PROSPECTS FOR SUPPLYING RAW MATERIALS TO THE REFRACTORIES INDUSTRY

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In order to speed up improvements in the working of the refractories industry it is necessary to use high-grade materials in the production of refractories. The prospects for supplying the various refractories enterprises with raw materials in the period to 2005 are defined by the subregional section worked out by the All-Union Institute of Refractories "Schemes for developing and disposition of ferrous metallurgy for the period up to 2005",* approved of by the collegiate of the Ministry of Ferrous Metals of the USSR (Minchermet).

The most important and also the most difficult task is to supply the region with magnesia raw materials. The stocks of magnesites subject to working by the open method at deposits of the Satkinsk group are close to exhaustion. Those deposits existing close to the combine whose development is possible by the open method (Semibratsk, Beloretskaya group) are of relatively small capacity and reserves, and of a poorer quality than the Satkinsk magnesites; they have also not been thoroughly investigated. The connection with this, supplying the combine with raw materials in the future, to a large extent, is planned through introducing capacity through the underground method of mining magnesite.

In order to maintain the levels attained for the production of periclase powders, starting from the firing capacity existing at the Magnezit combine, measures have been specified for supporting the capacity of the Karagaisk quarry, the construction of the Mel'nichno-Palenikhinsk quarry, and to continue with the building of the Magnezitovaya shaft. By 1992 in connection with the total working-out of magnesites in the Stepnoi and Nikol'sk quarries, it is proposed to go on to full capacity at the Mel'nichno-Palenikhinsk and Bezrezovsk quarries, and by 1995 – the first stage of the Magnezitovaya shaft.

In connection with the reduced quality of the mined raw materials measures are necessary to hold up the quality of the periclase powders being produced. In the 13th five-year plan provision is made for the four-fold expansion of capacity for the benefication of magnesite in heavy suspensions, or by the photometric separation method. To ensure an expanding production of periclase-carbon refractories for lining oxygen converters with combined blow techniques, electric furnaces of increased capacity, and periclase-spinel refractories for out-of-furnace working of steel, with powders having a MgO content equal to 94-95%, the 13th five-year plan states that there is a need at the Magnezit combine to construct the first stage of a flotation factory.

The 14th five-year plan specifies further development in underground mining of magnesites, which will compensate for the closing down of the Karagaisk quarry.

As an additional raw-material base for the Magnezit combine it is planned to consider the Semibratsk deposits of magnesites, where in 1988-89 it is planned to carry out work on preliminary developments. To determine the trends in developing the raw material base, including the establishment of rational volumes of beneficiating magnesite with various methods (in heavy suspensions, flotation, chemical), and also the desirability of opening up the Semibratsk deposits and new sections of the Satkinsk deposits in 1989, project plans will be drawn up for the development of the raw material base at the Magnezit combine for the period up to 2010.

In the 13th and 14th five-year plans the importing of periclase powders is retained. In connection with the reduction in the consumption of fettling powders and the increased demands on the quality of magnesia refractories, the "Scheme 2005" proposes, in place of imports, to develop the production of high-quality powders on the basis of Savinsk magnesites, with the start of preparatory work in the 13th five-year plan. Considering the significant capital investment, and also the time period for building the Savinsk magnesite combine, and also the

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productivity of the combine, it should be linked with decisions on the development of the raw-material base of the Magnezit combine.

For the production of the highest grade magnesia refractories, in the first place intended for the bottoms of converters with combined blow techniques, equipment for out-of-furnace processing of steel, and also electrotechnical periclase, we require sintered and fused powders with 97-98% MgO (mass). For their production it is necessary to set up, in the 13th five-year plan, industrial production capacity for synthetic magnesium oxide and powders based on it, with a volume of up to 50,000 tons a year. The Eastern Institute of Refractories needs to accelerate the perfecting of the technology which will enable us to advance to the projected planning of the facility.

One trend in obtaining a relatively small quantity of powders with 96% MgO is the realization (possibly, with the involvement for foreign firms) of a technology developed at the Eastern Institute of Refractories for the thermochemical benefication of nonstandardized brucites.

