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INCREASE THE SERVICE LIFE OF THE INDUCTION FURNACE BASED ON THE DEVELOPMENT OF ITS LINING

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Abstract
In this article, in the process of melting metal in an acid induction furnace, the destruction of the furnace lining depending on the heat and chemical composition of charge materials was taken into account, and the importance of processing liquid metal with slag-forming modifiers was tested in research.

Keywords: Lining, acid, refractory, induction furnace, refractory material, oxides, inductor, dynas brick.

Introduction

After the independence of our republic, in our country, in the fields of metallurgy, manufacturing plants and foundries, scientific and research work was carried out on the reuse of refractory materials used in the lining of electric furnaces, and a number of results are being achieved.

Scientific innovations are being made in a number of directions to increase the service life of the furnace lining by reducing the erosion of the lining of electric furnaces. In this regard, the United States, Slovakia, South Africa, Nigeria, Russia, Ukraine and other countries are the leaders in improving the wear resistance of the furnace lining [1, 2]. From year to year, special attention is paid to the creation of the technology to increase the wear resistance of the furnace lining based on an effective method that provides resource saving by reducing the corrosion of the furnace lining and increasing its service life during [3] the process of liquefying ferrous metal and its alloys in induction furnaces.

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MATERIAL AND METHODS

Nowadays, there are induction furnaces in various sectors of the country and they are operating at high capacity. In an induction electric furnace, an alternating electric current passes through copper tubes (inductor) [4-6]. In the furnace, a magnetic field is created in the crucible of the furnace through refractory materials, and as a result of the excitation of metal atoms, solid materials melt. This causes an electric current to flow through the metal charge itself, generating rapid heat and causing the metal to liquefy. Although some surfaces of the furnace can get hot enough to cause burns [7,8], the inductors liquefy the slag, not the furnace. The furnace was assumed to have an electrical inductor with a number of turns in direct contact with the electrical circuit.

1 – fig. The process of melting metal in an induction furnace

Induction furnaces require two separate electrical systems: one for the cooling system [9, 10], furnace bending and tooling equipment, and the other for induction power. Power for the induction furnace inductor is provided by: A three-phase, high-voltage, high-amperage power line is required. The complexity of the connected power supply depends on the type of induction coils oven and its use [11].

The frequencies of the induction furnaces used in the production enterprise are different, and their power source in most cases requires medium and high frequencies. Increasing the frequency of alternating current passing through the inductors of the induction furnace was delivered according to the amount of energy delivered to the furnace of a fixed size. This, in turn, 1 ton induction furnace operates at an industrial frequency of 60 Grs and was able to liquefy the solid material within 2 hours [12-15]. The same furnace can be liquefied at a frequency of 275 Grs, but it liquefied 1 ton in 46 minutes or four times faster. Transformers, inverters and capacitors required for frequency regulation of high-efficiency induction furnaces can present a serious risk of electric shock. Therefore, the power sources of the furnaces were closed with a key or placed in steel cases and equipped with protective locks. Today, dynas brick is widely used as an acid refractory material for lining induction furnaces. As a raw material for its production, almost all silica consists of quartz and quartzites, which consist of SiO_2. Dinas brick contains >96% SiO_2, the rest consists of Fe_2O_3, Al_2O_3, CaO, TiO_2 additives [16-22].

Fire resistance of Dinas brick was 1710 °C, so the maximum working temperature when using it should not exceed 1700 °C. Dinas had a compressive strength of 300 kg/cm^2 and a density of about 2.35 g/cm^3.

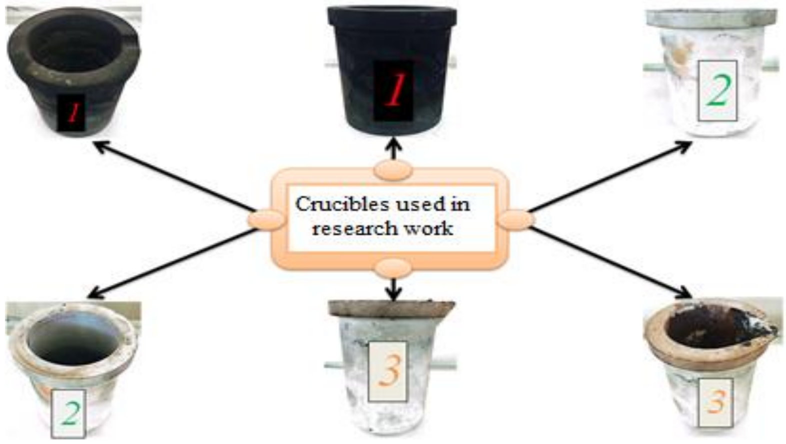
Despite the presence of special additives and careful heating, Dinas brick has low heat resistance. Therefore, it was recommended to heat the dynas using special electric heaters before installing them in the oven. The heating of the walls of the large furnaces was gradually heated up to 550 °C and lasted for 60 hours. Dinas brick expands when heated, so after every 4-5 bricks [23], the thickness between them is about 1.5% of the wall volume. For this reason, it was required to put gaskets made of easily flammable cardboard between them. The gaps created after the gaskets burned reduced the risk of additional stress on the furnace line. The greater the density of the dynas brick, the greater its expansion when heated. It is necessary to fill the bottom of the furnace with quartz sand and crushed quartz and compact it well [24]. Also, 95-97% SiO_2, 1% Fe_2O_3, 1-2% Al_2O_3 were used to fill the sides of acid electric furnaces.

RESULTS

Liquid metal was liquefied several times in laboratory conditions using crucibles. Thus, the interaction of crucibles at high temperature was studied. 6 crucibles are shown here, and crucible number 1 is a graphite crucible, the melting temperature of which is 3550 °C, in the process of melting the ingot, a certain amount of the crucible went into the liquid metal content and led to an increase in the amount of graphite. Due to the high temperature, it can be liquefied up to ten times [25]. In this case, the slag was liquefied 5-6 times due to the addition of a modifier and oxidation of the slag.

In crucible № 2, with Si_4O oxide, the temperature of the ingot was 1600 °C, and the casting temperature was 1550-1560 °C.

№ 3 crucible is corundum based on aluminum oxide [26]. It withstands a temperature of 2000 °C. We diluted up to 10 times. The good thing is that there was no change in the reaction between our cast composition and the lining composition. Pouring up to ten times was achieved.



2 – fig. View of crucibles of various composition

CONCLUSION

In conclusion, it can be said that it is possible to study the influence of the temperature of the liquidized steel alloy on the corrosion of the furnace lining and increase the service life of the furnace lining.

It was developed based on the degree of dependence of the corrosion of the induction furnace lining on the alloy being liquidized. It serves to normalize the temperature of the alloy.

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