output of refractory concretes increases with the range of applications. They are now produced by the Khristoforov plant for refractory blocks and concretes, at the Pervouralsk plant, at the Panteleimonov and Semiluk refractories plants, and the "Magnezit" plant, at the Magnitogorsk and Kuznetsk Metallurgical Combines, and at the Suvorov Ore Administration (K. K. Strelov, D. S. Rutman, and P. N. Dyakov [1, pp. 6-24]) [4-6]. Production sections for refractory concrete are planned for the Novomoskovsk rham-motte plant, the East Siberian and Bogdanovich refractories plants, and a plant in Rudnom.

A large volume of research has been carried out in the theoretical principles of concrete production and a range of compositions for refractory concretes has been developed (A. K. Purgin, S. L. Shantarina, N. K. Pisarenko, et al. [1, pp. 52-63]; L. K. Doronin and N. V. Mikhailov [1, pp. 64-77]; P. S. Mamykin, V. D. Koksharov, and A. K. Purgin [1, pp. 135-142]; S. R. Zamyatin and P. S. Mamykin [1, pp. 143-150]) [7].

However, the terminology and principal characteristics used in the literature for describing refractory concretes are not unified, nor are the specifications and methods of testing.

It was deemed necessary, therefore, to standardize the basic conceptions and characteristics in the field of refractory concretes, and at the same time to prepare production standards for the various types. The first stage in the standardization of refractory concretes consisted of preparing a State Standard for their classification.

Based on a plan of the State Standards Committee the Eastern Institute of Refractories has drawn up State Standard GOST 19038-73 "Refractory Products and Materials. Classification of Concretes" which will come into force on January 1, 1975.

The new standard is based on GOST 4385-68 "Refractory Products. Classification" and use has been made of recommendations issued by ISO and COMECON, of non-Soviet standards for concrete, and of other literature sources.

In the current Construction Norms and Regulations [8-10] refractory and other concretes are grouped together under the head "Heat-Resisting Concretes." Such a classification serves no purpose since the concept lumps together materials and products with a wide range of properties and used at temperatures from 200 to 1700°C or higher.

The specifications for refractory concretes intended for service at temperatures above 900°C, at which sintering sets in and a liquid phase is formed, must differ from those used at lower temperatures. Moreover, the term "heat-resisting" which in application to metals and certain oxide-free refractories

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(e.g. silicon carbide) means resistant to oxidation [11] cannot describe refractory concretes since these are predominantly oxide materials. Refractory concretes are classed as refractory materials [12, p. 54].

These facts formed the development basis for a separate standard for refractory concretes.

In the new standard the term "refractory concrete" is defined as describing not only concretes which contain a refractory aggregate [10] but also concretes with a refractoriness of at least 1580°C.

The definition of a refractory concrete covers the principal features describing the composition, the conditions of setting and the main requirements for concrete as an unfired material, viz. limited shrinkage at the service temperature.

According to the standard, refractory concretes should include a large number of refractories in fabricated form (blocks and monolithic linings) and in the form of starting materials (the concrete batches and mixtures used for fabricating the product).

The standard applies to refractory concretes with organic and organomineral binders. The inclusion of organic and organomineral substances among binders and the refractory materials made with them among refractory concretes is substantiated by reference to the accepted principles of binder science [13, 14]. Moreover, certain unfired products with a low degree of shrinkage at the service temperature should also be included among refractory concretes. Among them are tar-bonded magnesite and dolomite products, chrome—magnesite products with sulfite lye binder, etc.

The classification of refractory products and materials including refractory concretes is based on the chemical and mineral compositions which govern the principal service properties. Refractory concretes are divided into types and groups in accordance with the chemical and mineral compositions of the aggregate and not of the concrete as a composition material since the mineral composition of the concrete may vary with the binder type, the setting conditions, the heat-treatment temperature, etc.

The classification of refractory concretes in accordance with their chemical and mineral compositions differs only slightly from that in GOST 4385-68. For example, there are now four in place of three groups of silica type concretes, the additional one being corundum-containing types including chrome—alumina and titan—alumina concretes.

The aggregates of refractory concretes differ in terms of the apparent density which determines the apparent density and porosity of the concrete. Constructional concretes are classified in accordance with the apparent density into super-heavy, heavy, light-weight and super-light concretes [8, 10]. Like the useful life of other refractory products that of refractory concretes depends not so much on the apparent density as on the open porosity which to a certain extent governs the corrosion and erosion resistance of the refractory.

In the new standard refractory concretes are therefore classified in accordance with the open porosity determined after heating for two hours at 800°C. The subgroups according to the open porosity are high-density, medium-density, normal-density, reduced-density and low-density concretes. The limiting values of the porosity in each group are defined by GOST 4385-68.

To ensure the correct and efficient utilization of refractory concretes they are classified, moreover, in accordance with their peak service temperature, i.e. the temperature at which the linear contraction should not be greater than 1% after heating for five hours. In this respect the concretes are divided into eight groups of service temperatures of 1100 to 1700°C and higher in steps of 100°C.

The production method predetermines the physiomechanical properties of concrete so that in the new standard the refractory concretes are divided into cast, vibro-cast, rammed and pneumatically or mechanically applied (gunite) concretes. Each kind of concrete is used in accordance with the purpose in a given field of utilization.

The refractory concretes are not classified in accordance with their strength, which is the practice in non-Soviet standards [15], or in accordance with the shape and size of the products. These criteria are best dealt with in standards for given groups of concretes.

The introduction of GOST 19038-73 will permit unification of terminology in the relevant technical literature. The new standard will form the basis upon which standards for individual concretes and their testing methods will be prepared.