ZAPOROZHOGNEUPOR PJSC

ПРАТ «ЗАПОРІЖВОГНЕТРИВ»

СЕРТИФИКАТ

соответствия системы менеджмента требованиям стандарта ISO 9001:2008

В соответствии с правилами сертификации подтверждено выполнение требований стандарта в организации

ПАО «Запорожогнеупор»
69106, Запорожье, Северное шоссе/ ул. Тепличная, д. 22 «б»/1,
Украина

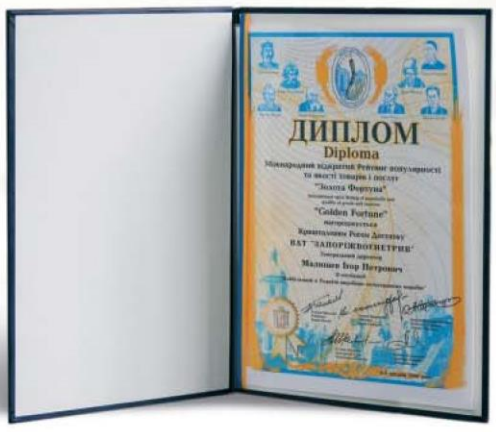
в области:

Разработка, проектирование, производство, сбыт и послепродажное обслуживание огнеупоров для металлургических и других отраслей промышленности

Регистрационный номер сертификата TIC 15 100 86054
Действителен до 2014-12-30
Действителен с 2011-12-31
Отчет по аудиту № 3330 2CKU G0
Первичная сертификация 2003

Сертификация проведена в соответствии с процедурой аудитирования и сертификации TIC и предусматривает проведение регулярных наблюдательных аудитов.

Орган по сертификации систем и персонала TÜV Thüringen e.V.
TÜV THÜRINGEN
Рига, 2011-12-23



PJSC "ZAPOROZHOGNEUPOR" ("ZAPORIZHZHIA REFRACTORIES") is Ukraine's largest producer of high-quality refractory products and materials.

The company produces chamotte, mullite silica, mullite, mullite-corundum, quartzite non-fired, periclase, periclase-chromite, chromite-periclase, periclase-carbon, alumina-periclase-carbon, corundum-carbon, concrete vibrocast shaped products, unshaped refractories and various types of chamottes, including fractionated, high-tech castables and mixes for steel, glass, cement, machine-building, chemical, sugar, and other industries.

The products are supplied throughout Ukraine and to various European countries.

The company has developed and operates a Quality Management System and is compliant with the requirements of the international standard ISO 9001:2015 in the TUV AUSTRIA certification system. ZAPORIZHZHIA REFRACTORIES applies the quality management system in the development, design, production, sales and after-sales service of refractories for steel and other industries.

By continuously implementing timely upgrades and improving its technical and economic resources, ZAPORIZHZHIA REFRACTORIES strives to dramatically improve product quality and maintain lasting competitiveness in the refractory market.

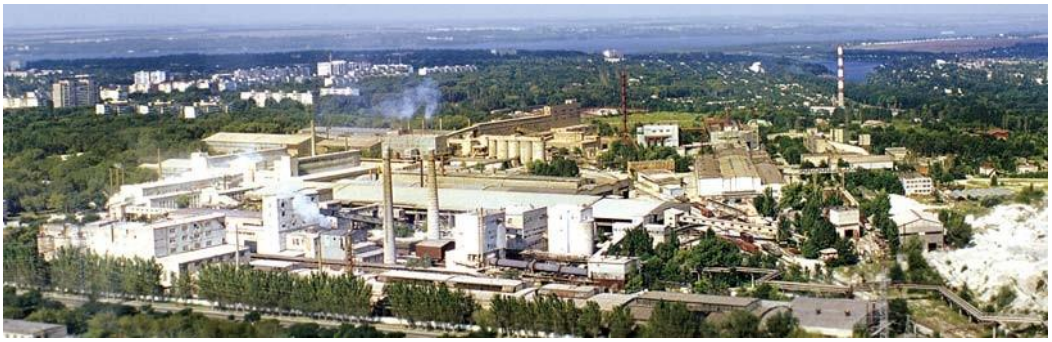
ZAPORIZHZHIA REFRACTORIES prioritises technical re-equipment and revamping of its production, development of new products, including high-tech ones, continuous work to enhance product quality, engineering support, warranty service, and technical assistance for our customers.

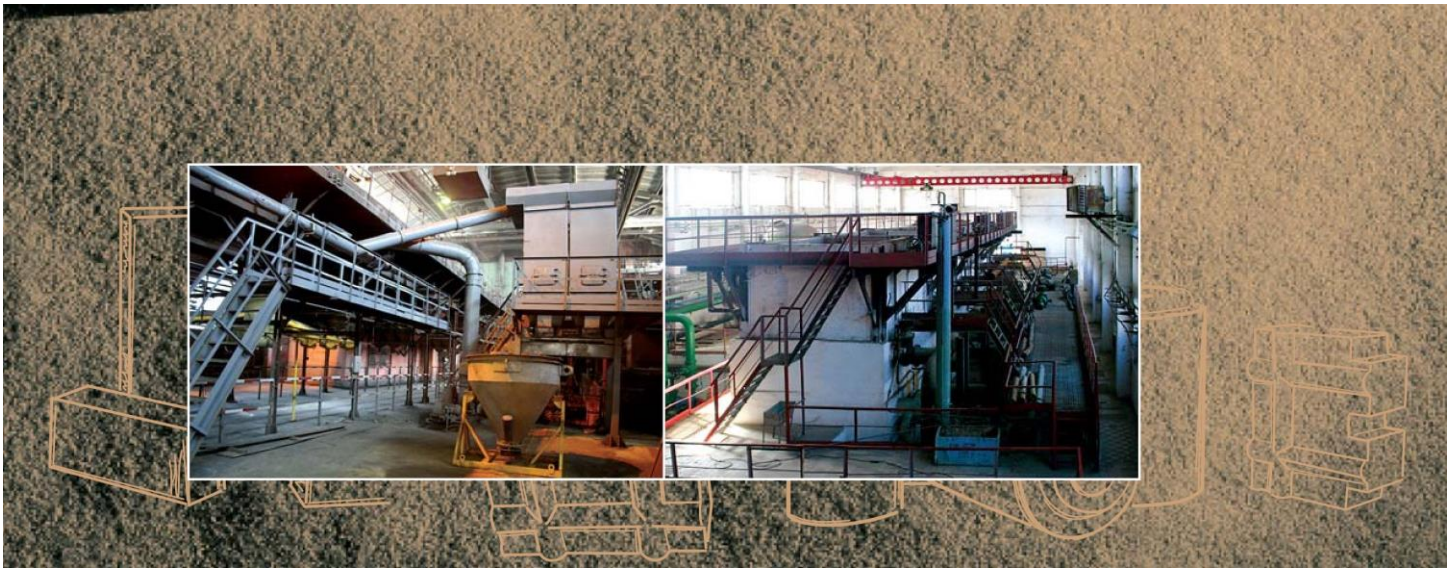
International and national awards recognising the company's competitive and high-quality products serve as a testament to its strong reputation in the business world.

We look forward to establishing long-term, mutually beneficial cooperation with you!

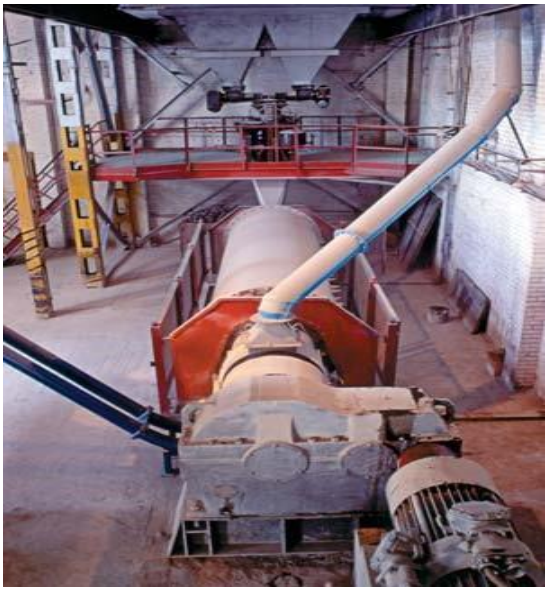
The construction of the Zaporizhzhia Refractory Plant commenced in August 1929. The plant was intended to supply refractories to steel, machine-building, and chemical industries in the Dnieper region and southern Ukraine. The first products were made in 1933.

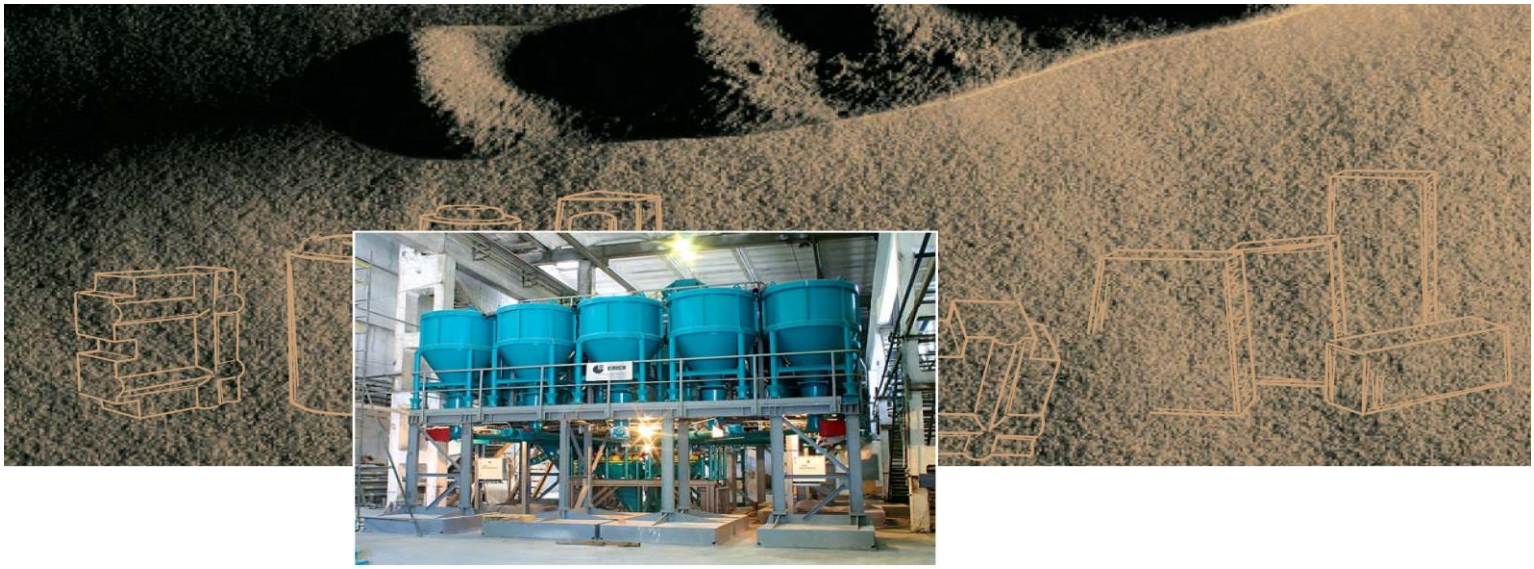
To meet the needs of the developing industry, the company expanded its range of chamotte products.





In parallel, production facilities for magnesia, high-alumina, and silicon carbide products were established. By government decision, the plant was designated as a pilot facility among refractory producers for automation, mechanisation, and the development of new products and technologies. The ring kilns were replaced by tunnel kilns with automatic control of the firing process, rotary kilns were installed, press equipment with mechanised removal and refractory product loading onto kiln cars were installed.





In 1995, the Zaporizhzhia Refractory Plant was reorganised into Open Joint Stock Company "ZAPOROZHOGNEUPOR".

The next modernisation of equipment was carried out in 1997: presses made by the German company Laeis-Bucher with a force of 1,250, 1,600, 2,000, and 2,500 tf were installed. The grinding areas of the shops were reconstructed, packaging equipment was purchased and put into operation, and the mechanical repair shop was re-equipped to manufacture high-precision and high-strength press tools from a range of high-alloy steels. All of this enabled the plant to achieve a new level of product quality.

In 2011, the company was reorganised into Public Joint Stock Company "ZAPOROZHOGNEUPOR".

In 2013, PJSC "ZAPOROZHOGNEUPOR" became part of Metinvest Group, marking a new milestone in the company's development. PJSC "ZAPOROZHOGNEUPOR" was now faced with the task of meeting the essential needs of the Metinvest Group companies in high-quality refractory products. One of the areas of focus for PJSC "ZAPOROZHOGNEUPOR" became the development of advanced technologies and the establishment of industrial production for high-tech refractory products and unshaped materials, which had until then been imported to meet the demand in the Ukrainian market.

So, in May 2013, PJSC "ZAPOROZHOGNEUPOR" put into commercial operation a new shop for producing high-tech refractory castables, designed and equipped with automated, high-precision equipment from EIRICH.

In 2015, the company set up a service department to improve the efficiency of technical solutions for maintaining the lining of metallurgical facilities and reduce repair costs for metallurgical enterprises. An unshaped refractories shop was set up on the premises of the silicon carbide refractories shop and the refractory castables and bodies shop.

In 2016, the company was reorganised into Private Joint Stock Company "ZAPOROZHOGNEUPOR".

In 2017, PJSC "ZAPOROZHOGNEUPOR" set a record for lining durability in Ukrainian steelmaking. Azovstal's first basic oxygen furnace lasted 6,842 heats before undergoing a major overhaul shutdown.

In 2018, following the expansion of the service function, the Service Department was reorganised, and two service centres were established: the Zaporizhzhia Service Centre and the Mariupol Service Centre.

