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Yu.V. Mosejko [1], associate professor, c.p.s.
Yu.V. Kuris [1], professor, d.t.s.
O.S. Vodennikova [1], associate professor, c.t.s.
R.I. Bespalov [1], associate professor, c.t.s.
Yu.S. Gavrilko [2], engineer of I category

RESEARCH OF INFLUENCE OF MAGNESIA CONTENT IN BLAST FURNACE SLAG ON MOVING OF SULPHUR FROM IRON

[1] Zaporozhe state engineering academy, Ukraine,
[2] OJS «Metallurgical combinate «Zaporozhstal′», Zaporozhe, Ukraine

There are presented results of research for influence of magnesia content in blast-furnace slags on their capacity to take up sulphur from cast-iron. It is set that at the growth of magnesia content in a slag to 3.25 % its capacity to delete sulphur from cast-iron in the interval of basicity 1.26…1.36 increases.

Keywords: blast-furnace slag, magnesia, cast-iron, removel of sulphur, basicity

Introduction. High demands to quality of cast-iron, that get at the conditions of the forced motion of blast furnaces which work on an agglomerate and pellets with the optimal specific expense of coke, need working off the optimal slag regime of the noted furnaces, and also choose of rational composition of final slag. At providing of the noted conditions the increases of output of cast-iron because of creation of more even motion of furnace and improvement of its high-quality factors because of the decline of content in its sculptures.

Analysis of achievements. It is known [1] that the process of moving off of sulphur from cast-iron is successfully carried out at a basic slag, in a restoration atmosphere, and also after minimum content of iron oxide (*FeO*) in a slag.

The considereble quantity of works is devoted to the receipt in the blast furnace of cast-iron with subzero content of sulphur [2-8].

In work [2] there is marked, that in the process of melting in a furnace the considerable quantity of sulphur is passed from a coke through a gas phase to products of melting. The most quantity of sulphur from a gas phase passes to the slag and metal on an area «horizon of tuyere area is bosh parallel».

Work of blast furnaces with a fully fluxed agglomerate and renowal of raw limestone from composition of charge promotes to the improvement of processes of translation of sulphur in a slag and receipt of cast-iron with its subzero content.

Results, that it is got at productive terms [3], confirm, that at work of furnaces with the use of agglomerate by basicity 1.10-1.12 is fixed the considerable increase of coefficient distribution of sulphur between cast-iron and slag (L_S).

By G.A. Volovik [4] is shown that at translation of blast furnaces on the use of fluxed agglomerate is observed decline of taking off of sulphur with top-dmoke gas and increase of its translation in a slag on all way of its forming, and, thus, increase of size of coefficient L_S.

Improvement of process of moving off of sulphur from cast-iron [5] reachs due by the increase of number of producing from a furnace, and, thus, and increase of quantity of bottom slag, better contacting with cast-iron.

In a monograph [6] the most thermodynamics analysis of desulphurizing of cast-iron is executed in blast furnaces and practical measures on the increase of possibility of slag to take up sulphur at melting of low-manganese cast-iron are worked out.

By the authors of work [7] connections of sulphur, which enter in blast furnace with materials of charge, are studied. In a fluxed agglomerate considerable part of sulphur is related to the calcium in olivine, and in grains of magnetite there is a transition the determined quantity of *FeS* on *CaS*, that creates hard solutions in magnetite. Thus, application of fluxed agglomerate in blast furnaces creates more favourable conditions for diminishing of content of sulphur in cast-iron by its active scarifying.

In work [8] the results of researches of influence of expense of coke, temperature and basicity of slag on distribution of sulphur between cast-iron and slag are brought. It is set in the case of welding of cold little siliceous cast-irons (to a 0.2-0.5 % silicon), that a slag in the forge of blast furnace has a mionectic temperature (1400-1450 °C). As a result there is diminishing of coefficient of L_S in 1,5-2,0 times by comparison to a slag which has a temperature 1500 °C, that it is possible to explain influence temperatures on viscidity of slag and activity in its sulphurs.

The purpose of work is a study of influence of magnox content in a blast slag on moving off of sulphur from cast-iron.

Basic part of researches. Experiments in relation to the study of measure of absorption of sulphur by synthetic slags which contain 3.0-14.4 % *MgO*, and blast slags which contain 2.70-3.25 % *MgO* executed in a furnace of resistence with the internal diameter of the work volume a 80 mm. Moving off of sulphur from cast-iron carried out in graphite crucible, that placed in central part of the work volume of the noted furnace - in the zone of high temperature. Temperature in the work volume of furnace was taken at all experiment by means of optical pyrometer TERA-50.

