EXPERIENCE WITH THE USE OF A VIBROMILL
FOR DETERMINING THE ABRADABILITY
OF REFRACTORIES

E. V. Degtyareva and V. A. Kyktenko

Ukraine Refractories Research Institute
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The well known method of evaluating the abradability of refractories on a rotating disc with quartz sand [1] is useful for determining the wear of only a single face of the specimen at any one time. When the properties of the refractory are anisotropic this makes the results indefinite.

The method of determining abradability with the aid of abrasive cups [2] makes it possible to measure it in the hot state. This method, like that with the disc, allows only one plane to be tested and only a small part of one surface, depending on the dimensions of the abrasive cups (2.5-4.5 cm²).

When abradability is determined in a rotating drum [3] the specimens are worn on account of reciprocal friction. There is simultaneous destruction from the impact of one specimen on another and on the walls of the drum.

The authors of this article have used a new method for determining abradability.

A vibromill with a capacity of 10 liters (oscillation frequency 3000/min) is filled with dry quartz sand of the following grading: 40% fraction 0.5-0.2 mm and 60% 0.2-0.1 mm.

The specimens of refractories are made in the form of cylinders 36 mm in diameter and 50 mm high or cubes with 50 mm sides. They are dried and weighed, after which they are placed in the sand.

It is possible to test eight specimens simultaneously and they should be insulated from each other and from the walls of the mill.

The magnitude of the abradability is determined as the average of measurements on three specimens.

The specimens are tested for an hour and then weighed to determine the loss of weight.

Abrasion can be expressed as a percentage in relation to the original weight of the specimens according to the formula

\[ K_v = \frac{G_1 - G_2}{G_1} \times 100, \]

where \(K_v\) is the abraded weight,%; \(G_1\) is the specimen's weight before testing, g; \(G_2\) is the weight after testing, g.

The abradability can also be expressed by the magnitude of the weight loss in relation to the worn surface of the specimen:

\[ K_s = \frac{G_1 - G_2}{S}, \]

where \(K_s\) is the abrasion of the surface, g/cm², and \(S\) is the surface of the specimen before testing, cm².

This method permits a comparison to be made between the abradability of different specimens regardless of their shape and sizes.

The advantage of the described method is the possibility of wearing away the entire surface of the article without the action of other destructive factors, e.g., impacts. The abrading action is maintained constant for the whole test period. The reproducibility of the results of determining the abradability in vibromills is completely satisfactory (see table). The deviation does not exceed ±3% of the average value.
Results of Determining Abradability in Vibromill, g/cm²

<table>
<thead>
<tr>
<th>No. of specimen</th>
<th>Magnesite refractory, porosity 20%</th>
<th>Silicon carbide, porosity 25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.197</td>
<td>0.067</td>
</tr>
<tr>
<td>2</td>
<td>0.199</td>
<td>0.063</td>
</tr>
<tr>
<td>3</td>
<td>0.203</td>
<td>0.066</td>
</tr>
<tr>
<td>4</td>
<td>0.198</td>
<td>0.063</td>
</tr>
<tr>
<td>5</td>
<td>0.208</td>
<td>0.068</td>
</tr>
<tr>
<td>Mean</td>
<td>0.201</td>
<td>0.065</td>
</tr>
</tbody>
</table>

Fig. 1. Relationship between abradability of magnesite (a) and silicon carbide (b) specimens and their porosity, shape and method of testing. (1) cubes; 2) cylinders; 1) curves in drum; 2) cylinders in drum; 3) curves and cylinders in vibromill.

Fig. 2. Kinetics of the abrasion of magnesite (a) and silicon carbide (b) specimens, --- in drum; -- in vibromill; 1,2) highly porous; 3,4) little-porous.

Fig. 3. Abradability of magnesite: (1) chromemagnesite (2) high-alumina, (3) silicon carbide (4) refractories of different porosities in a vibromill.