The production of periclase-carbon refractories, one of the highest-margin products, increased by 52.8%.

To date, PJSC "ZAPOROZHOGNEUPOR" is Ukraine's largest producer of refractories, offering an unmatched variety of high-quality products, including more than 1,200 main grades of refractories, unshaped materials, and castables.

ALUMINOSILICATE PRODUCTION

Fire clay (chamotte) products

The plant's production activities began in 1933 with a workshop for the production of fire clay products. Due to its early development, production is characterized by the widest range of refractory products produced. The range of the workshop includes ladle, composite and particularly composite shapes, general-purpose products, stopper, center tubes, hoppers, siphons, stars, nozzles, etc. The grinding section is equipped with drying drums, clay crushing equipment, ball mills, general grinding tube mills, vibrating screens, which allows for high-quality preparation of powders of the required grain size. The pressing section is equipped with hydraulic presses (Laeis-Bucher) with a force of 1600 tf and DRP-350), mechanical presses CM 1085 with a system of cradle conveyors transporting semi-finished products to charging areas, ensuring a wide range of products. The workshop is equipped with 168 m and 87 m long tunnel furnaces with an automatic firing processes. The workshop includes a plastic pressing section dedicated to producing composite-shaped products and steel casting blanks. Finished products are stacked and loaded using electric forklifts and overhead cranes. The products are packed in bags, wrapped in paper and secured with metal straps. Upon agreement with the consumer, other types of packaging are provided to improve the appearance of packages and ensure safety of products during transportation.

GENERAL PURPOSE FIRECRAY PRODUCTS ***GOST 390-96*** **Shape and size** **TU U 23.2-00191885-031:2021**	

Physical and chemical parameters

Parameter	**Norm for grades**	
	ShA	**ShB**
1 Mass fraction, %: Al_2O_3, min	30	28
2 Fire resistance, ^{0}C, min	1690	1650
3 Open porosity, %, max for products of subgroup I II	 24 30	 24 30
4 Ultimate compression strength, MPa, min, for products of subgroup I II	 20 15	 - -
5 Temperature of deformation under load at increasing temperature °C, min	1300	-

REFRACTORY PRODUCTS FOR SIPHON CASTING OF STEEL ***DSTU GOST 11586:2006*** ***(GOST 11586-2005, IDT)***	

Physical and chemical parameters

Parameter	Norm for grades	
	ShS-32	**ShS-28**
1 Mass fraction, %: Al_2O_3, min	32	28
2 Fire resistance, ^{0}C, min	1690	1670
3 Permanent dimensional changes upon heating at 1350°C, %, max	0.4	0.5
4 Open porosity, %,	15-24	15-26
5 Thermal resistance, number of thermal changes, not less than the central, span and end siphon tubes, thermal exchange (heating up to 800 0C, cooling in air).	1	1

Note:

1. For products of the ShS-28 grade using a plastic production method, open porosity of not more than 28% is allowed.
2. For products of ShS-28 grade, upon agreement of the parties, the following standards are permitted: fire resistance– not lower than 1650C, residual change in dimensions upon heating – not more than 1.0%

REFRACTORY PRODUCTS FOR SIPHON CASTING OF STEEL TECHNICAL REQUIREMENTS TT 00191885-084:2022	

Physical and chemical parameters

Parameter	Norm for grades
	ShST-32
1 Mass fraction, %: Al_2O_3, min	32
2 Fire resistance, ^{0}C, min	1690
3 Permanent dimensional changes upon heating at 1350°C, %, max	0.4
4 Open porosity, %,	17.0 – 27.0
5 Thermal resistance, number of thermal changes, not less than the central, span and end siphon tubes, thermal exchange (heating up to 800 ^{0}C, cooling in air).	1

REFRACTORY FIRECLAY PRODUCTS FOR BRICKING OPEN-HEARTH FURNACES ***TU U 23.2-00191885-033:2023***	

Physical and chemical parameters

Parameter	Norm for grades	
	ShAM	**ShBM**
1 Mass fraction, %: Al_2O_3, min	30.0	28.0
2 Fire resistance, ^{0}C, min	1690	1650
3 Permanent dimensional changes upon heating at 1400°C, %, max	-	-
4 Open porosity, %, max, for products of subgroup I II	 24.0 30.0	 24.0 30.0
5 Ultimate compression strength, MPa, min, for products of subgroup I II	 20.0 15.0	 - -
6 Temperature of deformation under load at increasing temperature °C, min	1300	-

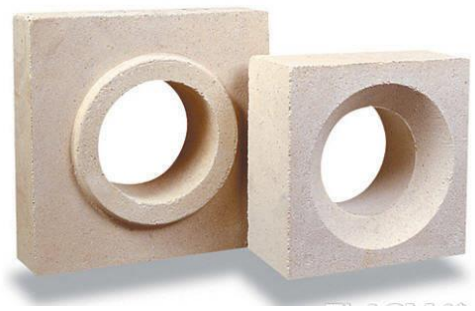
Note 1. It is permitted to manufacture ShBM grades with fire resistance of at least 1630^{0}C.

Note 2. For shaped products of ShAM grade, an ultimate compression strength of at least 10 MPa is permitted upon agreement with the consumer.

Refractory stopper products for casting steel from a ladle ***DSTU GOST 5500:2006 (GOST 5500 -2001, IDT)***	

Physical and chemical parameters

Parameter	Norm for grades	
	ShSP-32	ShSP-35
1. Mass fraction on ignition basis, %: Al_2O_3, %, min	32	3.5
2. Fire resistance, ^{0}C, min	1690	1710
3. Open porosity, %,	15-26	15-26
4. Additional linear shrinkage, %, max, at temperature: 1350 ^{0} C	1690 0.3	1710 0.3
5. Thermal resistance, number of thermal changes, min	1	

Refractory products for slide gates of teeming ladles. ***TUU 23.2 – 00190503--460:2021***	

Physical and chemical parameters

Parameter	Norm for well blocks of ShG-32 grade
1. Mass fraction on ignition basis, %: Al_2O_3, %, min	32
2. Open porosity, %, max	23
3. Ultimate compression strength, MPa, min	15

PRODUCTS FOR LINING LADLES

GOST 5341-98

Physical and chemical parameters

Parameter	Norm for grades						
	ShKU-37	**ShKP-37**	**ShKU-39**	**ShKP-39**	**ShKU-41**	**ShKP-41**	**ShKU-42**
Mass fraction,%: Al_2O_3, min	37	37	39	39	41	41	42
Fe_2O_3, max							3.5
Fire resistance, ^0C, min	1730	1730	1750	1750	1750	1750	1750
Open porosity, %, max	18	16	18	16	18	16	18
Ultimate compression strength, N/mm^2, min	30	40	30	40	30	40	40
Minimum deformation temperature, ^0C, min	1400	1410	1430	1450	1430	1450	1400
Additional linear shrinkage at 1400 0C, %, max	0.3	0.2	0.3	0.2	0.3	0.2	0.3
Thermal resistance, number of thermal changes, max	4	3	4	3	4	3	4

Notice: The parameters for products of ShKU-41, ShKP-41 grades to be agreed with the consumer.

REFRACTORY PRODUCTS

FOR BLAST FURNACE BRICKING

DSTU 2345-94 (GOST 1598-96)

Physical and chemical parameters

Parameter	Norm for products of grades		
	ShPD-43	**ShPD-41**	**ShPD-39**
Mass fraction,%:			
Al_2O_3, min	43	41	39
Fe_2O_3, max	1.5	1.5	1.5
Fire resistance, ^{0}C, min	1750	1750	1750
Deformation onset temperature, ^{0}C, min	1530	1500	1440
Additional linear shrinkage at a temperature of 1450 0C, %, max	0.2	0.2	0.2
Open porosity, %, max	12	12	16
Ultimate compression strength, N/mm^2, min, for product numbers:			
5,6,7,8	40	40	-
other	70	70	50

REFRACTORY PRODUCTS
FOR ROTARY FURNACE LINING
DSTU GOST 21436:2006

Physical and chemical parameters

Parameter	Norm for grades		
	MLTs	**MKRTs**	**ShTsU**
Mass fraction,%: Al_2O_3, min	62	45 (50)	32
Fire resistance, ^{0}C, min	1800	1750	1710
Deformation onset temperature, ^{0}C, min	1450	1400	1370
Open porosity, %, max	24	22	20
Ultimate compression strength, N/mm^2, min	25	30	25
Thermal resistance, thermal changes, min	4	3	4
Residual change in dimensions, %, max, at a temperature of ^{0}C: 1500	0.4		
1400		0.5	0.3

REFRACTORY FIRECLAY PRODUCTS FOR OPEN-HEARTH FURNACE REGENERATOR NOZZLES

TUU 23.2-00190503-458:2021

Physical and chemical parameters

Parameter	Norm for products of grades		
	ShKN-41	**ShN-38**	**ShN-37**
Mass fraction,%: Al_2O_3, min	41	38	37
Open porosity, %, max	21	21	21
Ultimate compression strength, N/mm^2, min	26	22	22
Temperature of deformation under load: 0.2 N/mm^2, (T0,5), ^0C, min	1450	1400	1400
Permanent dimensional changes upon heating at 1400^0C with a holding time of 2 hours, %, max	0.4	0.4	0.4
Fire resistance, ^0C, min	-	1730	1730

REFRACTORY PRODUCTS FOR BRICKING HOT STOVES AND HOT BLAST AIR DUCTS OF BLAST FURNACES

TUU 23.2-00191885-038:2020

Physical and chemical parameters

Parameter	Norm for grades		
	ShV-28	**ShV-37**	**ShV-42**
1. Mass fraction, % Al_2O_3, min Fe_2O_3, max	 28.0 -	 37.0 -	 42.0 1.7
2. Fire resistance, ^{0}C, min	1670	1730	1750
3. Open porosity, %, max, for products: - nozzle - wall, top and for air ducts	 25.0 27.0	 23.0 25.0	 20.0 20.0
4. Ultimate compression strength, N/mm^2, min, for products: - nozzle - wall, top and for air ducts	 15.0 15.0	 20.0 20.0	 40.0 30.0
5. Temperature of deformation under load (deformation point), ^{0}C, min	1270	1330	1500

ZAPORIZHZHIA REFRACTORIES manufactures nozzle products of

ShV 37 No. 80a, ShV 42 No. 80a - 19 channel

REFRACTORY FIRECLAY PRODUCTS FOR LINING LIME KILNS TUU 23.2-00191885-045:2022	

Physical and chemical parameters

Parameter	Norm for products of grades
	ShI
Mass fraction Al_2O_3, %, min	32
Fire resistance ^{0}C, min	1690
Open porosity, %, max	20
Ultimate compression strength, N/mm^2, min	30
Temperature of deformation under load at increasing temperature °C, min	1300

REFRACTORY FIRECLAY PRODUCTS FOR LINING HOT METAL LADLES TUU 23.2-00191885-034:2024	

Physical and chemical parameters

Parameter	Norm for grades	
	ShChU-37	ShChU-41
Mass fraction of Al_2O_3, %, min	37	41
Fire resistance, ^{0}C, min	1730	1730
Open porosity, %, max	20	20
Ultimate compression strength, MPa min	25	25
Permanent dimensional changes upon heating at 1400^{0}C, %, max	0.4	0.4

REFRACTORY FIRECLAY PRODUCTS FOR COKE PRODUCTION PLANTS

TU U 23.2-00191885-041:2022

Physical and chemical parameters

Table 1

Parameter	Norm for products of grades		
	ShK-37	ShK-35	ShK-28
	Typical bricklaying locations		
	bottom, doors, chambers of dry coke quenching plants, gas burners	roof, hatches, shafts, regenerator walls, gas burners	grate nozzles, other places, chambers of dry coke quenching plants, grating
1	2	3	4
1. Mass fraction, %:			
Al_2O_3, min	37	3.5	28
Fe_2O_3, max	2.5	Not regulated	
2 Fire resistance, ^{0}C, min	1730	1710	1670
3 Open porosity, %,			
max	-	26	26
within the range	12-24	-	-
4 Ultimate compression strength, MPa, min,	Limits in accordance with the note to the table		
5. Permanent dimensional changes upon heating %, max, at a temperature:			
1350^o C	+ 0.4	+ 0.4	+ 0.6
1450^o C	Not regulated		
6. Thermal resistance, thermal changes, min	Not regulated	2	Not regulated

Note 2. For ShK-37 grade, the standard for the ultimate strength during compression is:

- lining for chambers of dry coke quenching plants with a thickness of up to 65 mm inclusive and hearth products - min 40 MPa, with a thickness of more than 65 mm - min 30 MPa;
- extreme roof, corner, hatch bricks and inspection shafts - min 35 MPa;
- door linings - min 20 MPa.

Permanent dimensional changes upon heating are not regulated for chambers of dry coke quenching plants.

End of table 1 to **TU U 23.2-00191885-041:2022**

1	2	3	4
Note 3. For ShK-35 grade, the norm for the ultimate compression strength is: - extreme roof, corner, hatch bricks and inspection shafts - min 25 MPa; - products for other bricklaying locations – min 20 MPa. Norms for the following parameters for gas burners: - ultimate compression strength and permanent dimensional change upon heating are not regulated; - open porosity – within (12 – 20)%; - thermal resistance (at least 2 thermal changes without cracks) is set only for gas burners **Note 4.** For ShK-28 grade, the norm for permanent dimensional changes upon heating is set only for products in other bricklaying locations; Norms for ultimate compression strength: - grate nozzles – min 12 MPa; - lining for chambers of dry coke quenching plants – min 15 MPa. **Note 5.** For grades ShK-28, ShK-34, ShK-37 made from non-fired raw materials (kaolin), by plastic molding or vibration casting, an increase in open porosity of up to 28% is allowed.			