At preparation of samples of sulphureous cast-iron to melting a charge was formed by careful interfusion of mixture which consists of 100 parts of cast-iron and 1.2 parts of clean sulphur. Such mixture was loaded in corundum crucible, set its in a furnace and sintered at temperatures 500-600 °C during 15 minutes with the receipt of sulphureous cast-iron.

The samples of synthetic slag were characterized by content *MgO* in an quantity 2.5; 4.2; 5.8; 7.5; 9.1; 10.8; 12.4 and 14.2 %, and also by a presence 0.3-0.,5 % *FeO*. By components of slag were chemically clean magnox *MgO* and dioxide aluminum Al_2O_3, and also limestone $CaCO_3$ and quartz sand. The corresponding quantity of components was carefully mixed and in graphite crucible, loaded in a furnace, where heated to the temperature 1500 °C. Molten slag after self-control during 15 minutes at the noted temperature was outpoured in the special mould. After cooling a slag was added to crushing to faction a less than 3.0 mm and carefully mixed.

Samples of slag and cast-iron by mass 30 g loaded in graphite crucible and heated to the temperature 1400 °C. Fusion was added to self-control during two hours

and sent to the chemical analysis to plant laboratory. The results of experiments are given in a table. 1.

Table 1 - Influence of MgO on ability of slag to take up to sulphure (results of laboratory researches)

Content *MgO* in a slag, %	Coefficient of distribution of sulphur, L_S	Basicity of slag CaO / SiO_2	Total basicity of slag $(CaO + MgO) / SiO_2$
5,88	33,00	1,05	1,20
7,84	21,40	0,96	
9,50	23,70	0,98	
12,01	22,20	0,89	
12,70	23,50	0,81	
13,69	19,00	0,81	
4,41	46,10	1,12	1,25
5,58	34,30	1,10	
7,54	42,00	1,05	
8,66	33,60	1,03	
11,82	42,00	0,96	
14,40	28,40	0,87	
2,95	59,70	1,20	1,30
4,48	44,00	1,18	
5,68	45,50	1,17	
6,40	41,80	1,17	
7,74	39,20	1,09	
8,13	42,50	1,10	
11,20	34,40	0,89	
12,50	33,20	0,96	

Table 2 - Influence of basicity of slag on its ability to take up eukphure (industrial data, in a slag 2.70 MgO %)

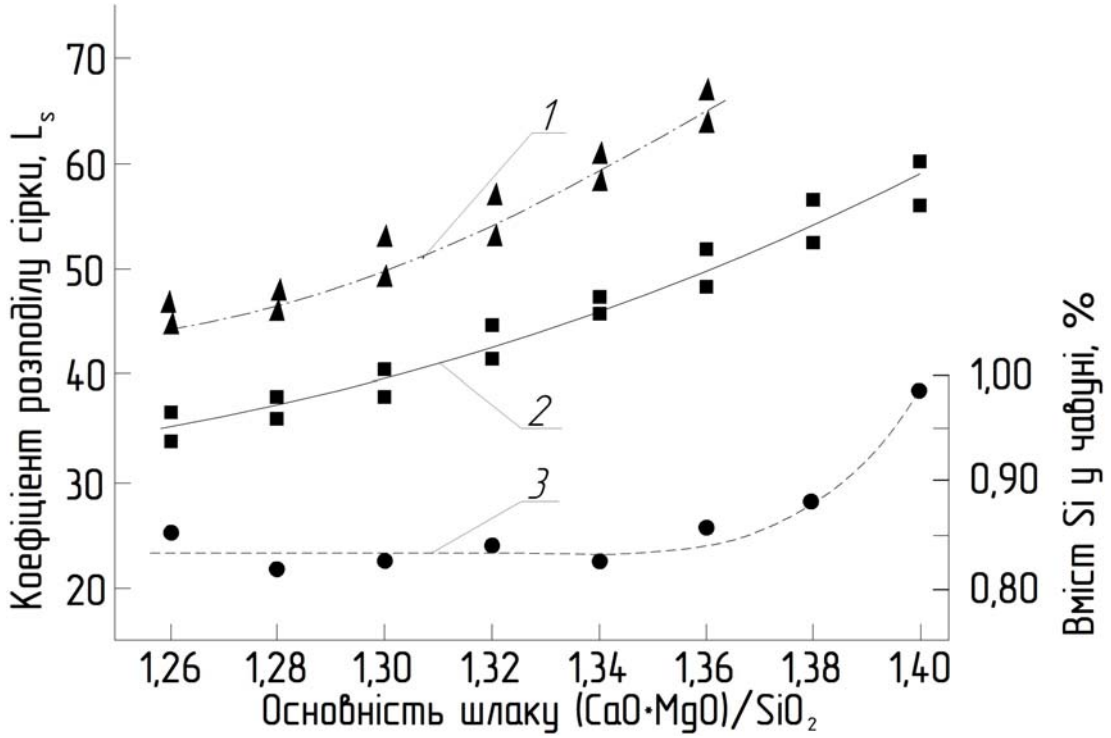
Basicity of slag $((CaO + MgO) / SiO_2$	Blast furnace				Content of silicon is in cast-iron, %
	N 4		N 5		
	Ls	Quantity of the treated data	L_S	Quantity of the treated data	
1.26	32.7	2	42.2	1	0.85
1.28	42.5	3	46.0	7	0.91
1.30	40.2	9	41.5	27	0.83
1.32	42.9	36	45.0	60	0.85
1.34	46.1	46	46.5	59	0.84
1.36	49.5	29	.	31	0.86
1.38	56.9	12	53.6	15	0.90
1.40	58.7	3	58.9	4	0,88
middle	46.4		47.2		

