Це треба брати до уваги при призначенні електродного матеріалу для технологічного процесу зварювання, особливо при проведенні зварювання в несприятливих умовах, зокрема при живленні від нестабільної мережі.

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DOI https://doi.org/10.30525/978-9934-26-361-3-3

ORGANIZATION OF ENERGY-EFFICIENT BLAST FURNACE PRODUCTION WITH REDUCED ENVIRONMENTAL IMPACT

ОРГАНІЗАЦІЯ ЕНЕРГОЕФЕКТИВНОГО АГЛОДОМЕННОГО ВИРОБНИЦТВА ЗІ ЗНИЖЕНИМ ВПЛИВОМ НА ДОВКІЛЛЯ

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The last twenty years have seen a significant increase in global steel production. For example, from 2000 to 2018, production increased from 850 to 1825 million tons per year [1]. To produce this amount of steel, a large

amount of material and energy resources is required, both for the main metallurgical processes and for the processes of extraction, processing, and transportation of raw materials and energy. Increased volumes complicate the organization of production, increase the need for energy and material resources, and increase the requirements for transport infrastructure. If the global market for metallurgical raw materials is sufficiently developed, energy resources are the main constraint to increasing production volumes. In addition, the issue of reducing the environmental impact of the steel industry in the context of global steel production growth is also important.

Depending on the steelmaking technology, the raw materials used are iron ore sinter (55-65% Fe) and iron ore pellets (63-68% Fe) (obtained mainly from iron ore concentrate), steel scrap, direct reduced iron (DRI), and hot briquetted iron [2]. In total, more than 2,000 million tons of iron ore and concentrates containing 1,500-1,600 million tons of iron and 300-400 million tons of steel scrap are used for steel production worldwide. In addition to these materials, various fluxes, reducing agents, ferroalloys and alloying materials are used, including high-purity metals and others The main alloying elements are manganese, chromium, nickel, molybdenum, which are also obtained by processing the corresponding ores. In 2022, alloying materials were used in the steel industry in the following amounts (million tons of ore concentrates) Mn ~ 20, Cr ~ 20, Ni ~ 3.2, Mo ~ 0.25 [3]. The extraction and processing of raw materials requires significant energy consumption, so it is important to process them as completely as possible and to actively use man-made materials containing the necessary components. Particular attention should be paid to the waste and residues of the mining and metallurgical industry itself.

As before, the bulk of steel is produced at integrated steelmaking facilities that include blast furnaces and oxygen converters, accounting for more than 70% of total steel production. In addition, over 25% of steel is produced at enterprises equipped with electric arc furnaces. In comparison, the second method of steel production requires less energy and has a lower environmental impact [4, 5]. However, in enterprises without blast furnaces, electric arc furnaces use mainly scrap metal, which is limited in supply. The use of primary iron in the form of direct reduced iron and hot briquetted iron accounts for less than 4% of the total amount of iron-containing raw materials. The use of pig iron in liquid or solid form also requires integrated enterprises with blast furnaces and electric furnaces instead of oxygen converters [6].

If we compare energy consumption in different technological processes of metallurgical production, the largest amount of energy is used in blast furnace production (especially if we take into account the costs of producing coke and sinter) [7]. These processes are also responsible for the main emissions of substances harmful to the environment, including carbon dioxide CO_2. Therefore, blast furnace production and related sinter and coke production

processes have a significant reserve for reducing energy consumption and environmental pollution. The main areas of development of sinter and blast furnace production enterprises are: the use of iron ore with increased processing depth (increased iron content, partial metallization); improvement of the quality of iron ore, use of man-made deposits of metallurgical raw materials and metallurgical waste; construction of new generation sinter plants and blast furnaces; introduction of energy-saving technologies in sinter and blast furnace production aimed at reducing energy consumption; use of technological units for utilization of secondary energy resources, new types of energy carriers, in particular, coke substitutes; improvement of equipment and technology of the blast furnace process for the production of high-quality pig iron, reduction of labor, material and energy costs [8]. The gradual development of these areas has helped reduce energy consumption in steel production by more than 50% over the past half century. The main incentives for this were, firstly, an increase in the cost of energy resources, as energy costs can currently account for more than 40% of the cost of steel, and, secondly, increased requirements for environmental safety of production [9].

However, there are still significant reserves for further reducing the total energy costs of steel production through the use of advanced technologies and the development and implementation of new, more energy-efficient ones. In addition, the use of more environmentally friendly energy sources, including electricity from renewable sources, biomaterials as fuels and fuels and reducing agents that do not contain carbon, primarily hydrogen, is becoming more relevant. The greatest effect from the use of these energy sources can be obtained in the technological processes of primary metal production, i.e. in blast furnace production.

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DOI https://doi.org/10.30525/978-9934-26-361-3-4

UNIFIED BLAST FURNACE AIR TUYERE

УНІФІКОВАНА ПОВІТРЯНА ФУРМА ДОМЕННОЇ ПЕЧІ

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Стійкість фурм доменних печей є одним із найважливіших факторів, що впливають на продуктивність та енергозбереження доменної плавки. Це пов'язано з тим, що однією з найчастіших причин зупинок доменних печей є вихід з ладу повітряних фурм в основному через прогар, що призводить до втрат виробництва чавуну та збільшення витрати коксу.

Накопичений десятиліттями досвід, дозволив спеціалістам ТОВ НВФ «КОШ» домогтися збільшення стійкості повітряних доменних фурм більш ніж у 4 рази порівняно з аналогами, що використовуються в даний