PRODUCTION AND EQUIPMENT

CONTEMPORARY TECHNOLOGY FOR PREPARING HIGH DENSITY PERICLASE POWDER[1]

M. B. Sharov,[2] L. Vaskovich,[2] M. A. Eroshin,[3] and M. I. Nazmiev[2]

Translated from *Novye Ogneupory*, No. 9, pp. 17 – 19, September, 2009.

Original article submitted May 22, 2009.

A unit has been put into operation in OAO Kombinat Magnezit for producing densely sintered periclase. A production scheme is described. Advantages are demonstrated for using high-density periclase powder for preparing refractory objects compared with powders sintered in a rotary furnace.

Keywords: periclase powder, densely sintered periclase clinker, calcined magnesite, rotary furnace.

Under severe competition conditions in the refractory market an effective innovation strategy is development of an enterprise. One of the main points of the development strategy in 2008 is the construction and introduction into operation of a unit for producing densely sintered periclase clinker. The capacity of the unit is 50,000 tons of product per year. Previously, before deciding to construction a unit for producing densely sintered periclase a series of test works were carried for preparing densely sintered clinkers from different magnesites and periclase-containing materials, and the requirements were determined for the starting raw material; subsequently starting components were obtained for clinker production with the required parameters. As a result laboratory tests and research work the optimum production scheme was developed for equipment (Fig. 1) and its performance. The main production equipment was assemblies from leading European producers, a mill from Hosakava Alpine, roller presses from Verexk, a cone crusher from MFL, and a high-temperature furnace from the firm RCE.

The unit for producing densely sintered periclase clinker included calcifying firing of the raw magnesite fraction finer than 40 mm in rotary furnaces, screening to a fraction finer than 2 mm and coarser than 2 mm of calcined magnesite after firing at about 1200°C (Table 1). As a result of prior calcination there was enrichment and balancing of the material. Then the calcined magnesite prepared entered the unit directly where it was subjected to fine grinding in a pipe mill with a closed separation cycle. Calcined magnesite after grinding has a specific surface (external) of about 1.5 m^2/g and it contains not less than 90% of grains with a size less than 20 μm. Fine grinding promotes preparation of more densely sintered material and additional blending of it. After grinding the material is briquetted in roller presses under a pressure of 3000 kN and fed to a shaft furnace for sintering up to 2200°C (Fig. 2). Grinding, briquetting and firing is automated to the maximum, the main control parameters for

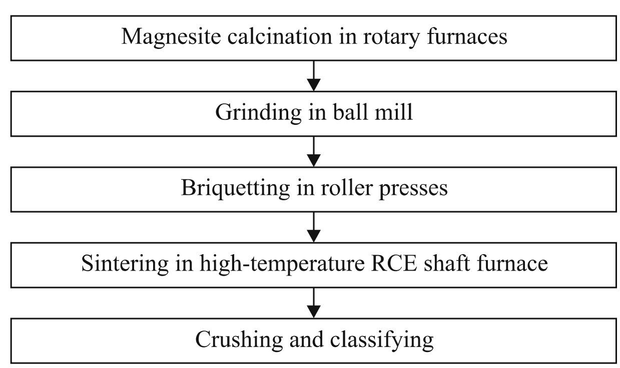

Fig. 1. Production scheme for high density periclase powder.

TABLE 1. Chemical Analysis of Calcifying Firing Products, %

Fraction	MgO (as calcined substance)	SiO_2	CaO	Δm_{cal}
<2 mm (whole product)	96.2	1.1	1.3	1.5
>2 mm (enrichment tailings)	91.1	3.7	3.4	1.8

[1] Proc. International Conference of Refractory Workers and Metallurgists (Moscow 23 – 24 April, 2009).
[2] OOO Gruppa Magnezit, Moscow, Russia.
[3] OAO Kombinat Magnezit, Satka, Chelyabinskoi Region, Russia.

1083-4877/09/5005-0333

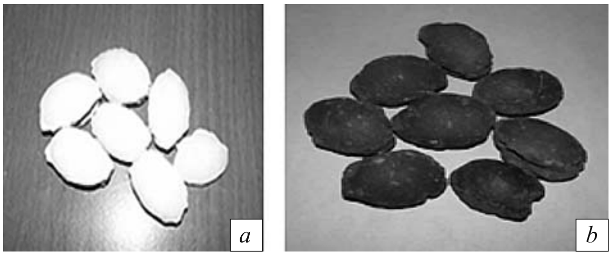

Fig. 2. Briquettes before firing (*a*) and afterwards (*b*).

