The use of the presses will enable to launch the mass production of sleeve bricks by semi-dry method. The rated yearly savings as a result of the use of these presses will be 54,000 rubles. A mechanical shovel for the unloading of magnesite powder from railway cars was proposed by G. T. Tayganikov and drawings were elaborated by the designing office. Another project pertains to the delivery of the mixture to 200-ton hydraulic presses for the production of refractories by semi-dry method. Upon the proposal of N. Z. Pashchenko a filling valve for that press was elaborated. All these measures enhanced the productivity of the press. A technological line for the production of metal boxes including a punch yields a yearly economy of 19,000 rubles to the plant.

Upon the initiative of the local population a Public Designing Office was set up in 1961. The members of that office completed a plant for centralized lubrication of the "SM-143" type press and a project for a crusher to grind defective raw material in the chamotte shop. Work is under way to mechanize a subsidiary kolkhoz. The work of the designing offices allowed the implementation of a number of effective measures concerned with the mechanization and automation of production processes within a short period of time. The staff of the designing offices will marshal every effort to turn the Zaporozh'ye Refractory Plant into a highly mechanized and automated enterprise.

RAW MATERIAL

FIRECLAY MINING IN KIMOVSK COALFIELDS

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The considerable deposits of fireclay in the Tutal oblast coalfields are worked by open method. Underclay, beds between coal seams and top clays are mined at different sections of the Kimovsk coalfields simultaneously with coal. The color of the fireclays is gray and dark gray. It contains small pyrite nodules and carbonaceous matter. The estimated deposits of fireclay in that area amount to about 100 million tons.

The properties of the fireclay were studied at the Greater Moscow Coal Institute that prepared 380 specimens from the underclays, beds between coal seams and top clays jointly with the Tula Geological Survey Expedition. The occurrence of the clays and coal seams is shown in Fig. 1.

Underclays underlie the basic coal seam and expand throughout the coalfield. Their color is gray and dark grey. They are platic and change into gray somewhat sandy clays in the north western part. The thickness of the bed is three to four m. Chemical composition and physical properties of underclays are shown in Table 1.

The underclays may be classified into two groups: (a) clays with at least 30% Al_2O_3 + TiO_2 and maximum 3% Fe_2O_3 after firing, loss on ignition not over 15%, refractoriness minimum 1670 °C; (b) clays with a minimum 18% Al_2O_3 + TiO_2 and a maximum 4% Fe%O_3 after firing, loss on ignition not over 12%, minimum refractoriness 1670 °C; the deposits amount to 1,200,000 ton.

The central clay separates the main coal seam into two 1.0 to 4.0 m thick beds. The expansion and thickness of the clay layer is rather uniform. In the first section, the color is dark gray and occasionally black, the clay is plastic and oily.

The deposits of central clays in coalfield Nr 1 amounting to 1 million ton are suitable for the production of grog in manufacturing grade B refractories. At coalfield Nr 2 the central clays extend throughout the entire area. The thickness of the seam ranges from 0.6 to 7 m with an average of two to three meters. The color is gray and dark gray, the

TABLE 1
PROPERTIES OF UNDERCLAYS

Performance figures	Minimum	Maximum	Predominant
Content in sintered material, %:			
$Al_2O_3 + SiO_2$.	17,50	42,63	30,0—35,0
Fe_2O_3	0,80	6,55	1,8—2,0
Loss on ignition, % .	6,63	23,28	10,0—15,0
Refractoriness,°C .	1600	1750	1670—1700
Water content, % . .	17,0	29,0	20,0—25,0
Air shrinkage, % . .	3,8	8,8	5,0—6,0
Firing shrinkage at 1300 °C, % . .	7,8	18,9	13,0—15,0
Absorption at 1300 °C, % . . .	1,13	19,35	5,0—10,0

