The increased wear resistance of dense, high-fired magnesite-chrome roof refractories in service in the roofs of rocking furnaces was due to reduction in the size of the spalling working part and a longer period between spalling as a result of delayed migration of the melts and the associated rate of formation of zones in the brick.

It is possible to bring about a considerable reduction in the intensity of the wear and tear in magnesite-chrome roof refractories during service in open hearth furnaces by increasing the temperature gradient (ΔV/Δz) through the thickness of the roof, by intensive cooling of the outer surface of smooth roofs during the first half of the run, and also by using dense magnesite-chrome refractories.

BIBLIOGRAPHY


RESEARCH WORK

INTERACTION BETWEEN CALCIUM OXIDE AND ALUMINA
WHEN TEMPERING DINAS MIXTURES

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In the presence of water and at normal temperatures, as well as during the water-heat treatment under pressure, there is an interaction between silica, no matter what form it is in, and Ca(OH)$_2$, with the formation of calcium hydro-silicates (1-4). In the first case the reaction is less intensive than in the second. The reaction rate depends on the degree of pulverization of the silica, its form and temperature. Study of the reaction is made difficult by the fact that adsorption, hydration of SiO$_2$, carbonization of CaO, and other processes take place at the same time.

BONDING OF CaO BY SILICA IN QUARTZITE DURING MAKING OF DINAS MIXTURES:

Grain composition of mixtures <3 mm (35% < 0.088 mm); moisture content 6.1% **

<table>
<thead>
<tr>
<th>No. of charge</th>
<th>CaO added to mixture in form of</th>
<th>CaO content in mixture after tempering, %</th>
<th>Amount of CaO bonded in hydro-silicates, me/g quartzite</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>total</td>
<td>in CaCO$_3$</td>
</tr>
<tr>
<td>Tempering time 5 minutes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>79</td>
<td>Not added</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>80</td>
<td>CaCO$_3$</td>
<td>2.40</td>
<td>2.37</td>
</tr>
<tr>
<td>81</td>
<td>CaO</td>
<td>1.90</td>
<td>0.80*</td>
</tr>
<tr>
<td>82</td>
<td>Ca(OH)$_2$</td>
<td>1.80</td>
<td>0.70*</td>
</tr>
<tr>
<td>Tempering time 25 minutes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>81</td>
<td>CaO</td>
<td>1.90</td>
<td>0.80</td>
</tr>
<tr>
<td>82</td>
<td>Ca(OH)$_2$</td>
<td>1.80</td>
<td>0.70</td>
</tr>
</tbody>
</table>

* Milk of lime with a large amount of underbrunt chalk was used.

** All commas are equivalent to a decimal point.
When dinas mixtures are tempered, conditions are created for interaction between Ca(OH)$_2$ and SiO$_2$. Data is available showing that under these circumstances there is formation of calcium silicates (5, 6), which is very unlikely in the presence of water.

Apart from scientific interest, the reaction between Ca(OH)$_2$ and SiO$_2$ during tempering of dinas mixtures is of great practical importance: for example, the excessive formation when tempering calcium hydrosilicates impairs the properties of the dinas (7).

Experiments were carried out with Ovruch quartzite containing 97.8% SiO$_2$; calcium oxide was added in the form of CaCO$_3$, there was no free CaO in the charge. The grain composition of the mixtures was: 22 - 25% >3 mm; 9 - 12% 2 - 1 mm; 15 - 26% 1 - 0.54 mm; 15 - 20% 0.54 - 0.088 mm, and 30 - 35% finer than 0.088 mm; the milk of lime was added on the basis of pure chalk fired at 1250 ~ containing 97.8% SiO$_2$; calcium oxide was added in the form of CaCO$_3$.

The mixtures were prepared in laboratory tempering mills. The grain composition of the mixtures was: 22 - 25% fraction 3 - 2 mm, 9 - 12% 2 - 1 mm, 15 - 26% 1 - 0.54 mm, 15 - 20% 0.54 - 0.088 mm, and 30 - 35% finer than 0.088 mm; the milk of lime was added on the basis of a CaO content in the mixture of 2.0 - 2.5%; the moisture content of the mixtures was 5.9 - 6.1%. When studying the effect of different technological factors, the latter were only varied within limits of practical importance.

The grain composition of the mixtures was checked by screen analysis. The CaO content in the mixtures was determined by reverse titration with 1% HCl and NaOH solutions; the free calcium oxide content was checked by the ethyl glycerate method; the CaO content bonded in the CaCO$_3$ was checked from the amount of CO$_2$ by the volumetric method (8); the content of CaO bonded in the hydro-silicates was checked for the difference between the total CaO content in the mixture and the total CaO both free and bonded in the CaCO$_3$. Thermograms were taken with a Kurnakov thermograph.

When calcium oxide was left out of the charge, or when added in the form of CaCO$_3$, there was no free CaO in the mixture (Table 1). When calcium oxide was added to the mixtures in the form of CaO and Ca(OH)$_2$, its content is reduced in the mixture with Ca(OH)$_2$ to a greater extent than in the CaO mixture after five minutes mixing. After 25 minutes tempering, the amount of free CaO in these mixtures is almost the same. The lag in the bonding of the CaO is due to intermediate hydration.

Table 2 shows that one gram of quartzite may bond up to 0.7 millequivalents CaO, which, generally speaking, tallies with the results (1) of an investigation showing that pulverized sand may absorb up to 2% CaO.

It is very important that the amount of bonded CaO increases when changing from coarse grain to fine grain mixtures; this is due to the specific surface (Table 3). An increase in the temperature of the mixture to 35 ~ intensifies the bonding of the CaO up to a certain level, which does not then increase when the temperature is raised to 70 ~ (Table 4).

The response of quartzite to the effect of 5% solution of Na$_2$CO$_3$ was determined by five-fold lixiviation with boiling for a half-an-hour.

It was found (Table 5) that as the grain composition becomes finer, and that the amount of SiO$_2$ soluble in a 5% soda solution increases; but the amount of soluble SiO$_2$ in the dinas mixture is proportional to its grain composition. This shows the marked reactivity of fine-grain dinas mixtures.

We made a thermographic analysis of samples of dinas mixture taken from the tempering mill pan 3, 10, 15, 20 and 30 minutes after the tempering had begun, and also Ca(OH)$_2$, quartzite, a mixture of dry Ca(OH)$_2$ with quartzite and with Cr$_2$O$_3$ for comparison (1).

It was found that when there is no reaction between the Ca(OH)$_2$ and the basic component of the mixture (CrO$_3$ and quartzite in dry mixing), the endothermal effect from dehydration of the Ca(OH)$_2$ occurs at 525 - 560 ~ (see Fig. 1, curves 1, 2 and 4). Besides a dehydration effect, curve 4 shows an endothermal effect on account of the $\beta \rightarrow \alpha$ conversion of the quartz with a maximum at 575 ~. It follows from the thermograms for the dinas mixture that as the tempering time is extended, the dehydration effect is first reduced, then for practical purposes vanishes, and the endothermal effect increases at 740 - 760 ~, due to decomposition of calcium hydroxidelsites; this is clear from comparison of the thermograms for the dinas mixture with...