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POSSIBLE WAY OF EFFECTIVE ENRICHMENT OF THE MIXED ORES

The results of experimental researches which allowed to develop and recommend to introduction the new technical decisions of the complex processing of the mixed (semioxidized) iron ores with the use of ecologically safe technology of magnetic separation in the weak and strong fields are expounded, providing the receipt of high-quality commodity concentrate with the mass stake of iron 65-66,2%.

Last years the mineral-raw complex of Ukraine provides about 40% of the state budget incomes. Ukraine receives an essential share of currency receipts due to export of primary mineral raw material, first of all, iron-ore concentrate, agglomerate, pellet.

In Ukraine interior there is concentrated the significant part of the world explored reserves of iron ores. At an total number of the population of Ukraine that makes approximately 0,65% of the Earth one, the country provides about 15 % of world extraction of iron ore raw material. Extraction and processing iron ore raw material makes an economy basis of Ukraine.

In many regions of the country the iron ore enterprises, including serving organizations, found towns and provide up to 80% of work places. Krivorozskiy iron ores basin is a basis of all mining industry. Alongside with that here there are extracted and processed a wide rates of magnetite quartzite at five ore dressing plants, the ores having partial oxidation, from mass fractions magnetite within the ranges of 5-15 %, are stored now, thus creating difficult ecological conditions in city.

The most of iron ore deposits were formed as a result of magmatogene, sedimentation (exogenous) and metamorphic processes. They are extremely characterized on geological age variety, genetic and morphological types, the sizes and deposit conditions, and also on material structure, dressability and metallurgical properties of ores.

The basic minerals determining industrial value of iron ores deposits are magnetite, hematite, martite, hertite. In mixed half-oxidized iron ores the ratio of the main ore minerals changes in wide ranges depending on physical and chemical processes magmatogene ore formation. There is no Industrial use of these ores as the raw-material base for the enterprises of Ukraine.

The regulation problem of interior use process in Ukraine and the UIC countries was discussed repeatedly from the various points of view. It is connected with that last years the significant scientific and technical potential is saved up in the field of technologies on processing iron ores raw material of various mineral structures. In Ukrainian practice iron ores raw material with mass fractions of magnetite iron up to 15 % practically is not processed and stored in dumps.

Far abroad enrichment scales of the poor mixed ores of various mineral structures are growing. At the same time many enterprises in the USA, Canada and China extract and enrich these ores of various material structure, impregnation and texture structural features.

Ores dressability and the iron mass fraction in final concentrates depend on their physical properties determining ore and nonmetallic minerals disclosing during crushing and grinding and causing application of different enrichment methods.

Processing technologies of iron ore raw material used now in Ukraine and the UIC demand perfection that is caused by difficult ore base of developed deposits and low competitiveness of received concentrates.

The decision of this problem is the increase of completeness and integrity of iron ore raw material use, decrease of expenses for its processing by introduction of new technologies and economic decisions and their combination, that frequently happens

The main use condition of new technological decisions at the mixed iron ores processing is in the research of their crushing laws, ore and nonmetallic minerals disclosing, magnetic separation for finding of optimum modes and these process parameters for maintenance of all ore minerals maximal extraction.

Methodological basis of the decision of efficiency increase problem of half-oxidized iron ores use, is process fundamental researches of crushing, magnetic separation in weak and strong fields, perfection of ores processing technology at the best concentrating enterprises of near and far abroad countries.

On the above-stated basis, authors had been researched the development of ecologically safe and highly effective processing technology of mixed (half-oxidized) iron ores with reception of the concentrate which satisfy the European quality requirements.

For experimental researches, samples of the mixed iron ores of Krivbass and KMA have been submitted. At the first stage of researches in samples, crushing up to size of 0-3 mm there have been already observed increase of sludge formation. The mass sludge fraction changes from 5,1 to 8,6 %. Magnetite – hematite ores version are more disposed to sludge formation.

At crushing samples to accepted size of the first stage ore preparation of -0,074 mm class shared 70%, the mass fraction of sludge particles in samples has increased up to 15-19 %, and at crushing up to 95-96 % of a -0,044 mm class, the mass fraction of disperse particles increases up to 25-26 %. It is known, that formed disperse ore particles and nonmetallic minerals influence negatively on the further dressing [1, 2].

Results of mineralogical and chemical analyses of researching samples proved that magnetite associates with the certain part of quartz that considerably complicates technologies of a high-quality concentrate reception both from magnetite, and oxidized parts iron ore raw material.

With the purpose of feature definition of technological properties of the mixed iron ores samples the following variants were used: ore preparation with consecutive crushing and enrichment; crushing and classification on product boundary fineness

with the subsequent enrichment.

It should be noted that at the stage magnetic analysis of samples without sludge, the mass iron fraction in the incorporated magnetic products is lower on 0,6-1,8 % than a mass fraction of the incorporated magnetic product received by the second variant (fig. 1). It has confirmed that magnetic floccules, formed after the first separation stage considerably worsen the further process both ore preparation and magnetic division. Besides, disperse magnetite presence in nonmetallic and low ore grains predetermines selection disturbance at separation.

Thus, the basic and determining factor causing selection disturbance at mixed (semi-oxidized) iron ores enrichment in weak and strong magnetic fields are texture-structural features of raw material i.e. joint presence of residual magnetite with hematite, martite, quartz.