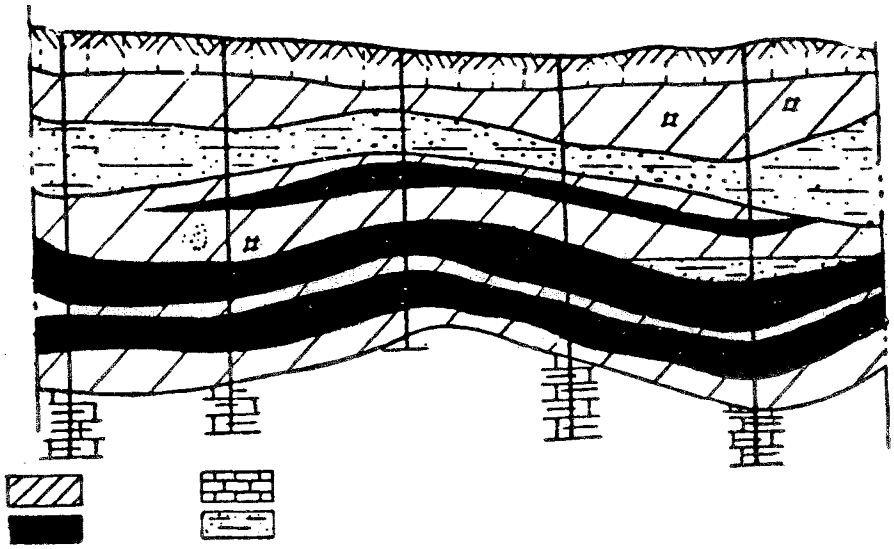

Fig. 1. Clay Occurrance.

clays are dense and, occasionally, friable. Chemical and physical properties of central clays are indicated in Table 2. The deposits in coalfield Nr 2 are 12.8 million tons. The tests conducted by the Research Institute of Building Refractories affirm the suitability of these clays for ceramic manufacturing.

Top clays are most versatile with regard to composition and quality. The thickness of the bed varies between 2 and 3 m in all investigated sections. The bed is composed of lithologically different 0.5 to 0.9 m layers. The color range includes dark gray, dense and oily specimens and gray sandy clays. The complex lithological composition of top clays will greatly complicate mining. Chemical and physical properties are given in Table 3.

The clays are of inferior quality and only suitable for the production of ceramics. The deposits in both coalfields amount to about 10 million tons. At the Kimovsk coalfields excavators (ESh-4/40, ESh-6/60 and ESh-14/75) are used in opencasting; there is no transport system. EKG-4 and SE-3 excavators with elongated and normal equipment are used in mining. The coal and the clay are delivered to the charging platform by means of automatic dumping cars.

Until recently the clay was mined together with coal. As a result of a simple assortment excavator, the clay was separated from the coal and charged on dumping cars.

The Komovsk coalfields are expected to supply 140,000 tons of clay per year to Novomoskovskiy Chamotte Plant. That

PROPERTIES OF CENTRAL CLAYS — TABLE 2

Performance figures	Coalfield Nr 1			Coalfield Nr 2		
	Minimum	Maximum	Predominant	Minimum	Maximum	Predominant
Content in sintered material, %:						
$Al_2O_3 + TiO_2$	23.78	44.2	30.0—35.0	16.07	37.0	20.0—25.0
Fe_2O_3	1.4	3.26	1.8—2.0	0.40	4.32	1.8—2.0
Loss on ignition, %	10.04	27.64	20.0—25.0	6.9	21.01	13.0—14.0
Refractoriness, °C	1570	1750	1700—1720	1540	1690	1640—1660
Water content, %	19.4	30.5	25.0—29.0	18.3	28.0	20.0—25.0
Air shrinkage, %	5.3	10.1	5.0—7.0	4.8	9.3	6.0—7.0
Firing shrinkage at 1300 °C, %	9.5	41.6	13.0—16.0	7.8	15.7	10.0—13.0
Absorption at 1300 °C, %	1.12	22.6	10.0—15.0	6.44	23.73	9.0—12.0