Results of the statistical processing of data of work of blast furnaces N 4 and N 5 OAJ «Metallurgical combine «Zaporozhstal′» at content in a slag 2.70 and 3.25 % *MgO* allowed to define for every value of basicity the mean value L_S and middle content of silicon in cast-iron (table 2 and table 3).

Table 3 - Influence of basicity of slag on its ability to take up to sulphure (industrial data; in a slag 3.25 % MgO)

Basicity to the slag $(CaO + MgO) / SiO_2$	Blast furnace				Content of silicon in cast-iron, %
	N 4		N 5		
	L_S	Quantity of the treated data	L_S	Quantity of the treated data	
1.26	44.7	2	-	-	0.80
1.28	46.6	5	47.2	4	0.88
1.30	53.2	11	45.5	7	0.85
1.32	60.2	9	46.8	8	0.87
1.34	56.2	3	58.9	3	0.88
1.36	-	-	66.2	4	0.78
middle	54.2		50.4		

With the use of table 2 and table 3 dependence of coefficient L_S on basicity of slag is got (fig. 1) from which follows, that slags with content of magnox 3.25 % have the the best opportunity to take op sulphur, what slags with its content 2.70 %.



1 – 3.25 % *MgO* in a slag; 2 – 2.70 % *MgO* in a slag; 3 is content of silicon in cast-iron

Figure 1 - Dependence of L_S on basicity of slag at data of industrial researches

Except for that, it is set that with the increase of basicity of slag its possibility to take up sulphur grows. Yes, at basicity of slag 1.26 and increase of content of *MgO* a to 3.25 % coefficient of distribution sulphur grows to 45.0, at basicity 1.36 its value rises to 66.0, id est. its increment in two times, than at basicity 1.26.

Curve of treason of content of silicon in cast-iron for the interval of basicity 1.26-1.38 is practically horizontal, that specifies on the insignificant vibrations of heating of forge of furnace. Thus, slags which contain 3.25 % *MgO* have the best opportunity to take up sulphur due to the decline of their viscidity which accelerate the processes of diffusion and improves moving off of sulphur from cast-iron at the impregnation of it's in the farge of

furnace through the layer of slag. Except for that, from the got dependence follow, that increase of content *MgO* in a slag from 2.70 to 3.25 % allows to work at industrial conditions with the use of slags with less basicity, not reducing their possibility to take up sulphur here. For example, if slag with contetnt 2.70 % *MgO* and basicity 1.36 has $L_S = 48$, then slag with content 3.25 % *MgO* has the same value L_S at its basicity 1.31.

Conclusions. The results of the executed researches allowed to set that at the increase of magnox content in industrial blast slags from 2.70 to 3.25 % there is an increase of their possibility to take up sulphur in the interval of basicity 1.26-1.36. Translation of blast furnaces on work with slags which contain to 3.25 % *MgO*, allows to use the slags of less basicity.

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