High Alumina Shapes

The shop was put into operation in 1961 for the production of high-alumina high strength refractories with an Al_2O_3 content of 62 to 85%. The products of the shop are used for lining blast furnaces stoves, hot blast and secondary metallurgy pipelines, and other thermal generating units of non-ferrous metallurgy. The shop is equipped with high-efficiency grinding equipment, mechanical presses of domestic production and Laeis-Bucher hydraulic presses. The products are fired in a high-temperature tunnel kiln of 156 m in length with drying section of 45 m in length. The tunnel kiln has been modernized and has computerized process control of firing modes.
All products are packed in bags at the finished product warehouse. The shop of high-alumina refractory shapes at ZAPORIZHZHIA REFRACTORIES is the only one in Ukraine. The products of the shop are in demand in many countries of the world, as well as in the domestic market.

REFRACTORY PRODUCTS FOR BRICKLAYING BLAST FURNACE STOVES AND HOT BLAST DUCTS
TUU 23.2-00191885-038:2020

Physical and chemical parameters

Parameter	Norm for grades		
	MKRV-50	**MKV-72**	**MKVN-72**
1. Mass fraction, %: Al_2O_3, min Fe_2O_3, max	 50.0 1.5	 72.0 1.5	 72.0 1.5
2. Open porosity, %, max, of products for: - nozzles - walls, cones and air ducts	 21.0 23.0	 21.0 24.0	 23.0 -
3. Ultimate compression strength, - nozzles - walls, cones and air ducts	 40.0 30.0	 50.0 30.0	 40.0 -
4. Deformation temperature under load (softening point), ^0C, min	1,540	1,550	1,580

Note: By agreement with the customer, the mass fraction of Fe_2O_3 is maximum 2.0%.

CORUNDUM AND HIGH-ALUMINA REFRACTORIES

TU U 23.2-00191885-040:2020

Physical and chemical parameters

Parameter	Norm for grades			
	MKS-72	MKSK-72	MLS-62	MKRS-50
Mass fraction, %				
Al_2O_3, min	72	72	62	50
Fe_2O_3, max	2.0	2.0	2.0	1.8
Open porosity, %, max	24	24	24	24
Ultimate compression strength, N/mm^2, min	30	30	25	20
Deformation temperature under load (softening point), ^0C, min	1,500	1,500	1,450	1,400
Residual changes of dimensions (post-shrinkage), %, max, at a temperature, ^0C:				
1,400	-	-	-	0.5
1,500	-	-	0.4	-
1,600	1.0	1.0	-	-

MULLITE-SILICA REFRACTORIES FOR LINING STEEL LADLES

TU U 26.2-00191885-017:2011

Physical and chemical parameters

Parameter	Norm for grades		
	MKRK-45	MKRK-48	MKRK-50
1 Mass fraction, %:			
Al_2O_3, min	45	48	50
Fe_2O_3, max	1.8	1.8	1.8
2 Open porosity, %, max	23	22	22
3 Ultimate compression strength, N/mm^2, min	30	40	50
4 Deformation temperature at increasing temperature, ^0C, min	1,400	1,450	1,480
5 Residual changes of dimensions when heated, at a temperature of 1,400^0C, %, max	0.5	0.4	0.4
6 Thermal stress resistance (heating up to 1,300^0C, water cooling), heat changes, min	3	3	3
7 Fire resistance, ^0C, min	1,750	1,750	1,750

REFRACTORY PRODUCTS FOR SLIDE GATES OF STEEL LADLES TU U 23.2-00190503-460:2021

Physical and chemical parameters

Parameter	Norm for pocket blocks of grades	
	MKG-72 No. 1, MKG 72 No. 2	MKG-80 No. 1, MKG 80 No. 2
1. Mass fraction, %: Al_2O_3, min Fe_2O_3, max	 72.0 1.4	 80.0 1.4
2. Open porosity, %, max	24	23

Note: By agreement with the customer, the mass fraction of Fe_2O_3 is maximum 2.0%.

MULLITE-CORUNDUM REFRACTORIES OF MKS-85 GRADE

Physical and chemical parameters

Parameter	Norm for grade MKS-85
Mass fraction, %	
Al_2O_3, min	85
Fe_2O_3, max	2.0
Open porosity, %, max	23
Ultimate compression strength, N/mm^2, min	70
Temperature at the beginning of softening, ^0C, min	1,580
5 Residual changes of dimensions when heated (at a temperature of 1,600^{0}C), %, max	0.5

Physical and chemical parameters, drawings, overall dimensions of products, deviations from overall dimensions, appearance characteristics - in accordance with the contract (specification) of the customer.

HIGH-DUTY REFRACTORIES FOR LAYING HOT BLAST DUCTS OF BLAST FURNACES OF MKT-80 GRADE

Physical and chemical parameters

Parameter	**Norm for grades**
	MKT-80
Mass fraction, %	
Al_2O_3, min	80
Fe_2O_3, max	2.0
Fire resistance, ^0C, min	1,750
Open porosity, %, max	23
Ultimate compression strength, N/mm^2, min	40
Temperature at the beginning of softening, ^0C, min	1,600

Products are manufactured by agreement with the customer.

Physical and chemical parameters, drawings, overall dimensions of products, deviations from overall dimensions, appearance characteristics - in accordance with the contract (specification) of the customer.

Shape and dimensions should meet the requirements of TUU 23.2-00191885-038:2020.

LIGHTWEIGHT, HEAT INSULATING REFRACTORIES

DSTU 2342-94 (GOST 5040-96)

Physical and chemical parameters of lightweight products

Parameter	Norm for products of grades		
	ShKL-1,3	ShL-1,3	SHL-1,0
Apparent density, g/cm^3, max	1.3	1.3	1.0
Permanent linear shrinkage (growth) at holding within 2 hours, %, max at a temperature, ^{0}C	1.0 1,400	1.0 1,300	1.0 1,300
Ultimate compression strength, N/mm^2, min	3.5	3.5	3.0
Thermal conductivity, watt/(meter▪K), max, at average temperature, ^{0}C: 350±25 650±25*	 0.5 0.6	 0.6 0.7	 0.5 0.6
*Specified at the request of the customer			

QUARTZITE NON-FIRED LADLE REFRACTORIES

TT 00191885-087:2022

Physical and chemical parameters

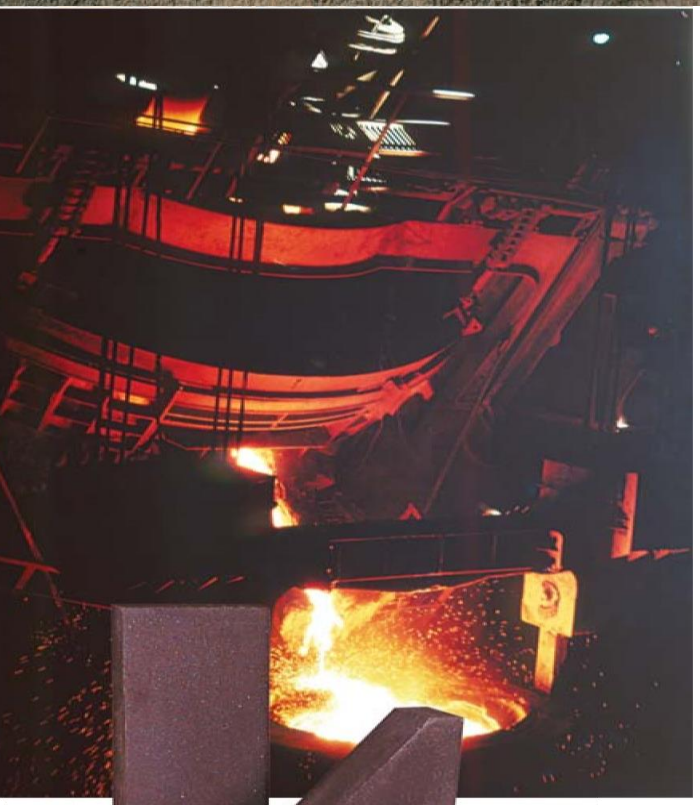
Parameter	Norm for products
	KBKZhS
Mass fraction of SiO_2, %, min	95
Mass fraction of $Na_2O + K_2O$*, %, max	1.2
Moisture, %, max	0.8
Fire resistance, ^{0}C, min	1,690
Open porosity after drying, %, max	18
Ultimate compression strength, MPa, min	17
Apparent density, g/cm^3, min	2.14
Note*. The mass fraction of $Na_2O + K_2O$* is specified by agreement between the manufacturer and the customer. It is determined optionally, reported in the quality certificate.	

ALUMINA-SILICA REFRACTORY AND HIGH-DUTY REFRACTORY TUBES FOR BLOWING THROUGH THE STEEL IN THE LADLE WITH INERT GASES AND FOR TUNDISH STOPPERS

Physical and chemical parameters

Parameter	Norm for grades
	MKF-72
1. Mass fraction, %: Al_2O_3, min Fe_2O_3, max	 74 2
2. Open porosity, %, range	18-23
3. Final changes of dimensions during heating at 1,600 ^{0}C, max	0.2
4. Thermal resistance (heating up to 800 ^{0}C, cooling - by air)	After seven thermal cycles, there should be no through cracks, along which the tube is divided into parts

Physical and chemical parameters, drawings, overall dimensions of products, deviations from overall dimensions, appearance characteristics - in accordance with the contract (specification) of the consumer.



PRODUCTION OF MAGNESIA REFRACTORIES

Magnesia refractories

The magnesia refractories shop produces a wide range of periclase, periclase-chromite, chromite-periclase, periclase-carbon, alumina-periclase-carbon, corundum-carbon products and unshaped refractory materials used for the lining of open-hearth, electric arc, basic oxygen, rotary furnaces and other thermal facilities. Magnesia refractories are and will continue to be the primary structural material for lining steelmaking and other metallurgical facilities in the near future. Carbon-containing refractories, used in advanced metallurgical processes, continue to be the most promising materials. Among carbon-containing refractories, periclase-carbon refractories play a key role in modern steelmaking, being used for lining basic oxygen furnaces, electric arc furnaces, steel teeming ladles, and more. The production facility is equipped with hydraulic presses from Laeis-Bucher with a force of 1,250, 1,600, 2,000, and 2,500 tf. To improve product quality, the pressing area is equipped with automated systems that load the pressed products onto a furnace car based on a pre-set program, alongside computerised monitoring of production parameters. The products are fired in a 156-meter-long tunnel furnace in an automatic firing mode. The tunnel kiln has been modernised and has computerised process control.

At the finished goods warehouse, after sorting and acceptance by the company's technological control department, the products are packed in packages, placed in corrugated cardboard boxes, with the top edges of the packages protected by corner protectors. They are then tied with polyester straps and wrapped in elastic polyethylene film, providing a good appearance and guaranteeing the safety of the products.

PERICLASE-CARBON REFRACTORY PRODUCTS FOR BASIC OXYGEN FURNACES
TUU 23.2-00191885-023:2014 with amendments 1,2

Parameter	Norm for grades									
	PUKK -1	PUKK -2	PUKK -3	PUKK -4	PUKK -5	PUKK -6	PUKK -7	PUKK -8	PUKK -9	PUK K -10
Mass fraction, %										
MgO, min.	93.0	93.0	93.0	93.0	93.0	93.0	91.0	91.0	91.0	91.0
Al_2O_3, within the range	-	-	-	-	-	-	3.0-5.0	3.0-5.0	3.0-5.0	3.0-5.0
SiO_2, max.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Fe_2O_3, max.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Mass fraction of total carbon (C), %, within the range	5.0-10.0	10.0-14.0	10.0-14.0	5.0-10.0.	5.0-10.0	10.0-14.0	5.0-10.0	10.0-14.0	5.0-10.0	10.0-14.0
Ultimate compression strength, N/mm^2, min.	35.0	35.0	32.0	35.0	35.0	35.0	35.0	35.0	40.0	40.0
Open porosity, %, max.	6.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0	4.0	4.0
Apparent density, g/cm^3, min.	2.88	2.88	2.88	2.88	2.90	2.90	2.90	2.90	2.95	2.95

Grades PUKK-1, PUKK-2 – for the lining of the basic oxygen furnace bottom (based on sintered periclase);
Grades PUKK-3, PUKK-4 – for the lining of the lower cone of a basic oxygen furnace (based on sintered and fused periclase);

Grade PUKK-5 – for the lining of the upper cone of a basic oxygen furnace (based on fused periclase);
Grade PUKK-6 – for the lining of the cylindrical zone of a basic oxygen furnace (based on fused periclase);
Grades PUKK-7, PUKK-8 – for the lining of the upper cone of a basic oxygen furnace (based on fused and sintered periclase with an antioxidant);
Grades PUKK-9, PUKK-10 – for the lining of the cylindrical zone of a basic oxygen furnace (based on fused periclase with an antioxidant).
The shape and dimensions of the products are according to TUU 23.2-00191885-023:2014 with amendments 1,2 "Highly refractory periclase-carbon products for basic oxygen furnaces" and the customer's drawings. Dimensional tolerances:
For sizes up to 400 mm ± 1.0 mm
For sizes greater than 400 mm ± 2.0 mm

PERICLASE-CARBON REFRACTORY PRODUCTS FOR THE LINING OF STEEL TEEMING LADLES

TUU 23.2-00191885-024:2014 with amendments 1,2

Parameter	Norm for grades									
	PU-1	**PU-2**	**PU-3**	**PU-4**	**PU-5**	**PU-6**	**PU-7**	**PU-8**	**PU-9**	**PU -10**
Mass fraction, %										
MgO, min.	88.0	90.0	90.0	92.0	90.0	93.0	91.0	93.0	93.0	91.0
Al_2O_3, within the range	3.0-5.0	3.0-5.0	3.0-5.0	3.0-5.0	-	-	3.0-5.0	-	-	3.0-5.0
CaO, max.	2.0	2.0	2.0	1.5	2.0	1.5	1.5	1.5	1.5	1.5
SiO_2, max.	2.0	2.0	2.0	1.5	2.0	2.0	1.5	1.5	1.5	1.5
Fe_2O_3, max.				1.0				1.0	1.0	1.0
Mass fraction of total carbon (C), %, within the range	10-13	7-10	10-13	5-10	5-10	5-10	10-15	10-15	10-15	10-15
Ultimate compression strength, N/mm^2, min.	35.0	35.0	32.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
Open porosity, %, max.	6.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0
Apparent density, g/cm^3, min.	2.88	2.93	2.90	2.93	2.90	2.93	2.90	2.90	2.90	2.90

Products intended for the lining of steel teeming ladles:

– grades PU-1, PU-2, PU-3, PU-4, PU-7, PU-10 – for the slag zone lining (with the addition of an antioxidant);

– grades PU-5, PU-6, PU-8, PU-9 – for the wall and bottom lining.