TABLE 2. Comparative Properties of Sintered Periclase Materials

Material	Average content*, %			Apparent density, g/cm^3
	MgO	CaO	SiO_2	
Periclase, sintered in rotary furnace	93.7 (2.19)	2.15 (17.2)	1.94 (11.4)	3.20
Periclase clinker	95.8 (0.48)	1.41 (5.9)	1.08 (3.7)	3.38

* Variation coefficient, %, given in brackets.

operation of the equipment are entered into an information system and monitored by technical specialists at any instant of time. Thus, the effect of the human factor on quality of the end product is reduced to a minimum. Some production limits make it possible to blend the starting materials well and to obtain a stable quality for the end product. Average quality properties are given in Table 2 for periclase materials and their stability; the lower the coefficient of variation, the more stable is the declared material quality.

Petrographic studies of briquettes showed that they have a densely sintered structure with a predominant periclase crystal size of 50 – 90 μm (the maximum size reaches 200 μm), a pore size of 3 – 10 μm (for periclase sintered in a rotary furnace 10 – 25 μm), and total porosity 5 – 7% (open porosity <2%). Use of the production scheme developed makes it possible to obtain a product stable with respect to physicochemical composition, independent of variations of the starting raw material quality. The densely sintered periclase obtained has an increased MgO content (95 – 96%), a more dense structure (up to 3.4 g/cm^3), and stable qualitative properties compared with periclase powder sintered in rotary furnaces. The low porosity and small pore

TABLE 4. Qualitative Properties of Powder From Crushed Clinker

Powder grade	Weight fraction, %				Apparent density, g/cm^3, not less than
	MgO, not less than	SiO_2, not more than	CaO, not more than	Fe_2O_3, not more than	
GMPK-94-94	94.0	2.2	2.0	2.5	3.20
GMPKP-94	94.0	2.2	2.0	2.5	3.29
GMPK-95	95.0	1.7	1.8	1.8	3.35

size makes it possible to predict and increase in refractory life manufactured from densely sintered periclase.

After crushing and screening sintered periclase powder is used for producing objects with improved user characteristics: periclase, periclase-carbon, periclase-spinel element grades for transitional zones of rotary furnaces, chromite periclase for nonferrous metallurgy. Use in a number of refractory objects of clinker with prescribed properties is a modern tendency that answers the consumer demand based directly on the service properties of objects. Use of series objects with improved service properties (Table 3) will make it possible to improve the life of refractories in problem areas of heating units of the metallurgical, glass and cement industries. Currently the enterprise has the potential for producing finished powders of the required grain size composition based on crushed clinker. Qualitative properties of the powders are provided in Table 4.

Entry into operation of the modern complex for producing densely sintered periclase clinker makes it possible for the enterprise;

– to increase the stability and predictability of the properties of refractories due to use within their composition of densely sintered periclase clinker, stable with respect to physicochemical properties;

– to develop new forms of refractories with improved service characteristics for problem areas of heating units of ferrous, nonferrous and cement industries;

– to save high quality magnesite by 25% compared with the technology for preparing periclase in rotary furnaces;

– to reduce stress on the economic system of the town and region (by more than a factor of four with a reduction in dust discharge compared with that from rotary furnaces).

TABLE 3. Comparative Properties of Objects Prepared From Periclase Sintered in a Rotary Furnace and Densely Sintered Clinker

Object grade	Ultimate strength in compression, MPa, not less than	Open porosity, %, not more than	Temperature for the start of deformation under load, °C, not lower than	Thermal shock resistance, thermal cycles, not less than	Weight fraction, %			
					MgO, not less than	SiO_2, not more than	CaO, not more than	Fe_2O_3, not more than
P-91 (series)	60	22	1550	—	91.0	3.0	3.0	2.5
GMP-95 (based on clinker)	60	18	1640	—	94.0	1.5	2.0	2.0
PShPTs-81	35	22	1530	8	81.0	2.2	2.5	7 – 12*
PShPTs-82 (based on clinker)	45	20	1620	9	84.0	1.5	1.5	9 – 13*

* Al_2O_3 content, %, shown.