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Use of Secondary Technogenic Formations of Ferrous Metallurgy for Production of Steel

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ABSTRACT: In article questions of use of secondary technogenic formations of the most metallurgical enterprise for production of steel are considered. When smelting steel and their processing pressure uses metallurgical slags, technological dust and mill scale. These materials contain rather larger amount of iron and, now, isn't used. Use of these materials considerably will expand a source of raw materials of JSC “Uzbeksteel” without carrying out investment cost on geological, mountain and mining and hauling charges.

KEYWORDS: slags, metallurgical dust, rolling scale, tails of dressing-works, iron, magnetite, fusion mixture, melting, arc steel-smelting furnace, production efficiency.

I. INTRODUCTION

One of the main problems of ferrous metallurgy of Uzbekistan is chronic the deficiency of a feed stock. For a variety of reasons available in the republic iron ore fields aren't involved in an industrial turn. JSC “Uzbeksteel” is forced to work for scrap metal which amount in the region continuously decreases almost completely. The main part of hot – the bricketed iron is imported from the foreign countries. These difficulties at conducted to the fact that only a small part of a necessary product is satisfied at the expense of characteristic production. In this regard involvement in production of sources. Gland being in secondary technogenic formations of the local industrial enterprises is "relevant" [1].

II.RELETED WORK

At the department of “Metallurgy” TashSTU researches on additional extraction of iron and its oxides from a wastage of metallurgical production are conducted.

The slags which are formed during smelting of steel in JSC “Uzbeksteel” contain in the structure, pure iron of 10 - 12%, and concentration of its oxides reaches several tens percent. In plant these slags subject dry magnetite enrichment and add the emitted material to proceeding fusion mixture. Tails of magnetite enrichment are a production wastage and are stored in special dumps [2].

The analysis which is carried out by us showed that this wastage contains rather large amount of iron and its oxides. So, mean value of content of metal iron made 3,8%, and its oxidic content of 16,8%. These concentrations quite compared with poor iron oxides and can be used in metallurgical production. Now in plant saved up more than 1,5 million ton. This wastage, and 60-70 thousand tons are annually formed follow-up. The same picture is observed also at other enterprises of ferrous metallurgy [3].

III. OBJECTS AND METHODS OF RESEARCH

For definition of an optimum way of extraction of iron and its connections the following methods of gravitational enrichment have been used: jigging; enrichment on a screw separator; enrichment on a concentration table.

Table 1. Chemical consists steelmaking slag SC “Uzbeksteel”

Fe	FeO	Fe_2O_3	CaO	SiO_2	Al_2O_3	MnO	MgO	P_2O_5	SO_3	Others
1,5-1,6	7,4-9,8	15,4-17,5	22,0-26,0	24,0-28,0	5,8-7,0	7,9-10,2	7,61-10,7	0,2-0,13	0,2-0,26	2,8-5,1

Optical properties of Fe_2O_3 sample were determined through UV-spectrum. The optical absorption spectra was recorded by using SHIMADZU IRAffinity – 1 (Figure 1).

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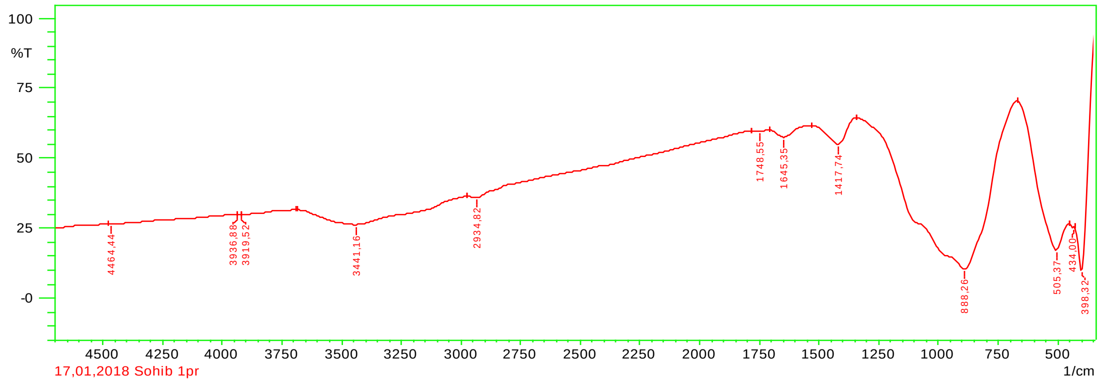

Figure 1. UV-spectrum of steel smelting slag SC "Uzbeksteel"

The UV spectrum of iron oxide manifests prominent absorption band located at 398.32, 434.00 and 507.37 cm^{-1}.