The shape and dimensions of the products are according to TUU 23.2-00191885-024:2014 with amendments 1,2 "Periclase-carbon refractory products for the steel teeming ladle lining" and the customer's drawings.

Tolerances for the lining layer and the brickwork thickness ± 0.5 mm

HIGHLY REFRACTORY MAGNESIA PRODUCTS FOR STEEL TAPHOLES OF BASIC OXYGEN AND OPEN-HEARTH FURNACES

TU U 23.2-00191885-042:2022

Parameter	Norm for products of grade
	PLK-94
1 Mass fraction, %:	
MgO, min.	94.5
Fe_2O_3, max.	1.5
2 Ultimate compression strength, N/mm^2, min.	30
3 Open porosity, %, max.	17

PERICLASE-CARBON REFRACTORY PRODUCTS FOR STEEL TAPHOLES OF BASIC OXYGEN AND OPEN-HEARTH FURNACES.

TU U 23.2-00191885-025:2013 with amendments 1,2

Parameter	Norm for products of PUL grade
1.Mass fraction (on ignition basis), %	
MgO, min.	92.0
AL_2O_3, within the range	3.0-5.0
CaO, max.	1.5
SiO_2, max.	1.5
Fe_2O_3, max.	1.0
C, within the range	8.0-15.0
2. Apparent density, g/cm^3, min.	2.95
3. Ultimate compression strength, N/mm^2, min.	37.0
4. Open porosity, %, max.	5.0
Note. Fused periclase with an MgO content of no less than 97% is used	

PERICLASE REFRACTORY PRODUCTS GOST 4689-94	

Parameter	Norm for grades		
	P-91	P-90	P-89
1	2	3	4
1.Mass fraction, %			
magnesium oxide MgO, min.	91.0	90.0	89.0
calcium oxide CaO, max.	3.0	4.0	4.5
iron oxide Fe_2O_3, max.	2.5	2.5	-
silicon dioxide SiO_2, max.	3.0	3.0	-
2.Open porosity, % max.	22.0	23.0	26.0
3.Ultimate compression strength, N/mm^2, min.	60.0	50.0	40.0
4. Temperature of deformation under load at rising temperature, ^0C, min.	1,550	1,550	1,500

PERICLASE REFRACTORY PRODUCTS

TU U 26.2-00191885-019:2011 with amendments 1-4

Parameter	**Norm for grades**							
	P-96	**P-94**	**P-93**	**P-92Si**	**P-91Si**	**P-91-1**	**P-90-1**	**P-89-1**
1	2	3	4	5	6	7	8	9
1. Mass fraction on ignition basis, %								
MgO, min.	96.0	94.0	93.0	92.0	91.0	91.0	90.0	89.0
CaO, max.	1.5	2.0	2.5	3.0	3.0	3.0	4.0	4.0
Fe_2O_3, max.	1.0	1.5	1.5	2.0	2.0	-	-	-
Fe_2O_3, within the range	-	-	-	-	-	2.5-6.0	-	2.5-8.5
SiO_2, max.	1.4	2.5	3.0	4.0	5.0	1.8	-	2.0
2. Open porosity, % max.	18.0	19.0	20.0	20.0	20.0	20.0	20.0	20.0
3.Ultimate compression strength, N/mm^2, min.	70.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
4. Temperature of deformation under load at rising temperature, ^0C, min.	1,600	1,550	1,530	1,530	1,530	1,530	1,500	1,500

HIGHLY REFRACTORY PERICLASE-CHROMITE PRODUCTS FOR THE LINING OF STEELMAKING FURNACE ROOFS

DSTU 2573-94

Parameter	Norm for products of grade		
	PKhSP	**PKhSUT**	**PKhSU**
1.Mass fraction (on ignition basis), %			
MgO, min.	70	70	65
Cr_2O_3, within the range	7-15	7-15	7-15
2. Open porosity, %, max.	16	18	20
3. Ultimate compression strength, N/mm^2, min.	37,5	35.0	32.5
4. Temperature of deformation under load at rising temperature, ℃, min.	1,560	1,540	1,540
5. Irreversible dimensional changes at 1650 ℃, with an exposure time of 3 hours %, max.	0.7	0.7	0.8
6.Thermal resistance (heating up to $1,300^0$C, water cooling), heat cycles, min.	4	6	5

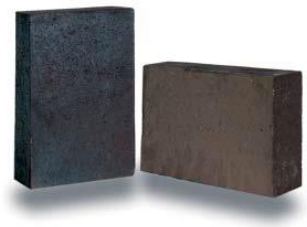
HIGHLY REFRACTORY PERICLASE-CHROMITE DIRECT-BONDED OPTIMISED AND MAGNESIA-SPINEL PRODUCTS FOR THE BRICKWORK OF OPEN-HEARTH FURNACE ROOFS

TU U 23.2-00191885-004:2022

Parameter	Norm for products of grade		
	PKhSOSP**	**PKhSOS**	**PKhShS**
1.Mass fraction (on ignition basis), %:			
MgO, min.	65.0	65.0	60
Cr_2O_3, within the range	12.0-17.0	12.0-17.0	11.0-17.0
SiO_2, max.	2.0	2.0	-
Fe_2O_3, within the range	7.0-13.0	7.0-13.0	7.0-11.0
Al_2O_3, within the range*	3.0-6.0	3.0-6.0	max. 8.0
CaO, max.*	3.0	3.0	3.0
2.Open porosity, %, max.	17.0	17.0	18.0
3.Apparent density (fired products), g/cm^3, min.	3.12	3.12	3.12
4. Ultimate compression strength, N/mm^2, min.	35.0	35.0	30.0
5. Temperature of deformation under load at rising temperature, ℃, min.	1,630	1,630	1,600
6. Irreversible dimensional changes during heating, %, max.	0.5	0.5	0.5
7. Thermal resistance (heating up to $1,300^0C$, water cooling), heat cycles, min.	8.0	8.0	8.0

Note*. The mass fractions of Al_2O_3 and CaO are subject to agreement between the manufacturer and the consumer.

Note.** For the PKhSOSP products – using fused periclase with an MgO mass fraction of no less than 97 %.



HIGHLY REFRACTORY PRODUCTS WITH AN OPTIMISED COMPOSITION FOR THE LINING OF ROTARY FURNACES
PKhTsOS

Parameter	Norm for products of PKhTsOS grade
1.Mass fraction (on ignition basis), %	
MgO, min.	68.0
Cr_2O_3, within the range	9.0-15.0
CaO, max.	2.0
2. Open porosity, %, max.	16.0
3. Ultimate compression strength, N/mm^2, min.	35.0
4. Temperature of deformation under load at rising temperature, °C, min.	1,640
5.Thermal resistance (heating up to $1,300^0$C, water cooling), heat cycles, min.	8.0

HIGHLY REFRACTORY PRODUCTS FOR THE LINING OF ROTARY FURNACES
DSTU GOST 21436:2006

Parameter	PKhTs	KhPTs
1.Mass fraction (on ignition basis), %		
MgO, min.	65.0	42.0
Cr_2O_3, within the range	8.0-18.0	20.0-30.0
2. Open porosity, %, max.	24.0	25.0
3. Ultimate compression strength, N/mm^2, min.	25.0	20.0
4. Temperature of deformation under load at rising temperature, °C, min.	1,500	1,450
5.Thermal resistance (heating up to $1,300^0$C, water cooling), heat cycles, min.	8.0	2.0

HIGHLY REFRACTORY PERICLASE-CHROMITE PRODUCTS FOR THE LINING OF STEELMAKING CONVERTERS

TUU 23.2-00190503-367:2012 with amendments 1,2

Parameter	Norm for products of PKhKU grade
1.Mass fraction (on ignition basis), %	
MgO, min.	65.0
Cr_2O_3, within the range	7.0-15.0
2. Open porosity, %, max.	20.0
3. Ultimate compression strength, N/mm^2, min.	32.5
4. Temperature of deformation under load at rising temperature, °C, min.	1,540
5. Irreversible dimensional changes at 1,650 °C, with an exposure time of 3 hours %, max.	0.8
6.Thermal resistance (heating up to $1,300^0$C, water cooling), heat cycles, min.	5.0

HEAT RESISTANT CHROMITE-PERICLASE PRODUCTS FOR THE LINING OF THERMAL FACILITIES IN METALLURGY

TUU 23.2-00190503-389:2014 with amendment 1

KhPTU

Parameter	KhPTU	KhPTS
1.Mass fraction (on ignition basis), %		
MgO, min.	55.0	55.0
Cr_2O_3, within the range	15-22	14-22
2. Open porosity, %, max.	20	23
3. Ultimate compression strength, N/mm^2, min.	25	20
4. Temperature of deformation under load at rising temperature, °C, min.	1,510	1,510
5.Thermal resistance (heating up to $1,300^0$C, water cooling), heat cycles, min.	6	6

HEAT RESISTANT CHROMITE-PERICLASE PRODUCTS OPTIMISED FOR THE LINING OF THERMAL FACILITIES IN METALLURGY

KhPTUOS

Parameter	KhPTUOS
1.Mass fraction (on ignition basis), %	
MgO, min.	58.0
Cr_2O_3, within the range	15-17
2. Open porosity, %, max.	17
3. Ultimate compression strength, N/mm^2, min.	3.5
4. Temperature of deformation under load at rising temperature, °C, min.	1,640
5.Thermal resistance (heating up to 1,300^{0}C, water cooling), heat cycles, min.	8

HIGHLY REFRACTORY MAGNESIA-CHROMITE PRODUCTS FOR BASIC OXYGEN FURNACES
TUU 23.2-00190503-464:2021
KhPKK

Parameter	Norm for products of KhPKK grade
1 Mass fraction, %: MgO, min. Cr_2O_3, within the range	 55 15-22
2 Ultimate compression strength, N/mm^2, min.	3.5
3 Open porosity, %, max.	18
4 Deformation temperature under a load of 0.2 N/mm^2,($T_{0.5}$), °C, min.	1,580
5 Thermal resistance, heat cycles (R_{tr}, water, 1,300), min.	5

HIGHLY REFRACTORY CHROMITE-PERICLASE PRODUCTS OPTIMISED FOR BASIC OXYGEN FURNACES TUU 26.2-00191885-007:2009 with amendments 1-3

Parameter	Norm for KhPKKOS products
1.Mass fraction, %	
MgO, min.	65.0
Cr_2O_3, within the range	12.0 - 17.0
SiO_2, max.	2.0
CaO, max.	3.0
Fe_2O_3, within the range	7.0-13.0
AL_2O_3, within the range	3.0-6.0
2.Open porosity, %, max.	16.0
3.Ultimate compression strength, MPa, min.	50
4.Temperature of deformation under load at rising temperature, °C, min.	1,630
5.Thermal resistance, heat cycles, min.	9

MAGNESIA UNFIRED NOZZLES AND COLLECTING NOZZLES TUU 23.2-00190503-460:2021

Parameter	PBS-88
1 Mass fraction on ignition basis, %: MgO, min. Al_2O_3, min. SiO_2, max. Fe_2O_3, max. Cr_2O_3, within the range	 88.0 - - - -
2 Mass change during ignition, %, within the range	-
3 Open porosity, %, max.	-
4 Refractoriness, °C, min.	-
5 Apparent density, g/cm^3, min.	2.55
6 Ultimate compression strength, N/mm^2, min.	25
7 Moisture content, %, max	0.5
Note. Unfired magnesia nozzles are waxed as agreed between the manufacturer and the customer.	