PROPERTIES OF TOP CLAYS TABLE 3

Performance figures	Coalfield Nr 1			Coalfield Nr 2		
	Minimum	Maximum	Predominant	Minimum	Maximum	Predominant
Content in sintered material, %:						
$Al_2O_3 + TiO_2$	20,20	34.02	25.0—28.0	18.04	43.56	24.0—26.0
Fe_2O_3	0,54	3.45	1.8—2.0	0.87	4.89	1.8 —2.0
Loss on ignition, %	8.75	26.45	14.0—16.0	10.0	28.78	14.0—16.0
Refractoriness, °C	1580	1740	1650—1690	1570	1750	1580—1620
Water content, %	18,2	29.3	20.0—23.0	22.2	34.9	20.0—25.0
Air shrinkage, %	5,9	8.0	6.0—7.0	5.3	9.1	6.0—7.0
Firing shrinkage at 1300 °C, %	9,1	17.5	12.0—15.0	7.8	22.4	12.0—14.0
Absorption at 1300 °C, %	2,31	21.8	10.0—13.0	4.04	28.75	8.0—12.0

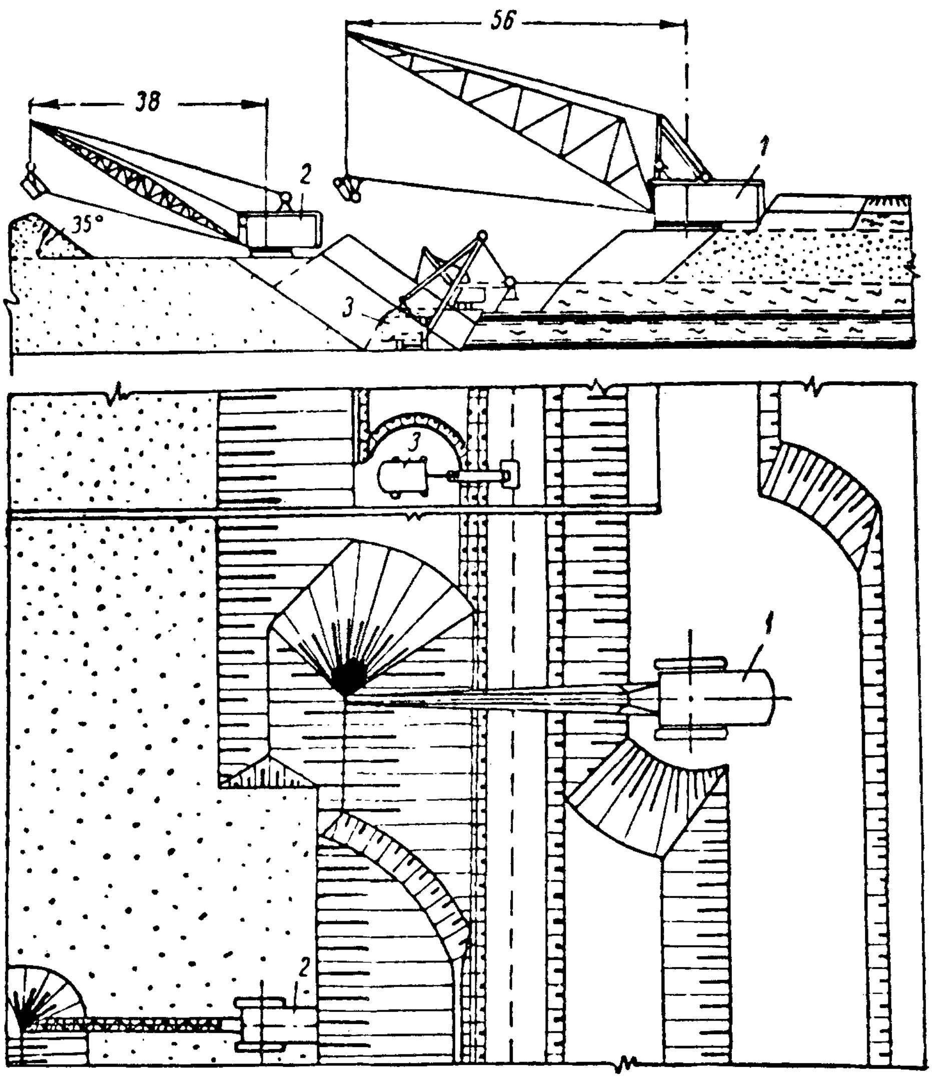

Fig. 2. Selective clay and coal mining:
(1) ESh - 6/60 excavator; (2) same, ESh - 4/40; (3) same, EKG - 4.

