Thus, while the pipes made of body B, fired at 1200°C, have a water absorption of 8.9%, a bulk density of 2.04 g/cm$^3$, and a bending strength of 15.4 MPa, the B-24 body pipes and the Sh-24 products fired at the optimum temperatures of 1150°C have water absorption values, respectively, of 3.6 and 5.2%, density 2.27 and 2.19 g/cm$^3$, and bending strengths of 28.6 and 20.9 MPa. The specimens of body B do not meet the requirements of GOST 286-74 in regards to water impermeability.

The results obtained were checked at the experimental factory of the institute by making a trial batch of pipes from bodies B, Sh-24, and B-8. The bodies were prepared by the well-known method. After being dried the pipes were fired in a kiln at 1200°C (bodies B and B-8) and at 1150°C (body Sh-24) with a 2-h soak at the final temperatures. The properties of the fired pipes are shown in Table 5.

It is seen that the pipes containing the additives have a higher mechanical strength than pipes made of body B without the additives. The strength of pipes made from body B-8 and Sh-24 increased by about 30%, and the water absorption dropped by more than 2%.

Calculations indicate that in preparing ceramic drain pipes from body B-24 (using basalt) in amounts of 16,000 tons, the savings is about 32,000 rubles. Since the wholesale price for ash-slag waste from electric power stations is 20–30 kopecks per ton, the use of this waste for pipe production by reducing the amounts of chamotte, whose cost, according to factory data is about 6 rubles per ton, will be economically justified.

Thus, the studies that were made established the possibility in principle of economically using IvanODolinsk basalts and ash-slag from the Mironov Power Station for pipe additives.

SYNTHESIS OF SITALLS BASED ON DISTRICT ELECTRIC POWER PLANT RESIDUES

V. A. Karyakin, G. Yu. Turushева, and Yu. D. Kruchinin

Using ashes and slags from the Novocherkass District Electric Power Station and Kirov Branch of the Rostov Technical Building Institute has synthesized ash-sitalls that possess outstanding physicochemical properties.

The feasibility of using these waste products for obtaining glasses and sitalls was studied previously [1, 2]. A study is now being made of ash from the Novocherkass Plant which has a relatively high SiO$_2$ and Al$_2$O$_3$ content. The chemical composition is as follows (% by weight): 45.26–53.84 SiO$_2$; 20.24–25.50 Al$_2$O$_3$; 11.7–17.1 Fe$_2$O$_3$; 3.10–4.26 CaO; 0.83–2.0 MgO; 2.8–4.6 K$_2$O; 0.9–1.2 Na$_2$O; 0.80–0.28 SO$_3$; 4.3–17.9 loss on ignition.

Lime was added to the batch to improve the working properties of the melts and increase the crystallization capacity of the glasses. Glasses melted from ash and limestone had an intense black color. Due to the high content of organic residues from unburnt fuel when the ash is heated an atmosphere is created in which the oxides are reduced to metallic iron [3]. Prefiring of the ash is an effective method of preventing this phenomenon, and in our case this was done at 900°C in 1 h.

<table>
<thead>
<tr>
<th>Glass composition</th>
<th>Density, g/cm$^3$</th>
<th>Refractoriness, C</th>
<th>Chemical resistance, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>967</td>
<td>3.06</td>
<td>0.92</td>
<td>97.46</td>
</tr>
<tr>
<td>366</td>
<td>3.22</td>
<td>0.01</td>
<td>99.79</td>
</tr>
</tbody>
</table>

Ash-based glasses with a crystallization catalyst during heat treatment will form only a coarsely grained structure. As is known, chromium oxide, manganese and iron sulfides [3] can be used as catalysts in the system SiO$_2$–Al$_2$O$_3$–Fe$_2$O$_3$–CaO. We used chromium oxide, manganese oxide, combinations of chromium oxide and sodium sulfate. It was assumed that the chromium oxide and manganese oxide would help increase the number of spinel crystals initiating glass crystallization, and also increasing the amount of pyroxene phase which determines the final properties of the glass-crystalline materials. Furthermore, due to the strong oxidizing effect of the chromium oxide and manganese oxide the ferrous iron is converted into ferric, thereby improving even further the physicochemical properties of the sitalls.

Two ash sitalls possess the best properties: composition 2647 with a chromium oxide catalyst, and composition 366 with the manganese oxide catalyst. Electron-microscopic studies showed that in both cases the structural transformations when the glasses were heat processed occur in the following sequence. Liquation of glasses occurs in the range 600–700°C with the formation of numerous droplet inclusions up to 0.03 μ in size. We assume that crystals of metastable spinel phase form inside these droplets on which the crystallization of pyroxene mineral occurs at 850–900°C. It was shown by x-ray analysis that the basic crystal phase is complex pyroxene. The resulting ash sitalls have a fine crystalline structure with a grain size of 0.2–0.5 μ.

The features of the chemical reaction, good crystallization and a fine crystalline structure in combination with monomineral or almost monomineral pyroxene composition ensures the production of materials with outstanding properties (see Table 1).

Sitall 366 has somewhat better properties; this was synthesized with manganese oxide. Using both sitalls we obtained wall tiles (variously colored enamels were applied to them during the heat-process cycle), and also slag–sitall lining slabs for industrial purposes.

Trial meltings of glasses having the optimum compositions done in the experimental section of the branch confirmed that it is possible to use the Novocherkass slags and ash to obtain wall tiles and floor tiles. The tiles made in the experimental section had the following dimensions: (in mm): 100 × 100 × 5; 150 × 150 × 7; and 200 × 200 × 20. Glazes are used to provide a variety of colors: The glaze takes the form of powder applied as soon as the products are formed, followed by crystallization. During crystallization the glaze finally melts and completely covers the surface of the article. The glazing quality was excellent. Thus, glazing can be combined with crystallization and annealing of the products.

On the basis of these results the Kirov Branch developed a technical working project for a prototype department for making ash-sitall tiles with a capacity of 100,000 m$^2$/yr for the Novocherkass Building Materials Factory. The layout is shown in Fig. 1.