HIGHLY REFRACTORY CHROMITE-PERICLASE PRODUCTS
DSTU 2509-94(GOST 5381-93)

Parameter	Norm for products of grades				
	KhP -1	KhP 2	KhP 3	KhP 4	KhP 5
1.Mass fraction (on ignition basis), %					
MgO, min.	46	46	42	42	42
Cr_2O_3, within the range	22	22	20	15	15
SiO_2, max.	6	7	8	8	8
2. Open porosity, %, max.	20	22	23	24	25
3. Apparent density, g/cm^3, min.	2.95	2.95	2.95	-	-
4. Ultimate compression strength, N/mm^2, min.	30	27.5	25	25	20
5. Temperature of deformation under load at rising temperature, °C, min.	1,550	1,520	1,500	1,500	1,450
6.Thermal resistance (heating up to $1,300^0C$, water cooling), heat cycles, min.	2	2	2	-	-

PERICLASE-CHROMITE REFRACTORY PRODUCTS FOR OPEN-HEARTH FURNACE REGENEATOR CHECKERS
TU U 23.2-00191885-014:2022

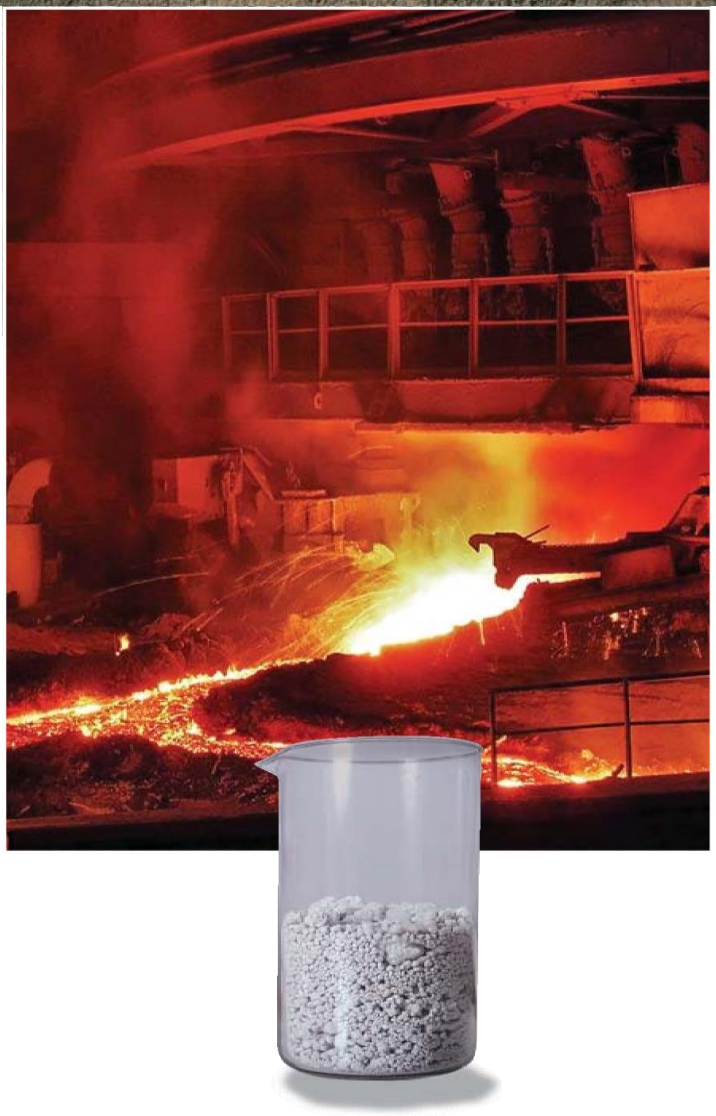
Parameter	Norm for PKhN products
1.Mass fraction, %:	
MgO, min.	65.0
Cr_2O_3, within the range	10.0-15.0
Fe_2O_3, max.	12.0
Al_2O_3, max.	5.0
2.Open porosity, %, max.	18.0
3. Ultimate compression strength, N/mm^2, min.	30.0
4.Temperature of deformation under load at rising temperature, °C, min	1,540
5. Thermal resistance (heating up to $1,300^0C$, water cooling), heat cycles, min.	6.0

ALUMINA-PERICLASE-CARBON REFRACTORY PRODUCTS FOR THE STEEL TEEMING LADLE BOTTOM LINING
TU U 23.2–00191885–051:2023

Parameter	APU-65	APU-70
1.Mass fraction, %		
Al_2O_3, min.	65.0	70.0
MgO, min.	9.0	9.0
CaO, max.	-	-
Fe_2O_3, max.	-	-
2.Mass fraction of total carbon (C), %,	within the range 8-12	min. 6
3.Ultimate compression strength, MPa, min.	35.0	45.0
4.Open porosity, %, max.	10.0	6.0
5.Apparent density, g/cm^3, min.	2.95	3.20

CORUNDUM-CARBON REFRACTORY PRODUCTS FOR THE HOT METAL LADLE LINING BRICKWORK
TU U 23.2–00191885–051:2023

Parameter	Norm for grades	
	ZOZ brick KS-60	ZOZ brick KS-85
1.Mass fraction, %		
Al_2O_3, min.	60	85
MgO, min.	-	-
CaO, max.	1.0	1.0
Fe_2O_3, max.	2.0	2.0
2.Mass fraction of total carbon (C), %,	min. 8	min. 8
3.Ultimate compression strength, MPa, min.	35.0	35.0
4.Open porosity, %, max.	10.0	8.0
5.Apparent density, g/cm^3, min.	2.80	3.0



PRODUCTION OF UNMOULDED REFRACTORIES

The use of unmoulded refractories instead of artificial refractories
creates conditions for mechanizing the lining process. In some cases, the use of unmoulded refractories allows increasing the service life of the lining in thermal units and reduce the costs of performing refractory work.

GROUND CHAMOTTE AND REFRACTORY CLAY POWDERS AND CHAMOTTE-CLAY POWDERS TECHNICAL SPECIFICATION TU U 23.2-00191885-052:2024

Physical and chemical parameters

Powder grade	Parameter		
	Fire resistance, ^{0}C, min	Mass fraction on ignition basis, %, AL_2O_3, min	Moisture content, %, max
PShKA	1730	3.5	4
PShKB	1670	30	4
PShTA	1730	3.5	4
PShTB	1670	30	4
PShTV	1580	28	4
PShGT-2	1730	36	5

In terms of grain size, ground refractory clay powders must meet the requirements specified in the table.

Parameter	Norm for powders of grades		
	PShTA, PShTB, PShTV	PSHKA, PShKB	PShGT-2
Undersized through screen No.3,2 mm, %, min	-	100	-
Undersized through screen No.2, %, min	-	90	95
Undersized through screen No.1, %, min	100	-	-
Undersized through screen No.05, %, min	90	40	within the range of 40-65
Undersized through screen No.009, %, within the range	-	-	20-30

Note. By mutual agreement between the manufacturer and the consumer, it is acceptable to supply ground chamotte, refractory clay and chamotte-clay powders with a custom grain size.

GROUND CHAMOTTE AND REFRACTORY CLAY POWDERS AND CHAMOTTE-CLAY POWDERS TECHNICAL SPECIFICATION TU U 23.2-00191885-052:2024

Physical and chemical parameters

Powder grade	Parameter		
	Fire resistance, ^{0}C, min	Mass fraction on ignition basis, %, AL_2O_3, min	Moisture content, %, max
PGOSA	1730	3.5	12
PGOSB	1670	30	12
PGPKV	1580	18	12
PGOSV	1580	28	12
PGPKB	1670	23	12

Note. By mutual agreement between the manufacturer and the consumer, it is acceptable to supply clay powders of PGOSA, PGOSB and PGOSV with moisture max 18%.

In terms of grain size, ground refractory clay powders shall meet the requirements specified in the table.

Parameter	Norm for powders of grades
	PGOSA, PGOSB, PGOSV, PGPKB, PGPKV
Undersized through screen No.3,2 mm, %, min	100
Undersized through screen No.1, %, min	98
Undersized through screen No.1, %, min	-
Undersized through screen No.05, %, min	40

Note. By mutual agreement between the manufacturer and the consumer, it is acceptable to supply chamotte and refractory clay with a custom grain size.

REFRACTORY CHAMOTTE MORTARS

TU U 23.2-00191885-037:2020

Physical and chemical parameters

Parameter	Norm for grades			
	MSh 36	**MSh 39**	**MShA 36**	**MShA 39**
1 Mass fraction, %: Al_2O_3, min Fe_2O_3, max	 36.0 2.0	 39.0 2.0	 36.0 2.0	 39.0 2.0
sodium carbonate (Na_2CO_3), within the range lignosulphonates (LST), within the range	0.12-0.18 0.07-0.13	0.12-0.18 0.07-0.13	-	-
2 Mass change during ignition, within the range, %	1.3 – 3.2	1.3-3.2	1.3 – 3.2	1.3 – 3.2
3 Fire resistance, ^0C, Min	1730	1730	1730	1730
4 Moisture content, %, max	5.0	5.0	5.0	5.0
5 Grain size, %, undersized through screen No.: 1, min 0.5, min within the range of 009-65	 100.0 95.0 60.0 - 85.0	 100.0 95.0 60.0 – 90.0	 100.0 95.0 60.0 - 95.0	 100.0 95.0 60.0 – 95.0

REFRACTORY CHAMOTTE MORTARS

DSTU 3475-96 (GOST 6137-97)

Physical and chemical parameters

Parameter	Norm for grades	
	MP-18	**MSh-28**
1 Mass fraction, %: Al_2O_3, min Fe_2O_3, max	 18 -	 28 -
sodium carbonate (Na_2CO_3), within the range lignosulphonates (LST), within the range	0.12-0.18 0.07-0.13	0.12-0.18 0.07-0.13
2 Mass change during ignition, within the range, %	1.3-3.0	1.3-3.0
3 Fire resistance, ^{0}C, Min	1610	1650
4 Moisture content,%, max	6	5
5 Grain size, %, undersized through screen No.: 2, min 0.5, within the range	 100 60-94	 100 60-94

REFRACTORY MULITECORUNDUM MORTAR

TU U 23.2-00190503-392:2015

Physical and chemical parameters

Parameter	**Norm for grades**
	ММК-72-1
1 Mass fraction, %:	
Al_2O_3, min	72
Fe_2O_3, max	1.5
2 Mass change during ignition, %, max	3.0
3 Moisture content, %, max	5
2 Grain size, %:	
undersized through screen No.05, min	100
undersized through screen No.009, within the range	60– 85

Note: Upon agreement with the customer, the mass fraction of Fe_2O_3 is maximum 2.0%.

REFRACTORY CHAMOTTE ALUMINOSILICATE
DSTU 3485-96 (GOST 6137-97)

Physical and chemical parameters

Parameter	Norm for grades	
	MML-62	**MMK-72**
1 Mass fraction, %:		
aluminum oxide (Al_2O_3), min	62	72
iron oxide Fe_2O_3, max.	1.5	1.5
sodium carbonate (Na_2CO_3), within the range	0.12-0.18	0.12-0.18
lignosulphonates (LST), within the range	0.07-0.13	0.07-0.13
2 Mass change during ignition, within the range, %	1.5-3.0	1.6-3.0
3 Fire resistance, ^{0}C, min	1790	-
4 Moisture content, %, max	5	5
5 Grain size, %, undersized through screen No.:		
undersized through screen No.05, min	100	100
undersized through screen No.009, within the range	-	60– 85
min	70	-

Note: Upon agreement with the customer, the mass fraction of Fe_2O_3 is maximum 2.0%.

REFRACTORY MORTARS MULLITE SILICA AND MULLITES

TU U 23.2-00190503-415:2016

Physical and chemical parameters

Parameter	Norm for grades		
	mullite silica		mullite
	MMKR 45	MMKR 50	MMLA 62
1 Mass fraction, %: Al_2O_3, min Fe_2O_3, max	 45 3.0	 50 2.6	 62 1.5
2 Mass change during ignition, within the range of 40-65, %	1.5-3.3	1.5 – 3.0	1.5 – 3.0
3 Fire resistance, ^{0}C, min	1750	1770	1790
4 Moisture content, %, max	5.0	5.0	5.0
5 Grain size, %: undersized through screen No.05, min undersized through screen No.009, within the range min	 100 60 – 90	 100 60 - 90	 100 - 70

MULLITE BUFFER MIXTURE OF MLBS-62 GRADE

TU U 23.2–00191885–036:2024

Physical and chemical parameters

Parameter	Norm for MLBS-62
1. Mass fraction (on ignition basis), %:	
Al_2O_3, min	62.0
Fe_2O_3, max	3.0
P_2O_5, within the range	0.3-1.0
2. Moisture content, %, within the range	1.0-2.0
3. Grain size, %:	
residue on screen No.5, max	5.0
residue on screen No.3, max	15.0
undersized through screen No.0.5, within the range	37.0-47.0
undersized through screen No.009, within the range	28.0-37.0

MORTARS
REFRACTORY PERICLASE-CHROMITE

TU U 26.2-00191885-016:2011

Physical and chemical parameters

Parameter	Norm for grades	
	MPKh	MPKhG-10
1 Mass fraction, %:		
MgO, min	65	50
Cr2O3, within the range	13-17	12-17
Al_2O_3, min	optionally	5
2 Grain size, %:		
undersized through screen No.05, min	-	90
undersized through screen No.0063, min	93	75

By mutual agreement between the manufacturer and the consumer, it is acceptable to supply mortar with a custom grain size.

REFRACTORY FILLERS

GOST 23037-99

Physical and chemical parameters

Parameter	Norm for grades		
	ZShA	ZMK	ZShB
Mass fraction, %:			
Al_2O_3, min	3.5	72-95	28
Fe_2O_3, max	-	1.5	-
Fire resistance, ^{0}C, min	1690	-	1630
Moisture content, %, max	5	5	5
Water absorption, %, max	6	3	8

Notes:
For fillers produced from scrap and rejects, water absorption is limited to a maximum of 15%, while the Fe_2O_3 content is not regulated.
For fillers in classes 5-8, water absorption is not regulated.

