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INFLUENCE OF METHOD OF SERVE FOR POWDERED-COAL FUEL AT EFFICIENCY OF HIS USE IN BLAST-FURNACE MELTING

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Influence of method for serve of coal-dust fuel at efficiency of his use in the blast-furnace workshop of OAS the «Metallurgical combine «Zaporozhstal» has researched. The results of calculations for quantity of coke, shown out from the domain melting due to the increase of degree of combustion for coal-dust fuel are presented.

Keywords: blast furnace, blast furnace coal-dust fuel, coke, technical oxygen

Different fuel additions which are serving as the substitutes of coke and natural gas are used in blast-furnace technology. In the last decade technology of the use of powdered-coal fuel (PCF) most actively develops because of his greater availability and minimum cost at high enough calorie content. Decline of coke expense and abandonment from application of natural gas at smelting of cast-iron, and also replacement of them by a powder-coal fuel, is not only economic advantageous, but also answers the hard ecological requirements of the European and national legislative norms.

On OAS the «Metallurgical combine «Zahaporozhstal» from November, 2010 the experienced-industrial melting with replacement of natural gas by more cheap powdered-coal fuel is carried out. Mastering of PCF-technology with a serve on one ton of cast-iron to 160 kg of powdered-coal fuel instead of 100 m^3 of natural gas are characterized by the decline of coke expense from 566 to 366 kg/t cast-iron, that in two times more than at the conduct of technological process of melting with the serve of natural gas. Thus the coefficient of coke replacement rises from 0.8 kg/m^3 of natural gas to 1.03 kg/kg of powdered-coal fuel [1].

Achievement of complete gasification of coal particles at the limits of tuyere zones is the main requirement of PCF-technology. Incompleteness of combustion for powdered-coal fuel stipulates the increase of carbon content in foods of melting, reduces intensity of melting and, as a result, productivity of blast-furnace process. Unfire-damaged coal particles, adsorbed on the surface of slag, sharply reduce his ability to filter the drops of cast-iron as a result the array of cast-iron at a contact with tu-yeres causes their mortality.

As experience of application for powdered-coal fuel shows in high furnaces, the substantial height of degree of his combustion at the increase of concentration of oxygen in blowing takes place. However the traditional methods of oxygen given in the tuyere zone of blast furnace do not provide the sufficient degree of mixing of particles of powdered-coal fuel with blowing. For achievement of their most

complete mixing the increase of concentration of oxygen, given in the stream of powdered-coal fuel is needed.

The method of given for PCF through the aquatic cavity of air tuyere and union coupling, placed athwart to the stream of hot-air in the distance 330…350 mm from the spout of tuyere is applied at PAS «Donetsk metallurgical plant». The tests of this method at the expense of powdered-coal fuel to 200 kg/t cast-iron specify on absence of sufficient degree of mixing for PCF with oxygen of hot-air.

By a firm «Armco Steel» (USA) the method of serve of powdered-coal fuel through a carbine which foresaw the input of powdered-coal tube through the wall of nozzle of air tuyere to the axis of stream of hot-air was applied at the metallurgical plant in Ashland. This method was improved by a firm «Thyssen Stahl» (Germany) [3] and a powdered-coal fuel it is suggested to give through a carbine in snot of air tuyere with the use of coaxial tube (a tube is in a tube), allowing to carry out admission of oxygen directly to the stream of coal powder. At an external tube is given technical oxygen, and on an internal tube – PCF. Such method of given of PCF in the stream of oxygen was adopted by technology of «Oxy-coal».

Due to possibility of local admission of oxygen to the particles of powdered-coal fuel this technology was used for building by the options of given of PCF in a blast furnace on OAS the «Metallurgical combine «Zaporozhstal»

For determination of influence of given method of powdered-coal fuel on efficiency of his use in the domain melting studied two technological periods of work for blast furnace:

– based (B), when PCF gave without oxygen, and all volume of oxygen (45.0 m^3/t cast-iron) was expended on enriching of hot-air (content of oxygen in blowing – 23.4 %);

– experienced (E), when PCF gave together with oxygen in accordance with technology of «Oxy-coal» (content of oxygen in blowing – 23.5 %). Thus 50 % oxygen given together with the hot blowing, and 50 % oxygen – through a coaxial tube.

High quality of coke is the basic condition of stable work of blast furnace and the more so – at the expense of powdered-coal fuel more than 100 kg/t cast-iron. At the increase of quantity of the given powdered-coal fuel time of stay of coke increases in a blast furnace, proportionally which the amount of cast-iron increases, slag, alkalis and ore-hearth gases, contacting with a coke.

As compared to the coke of base period the indexes of hot durability (CSR) and reactionary ability (CRI) of coke for the experienced period change insignificantly, that renders minimum influence at the change of efficiency of the use for powdered-coal fuel in a furnace.

For the experienced period the expense of dry coke goes down on 17.0 kg/t cast-iron, and a specific iron making increases on 31.1 kg/(m^3·day).

It is set experimental researches, that diminishing of coke expense is assisted decline of expense of flux and content of small fraction in iron-ore part of charge, and also content of admixtures in chemical composition of cast-iron. Due to more even motion of blast furnace duration of outages and quiet motion diminishes, that allows some to increase intensity of melting at blowing.

Maximal diminishing of coke expense, equal 7.20 kg/t cast-iron, arrive by expense an increase of powdered-coal fuel.

In addition, at the decline of coke expense favorable influence renders the decline of humidity of blowing at the insignificant increase of his temperature, and also decline of total content of oxygen and output of slag.

The change of the above-stated technological parameters is accompanied by the decline of coke expense at 3.58 kg/t cast-iron, and the improvement of quality of coke results in additional reduction of his expense on 7.78 kg/t cast-iron. As a result, the specific expense of dry coke in the experienced period grows short on 11.36 kg/t cast-iron.

Thus, at the given of powdered-coal fuel (at an quantity 151.0 kg/t cast-iron) with the use of technology of «Oxy-coal», the additional economy of coke makes (17.10 – 11.36) = 5.64 kg/t cast-iron (1.44 %), that testifies to the improvement of burning of powdered-coal fuel, increase of coefficient of coke replacement due to the increase of degree of combustion for the indicated fuel in blast furnace and general increase of efficiency for the use of PCF.

Conclusions. For the most complete combustion of PCF the increase of oxygen concentration, given in the stream of powdered-coal fuel particles is needed. The experienced-industrial melting's with local admission of oxygen to the powdered-coal fuel particles of in technology of «Oxy-coal» assists the increase of degree of combustion for PCF and additional economy 1.44 % coke (5.64 kg/t cast-iron) as compared to inputting of all oxygen in the hot blowing.

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