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Application of Plasma Processes in Iron Metallurgy

Scientists predict that considering the current use of fossil fuels their reserves in entrails of the Earth will run out by the end of XXI century, which causes an energy resources problem. The most expedient solution is the use of alternative energy sources that are inexhaustible. Nowadays a lot of industrial methods of coke-free iron metallurgy, which significantly reduce fossil fuel burning, are known. One of these methods is the use of plasma technology, in which hot recovery gases can be obtained in an electric discharge, based on the conversion or pyrolysis of hydrocarbons, heating hydrogen, products of gasification of solid fuels, as well as heating the exhaust gases of metallurgical machinery and chemical industries.

The use of thermal plasma in metallurgical industry will expand its capabilities to get rid of the temperature limitations, dependence on coal, natural gas and products of its conversion. The use of low quality fuels with their subjection to thermal plasma gasification to obtain high-quality synthesized gas fuel also becomes possible.

For example, in the Plazmosmelt process, developed by Swedish company SKF, the ore material in the first reactor is dried and heated, while in the second (boiling layer reactor) it is restored at 1000 - 1100 °C by 50 - 60% by the gas that comes out of the furnace shaft. Partially restored ore with charcoal powder and flux is injected into the lower part of shaft. Further restoration occurs at the expense of coke (supplied from the top), while the plasma gas runs the heat off. The consumption of coal and coke during this process is 200 kg and 50 kg respectively, while the power consumption is 1100 kW•h per 1 ton of pig iron. The blast furnace, such as number 9 at the JSC "ArcelorMittal Kriviy Rih", consumes 500 kg of coke per 1 ton of pig iron and 200 m^3 of natural gas and oxygen.

The National Metallurgical Academy of Ukraine proposed the method of obtaining liquid metal in the shaft furnace without coke. The process occurs in the shaft type reactor in which the lump ore materials are loaded from the top, with plasmatrons that generate plasma gas based on the technical mixtures of oxygen and natural gas mounted at the bottom. The bubbling mode of melt treatment provides full recovery of iron oxides. Specific productivity of the shaft furnace, equipped with plasma generators for obtainment of liquid metal, is higher compared to the blast furnace and is 50 - 60 tons/day with 1 m^3 of aggregate's volume; the specific productivity reaches 900 t/m^3 per day.

Application of plasma processes in metallurgy allows the obtainment of the same end products as the classic metallurgy, but at a lower cost of fossil fuel, higher efficiency of furnaces and higher quality of the product.