PERICLASE-CHROMITE AND CHROMITE-PERICLASE POWDERS FOR GUNNING THE WALLS AND SLOPES OF STEELMAKING FURNACES
TU U 23.2-00191885-044:2022

Parameter	Norms for powders of grades		
	PPKhT	PPKhT-1	PKhPT
1 Mass fraction, %:			
Cr_2O_3, within the range	15-25	10-25	30-40
MgO, min	55	55	-
max	-	-	55
SiO_2, max	5	5	7
CaO, max	3	3	2.5
2 Moisture content, %, max	1.5	2	2
2 Grain size, %			
residue on screen No.3	Not acceptable		
residue on screen No.1, max	5	10	10
undersized through screen No.05, within the range	65-85	-	70-80
including undersized through screen No. 009, within the range	20-30	20-40	20-30

CHROMITE POWDER
TU U 23.2-00191885-050:2023

Parameter	Norms for powders of grades		
		PKh-45	PKh-40
1 Mass fraction, %:			
Cr_2O_3, within the range		45	40
2 Grain size, %			
residue on screen No.3,2, min	Not acceptable		
residue on screen No.2, max		5	8
undersized through screen No.0.5, max		90	90

MULLITE-CORUNDUM REFRACTORY MIXES FOR LINING IN BOF AND BLAST FURNACE PRODUCTION
TUU 23.2-00190503-443:2019

Parameter	Norm for the mass for MMK-72 grade
1. Mass fraction (on ignition basis), %:	
Al_2O_3, min	72.0
Fe_2O_3, max	1.3
P_2O_5, within the range	2.4-3.2
2. Mass change during ignition, %, within the range	1.5-2.2
3. Moisture content, %, within the range	6-7
4. Grain size, %:	
undersized through screen No.5, min	100
undersized through screen No.3,2, within the range	90-100
undersized through screen No.2, within the range	80-90
undersized through screen No.05, max	70
undersized through screen No.009, within the range	39-46

CERAMIC OVERLAY MIXTURE

TU U 23.2-00191885-028:2016

Physical and chemical parameters

Parameter	Norm for SNK-1 grade
1 Mass fraction SiO2 (on ignition basis), % min	85.0
2 Moisture content, %, max	1.0
3 Fire resistance, ^{0}C, min	1580
4 Grain size, %, 0-1 mm	100

By mutual agreement between the manufacturer and the consumer, it is acceptable to make mortars with custom physical and chemical parameters as well as grain size.

REFRACTORY FILLERS FOR CONCRETE PRODUCTS, MASS, MIXTURES, COATINGS AND MORTARS
GOST 23037-99

Parameter	Norm for the fillers of grade				
	ZPKh	**ZPKh**	**ZKh-30**	**ZPSp-85**	**ZPSp-90**
1 Mass fraction, %:					
Cr_2O_3, within the range	5-20	15-35	Min 30	-	-
MgO, min	60	Max 55	-	85	90
SiO_2, max	5.0	7.0	8.5	5.0	4.0
CaO, max	-	-	2.0	10.0	8.0
2 Moisture content, %, max	2	3	3	1	1
3. Mass change during ignition, %, max	-	-	-	1	0.6

2 Grain size, %,	**Norm for class**			
	4	5	6	7
residue on screen No.10, max	Not acceptable	-	-	-
residue on screen No.5, max	5	Not acceptable	-	-
residue on screen No.2, max	40	50	Not acceptable	-
residue on screen No.1, max	-	-	5	Not acceptable
undersized through screen No.0.5, min	20	40	60	95
including No. 009, min	-	15	30	80

REFRACTORY CHAMOTTE PLASTIFIED DINAS

TU U 23.2-00191885-046: 2022

Physical and chemical parameters

Parameter	Norm for grades
	MD 94
1. Mass fraction, %:	
SiO_2 , min	94
Al_2O_3, within the range	2.0-3.5
Na_2CO_3, within the range	0.10-0.15
LST, within the range	0.07-0.12
2 Mass change during ignition, %,	
max	1.1
within the range of	
3. Moisture content, %, max	5
4. Grain size, %	
undersized through screen No.2, min	100
undersized through screen No.1, min	97
undersized through screen No.02, within the range	65-85
undersized through screen No.009, within the range	45-65

By mutual agreement between the manufacturer and the consumer, it is acceptable to make mortar with custom physical and chemical parameters as well as grain size.

REFRACTORY MORTAR
DINAS FOR BRICKLAYING
COKE OVENS

TU U 23.2-00191885-047: 2022

Physical and chemical parameters

Parameter	Norm for the mortar of grades	
	MDK-1	**MDK-2**
1 Mass fraction, %:		
SiO_2, min	90	90
Al_2O_3, within the range	3.5-5.0	3.5-5.0
Na_2CO_3, within the range	0.10-0.15	0.10-0.15
2 Mass change during ignition, %:		
within the range of	0.9-1.7	-
max	-	2.0
3. Moisture content, %, max	5	5
4. Fire resistance, ^0C, min	1610	1610
5. Grain size, %:		
undersized through screen No.2, min	100	100
undersized through screen No.1, min	97	97
undersized through screen No.02, within the range	65-80	65-80
undersized through screen No.009, within the range	45-60	45-65
6. Bricklaying properties – the thickness of the seam when the mortar spreads (105-110) mm, within the range	3-5*	3-5*
7. Aluminum sulphate, %	0.1**	-

Note: *-parameter is recommended, not subject to control

**Aluminum sulphate is added at a rate of 0.1% (over 100%) for the consumer and is not subject to control.

CASTING POWDERS

ZAPORIZHZHIA REFRACTORIES develops and produces slag-forming powders, heat-insulating and starting mixtures, which are used for continuous casting of steel, as well as for casting steel in casting moulds during bottom pouring for a long time.

At present, casting powders produced by ZAPORIZHZHIA REFRACTORIES are successfully used at steelmaking enterprises of Ukraine, etc.

With the use of the developed mixtures, more than 15 mln tonnes of various steel grades, including those with a carbon content of 0.03% to 0.8%, as well as alloyed with silicon, manganese, chromium, niobium, vanadium, aluminum, etc., were cast at slab and bloom CCMs.

Slag-forming mixtures are used in continuous casting of steel and bottom casting into moulds to protect the liquid steel surface from secondary oxidation, assimilation of non-metallic inclusions and improve the surface quality of cast steel.

Heat-insulating mixtures are used to insulate the steel surface in tundishes and steel ladles. Having low aggressiveness towards the tundish lining, the heat-insulating mixture allows you to increase the heat sequences and, as a result, reduce the consumption of gunning mix for lining the working layer of tundish. The use of heat-insulating mixtures in steel ladles allows you to ensure the fluidity of slag and its easy removal at the end of pouring. After the end of steel casting and slag removal, the lining of steel ladle is kept clean – without slag build-ups and steel scraps. The use of heat-

insulating mixtures in bottom casting of steel into moulds allows you to reduce the shrinkage cavities in ingots.
Starting mixtures are used to fill the ladle tap hole for easy opening of the slide gate for steel tapping, with guaranteed openness without the use of oxygen at least 99%.

SLAG-FORMING MIXTURES FOR STEEL CASTING TU U 26.2-00191885-010:2010

Physical and chemical parameters

Parameter	Norm for powder of the grade
	ShOS-14
Content, %:	
SiO_2, within the range	26.0-35.0
CaO^*, within the range	28.0-35.0
F_2, within the range	5.0-8.0
C_{free}, within the range	1.0-3.0
C_{total}, within the range	3.0-6.0
MnO, within the range	8.0 -15.0
AI_2O_3, max	6.0
S, max	1.0
FeO, max	1.5
Moisture content, %, max	0.5
Basicity, within the range	0.8-1.2
Grain size, %	residue on screen №3 is not allowed residue on screen №1 - maximum 3.0 residue on screen №063 - maximum 10.0 undersized through screen №0063 - minimum 50.0

Note 1. The basicity is determined by the ratio of calcium oxide (CaO) content to silicon oxide (SiO_2).

Note 2.* The total calcium content is converted to CaO. The free carbon is determined by calculation as the difference between the total carbon content of the mixture and the carbon content of the carbonates.

Note 3. At the request of the customer, powders and mixtures are supplied with narrow range of basicity and mass fraction of elements, which are specified in the supply contract.

Note 4. Foreign visible impurities are not allowed.

HEAT INSULATING MIXTURES FOR STEEL CASTING TU U 26.2-00191885-010:2010

Physical and chemical parameters

Parameter	Norm for mixture of the grade	
	USK	USK-2
Content, %		
SiO_2, within the range	30.0-50.0	30.0-40.0
CaO, max.	5.0	5.0-10,
C_{total}, within the range	20.0-35.0	15.0-20.0
MnO, max	2.0	2.0
Al_2O_3, within the range	20.0-40.0	20.0-30.0
Na_2O+K_2O	Max 5.0	within the range of 5.0-10.0
Moisture content, %, max	2.0	1.5
Grain size, %: undersize through screen №2	100	
Bulk density, kg/m^3, max	700	

STARTING CASTABLES FOR FILLING THE STEEL-TAPPING CHANNEL OF STEEL LADLE TU U 26.2-00191885-012:2010

Physical and chemical parameters

Parameter	Norm for grades	
	SSK-1	SSK-2
1 Content, %:		
SiO_2, min	75.0	25.0
Cr_2O_3, min	8.0	30.0
2 Mass change during firing, max, %	2.0	2.0
3 Moisture content, %, max	0.5	1.0
4 Grain size, %,		
undersized through screen №1, min.	92.0	96.0
undersized through screen №0.5, min.	40.0	70.0
undersized through screen №02, max.	10.0	15.0
5 Bulk density, g/cm^3, min	1.7	2.0

It is allowed to make a mixture of another grain size by agreement between the manufacturer and the customer.

PROCESS CASTABLES

TU U 23.2-00191885-029:2024

Physical and chemical parameters

Parameter	Specified value for products of the grade				
	ZOZ MIX ht 15–20/3	**ZOZ MIX rms 25-03**	**ZOZ MIX hm 25-02**	**ZOZ MIX hm 45-01**	**ZOZ MIX hs 30-01/2**
1. Content of **SiO_2,** %,	max 60.0	Max 28.0	within the range of 30.0-70.0	within the range of 30.0-50.0	within the range of 30.0-70.0
2. Content of **Al_2O_3**, %, within the range	15.0-40.0	-	-	-	10.0 – 30.0
3. Content of **CaO, %**	max 10.0	-	-	-	-
4. Content of **C, %**	within the range of 10.0-20.0	min 0.6	within the range of 20.0-35.0	within the range of 35.0 -45.0	max 25
5. Content of **Cr_2O_3,** %, min	-	34.0	-	-	-
6. Moisture content, %, max	2.0	0.5	2.0	4.0	2.0
7. Bulk density	-	mini. 1.8 g/cm^3	within the range of 150-300 kg/m^3	max 210.0 kg/m^3	max. 800.0 kg/m^3
8. Grain size, %	Residue on screen №5- max 5.0	Undersized through screen №1- min 95	-	-	-

PROCESS CASTABLES

TU U 23.2-00191885-029:2024 *(continued)*

Physical and chemical parameters

Parameter	Norm for products of the grade					
	ZOZ MIX *sfc* 7-12	***ZOZ MIX sfm 14-06***	**ZOZ MIX *sfc* 15-20 (M)**	**ZOZ MIX *sfc* 14-17**	**ZOZ MIX *sfc* 20-28**	**ZOZ MIX *sfc* 17-20**
1. Content of **SiO_2,** %, within the range of	27.0 - 34.0	26.0 - 35.0	20.0 - 30.0	22.0 - 30.0	20.0 - 30.0	20.0 - 30.0
2. Content of Al_2O_3, %, max	6.0					
3. Content of CaO, %, within the range of	25.0 – 32.0	28.0 – 35.0	22.0 - 30.0	23.0 - 32.0	20.0 - 30.0	22.0 - 32.0
4. Content of **$Na_2O + K_2O$, %**, within the range of	3.0 – 6.0	-	2.0 – 6.0	-	2.0 – 6.0	-
5. Content of C, %, within the range of	7.0 – 12.0	3.0 – 6.0	15.0 – 20.0	14.0 – 17.0	20.0–28.0	17.0 – 20.0
6. Carbon free, %, within the range of	5.0 – 10.0	1.0 – 3.0	-	11.0 – 15.0	-	-
7. Content of F_2, %, within the range of	5.0 – 8.0	5.0 – 8.0	5.0 – 10.0	5.0 – 10.0	5.0 – 8.0	5.0 – 10.0
8. Content of **S, %,** max	0.8	1.0	1.0	1.0	1.0	1.0
9. Moisture content, %, max	0.5	0.5	0.5	1.0	1.0	1.0
10. Basicity, within the range of **CaO/SiO_2**	0.8 – 1.2	0.8 – 1.2	0.8 – 1.0	0.8 – 1.2	0.8 – 1.2	0.8 – 1.2
11. Grain size, %	Residue on screen №3 is not allowed Residue on screen №1 - maximum 3.0 Residue on screen №063 - maximum 10.0 Undersized through screen №0063 - minimum 50.0					

The data given in the tables are for information as they are based on the average actual values obtained as a result of laboratory tests of serial products.

PRODUCTION OF REFRACTORY CONCRETES AND MIXTURES

The shop for the production of high-tech refractory concrete mixtures was put into operation in May 2013. The new production site, designed and equipped by EIRICH, is highly productive continuous automated plant, equipped with high-precision weighing, dosing and mixing equipment.
Production facilities allow the production of a wide range of high-tech refractory concrete mixtures of various compositions for lining thermal units of enterprises of metallurgical, cement, glass, chemical, heat and power industries, etc.

The use of modern refractory concretes is a key tool for reducing the specific consumption and costs of refractories, the development of new structural high-efficiency schemes for lining thermal units, improving the conditions of their operation and repair, improving the production culture of enterprises.