The chromium ores and concentrates required for the production of periclase-chromite and chromite-periclase refractories are supplied by the Donsk GOK combine (the main section) and the Saranovskaya shaft. At the Donsk GOK at the present time they are mastering the technology for the production of fine-grained (0-0.15 mm) low-silica concentrates with mass proportions of SiO_2 < 3 and < 1%. The planned volumes for such concentrates will totally satisfy the demands of the refractories industry in the period up to 2005. However, a large part of these concentrates may be used in the production of refractories only after granulation and firing in the form of granular materials of fractions 1-3 mm. In 1990-1991 at the Donsk GOK it is intended to put into action a section for beneficiating ores (0-10 mm) in which it is proposed to obtain concentratres of rational grain-size composition (0.5-3 mm), necessary for the production of refractories, and having not more than 5 and 7% SiO_2 in their compositions. However, studies made recently showed that during the transporting and drying of the concentrate and grains are to a large degree broken down and 30-40% of them are converted into the fractions 0.2mm. In connection with this, granulation and calcination need to be done at least on part of these concentrates. It is necessary to consider and solve the question of the organization of granulation and calcination of concentrates either at the Donsk GOK or in refractories enterprises, having selected the optimum version.

The organization at the Donsk GOK of the production of chromium concentrates containing less than 1% SiO_2 puts in doubt the need to set up the production of synthetic chrome-spinel. A cost-effective evaluation should be carried out of the desirability of the design section at the Minchermet of the USSR building a department at one of the enterprises of Minkhimprom of the USSR.

At present benefication of chrome ores from the Saranovsk deposits in heavy suspensions is being organized with the production of concentrate fractions 4-100 mm containing not more than 5% SiO_2 (mass), which will create the conditions for a wider utilization of the raw maerials from the Saranovsk deposits in the production of refractories. It is necessary to determine the rational direction of their use in enterprises of the refractories industry.

In connection with the planned (Scheme 2005) introduction of capacity for the production of periclase-graphite and corundum-graphite refractories, there will be a substantial increase in the demand for graphite. Supplying it is allowed for as a result of the setting up of the collection of graphitic wastes from metallurgical production, with subsequent benefication in existing enrichment plants belonging to the Ministry of Building Materials of the USSR, and also the supply of natural crystalline graphite from the concerns of this ministry. Considering the difficulties with supplying crystalline graphite, the research institutes should continue their work on replacing it with less scarce materials: pitch coke, graphitic wastes from electrometallurgy, electrode and other production areas, and cryptocrystalline graphite.

As previously, high-grade raw materials for the production of tar-bonded, magnesia-lime converter refractories are not being provided. The Novolipetsk metallurgical combine used dolomites that are not distinguished by high-quality from Western Siberia in volumes of 100,000-120,000 tons a year. It is necessary to accelerate the solution to the problem of supplying the combine with dolomites of good quality from the neighboring Melekhovo-Fedotovsk or Lankovsk deposits. At the Dokuchaev flux-dolomite combine they are firing up to 60,000 tons per annum of dolomites for converter production in metallurgical factories of the Ukrainian SSR. Moreover, at the combine it is necessary to develop the production of dense powders from dolomites

of the Elenovsk and Bosninsk deposits that are relatively free of impurities but difficult to sinter. In the first stage this may be done by firing with sintering additives. Subsequently, it will be possible to change to pelletizing technology.

The level attained in mining refractory clays and kaolins at the sites exploited by the Ministry of Ferrous Metals of the USSR at present satisfies the demands of iron and steel and other sections of the national economy. In future it is intended to reduce considerably the production of chamotte refractories, and accordingly reduce the gross volume of clay and kaolin output. The development of the raw-material base of the fireclay production will be based mainly on fulfilling capacity for mining high-grade raw materials. To supply the Borovich refractories combine with local materials in future years, the first stage of the quarry at the Okladnevsk deposits will be introduced (output 150,000 tons per annum). By the year 2000 it is intended to implement similar developments for mining clays at this quarry, so as to enable the combine to eliminate underground methods of mining raw materials. In the 13th plan the supply to the combine of high-quality clays and kaolins from the Ukraine deposits will be maintained, and also clays from the Arkalyksk deposits. Subsequently, these supplies to the combine will be reduced to a minimum (50,000-60,000 tons a year).

Because of the low quality of fireclays at the Suvorovsk depotis their mining in the future will be discontinued.

At the Latnensk deposits, by 2000, it is intended to put into action the second stage of the Belyi Kolodets quarry, and a mine at the Khokhol Don sectons, in which it will be necessary to accelerate the work of detailed exploitation. The results obtained can be used to make essential corrections to the planned program for the development of the raw material base of the Semiluksk refractories factory.