required the organization of selective coal and clay mining. The demands of the plants of the Tula Sovnarkhoz for Kimovsk clay do not exceed a yearly 150,000 tons. The possibility of simultaneous clay and coal mining according to the project is summed up in Table 4.

In order to ensure a sufficient supply of quality clay to the consumer the Greater Moscow Research Coal Institute has launched a series of experiments in selective clay and coal mining. The Institute recommended a system of selective mining with the use of the available equipment (see Fig. 2). The thickness of opencast seams amounting to an average 19 to 20 m, the work should be carried out by Sh-14/75, ESh-6/60 and ESh-4/40 excavators. According to that project the top, center and underclays and both coal seams are worked consecutively from the bottom upward. After the overlying bed of top clay is thoroughly cleaned by bulldozer, an EKG-4 excavator is used for mining. Subsequently, the top coal seam is worked and clay removed from its upper layer. The same procedure is employed in mining the center clay (SE-2 "Kovrovets" excavator with a 0.75 m3 bucket). The bottom coal seam and the underlying clay are worked in the same manner.

TABLE 4

PLANNED COAL AND CLAY MINING, IN 1000 TONS

Number of Coalfield	Carbon	Fireclay			
		Underclay	Centerclay	Topclay	Total
1 (basic)	938	300	190	300	790
2 (basic)	440	—	210	90	300
4	151	—	90	—	90

The above method greatly enhances the properties of clay. However, further quality improvement would be achieved by the use of rotary excavators.

CONCLUSIONS

The laboratory and industrial investigations of fireclays in the Kimovsk coalfields corroborate their suitability for the production of grade B chamotte and ceramic ware.

The deposits of fireclay in the Kimovsk coalfields may serve as an additional source of raw material for the refractory plants of the Central region.

The quality of the fireclays may be substantially improved by a thorough removal of gangue and coal from the top layer and selective mining by medium power rotary excavators.

The complex exploitation of the deposit is economically justified insofar as fireclay mining is a secondary process with the per ton cost not exceeding 90 kopeks.

REFRACTORIES IN SERVICE

TESTING ZIRCONIA DINAS BRICKS IN ARC FURNACES

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The Ukrainian Research Institute of Refractories developed a new type of acid refractories known as dinas zirconia bricks and made of quartzite and zirconium concentrate.

Dinas zirconia brick contains 77.3% SiO_2, 17.5% ZrO_2. Initial softening point: 1800 to 1840 °C, initial deformation under a load of 2 kg/cm^2: 1530 to 1540 °C; porosity: 22.4 to 24.1%; apparent density: 2.90 to 2.92 g/cm^3; compressive strength: 200-220 kg/cm^2; resistivity within the 1000 to 1325 °C range: 8.10^5 to 9.10^4 ohm. cm; thermal stability: (heating up to 800 °C) 15 heating-cooling cycles. Mineralogical composition[1]: 30 to 35% quartz; 20 to 25% metastable crystobalite; 25 to 30% zirconium, 10 to 15% cryptocrystalline matter. Fig. 1 shows the fusibility of electrodinas and dinas zirconia.

A batch of dinas zirconia brick was observed in two 5 ton electric furnaces (KhTZ) for manganese steel production; the mean melting time is 140 minutes. In the arch of the first furnace, parts that are subjected to heavy wear were lined with 300 mm dinas zirconia; i.e. main arc (1), side arcs (2), center piece (3) and the first row around the electrode openings (see Fig. 2).

The main arc between the electrode apertures and the part of the brick that touches upon the first phase was set with dinas zirconia brick in the second furnace. The

[1] Analysis carried out by Z.D. Zhukova.