EIRICH

DRY REFRACTORY CONCRETE MIX SSB-90V

TECHNICAL REQUIREMENTS TV 00191885–092:2024

Physical and chemical parameters

Parameter	**Norm for grades SSB-90V**
1. Content, %	
Al_2O_3, min	90.0
Fe_2O_3, max	0.5
CaO, max	1.5
2. Moisture content, %, max	0.2
3. Grain size, size 0-10 mm	
residue on screen №10, %, max	10
4. Ultimate compression strength, MPa, min	
after firing at 1,000°C ($T_{firing1}$)	50.0
after firing at 1,500°C ($T_{firing2}$)	80.0
5. Apparent density, g/cm^3, min.	
after firing at 1,000°C ($T_{firing1}$)	2.8
after firing at 1,500°C ($T_{firing2}$)	2.8

Note. 1 Type of binding: hydraulic

2. Laying method: vibration

3. The amount of mixing water, l/100 kg, in the range of 4.5-5.5 - when monolithic lining at the customer

DRY REFRACTORY CONCRETE MIX SSB-80V TECHNICAL REQUIREMENTS

Physical and chemical parameters

Parameter	**Norm for grades SSB-80V**
1. Content, %	
Al_2O_3, min	90.0
Fe_2O_3, max	0.5
CaO, max	1.5
2. Moisture content, %, max	0.2
3. Grain size, size 0-10 mm	
residue on screen №10, %, max	10
4. Ultimate compression strength, MPa, min	
after firing at 1,000°C ($T_{firing1}$)	50.0
after firing at 1,500°C ($T_{firing2}$)	80.0
5. Apparent density, g/cm^3, min.	
after firing at 1,000°C ($T_{firing1}$)	2.8
after firing at 1,500°C ($T_{firing2}$)	2.8
Note. 1 Type of binding: hydraulic 2. Laying method: vibration 3. The amount of mixing water, l/100 kg, in the range of 4.5-5.5 - when monolithic lining at the customer	

Physical and chemical parameters - in accordance with the contract (specification) of the customer

DRY REFRACTORY CONCRETE MIX SSB-80S

Physical and chemical parameters

Parameter	**Norm for grades SSB-80S**
1. Content, %	
Al_2O_3, min	90.0
Fe_2O_3, max	0.5
CaO, max	1.5
2. Moisture content, %, max	0.2
3. Grain size, size 0-10 mm	
residue on screen №10, %, max	10
4. Ultimate compression strength, MPa, min	
after firing at 1,000°C ($T_{firing1}$)	50.0
after firing at 1,500°C ($T_{firing2}$)	80.0
5. Apparent density, g/cm^3, min.	
after firing at 1,000°C ($T_{firing1}$)	2.8
after firing at 1,500°C ($T_{firing2}$)	2.8

Note. 1. Type of binding: hydraulic

2. Laying method: vibration

3. The amount of mixing water, l/100 kg, in the range of 4.5-5.5 - when monolithic lining at the customer

Physical and chemical parameters - in accordance with the contract (specification) of the customer

DRY REFRACTORY CONCRETE MIXTURES
TU U 23.2-00191885-030:2023
(for lining various thermal units)

Table 1 - Physical and chemical parameters

Parameter	**ZOZ CAST FC40 MCC**	**ZOZ CAST HA 60 VL**	**ZOZ CAST HA 65 LCC**	**ZOZ CAST HA 75 LCC**	**ZOZ CAST FC 55 MCC**	**ZOZ CAST HA 55-01 LCC**
Mass fraction on a fired substance basis, %						
Al_2O_3, min	45	60	65	80	62	55
Fe_2O_3, max	-	-	1.5	1.2	2.0	-
CaO, max	3.5	2	1.5	1.5	4.0	1.8
SiO_2, max	-	-	-	-	-	-
SiC, max	-	-	-	-	-	-
Moisture content, %, max	0.2	0.2	0.2	0.2	0.2	0.2
Amount of mixing water, l/100kg	7.5-8.0	6.0-7.0	6.0-6.5	6.0-6.5	7.0-7.5	5.0-6.0
Ultimate compression strength, MPa, min						
After drying at 110^0C	25		30	25	40	50
After firing at $1,000^0$C ($T_{firing2}$)	-	30	40	-	55	-
After firing at $1,500^0$C ($T_{firing2}$)			70	50	70	95
After firing at $1,400^0$C	30	-	-	-	-	-
Apparent density, g/cm^3, min						
After drying at 110^0C	2.15	-	2.45	2.65	2.4	2.4
After firing at $1,000^0$C ($T_{firing2}$)	-	-	2.5	-	2.4	-
After firing at $1,500^0$C ($T_{firing2}$)	-		2.52	2.65	2.35	2.3
After firing at $1,400^0$C	2.1	-	-	-	-	-

DRY REFRACTORY

CONCRETE MIXTURES
TU U 23.2-00191885-030:2023
(for lining various thermal units)

Table 1 (continued)

Parameter	**ZOZ CAST bot 16 VD**	**ZOZ CAST bot 17 VD**	**ZOZ CAST HA 85 LCC**	**ZOZ CAST wos 17 VD**	**ZOZ CAST bod 50 VD**	**ZOZ CAST bod 60 VD**
Mass fraction on a fired substance basis, %						
Al_2O_3, min.	80	72	85	90	50	66
Fe_2O_3, max	1.2	1.5	1.0	0.5	1.8	1.0
CaO, max	1.5	1.5	1.5	1.5	2.4	2.3
SiO_2, max	-	-	-	-	-	27
SiC, max	-	-	-	-	19	-
Moisture content, %, max	0.2	0.2	0.2	0.2	0.2	0.2
Amount of mixing water, l/100kg	5.5-6.0	5.5-6.5	5.5-6.0	4.5-5.5	4.0-6.0	4.6-5.2
Ultimate compression strength, MPa, min						
After drying at 110^0C	35	-	50	-	50	50
After firing at $1,000^0$C ($T_{firing2}$)	50	35	40	50	70	70
After firing at $1,500^0$C ($T_{firing2}$)	70	70	80	80	50	50
After firing at $1,400^0$C	-	-	-	-	-	-
Apparent density, g/cm^3, min						
After drying at 110^0C	2.65	-	2.8	-	-	-
After firing at $1,000^0$C ($T_{firing2}$)	2.6	2.5	2.8	2.8	2.65	2.65
After firing at $1,500^0$C ($T_{firing2}$)	2.65	2.5	2.85	2.8	-	-
After firing at $1,400^0$C	-	-	-	-	-	-

DRY REFRACTORY

CONCRETE MIXTURES

TU U 23.2-00191885-030:2023

(for lining various thermal units)

Table 1 (continued)

Parameter	**ZOZ CAST wad 57 VD**	**ZOZ CAST wad 48 VD**	**ZOZ CAST wod 65 VD**	**ZOZ CAST wod 70 VD**	**ZOZ CAST wod 71 VD**	**ZOZ CAST bod 74 VD**
Mass fraction on a fired substance basis, %						
Al_2O_3, min.	57	48	65	70	71	74
Fe_2O_3, max	1.5	2.0	1.0	0.5	2	0.8
CaO, max	2.7	2.9	1.0	1.0	1.0	1.0
SiO_2, max	38	43	6.0	4.3	5.0	16.0
SiC, max	-	-	18.0	18.6	21	6.0
Moisture content, %, max	0.2	-	-	-	0.2	-
Amount of mixing water, l/100kg	4.5-5.8	4.5-5.8	4.2-5.0	3.5-4.8	3.0-4.2	4.1-5.1
Ultimate compression strength, MPa, min						
After drying at 110^0C	50	52	45	40	40	80
After firing at $1,000^0$C ($T_{firing2}$)	50	40	55	40	40	-
After firing at $1,500^0$C ($T_{firing2}$)	-	-	-	-	-	100
After firing at $1,400^0$C	-	-	-	-	-	-
Apparent density, g/cm^3, min						
After drying at 110^0C	-	-	-	-	-	-
After firing at $1,000^0$C ($T_{firing2}$)	2.48	2.65	2.93	3.0	2.85	2.86
After firing at $1,500^0$C ($T_{firing2}$)	-	-	-	-	-	-
After firing at $1,400^0$C	-	-	-	-	-	-

DRY REFRACTORY

CONCRETE MIXTURES

TU U 23.2-00191885-030:2023

(for lining various thermal units)

Table 1 (continued)

Parameter	**ZOZ CAST wod 85 VD**	**ZOZ CAST wod 77 VD**	**ZOZ CAST wod 75 VD**	**ZOZ CAST wod 74 VD**
Mass fraction on a fired substance basis, %				
Al_2O_3, min.	85	77	75	74
Fe_2O_3, max	0.2	0.5	0.1	0.9
CaO, max	0.5	0.6	0.9	0.7
SiO_2, max	1.6	6	4.2	9.0
SiC, max	10	13	18	12
Moisture content, %, max	-	-	-	-
Amount of mixing water, l/100kg	3.4-4.4	4.4-5.4	3.8-4.8	3.4-4.4
Ultimate compression strength, MPa, min				
After drying at 110^0C	40	50	65	100
After firing at $1,000^0$C ($T_{firing2}$)	-			
After firing at $1,500^0$C ($T_{firing2}$)	60	140	80	100
After firing at $1,400^0$C	-	-	-	-
Apparent density, g/cm^3, min				
After drying at 110^0C	-	-	-	-
After firing at $1,000^0$C ($T_{firing2}$)	3.27	2.98	3.08	3.0
After firing at $1,500^0$C ($T_{firing2}$)	-	-	-	-
After firing at $1,400^0$C	-	-	-	-

Note 1. The content of SiC is ensured by the manufacturing process.

Note. The ultimate compression strength and apparent density at firing temperatures of $1,400^0$C and $1,500^0$C are ensured by the manufacturing process

PRODUCTS UNDER TESTING AND DEVELOPMENT

HARDENING AGENT OF
ZOZ MIH QH-2 GRADE
FOR HEAT-INSULATING INSERTS FOR MOLDS

Physical and chemical parameters

Parameter	Norm for ZOZ MIH QH-2 grade
1. Mass fraction, %	
Al_2O_3, min.	7.0
SiO2, min.	30
CaO, min.	3.5
2. Moisture content, %, max.	1.0
3. Grain size, %:	
Residue on screen №1, max. undersize for screen № 0.09 mm, max.	3 75

Physical and chemical parameters - in accordance with the customer's contract (specification)

GUNNING MIX
ZOZ AL55 SIC9

Physical and chemical parameters

Parameter	Norm for ZOZ AL55 SIC9 grade
1. Mass fraction, %	
Al_2O_3, min.	55
SiC , within the range	8 - 12
2. Moisture content, %, max.	0.5
3. Ultimate compression strength, N/mm^2:	
- after drying at 110°C (24 hours)	min. 10
- after firing at 1,500°C (5 hours)	min. 20
5. Apparent density , g/cm^3, min.	
- after drying at 110°C (24 hours)	min. 2.15
- after firing at 1,500°C (5 hours)	min. 2.25

Physical and chemical parameters - in accordance with the customer's contract (specification)

SHOTCRETE
ZOZ GUN 60-01 TD

Physical and chemical parameters

Parameter	Norm for ZOZ AL55 SIC9 grade
1. Mass fraction, %	
Al_2O_3, min.	60
Fe_2O_3, max.	1.0
2. Moisture content, %, max.	0.5
3. Ultimate compression strength, N/mm^2:	
- after drying at 110°C (24 hours)	min. 15
- after firing at 1,500°C (5 hours)	min. 20
4. Apparent density , g/cm^3, min.	
- after drying at 110°C (24 hours)	min. 2.10
- after firing at 1,500°C (5 hours)	min. 2.15

Physical and chemical parameters - in accordance with the customer's contract (specification)

VIBROCAST PRODUCTS

The shop includes a production area for products made from refractory castables, including the manufacture of particularly complex vibrocast items.

VIBROCAST CONCRETE PRODUCTS FOR CONTINUOUS STEEL CASTING TUNDISHES

Physical and chemical parameters

Parameter	Crucible	Well block
1. Mass fraction, %		
Al_2O_3, min.	90.0	90.0
Fe_2O_3, max	0.5	0.5
CaO, max.	1.5	1.5
2. Ultimate compression strength, MPa, min.: -after firing in the cold state	50.0	40.0
3. Apparent density, g/cm^3, min.: -after firing in the cold state	2.8	2.8

Note. Physical and chemical parameters, drawings, overall dimensions of the product, dimensional tolerances, and appearance parameters - in accordance with the customer's contract (specification).

VIBROCAST CONCRETE PRODUCTS FOR CONTINUOUS STEEL CASTING TUNDISHES

Physical and chemical parameters

Parameter	Impact plates	Block for the installation of thermocouples
1. Mass fraction, %		
Al_2O_3, min.	90.0	90.0
Fe_2O_3, max	0.5	0.5
CaO, max.	1.5	1.5
2. Ultimate compression strength, MPa, min.: -after firing in the cold state	50.0	40.0
3. Apparent density, g/cm^3, min.: -after firing in the cold state	2.8	2.8
Note. Physical and chemical parameters, drawings, overall dimensions of the product, dimensional tolerances, and appearance parameters - in accordance with the customer's contract (specification).		

Vibrocast concrete products for steel teeming ladles

Physical and chemical parameters

Parameter	Well block for slide gates	Tuyere block for argon bottom argon purging
1. Mass fraction, %		
Al_2O_3, min.	90.0	90.0
Fe_2O_3, max	0.5	0.5
CaO, max.	1.5	1.5
2. Ultimate compression strength, MPa, min.: -after firing in the cold state	50.0	50.0
3. Apparent density, g/cm^3, min.: -after firing in the cold state	2.8	2.8

Note. Physical and chemical parameters, drawings, overall dimensions of the product, dimensional tolerances, and appearance parameters - in accordance with the customer's contract (specification).

Vibrocast concrete products for steel teeming ladles

Physical and chemical parameters

Parameter	Ladle nozzle	Impact plate
1. Mass fraction, %		
Al_2O_3, min.	90.0	90.0
Fe_2O_3, max	0.5	0.5
CaO, max.	1.5	1.5
2. Ultimate compression strength, MPa, min.: -after firing in the cold state	50.0	50.0
3. Apparent density, g/cm^3, min.: -after firing in the cold state	2.8	2.8

Note. Physical and chemical parameters, drawings, overall dimensions of the product, dimensional tolerances, and appearance parameters - in accordance with the customer's contract (specification).