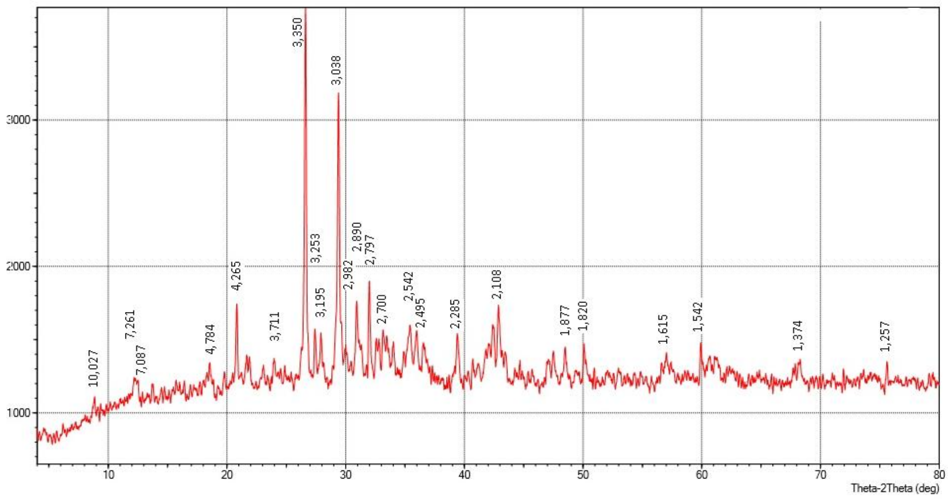

Figure 2. XRD pattern of steel smelting slag SC "Uzbeksteel"

The structural features of minerals are explored from XRD date (Figure 2). They are: anortit with sodium feldspar – 4,265; 3,343; 1,813; 1,539 Å; mullite – 2,855; 2,452 Å; hematite – 2,696; 2,518; 1,834; 1,688 Å; enstatit – 3,157 Å; magnetite 2,541; 1,612 Å.

On the structure steel-smelting slags are self-breaking up and low-active. The maintenance of Fe in slags fluctuates within 50 — 70%, pure iron — 10 — 12%.

Table 2. Particle size distribution of the processed steel-smelting slag

Class, mm	Mass, kg	Out put, %	Total «+», %
+3,0	0,859	17,18	17,18
-3,0+2,5	0,280	5,6	22,78
-2,5+2,0	0,320	6,4	29,18
-2,0+1,5	0,470	9,4	38,58
-1,5+1,2	0,243	4,86	43,44
-1,2	2,828	56,56	56,56
Total	5,0	100	100

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Extraction of iron and its connections from the processed steel-smelting slags is based by method of a jigging on a difference of speeds of a motion of grains in the pulsing environment [4]. The jigging was carried out in the laboratory two chamber jigger. At a jigging initial material is exposed to division into the layers differing on density and fineness which are formed on a jigger sieve in a result of periodic action of the ascending and descending streams of the dividing environment, the driving mechanism caused by work. In the lower layers the heavy product, and in the top-easy concentrates [5].

IV. RESULTS OF THE RESEARCH

The hinge plate of the processed steel-smelting slags weighing 5,0 kg was exposed to a research. Average values of results of 5-6 pilot studies are presented in tab. 3. In experiments tails of the first jigging loaded again into the jigger therefore received two concentrates.

Table 3. Qualitatively - a quantitative index of division of valuable components of the processed steel-smelting slag at a jigging

Products	**Out put, %**		**Content, %**		**Extraction, %**	
	kg	**%**	**$FeO+Fe_2O_3$**	**Fe**	**$FeO+Fe_2O_3$**	**Fe**
Original	5,0	100	17,6	3,8	100	100
Concentrate 1	2,45	49	15,2	2,21	42,3	28,6
Concentrate 2	1,05	21	16,8	2,3	20,0	12,8
Tails	1,5	30	34,4	7,4	37,7	58,6

At enrichment on a screw separator the uniformity of food was maintained. An amount of water in food it was set at the rate of receiving a pulp with a density of 20-30% of firm [6]. The consumption of flushing water is regulated visually and averages 0,05-0,2 p/a.
Results of distribution of valuable components of the processed steel-smelting slags at enrichment on a screw separator are given in tab. 4.

