EXPERIENCE IN USE OF CHAMOTTE-FIRING ROTARY KILNS

K. K. TOMASH AND A. M. BONDAREVSKYI
(Zaporozh'ye Refractory Plant)

The first rotary kiln at the Zaporozh'ye Plant was started up in January 1959, and the second in November of the same year.

The dimensions of the kilns are as follows: total length 60 m; length of diverging zone 12 m; diameter 3 m; diameter of diverging zone 3.6 m; length of cooling area 25 m; diameter 2.5 m; slope angle of kiln and cooling area 3.5°; the number of revolutions per minute ranges from 0.9 to 1.29, and in case of the cooler is 3 rpm.

The enlarged sintering zone in the kilns at the Zaporozh'ye Plant improves the output and distinguishes them from the rotary kilns at the Borovichi Combine, Velikiy AnadoP Plant and the Suvorov Mine Administration.

In order to improve utilization of the heat, kiln No. 1 includes 120 rabbling, blades (heat exchanger) placed over a section 10.23 m long at 2.72 m from the cold end. Kiln No. 2 does not have these blades. Both kilns have spiral devices, 2.72 m long, to improve the selection of raw material from the feed pipe.

The gases are cleaned free of dust and the heat is utilized by means of the following equipment: cyclones designed by the NIIOGAZ, boiler-salvagers and electric filters.

Beyond the electric filters are two D-34 flue gas pumps which feed cleaned gas to a stack 60 m high.

The cyclones in kiln No. 1 trap 1125-1150 kg per hour and those in kiln No. 2 trap 590-600 kg per hour, while each electric filter catches 520-540 kg/hour. According to preliminary calculations, the efficiency of the gas clearing units is as follows:

<table>
<thead>
<tr>
<th>Kiln No. 1</th>
<th>Kiln No. 2</th>
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<tbody>
<tr>
<td>cyclones</td>
<td>0.67</td>
</tr>
<tr>
<td>electric filters plus cyclones</td>
<td>0.973</td>
</tr>
</tbody>
</table>

Beyond the cyclones there are three boiler-salvagers each with an output of 2.8 tons of steam per hour. The schedule for the manufacture of lump chamotte is shown in the drawing.

The material stays in the kiln for 2 to 2-1/2 hours, and in the cooling area for 35-50 minutes according to the moisture content and grain composition.

It is clear from the description that the manufacture of chamotte has been fully mechanized, and this is one of the principal advantages of rotary kilns.

The productivity of the roller mills proved less than that of the kilns by a factor of 2 or 3 tons/hour on account of the large amount of crumbling, which reaches as much as 20 or 30%. The compacts were insufficiently firm.

The grain composition of chamotte made by mixing clay in roller presses is almost the same as when the raw material is fed directly to the kiln from a two-high mixer (Table 1). Hence at the present time clay and kaolin for firing are prepared exclusively in these mixers.

The dust trapped in the gas cleaning devices is conveyed to a bunker, from which it is loaded into dump cars and taken to the raw-material store for secondary firing. This operation involves great difficulties.

In order to reduce the loss through dust, the number of rabbling blades in kiln No. 1 has been reduced from 120 to 60, and the moisture content of the raw material processed in the two-high mixer has been raised to 24%.

These arrangements have brought about a reduction in loss through dust in kiln No. 1 to 1000-1300 tons per month. Furthermore, the temperature in the dust chamber in kiln No. 1 has been raised from 260-280 to 420-450°, which has helped to create a stable operating regime for the boiler-salvagers, and enabled the electric filters to operate more smoothly.

A mixture of coke and natural gases with a calorific value $Q_H = 4600 - 4800$ kcal/m3, used to be used in kiln No. 1, and the specific consumption of referred fuel for firing chamotte amounted to more than 160 kg/ton, instead of the 150 kg planned.

Despite the fact that the fuel consumption in kiln No. 1 was stepped up, the new arrangements were not economical.

With the assistance of the Central Planning and Designing Office of the Glavproektmontazhavtomatika Organization, we took a number of steps to reduce the specific fuel consumption.

The kiln was changed to coker gas with a calorific value $Q_H = 4000$ kcal/m3.

