The sintering of polymineral refractory mixtures occurs in the presence of a liquid phase which densifies the material during firing. Complete densification requires a sufficient quantity of liquid phase, solubility of the solid phase, and complete wetting of the system by the resulting liquid. Literature data on sintering in multicomponent refractory systems in various gaseous conditions is limited. A study of these problems is of practical significance since in some cases a change in the gaseous atmosphere during firing of the briquettes or products causes a considerable change in the properties of the material.

The present paper gives some results of a study of the sintering of mullite-corundum briquette in oxidizing and reducing atmospheres. The starting materials consisted of a raw technical alumina GA85 and Polozhe kaolin PLKO, whose chemical compositions are given in Table 1.

Technical alumina consists of fine-grain body consisting of spherolites and lumps having a low birefringence and refractive index, varying in the limits 1.670-1.710. The spherolites and lumps are transition forms of alumina from bötimate $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$ to isotropic $\text{γ-Al}_2\text{O}_3$. The content of transition forms in the sample equals 93-95%. There are small quantities (5-7%) of corundum in the form of transparent anisotropic aggregates with a refractive index approximating to normal for corundum ($\text{No} = 1.768 \pm 0.003$ and $\text{Ne} = 1.758 \pm 0.003$).

The Polozhe kaolin consists of friable, dust-like body, white in color, consisting of semitransparent, slightly birefringent lumps of kaolinite with average sizes of 0.03-0.1 mm. The lumps contain 6-8% inclusions of mica plates, 5-7% grains of quartz, and 1-2% accessory minerals consisting of grains of zircon, rutile, limonite, chalcedony, and feldspar.

The technical alumina was ground for 24 h in a ballmill to a fineness characterizing a concentration of particles measuring more than 0.06 mm of not more than 4%. The Polozhe kaolin was ground on runner mills and screened through 1 mm mesh. The alumina and kaolin were blended for 2 h in a ballmill with a component ratio of 90:10.

The resulting mixture was moistened on a runner mill with an aqueous solution of sulfite lye. The body with a moisture content of 27-30% was passed through a vacuum pugmill. Using the densified briquette the body intended for obtaining high-alumina chamotte was shaped by the plastic method into cylindrical specimens of diameter 20 and height 24 mm. After drying in the workshop the upper and lower parts of the specimens were ground off. Then the specimens were dried in a drying cupboard at 100-110° to constant weight.

### TABLE 1. Chemical Composition of Starting Materials, %

<table>
<thead>
<tr>
<th>Material</th>
<th>$\text{SiO}_2$</th>
<th>$\text{Al}_2\text{O}_3$</th>
<th>$\text{TiO}_2$</th>
<th>$\text{Fe}_2\text{O}_3$</th>
<th>CaO</th>
<th>MgO</th>
<th>R$_2$O</th>
<th>Loss on ignition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical alumina GA85</td>
<td>0.02</td>
<td>99.58</td>
<td>0.03</td>
<td>0.03</td>
<td>0.01</td>
<td>0.01</td>
<td>0.32</td>
<td>11.96</td>
</tr>
<tr>
<td>Polozhe Kaolin PLKO</td>
<td>0.04</td>
<td>98.21</td>
<td>0.77</td>
<td>1.08</td>
<td>0.49</td>
<td>Trace</td>
<td>0.15</td>
<td></td>
</tr>
</tbody>
</table>

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The specimens were heat processed for 2 h at 200–1700° with intervals of 100–200° in oxidizing and reducing conditions. The reducing atmosphere was developed by sprinkling the specimens with activated carbon PM–75 so as to achieve the maximum effect of the reducing atmospheres. After each experiment we determined the loss in weight, the change in volume, the water absorption, the apparent density, and the compressive strength.

In order to study the thermal transformations occurring during heating of the briquettes mixture, after drying at 100–110° to constant weight and grinding to obtain particles < 0.06 mm, it was subjected to differential thermal analysis (carried out by E. V. Levintovich). The DTA curve for the briquette mixture (Fig. 1) shows four endothermic effects and one exothermic effect. Identification of these effects suggests that during the preparation of the briquettes (moistening, blending and densification on the pugmill) from finely milled technical alumina certain quantity of hydrargillite Al(OH)₃ is formed.

The first three endothermic effects (at 115, 270 and 445°) are typical for the thermal breakdown of the hydrargillite structure [1,2]. The possibility of the conversion of γ-Al₂O₃ into hydrargillite at room temperature and under the prolonged action of water is confirmed by data in [3]. The fourth endothermic effect at 550° indicates dehydration of kaolinite. In the region of the exothermic effect (1190°) crystallization of mullite and corundum occurs from the transition forms of alumina.

A study of the properties of the briquette showed that the loss in weight of the specimens during heating to 400° in an oxidizing and reducing atmosphere is slight (Fig. 2). In the range 400–600° there is a sharp increase in the weight loss owing to removal of water from the kaolinite lattice. The DTA curve shows this process by the endothermic effect at 550°. At temperatures from 600 to 1400° we note further increase in the weight loss. In the reducing atmosphere it occurs somewhat more intensely than in the oxidizing.

With an increase in the temperature from 1400 to 1700° the loss in weight in the specimens in the reducing atmosphere sharply increases, and equals 8%, while in the oxidizing atmosphere it is less than 4%. This is due to the increasing reduction process, the rise in firing temperature, the reduction of SiO₂ to the silicon monoxide, and its volatilization. In the absolute weight loss of the specimens fired up to 1700° in an oxidizing atmosphere we include losses due to the decomposition of the newly formed hydrargillite, dehydration of kaolinite, and combustion of the sulfite lye added to the body during moistening.

From the results of chemical analysis the content of SiO₂ in the specimens fired at 1700° in oxidizing conditions equals 7.04%, and in reducing 0.56%. The content of SiO₂ in the briquette fired in oxidizing atmospheres is higher than should be obtained from the calculation which is due to the variations in batching the components during production.