Table 4. Qualitatively - a quantitative index of division of valuable components of the processed steel-smelting slag on a screw separator

Products	**Out put, %**		**Content, %**		**Extraction, %**	
	kg	**%**	**$FeO+Fe_2O_3$**	**Fe**	**$FeO+Fe_2O_3$**	**Fe**
Original	5,0	100	17,6	3,8	100	100
Concentrate 1	2,10	42,0	15,42	2,96	38,6	32,7
Concentrate 2	1,75	35,0	9,35	2,32	18,6	21,4
Tails	1,15	23,0	35,12	7,58	42,8	45,9

Analysis of data of tab. 4. Shows that losses with tails make considerable size that significantly reduces indicators of process and can hardly be an effective method of processing of the fulfilled steel-smelting slags.
At extraction of iron and its connections on a concentration table division of materials of slag comes from the processed steel-smelting slags in thin water flow, (sound board) flowing on a low-bevel flat surface of a table [7]. The sound board makes asymmetric returnable step the movements in the horizontal plane.
Pilot studies were conducted on a laboratory single-tier concentration table of LKS – 1Ya. The table is intended for material enrichment by fineness – 3 mm, productivity of a table of 15-20 kg/h; the size of the course of a sound board is regulated in repartitions of 8 - 16 mm; number of the courses in a minute 275-325; inclination of a sound board from 0 to 100; water 0,5 consumption of m^3/h [8].
After establishment of technical indicators of a table began performance of pilot study.
At first water in the quantity sufficient for a covering was pumped by a thin layer of all surface of a table. The processed steel-smelting slag moved in a loading box of a table in the form of the pulp received after crushing with L:S relation = 2:1.
Qualitative quantitative indices of enrichment of the crushed processed steel-smelting slags on a concentration table are given in tab. 5.

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Table 5. Average values qualitatively - quantitative indices of division of valuable components of the processed steel-smelting slag on a concentration table

Products	Out put, %		Content, %		Extraction, %	
	kg	%	$FeO+Fe_2O_3$	kg	%	$FeO+Fe_2O_3$
Original	5,0	100	17,6	3,8	100	100
Concentrate 1	1,46	29,3	37,9	10,2	63,0	78,2
Concentrate 2	1,2	24,0	16,8	1,73	22,8	11,2
Tails	2,34	46,7	5,3	0,9	14,2	10,6

By results of the conducted researches it is visible that at enrichment of the processed steel-smelting slags on a concentration table extraction of valuable components makes, %: a concentrate 1 - $FeO+Fe_2O_3$ - 63,0; Fe – 78,2; a concentrate 2 - $FeO+Fe_2O_3$ - 22,8; Fe – 11,2.
The comparative analysis of indicators of extraction of FeO, Fe_2O_3 has been made for the choice of an optimum way of gravitational enrichment of the processed steel-smelting slags, Fe results of which are given in tab. 6.

Table 6. The comparative analysis of extraction of useful components from the processed steel-smelting slags by method of gravitational enrichment

Method extraction	Extractive valuable compounds	Extraction, %		
		Concentration - 1	Concentration - 2	Tails
Jigger	$FeO+Fe_2O_3$	42,3	20,0	37,7
	Fe	28,6	12,8	58,6
Screw-separator	$FeO+Fe_2O_3$	38,6	18,6	42,8
	Fe	32,7	21,4	45,9
Concentration table	$FeO+Fe_2O_3$	63,0	22,8	14,2
	Fe	78,2	11,2	10,6

V.CONCLUSION

As a result of the carried-out comparison of results of enrichment of the processed steel-smelting slags, it is established that an optimum method at which the maximum extraction of FeO, Fe_2O_3, Fe is reached is enrichment of the processed steel-smelting slags on a concentration table.
The analysis of chemical, fractional and mineralogical composition of the processed steel-smelting slags is carried out.
It is established that for processing of these slags by the most acceptable use of gravitational enrichment is.
It is shown that from all studied enrichment methods the most suitable technical and economic and technological indicators are received at enrichment of slags on a concentration table which can be recommended for industrial introduction.
Use of this development in the industry will allow to expand a source of raw materials of plant without capital expenditure for geological and mining operations and to pass to low-waste technology. At the same time waste slag can be actually eliminated that will favorably affect an ecological situation around iron and steel works.

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