# SOME PROPERTIES OF ELECTROFUSED ZIRCON – MULLITE REFRACTORY

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The present authors studied the properties of electrofused zircon–mullite refractory obtained from Tumanyan stone-like clay, processed alumina, and zircon concentrates. The zircon–mullite specimens obtained by melt casting consist of a light-gray material of high density with a fine crystalline homogeneous structure. The main phase making up the refractory is mullite (85-90%), and the gaps between the mullite crystals are filled with a glass phase.

The properties of fused – cast refractories were compared with those of fireclay products which at present are used for lining glass tanks and some heating units in the iron and steel industry (Tables 1 and 2).

The dynamic properties of the material possess a certain relationship with their static properties. To determine the elastic characteristics we used the ultrasonic method based on measuring the rate of spread of longitudinal ultrasonic waves.

The dynamic elasticity modulus $E_d$ is calculated from the equation

$$E_d = \frac{\gamma_0 v^2 \cdot 10}{K \cdot 981} \text{ kg/cm}^2,$$

TABLE 1. Chemical Composition of Refractories, %

| Material | $SiO_2$ | $TiO_2$ | $Al_2O_3$ | $ZrO_2$ | $Fe_2O_3$ | CaO | MgO | $Na_2O$ |
|---|---|---|---|---|---|---|---|---|
| Zircon–mullite | 22,13 | 0,90 | 66,80 | 6,55 | 0,30 | 1,33 | 0,50 | 0,65 |
| Chamotte | 59,00 | 1,50 | 35,00 | — | 1,30 | — | — | — |

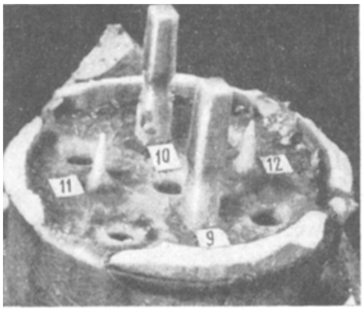

Fig. 1

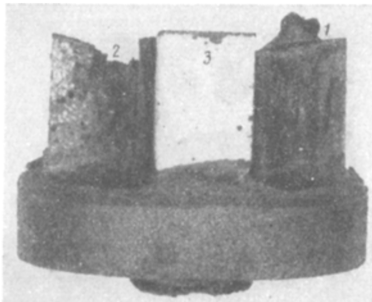

Fig. 2

Fig. 1. Specimen after testing for glass resistance: 9 and 10) zircon mullite; 11 and 12) chamotte.

Fig. 2. Specimens after testing for slag resistance: 1) zircon –mullite; 2) firebrick; 3) standard.

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TABLE 2. Properties of Refractories

| Material | Refractoriness, °C | Refractoriness under 2 $kg/cm^2$ load, °C | Apparent porosity, % | Density, $g/cm^3$ | |
|---|---|---|---|---|---|
| | | | | apparent | true |
| Zircon – mullite | 1780 | 1750 | 1.45 | 3.15 | 3.29 |
| Chamotte. . . . . | 1690 | 1400 | 16.0 | 2.0 | 2.10 |

TABLE 3. Properties of Specimens

| Material | Strength, $kg/cm^2$ | | | Strength at 1200°C, $kg/cm^2$ | | Abrasion, $g/cm^3$ | Dynamic elasticity modulus, $E \cdot 10^{-5}$, $kg/cm^2$ |
|---|---|---|---|---|---|---|---|
| | compressive | tensile | bending | compressive | tensile | | |
| Fused zircon – mullite. . . . | 3860 | 360 | 543 | 947 | 341 | 0 | 14.5 |
| Fireclay . . . . | 325 | 60 | 220 | - | - | 0.46 | 2.55 |

where v is the velocity of the impulse during straight-through exposure, and this is determined from the ratio $\nu = l/t \cdot 10^6$ μsec; $l$ is the base of the measurement, m; t is the time of spread of the signal, msec; $\gamma_0$ is the apparent density of the material, $g/cm^3$; K is the coefficient which is a function of $\mu_d$. In this case K = 1 since $\lambda > a$ and $\lambda > b$ ($a$ and b are the dimensions of the cross section of the specimen); λ is the length of the longitudinal wave established from the ratio $\lambda = \nu T \cdot 10^{-4}$, where T is the running period of the wave in μsec.

The compressive strength was determined on cylindrical specimens of height and diameter 50 mm with a constantly increasing pressure at a rate of 7-10 $kg/(cm^2 \cdot sec)$, ensuring the minimum spread in the strength factors. The test results are given in Table 3.

Studies of the glass resistance of the experimental specimens using the method developed by the Institute of Glass, and their resistance to iron oxides, using equipment designed by the All-Union Institute of Refractories, confirmed that fused zircon–mullite specimens are much more resistant to these reagents than firebrick (Figs. 1 and 2).

The results of the comparative tests showed that in terms of density, strength at normal and high temperatures, resistance to abrasion, and slagging reagents, fused – cast zircon – mullite refractories based on Tumanyan stone-like clay are better than fireclay, and may be recommended for use in glass furnaces and certain metallurgical furnaces.