CURRENT STATE OF STEEL-MELTING PRODUCTION AND THE TECHNOLOGY FOR AND RAW-MATERIALS BASE OF MAGNESIA REFRACTORIES IN UKRAINE

A. I. Ryabov1 and Ya. R. Krass1


The state of steel-melting production in Ukraine in 1991 - 1995 is considered. About 50% of the steel is produced in open-hearth furnaces. The imperfect structure of steel-melting production, the low quality of the refractory materials used, and the unstable operating conditions of steel-melting equipment determine the high specific consumption of magnesia refractories which exceeds that in the leading industrial countries by a factor of 2 – 3. The volume of out-of-furnace treatment of steel by the LF, AOD, ACEA - CKF, and VKO processes does not exceed 1% of the total yield.

The production volume and quality of magnesia refractories is determined foremost by the tendencies and rates of development of consumers of the products, e.g., ferrous metallurgy, the industry building-materials (production of cement, glass, etc.), mechanical engineering, and the chemical industry. Ferrous metallurgy is a highly material- and power-consuming industry. It consumes about 9% of the fuel and power resources in the country and the proportion of material expenses in this branch amounts to almost 80% of the total cost of production [1].

The general features of the structural changes of today consist in a gradual transformation of the structure of an production with a high proportion of branches dealing with raw materials, which consume much money and materials and produce intermediate products, to more progressive and dynamic science-intensive branches. The change in the priorities is manifested by the steady decline of the proportion of ferrous metallurgy in the structure of the production of developed countries [2]. In the last 10 – 20 years the production producing refractory materials has been affected by the following factors:

- reduction of the volume of production of the iron- and steel-melting production [3], foremost due to the introduction of other materials such as plastic mixtures;
- introduction of new technological processes into the production of iron and steel, such as direct reduction of iron ore and continuous casting and out-of-furnace treatment of steel;
- decline of the production of cement, glass, products for machine building, etc.;
- structural rearrangement of ferrous metallurgy and, foremost, liquidation of open-hearth furnaces in the leading countries, radical improvement of the quality of magnesia refractories due to the use of pure and superpure raw materials, modernization of equipment and computerization, use of periclase-carbon refractories, cooling and protection of refractories, guniting, restoration repairs, etc.;
- introduction of new shaping techniques, vibrocompaction, fiber materials, etc.

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In connection with the disintegration of the USSR, under conditions of a general economic crisis, disruption of industrial ties, financial instability, market reforms of production relations, outdated equipment of the enterprises, absence of investments, and other social and economic factors the production of steel in Ukraine and Russia has been more than halved in 1990 – 1995. The structure of steel-melting production in Ukraine (as in Russia) is imperfect; about 50% of the
Fig. 1. Structure of steel-melting production in Ukraine in 1994 and in Russia in 1993: S) total yield; O) open-hearth; C) converter; E) electrosteel; the numbers at the columns denote the yield in million tons (numerators) and in % (denominators).

Fig. 2. Specific consumption of refractories in steel-melting production in Ukraine in 1994 (a) and in Russia in 1993 (b): PC) periclase-chromite; PL) periclase-lime; CP) chromite-periclase; P) periclase; MS) magnesia-silicate; D) dolomite powders.

Fig. 3. Lining endurance (a, b) and specific consumption of magnesia refractories in open-hearth production in Ukraine (c) and in Russia (d) in 1991–1995: 1) 900- and 600-ton furnaces of the Illich Plant; 2) 300-ton furnace of the Alchevskii plant; 3) 400-ton furnace of Azovstal'; 4) 200-ton furnace of the Makeevskii plant; 5) 600-ton furnace of the Cherepovetskii plant; 6) DSPA of Krivorozhstal'; 7) 600-ton furnace of the Nizhnetagil'skii plant; 8) 800- and 300-ton furnaces of the Magnitogorskii plant; 9) 400-ton furnace of the Kuznetskii plant; 10) 200-ton furnace of the Kazneevskii plant; 11) DSPA of the Magnitogorskii plant; A) pieces; B) filler powders; C) total.

Steel is melted in morale-wise and physically outdated open-hearth, twin-bath, and direct-flow furnaces (Fig. 1).

Figure 2 presents data on the specific consumption of magnesia refractories in steel-melting production of Ukraine (and in Russia for comparison). The specific consumption of magnesia refractories and unshaped materials in Ukraine and in Russia is close; the consumption of periclase-lime refractories in Russia is lower and that of periclase filler powders (in proportion to dolomite ones) is higher. On the whole, the specific consumption of magnesia refractories in steel-melting production of Ukraine and Russia exceeds that in the leading industrial countries by a factor of 2–3 due to the imperfect structure of steel-melting production and for some other reasons [4].

Open-hearth production in Ukraine is represented by 600–900-ton furnaces built in the 70s (Krivorozhstal' and Illich Plants) and 200–500-ton furnaces built in the 60s (Makeevskii, Dzerzhinskii, Zaporozhstal', Alchevskii, Azovstal', Libnekht plants); there are also two twin-bath furnaces (Alchevskii and Zaporozhstal' plants) and two direct-flow steel-melting units (Alchevskii, Krivorozhstal').

Converter production is represented by 350-ton converters of the Azovstal' plant, 250-ton converters with combined blowing of the Dzerzhinskii plant, and 160-ton converters of the Illich, Krivorozhstal', and Enakievskii plants. There are also 50-ton converters in the Petrovskii plant.

Figures 3 and 4 present sample data on the endurance of linings and the specific consumption of magnesia refractories in open-hearth and converter production of Ukraine and Russia in 1991–1995, and Table 1 presents operational characteristics of 500–900-ton open-hearth furnaces in Ukraine in 1992 (a period of stable functioning of the production). Analyzing the data of Fig. 3 and Table 1 we will see that:

- the endurance of linings of 200–900-ton open-hearth furnaces in Ukraine fluctuates from 350 to 230 heats with a certain tendency toward decreasing by 1995; the endurance of the arch of the twin-bath steel-melting unit (DSPA) of the Krivorozhstal' plant is quite stable and amounts to 870–930 heats due to the use of water-cooled parts (slot beams) in the arch;

- the specific consumption of magnesia refractories in Ukraine in 1991–1994 has increased from 8.8 to 10.4 kg per ton of steel and that of filler powders, on the other hand, has decreased from 19.2 to 14.4 kg/ton, providing a total reduction in consumption from 27.0 to 23.8 kg/ton;

- in Russia the endurance of arches of 200–860-ton open-hearth furnaces differs slightly from that of Ukrainian furnaces except for the DSPA of the Magnitogorskii plant, which has decreased from 830 heats in 1991 to 600 heats in 1995.