An automatic gas analyzer was installed to determine the oxygen content in the combustion products, thermocouples were installed in the preheating zone and at the sintering zone inlet, a self-recording device was installed to measure the consumption of primary air, and instruments were installed for automatic regulation of the rarefaction in the hot head of the kiln.

As a result the specific consumption of referred fuel dropped to 118 - 120 kg/ton.

The implementation of these measures in kiln No. 2 reduced the specific consumption from 168 to 134 kg/t.

1) V. R. Ksendzovskiy and others, Ogneupory, 1961, No. 5.
Experience in Use of Chamotte-Firing Rotary Kilns

The consumption of raw material per ton of chamotte amounts to 1600 kg as envisaged in the design.

The chamotte was fed to the dispatch bunkers from the cooling areas by means of plate conveyors, which wore out in a year and slowed down the normal operation of the kilns. On account of this the conveyors were replaced by the belt type with water-air burners to cool the chamotte.

In the 30 months that kiln No. 1 has been operating the lining in the firing zone has been replaced 3 times, and the lining in the cooling zone once. Over an area 5 m long under the binding of support No. 3, the lining was replaced four times during this period, and over a ±10 meter area between supports Nos. 2 and 3 just in front of the pinion the lining was not changed at all during the 2-1/2 year period. Similar situation was found in the lining in kiln No. 2.

The strength of the lining in the cooling area and in the rabbling blade zone is not very great and ranges from 3 to 6 weeks on account of the abrasive action of the chamotte.

When the lining was strengthened with iron inserts, its life was increased to six months. In the area without the rabbling blades the life of the lining amounted to 10 or 12 months.

Some of the characteristics of the kilns are shown in Table 2.

Over June and July 1961, the quality of the chamotte produced is shown in Table 3.

The All-Union Institute of Refractories, the Ukrainian Institute of Automatic Machinery are working on the mechanization and automation of the manufacture of a chamotte-firing plant.

When designing and constructing chamotte firing plants with rotary kilns, provision has to be made for the complex mechanization and automation of production, including the automatic determination of the qualitative characteristics of the chamotte in different stages.

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**TABLE 1**

**GRAIN COMPOSITION OF CHAMOTTE FOR DIFFERENT SYSTEMS OF PREPARING THE RAW MATERIAL**

<table>
<thead>
<tr>
<th>Date of observation in 1951</th>
<th>System of preparation</th>
<th>Moisture content of raw material, %</th>
<th>Chamotte grain size, mm</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;4</td>
<td>4-3</td>
</tr>
<tr>
<td>Chamotte made of kaolin; firing in kiln No. 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17/11</td>
<td>Without preparation</td>
<td>18-21</td>
<td>37</td>
<td>9</td>
</tr>
<tr>
<td>5/11</td>
<td>In mixture</td>
<td>24-25</td>
<td>46</td>
<td>14</td>
</tr>
<tr>
<td>4/1</td>
<td>In mixture and roll press</td>
<td>24-25</td>
<td>52</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Same</td>
<td>24-25</td>
<td>43</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24-25</td>
<td>42</td>
<td>8</td>
</tr>
</tbody>
</table>

Chamotte from Polotl clay; firing in kiln No. 2

| 6/11                      | Without preparation         | 20-21                               | 37 | 13  | 11  | 12  | 9     | 18   |
| 4/1                       | In mixture                  | 24-25                               | 46 | 12  | 10  | 10  | 6     | 15   |
|                           | In mixture and roll press   | 24-25                               | 37 | 13  | 11  | 9   | 9     | 21   |

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**Diagram**

- Raw material store
- 10-ton bridge grab cranes
- Receiving bunkers
- Clay-cutting machinery
- Horizontal belt conveyor
- Dust from dust chamber
- Sloping conveyor with scales
- Two-high mixer
- Roll press (stopped)
- Bunker
- Plate feed
- Feed pipe
- Kiln
- Cooling area
- Plate conveyor
- Chamotte bunker
- Crushing section in chamotte shop
- Railroad cars
- Chamotte production at chamotte firing plant at Zaporozh'ye Plant