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RESEARCH OF QUALITY COKE INFLUENCE ON EFFICIENCY OF THE COAL-FIRED FUEL USE

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The influence of quality of coke on the change of its expense in the blast furnaces of OAJ «Metallurgical combine «Zaporozhstal» for 2010-2012 at the use of coal-fired fuel is investigated. Calculations on determining the quantity of coke, derived from the blast furnace melting due to the improvement of its physical and chemical properties are executed.

Keywords: blast furnace, cast-iron, coke, coal-fired fuel, quality

High quality of coke is a key factor for stabilizing of work of blast furnace during insufflation of coal-fired fuel (CFF).

On the maximally possible expense of CFF in a blast furnace influence content of ash (A), sulphur (S), moisture (W), volatile (V), meadows, dispersion of coke on size of parts, mechanical durability (M25, M10), loss of mass coke after the reaction of Boudoir (CRI), hot durability after the reaction of Boudoir (CSR) etc. [1]. The rise of quantity of CFF, which is blown, increases time of stay of coke in a blast furnace.

Productive experience of metallurgical companies defined necessary requirements to quality of coke during insufflation 100-150 kg of CFF on one tone of cast-iron [2]: CSR $\geq$ 62 %, CRI $\leq$ 28 %, faction +25 mm – 94-96 %, faction -12.5 mm – 0-2.0 %, A < 8.5 %, V < 1.0 %, S < 0.75 %, alkali < 0.22 %, W < 5.0 %.

From November in 2010 on OAJ «Metallurgical combine «Zaporozhstal» the experienced-industrial melting, related to substituting of valuable natural gas by more cheap coal-fired fuel are began. Mastering of CFF-technologies on the blast furnace No 2 combines with insufflation 90-130 kg CFF on one tone of cast-iron instead of 100 m^3 natural gas were characterized by the decline of expense coke from 538 to 424 kg/t cast-iron, id est his total economy folded 114 kg/t cast-iron which more than twice exceeds efficiency of the technological mode with insufflation in the blast furnace of natural gas. The coefficient of replacement of coke here zone grows from 0.8 kg/m^3 natural gas to 1.03 kg/kg CFF. It became possible also due to the improvement of quality of charge materials, in particular to the coke, which began before realization of the experienced-industrial melting with application of coal-fired fuel. The coke of the improved quality contains: A < 12 %, V – 0.8 %, W – 5 %, CRI < 39.5 %, CSR > 48.0 %.

In November in 2010 on the eve of beginning of experienced-industrial period of insufflation of CFF on the blast furnace No 2 combines tested the experienced party of Yasinovsky coke of mark «Premium», which contains less admixtures, more carbon, and also improvement physical and chemical properties. There are dot o 4 % economies of coke and to 13 % increase of the productivity of process. The quantity

of fire-damaged tuyeres grew short almost in three times, pyrogenating of cast-iron of the second sort diminished from 4.0 to 1.8 %. Positive experience of the use of coke of mark «Premium» allowed to accept cardinal measures on the improvement of quality of coke PAY «Zaporozhcoke».

From December in 2010 on PAY «Zaporozhcoke» there are began to carry out work with upgrading of quality coke due to the improvement of composition of coal to the charge and optimization of the coking regimes.

Technical composition regimes and physical and chemical properties of coke of base period (in 2010) and two experienced periods (in 2011, first quarter in 2012), when blast furnaces worked on the coke of the improved quality are brought in a table 1.

Table 1 is Technical composition and physical and chemical properties of domain coke PAY «Zaporozhcoke», %

Period, year, quarter	S	A	W	V	M25	M10	+80 mm	-25 mm	CSR	CRI
in 2010 – bases.	1.36	11.7	4.5	0.90	86.7	7.7	7.1	3.8	23.2	52.3
in 2011 – resea.	0.93	11.4	4.7	0.82	87.7	7.4	7.3	3.5	47.9	39.5
2012, 1 apt. – rease	0.77	11.4	4.5	0.49	89.2	7.0	6.2	3.6	48.4	38.3

From a table 1 evidently, that technical composition and physical and chemical properties of coke for the experienced periods became better substantially comparatively with a base period (in 2010). The special attention is turned on itself the ponderable increase of index of hot durability (on 24.7 %) and (25.2 %) accordingly, id est more than in two times, and also diminishing of reactionary ability of coke on 12.8 and 14.0 %. However the indexes of hot durability and reactionary ability remain substantially below, than necessary world sizes: CSR > 58 %, CRI < 22 %.

For determination of efficiency of the use of coke of the improved quality two periods of work of blast furnaces are taken:

– base (in 2010), when blast furnaces worked on an ordinary coke;

– experienced (in 2011), when blast furnaces worked on the coke of the improved quality.

A main task was determination of influence of treason for technological characteristics of work of furnaces on main economic indicators – expense of coke, intensity of run of furnaces and productivity. The real treasons of these parameters are calculated, the sum of treasons of these parameters is certain in relation to treason of technological sizes and after a difference influence of the sought factor, which is quality of coke, is certain.

Positive influence on treason of expense of coke and productivity of furnaces took place due to the increase of content of iron in a charge, that was expressed in the decline of output of slag, expense of flux and part of raw ore, increase of implementation of chart of producing of foods of melting, diminishing of outages of furnaces and quiet run of furnaces, due to their more even run of furnaces, to what the less values of general overfull of pressure gases testify on the height of blast furnaces.

Maximal diminishing of expense of coke (74.3 kg/t cast-iron) are got due to insufflation of CFF.

Negative influence on the expense of coke carried out the cost of natural gas cutting on 63.0 m^3/t cast-iron, decline of intensity of melting in relation to blowing and part in it to oxygen during the insignificant diminishing of temperature blowing, and, as said higher, increase of theoretical temperature of burning and in this connection increase of degree of direct renewal.

As a result due to treason of the noted higher technological parameters the expense of coke went down on 29.14 kg/t cast-iron, and the productivity of furnaces grew on 52.07 t/twenty-four hours. If these changes to take away from really got, then the economy of coke due to the increase of it quality will lay down 45.0 – 29.14 = 15.86 kg/t cast-iron (3.55 %), and increase of the productivity of process : 498.0 – 52.07 = 445.93 t/twenty-four (5.78 %) hours.

Conclusions. Use in the blast furnaces of coke PAY «Zaporozhcoke» the improved quality allowed: to increase the expense of blowing on 168 m^3/minutes; to get the higher economy of coke due to replacement of natural gas on CFF; to eliminate disorders of run of blast furnaces due to the improvement of gasodinamics process: burning of tuyeres grew short more than in three times; to decrease pyrogenating of cast-iron of the second sort from 4.0 to 1.8 %; to promote imple-mentation of chart of producing of cast-iron and reduce outages and «quiet motion» of stoves; to get the economy of coke due to the increase of it quality 15.86 kg/t cast-iron (3.55 %) and to promote the productivity of process on 445.93 т/twenty-four (5.78 %) hours.

Obviously, that an improvement of quality of domestic coke is a major and necessary compensating measure at time to work of blast furnaces with application of CFF.

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