In order to maintain the capacity for mining highly plastic clays at the Nizhne-Uvel'sk deposits up to 1990, it is intended to put on stream the second stage of the Bugor mine. In connection with the planned (1995) withdrawal of the outdated refractories production section of the Orsko-Khalilovsk metallurgical combine, there will be no need for mining clay at the Kumaksk deposits. At the Chasov Yar deposits, in order to maintain the mining levels for the main varieties of clays, including the special sort, it is planned to introduce by 1995 the first stage of the Block No. 1 mine, and by the year 2000 the third stage of the Severnyi mine. In the 13th five year plan the third stage of the Novoselitsk quarry at the Vatutinsk refractories combine should come into use. After exhausting the mine it will be possible to supply high grade kaolins to the combine from the Oboznovsk quarry, now being constructed, which is being introduced to replace the worked-out quarry at the Kirovogradsk deposits. It is planned to make wider use, in production of high-grade refractories, of clays from the Arkalyksk deposits, and by the year 2000 — clays from the Krasno-Oktyabrsk deposits, of which 80% is high-alumina material.

Let us examine the contemporary state of the problem of the beneficiation of fireclays and kaolins. The technology that has been developed consists in converting clays into water suspensions with additions of peptizators, separation of the coarse particles according to standard size limits, and subsequent removal of the water from the suspension to obtain plastic or friable, powderlike materials — the concentrate. In this case, the finely dispersed impurities are not removed, especially the iron hydroxides, whose concentration is somewhat increased in the concentrate on account of the reduction in the mass of the raw materials with the removal of the coarse impurities, consisting mainly of grains of quartz.

These methods are adequate for beneficiating raw materials with low concentrations of finely dispersed harmful impurities for example, primary kaolins. The cost of the method is quite high — about 15 rubles for 1 ton of concentrate. Therefore, the enrichment of clays and secondary kaolins for the refractories industry is desirable only in cases when it is necessary and effective. An example may be the organization of the beneficiation of Troshkovsk clays contaminated with silica gravel and found at the East Siberian refractories factory, where they are building and developing a section for beneficiation with an output of 100,000 tons of concentrate a year. The development of the section on full capacity will enable the factory to practically eliminate supplies of clays for the bond part of the batch, excluding the small volume of highly plastic clays for the production of high-duty or special purpose bricks. The effectiveness of the beneficiation of secondary kaolins and fireclays not containing coarse inclusions requires refinement. Using the experimental-industrial equipment introduced in 1987 at the Vatutinsk refractories combine it is now planned to carry out a wide series of experiments on the benefication of kaolins and fire-

clays (firstly, Murzinsk kaolins and Chasov Yar clays) in order to develop the process and clarify its effectiveness. Before carrying out these experiments a decision will be taken about the premature building of other types of beneficiation plant. The Uralmekhanobr institute should carry out a study aimed at increasing the beneficiation effectiveness, including a reduction in the concentrates' ferruginous impurity contents.

For the organization of the centralized supply of prepared powders to enterprises for the bonding of refractories it is planned to construct departments for grinding clays in the Druzhkovsk, Priazovsk, and Chelyabinsk mining commissions with outputs of 500,000; 200,000; and 200,000 tons, respectively with the introduction of these units on stream in the 13th and 14th five-year plan periods.

The future mounting production of high-alumina refractories, as previously, will be based on technical alumina, the demand for which will increase. The increase in the use of alumina requires the introduction in the 13th plan of capacity for its calcination and melting.

The capacity for mining quartzites at the Perovouralsk dinas factory and the Ovruchsk mining commission, bearing in mind their periodic maintenance, will permit us to completely supply the demands for these materials in the refractories industry. The developmnt of new deposits in the period up to 2005 is not specified in the plans. With the aim of increasing the quality of quartzites mined at the operational Perovouralsk dinas factory's deposits, situated at Gora Karaul'naya, the Uralmekhanobr institute has carried out investigations into their beneficiation by the foam separation method. The results showed that the technology does not guarantee a marked increase in the quality of the quartzites.

Together with the technical alumina and graphite raw materials, in the future there will be a significant increase in the demands by the refractories industry for other types of raw materials and products, obtained from other sections of the national economy and needed for organizing the production of new, highly effective refractories: zircon, kyanite-sillimanite, quartz concentrates, low-iron bauxites, high-alumina cement, silicon carbide, chemical bonds, antioxidant additives, aluminum oxychloride, silica gel, chromium oxide, crystalline silicon, etc. In the "Scheme 2005" demands are specified for other regions of the economy for supplies of these materials. In modern conditions the most realistic means of ensuring that the refractories industry received these materials lies in strengthening the direct links with the suppliers and producers.

The problems of supplying the refractories industry with raw materials are rather complex and many-sided. In "Scheme 2005" substantial capital investment is assigned to solving these problems, amounting to up to 60% of the total limit of capital outlay on the refractories industry. To solve these problems we shall have to involve workers' collectives of mining enterprises, refractories and metallurgical factories, researchers, and planning institutes in the industry.