Vibrocast concrete products for pellet induration machines

Physical and chemical parameters

Parameter	Burner block
1. Mass fraction, %	
Al_2O_3, min.	58.0
2. Ultimate compression strength, MPa, min.: -after firing in the cold state	20.0
3. Apparent density, g/cm^3, min.: -after firing in the cold state	2.6
4.Open porosity,%, max. -after firing in the cold state	25

Note. Physical and chemical parameters, drawings, overall dimensions of the product, dimensional tolerances, and appearance parameters - in accordance with the customer's contract (specification).

REFRACTORY SERVICE OF ZAPORIZHZHIA REFRACTORIES

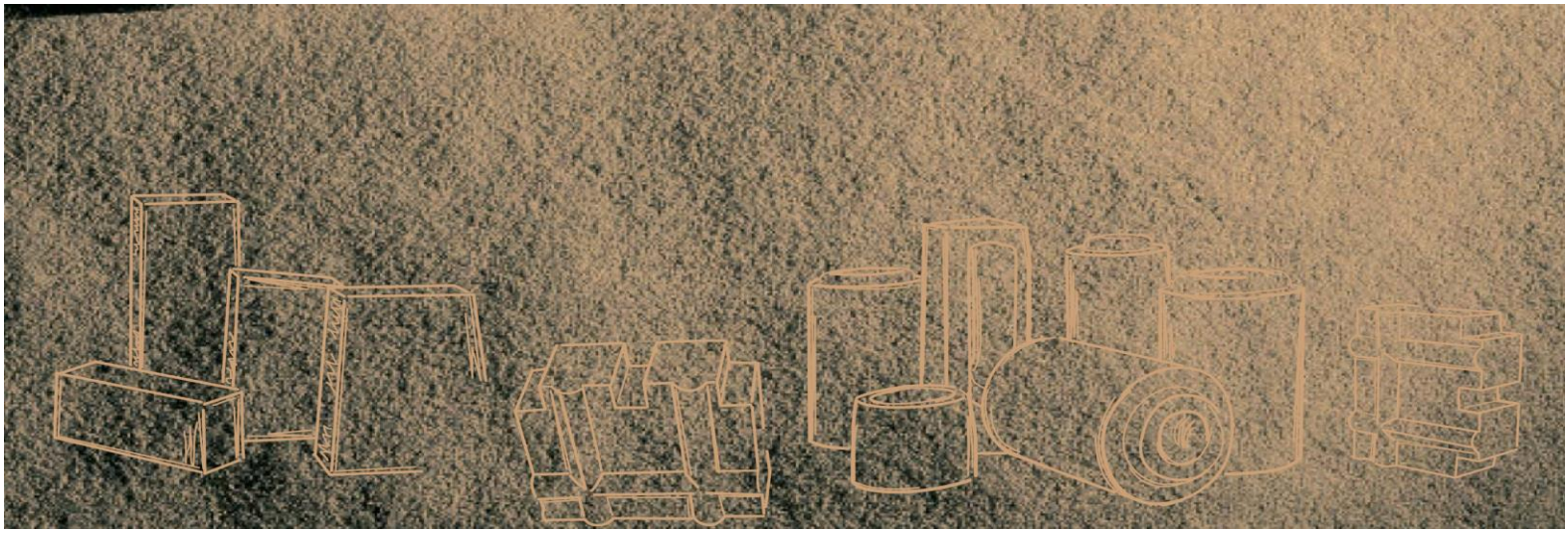
One of the new and prioritised areas of activity for ZAPORIZHZHIA REFRACTORIES is the performance of refractory works. Many years of experience in the refractory business have demonstrated that while high-quality refractory products are important, they are not the sole factor in the efficient use of refractories. Our customers often cite "low-quality" refractories as the reason for not achieving the planned economic benefits. However, failure to follow the methodology for performing and preparing the lining for operation, as well as lining maintenance recommendations or intermediate repair schedules, leads to premature lining wear, which increases specific costs and reduces the efficiency of use of refractories.

Only through total control and adherence to the technical standards for the lining preparation and operation provided by refractory suppliers can consumers achieve the goal of ensuring trouble-free production, achieving the set specifications of finished products, reducing labour effort for refractory work, improving lining reliability, and lowering specific and refractory costs.

To date, ZAPORIZHZHIA REFRACTORIES offers a wide range of services for the organisation and provision of refractory services:

– inspection of facilities;
– development of the lining design;
– selection of required materials;
– manufacture and supply of refractories and related materials;
– performance of refractory works, including on a turnkey basis;
– putting facilities into operation;
– after-sales warranty service.

This allows customers to focus on managing and improving the efficiency of their core business; to reduce the amount of refractory stocks and to untie part of the working capital; to lower specific costs for refractories and their use; to decrease costs for personnel involved in the lining assembly, installation, maintenance and repair.



PACKAGING

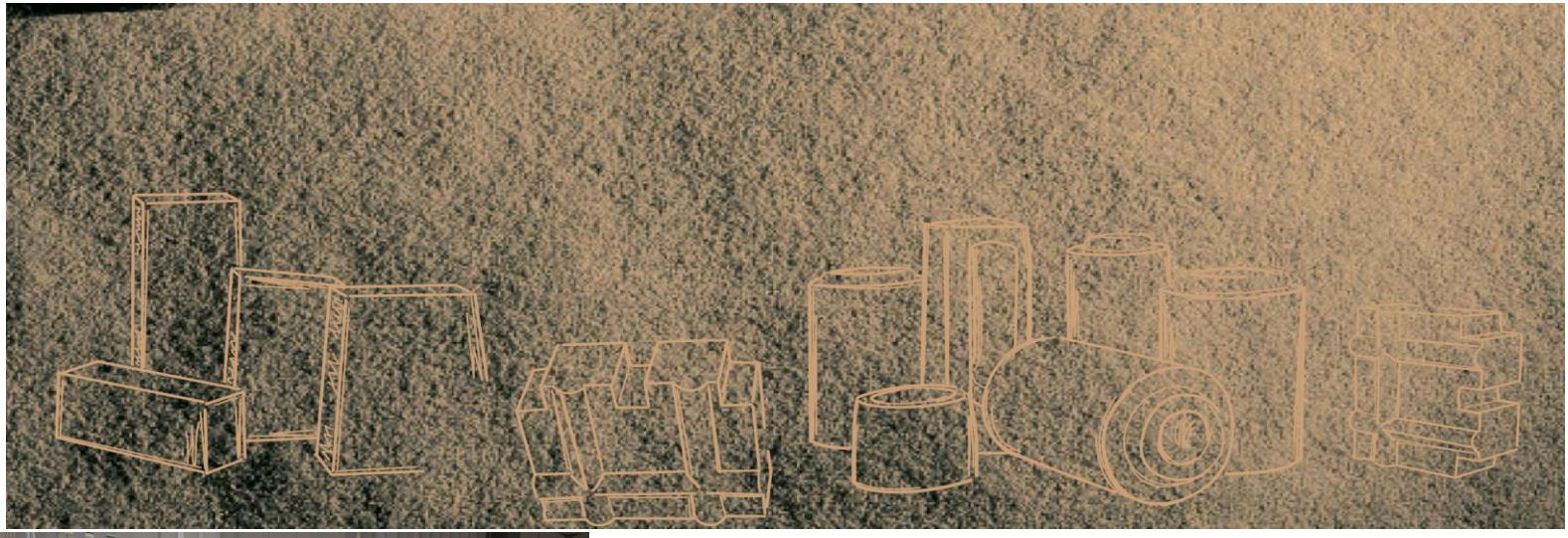
Effective packaging guarantees the safety of refractory products during delivery, preserving their presentation and ensuring moisture protection.

The company has done a lot in this regard. Refractory products are packed in packages placed on metal or wooden pallets, with palletised packages further protected by corrugated cardboard boxes and stretch plastic film. All packages are tied with polyester straps. Special packaging machines purchased in Canada and the U.S. mechanically wrap packages in self-adhesive film, protecting the products from mechanical damage and moisture.

Particularly complex refractories are packed in wooden boxes weighing up to 1 tonne. Bulk materials are packed in big bags.

While improving packaging, we completed the mechanisation of warehouse operations and the loading of refractories onto rail and road transport.

Reliable packaging guarantees that refractory products are delivered to consumers with all specified physical and chemical properties preserved, as specified in regulatory and technical documentation.



QUALITY CONTROL

All raw materials supplied to the company are subject to incoming inspection: ore, magnesites, clays, kaolins, etc.

The samples taken are sent to the central laboratory of the Quality Control Department to determine quality indicators: chemical composition, moisture, grain size, etc. Chemical composition analysis is carried out in the Quality Control Department using chemical and X-ray spectral methods on a Simultix 14 unit. The raw materials are qualified based on the results of laboratory tests.

Finished products undergo certification by the technological control department for compliance with regulatory documents (GOST, DSTU, TUU, etc.) and attestation according to ISO 17025, as well as other regulatory documents applicable at the manufacturer and in Ukraine.
Based on external inspection (such as dimensions, composition, packaging, etc.), along with physical and mechanical testing and chemical composition analysis according to QC data, a conformity certificate is issued for the products. All shipped products have quality certificates.

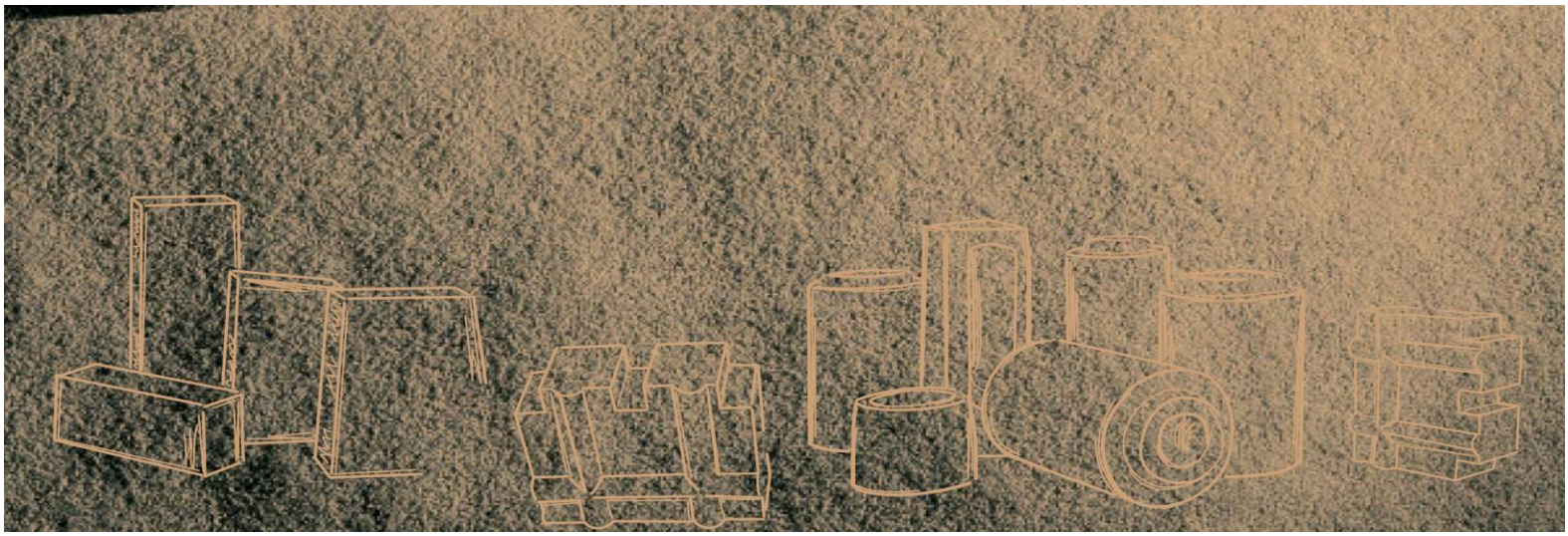
RESEARCH WORK

ZAPORIZHZHIA REFRACTORIES' central integrated laboratory (CIL), supported by the company's technical functions, includes a research and development (R&D) department. The department was established to develop new types of refractories and improve products, conduct product testing at customers' sites, and collect data on refractory service life analysis. The creation of the R&D Department enabled the company to adopt new technologies and launch the production of modern refractories at minimal cost, such as periclase-carbon refractories for the lining of ladles, basic oxygen furnaces, and steel tapholes, periclase fired refractories for steel tapholes, periclase-chromite direct-bonded refractories for the lining of open-hearth furnace roofs. This led to an increase in the service life of thermal facilities and a reduction in the specific consumption of refractories by consumers.

The R&D Department provides engineering services and advice on the sustainable use of refractories. Based on customer requests, they develop technical proposals for the lining of thermal facilities for enterprises.

After developing new products and transitioning them to mass production, the R&D Department studies the service life of refractories at customers’ sites and adjusts their properties to meet specific service conditions.

Systematic research and development drive improvements in the production technology of aluminum silicate and magnesia refractories, reduce rejection, and improve the equipment of process flows.



ENVIRONMENTAL PROTECTION

ZAPORIZHZHIA REFRACTORIES is committed to reducing emissions of harmful substances to the atmosphere and discharges into water basin. By-products, raw materials generated during processing, and non-conforming products are recycled. The company currently operates 135 dedusting plants of various types, ensuring coverage of all process equipment. From 1995 to 2005, the company spent more than twelve million hryvnias on the reconstruction, replacement and construction of modern electrostatic precipitators. In parallel, funds are allocated to improve production equipment and implement additional measures, which also help reduce harmful emissions. For these purposes, the company spends UAH 1-2 million annually from its production development fund.

In 1998, to eliminate discharges into the Dnieper River and transition shops to full water recirculation, the company introduced new treatment facilities that integrate industrial wastewater and rainwater runoff into one recirculation system, reusing treated water for production.

The construction of the treatment facilities brought the concentration of harmful substances in the discharges in line with the regulatory values and decreased the discharge volume by 10 times.

Work is currently underway to further modernise and improve dedusting equipment.