The parts are fired in ring kilns at 1320° for 6 hours. The grates are lashed on their ends one row high reaching up to the kiln roof.

The characteristics of fired parts pressed by the semi-dry method are as follows: porosity 24-24.6%, additional shrinkage 0.26-0.57%, bulk density 1.88-1.92 g/cm³, and compressive strength 250-120 kg/cm².

The grates made by the plastic method showed the following characteristics: porosity 30%, additional shrinkage 0.69-0.71%, bulk density 1.10-1.81 g/cm³, and compressive strength 125-150 kg/cm².

The experiment in pressing grates from semi-dry mixtures confirms that this is a progressive method and enables us to produce parts with more accurate dimensions than those made with plastic mixtures.

The yearly economics from the use of the semi-dry method of pressing grates amounts to 7328 rubles.

HEAT ENGINEERING

HIGH TEMPERATURE TUNNEL-TYPE KILN OPERATING ON NATURAL GAS

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At the Semihak refractory plant there is a high temperature tunnel-type kiln working on natural gas from the Staropol deposit. The kiln was designed by the All-Union Institute of Refractories.

The thermal capacity of the gas is \( Q_H = 5560 \text{ kcal/m}^3 \).

The chemical composition of the gas is 98.07 \( \text{CH}_4 \), 0.57 \( \text{C}_2\text{H}_6 + \text{C}_3\text{H}_8 \), 0.02 \( \text{C}_4\text{H}_{10} \), 1.18 \% \( \text{N}_2 \), and 0.32 \% \( \text{CO}_2 \).

The theoretical combustion temperature of the gas is 2650°.

The flash point is 615-550°.

The kiln is used to fire high-alumina parts of different kinds, and also chamotte.

The maximum firing temperature of the different types of products are shown in Table 1. The length of the kiln is 156 meters, width 3.2 meters, and the height between the floor of the car and the roof is 1.1 m.

The kiln takes 52 cars 3 m long. Each position in the kiln corresponds to the length of one car. The kiln roof is suspended, flat, and assembled at positions 1-14, 17, 19-35, 38-52 from shaped chamotte parts; at positions 11-23 and 34-37 it is made from high-alumina parts containing 60% \( \text{Al}_2\text{O}_3 \), and at positions 23-34 it is made from high-alumina parts containing 80%.

In the firing zone, and partly in the pre-heating and cooling zones, the walls are lined with chrome-magnesite bricks, while the remaining parts of the kiln are made with class A chamotte parts.

Through the change in the conditions for firing the parts and the chamotte, in the last seven years the kiln has been stopped twice for capital repairs in the firing zone. During the first campaign the kiln roof lasted two years, and during the second it lasted three years.

The wear and tear of the roof parts was mainly due to breaking off of the ends facing the combustion space in the kiln.

The best service was shown by parts made of a charge containing a large amount of coarse-grain chamotte. The chrome-magnesite lining of the walls of the firing zone wore out, forming a loose structure.

The flue gases are removed from the kiln through pipes installed at the first position and at the joints between positions 1-2, 2-3, 3-4, 4-5 and 5-6, and are led off into the air by a Sirokko No. 11 medium-pressure fan. There is also a reserve fan.

The temperature of the flue gases varies between 150° and 250°, in accordance with the firing conditions. The natural gas is fed to the firing zone through 9 pairs of burners arranged symmetrically opposite one another along

<table>
<thead>
<tr>
<th>Parts</th>
<th>( \text{Al}_2\text{O}_3 ) %</th>
<th>Firing temperature, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air-heater brick</td>
<td>45</td>
<td>1420-1450</td>
</tr>
<tr>
<td>Blast furnace brick for hearth, extra-intricate and simply-shaped parts</td>
<td>62</td>
<td>1480-1500</td>
</tr>
<tr>
<td>Shaped parts</td>
<td>72</td>
<td>1550</td>
</tr>
<tr>
<td>Chamotte (from plastic pressed compact)</td>
<td>67-69</td>
<td>1620-1630</td>
</tr>
<tr>
<td>The same</td>
<td>80-85</td>
<td>1640-1660</td>
</tr>
</tbody>
</table>
The burners are the single-tube, injection type, with a productivity of 80 m³/hour.

When firing different types of petrol, the burner opening is regulated in order to balance the temperature along the sides of the kiln. The consumption of natural gas ranges between 500 and 800 m³/hour. The natural gas is fed to the kiln at a pressure of 0.6 gauge atmospheres. A reduction in pressure in the main pipeline from 6.0 to 0.6 gauge atmospheres is made at the control panel by RUS-130 regulating valves (Fig. 2).

The working pressure of the gas at the burners varies between 420 and 450 mm H₂O, according to the gas consumption.

The consumption of referred fuel per ton of acceptable output is 320 kg. The following components are fed in to burn the gas: a) primary hot air; b) secondary hot air; c) cold air.

The primary air is fed in the proportion of 20% of the total consumption to the burners through channels in the walls on both sides of the kiln.

In the cooling zone at the joins between positions 34 and 35, there are windows on both sides of the kiln for the removal of the hot air. The air is led off and fed to the burners by means of injection devices, the air being injected at a pressure of 0.4-0.8 gauge atmospheres. The injector nozzle diameter is 9-11 mm.

There are two rotation RMK-3 blast machines working at 730 rpm to feed the air to the injectors. The power of the electric motor is 28 kilowatts. One of the blast machines is reserve. The air consumption is 400-440 m³/hour. The pressure in the injector channel at the 34th position is 1.0-1.5 mm H₂O.

The temperature of the hot air is 800-900°C. The amount of hot air fed to the burners is regulated by a gate in the tubes connecting the burners to the injector channel.

The secondary air constitutes about 40% of the total consumption. It is fed in through the kiln working channel.

For ballasting the gas, cold air is fed to the burners in the proportion of 40% of the total consumption. Fan no. 8 is installed for this purpose. The air pressure is 50 mm H₂O, and the consumption is 3000 m³/hour.