The fineness of the mixed ore mineral particles in a magnetic field influences on dividing process. With a material fineness reduction duration of its fastening grows proportionally, hence iron extraction in a magnetic product decreases.

Allocation of strong magnetic mineral particles from the prepared raw material is rather effective at use of such separators as PBM.

For a most effective magnetic separator choice for low-magnetic mineral particles enrichment devices with a horizontal and vertical induction of a magnetic field vector direction were tested. The vector direction of a magnetic field induction in a separator renders essential influences on process of the mixed iron ore division as can or can't coincide with a direction of initial feed submission. In case of these vector concurrence the blocking probability of separator working backlashes by strong magnetic particles (magnetite), which are present at a feed, is decreased. At discrepancy of induction field vector and initial feed submission there increase a blocking danger of working backlashes.

For carrying out of magnetic samples enrichment of the mixed iron ores with a horizontal induction vector direction of magnetic field it is used a rotor stand separator created by COC "STC MAGNIS of LTD", which working matrixes are executed as gear plates. With a vertical vector induction direction of a magnetic field there was used high-intensity magnetic separator LGS WHIMS by company LONGI (China) which working matrixes were rod ferro filler. Besides in a working separator zone there is a pulsator, which provides periodically with the set frequency, pulp returning in a matrix that promotes increase of division process accuracy.

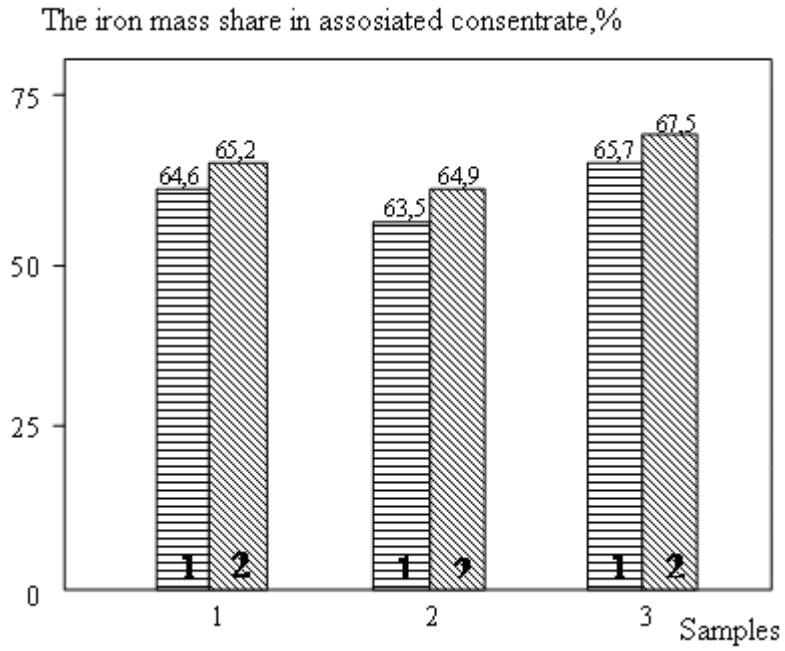

Fig. 1. Quality indicator histograms of the sample magnetic analysis
at staged (1) and the combined (2) stages of separation:
Samples: 1 - hematite - magnetite; 2 - magnetite - hematite;
3 - hematite - silicate -magnetite

As research results (table) have shown, application in enrichment technology high-intensity LONGI separators in the oxidized circuit branch promotes reception of a better concentrate at significant iron loss reductions in tailings. It is achieved due to magnetic stream low dispersion, uniformity of a magnetic field induction in a working separator zone. Besides initial feed submission and jet-wash water miss in opposite directions concerning matrixes, promoting self-unloading of rather large ore mass particles, which were not past through a matrix backlashes.

Comparative tests of the mixed iron ore enrichment on separators ERL and LONGI

Initial product, separator	Mass share, $Fe_{general}$, %	Magnetic product, %			Nonmagnetic product, %		
		yield	Iron mass share	extraction	yield	Iron mass share	extraction
Magnetite-hematite ore, separator ERL	28,7	28,9	62,7	63,1	71,1	14,9	36,9
Magnetite-hematite ore, separator LONGI	28,7	30,1	63,8	66,9	69,9	13,6	33,1
Hematite – magnetite ore, separator ERL	23,4	17,9	61,1	46,7	82,1	15,2	53,3
Hematite – magnetite ore, separator LONGI	23,4	18,1	62,4	48,3	81,9	14,8	51,7
Hematite – silicate-magnetite ore, separator ERL	26,3	18,1	60,8	41,8	81,9	18,7	58,2
Hematite – silicate-magnetite ore, separator LONGI	26,3	22,8	62,5	54,2	77,2	15,6	45,8

On the basis of an advanced foreign factories experience processing similar raw material, and also on the basis of own experimental researches, technological enrichment opportunities of magnetic mixed iron ores with preliminary raw material preparation for enrichment are determined.

Sludge removal operation promotes highly effective conducting magnetic enrichment process, both in strong and weak magnetic fields.

The recommended enrichment technology of the mixed ores for Mihaylovskiy MDF will ensure a total commodity concentrate from mass iron fractions of the general of 66,2 % at extraction of 75,1 % (fig. 2). Such technology will promote complex processing iron ore raw material and will provide competitiveness of a commodity output.

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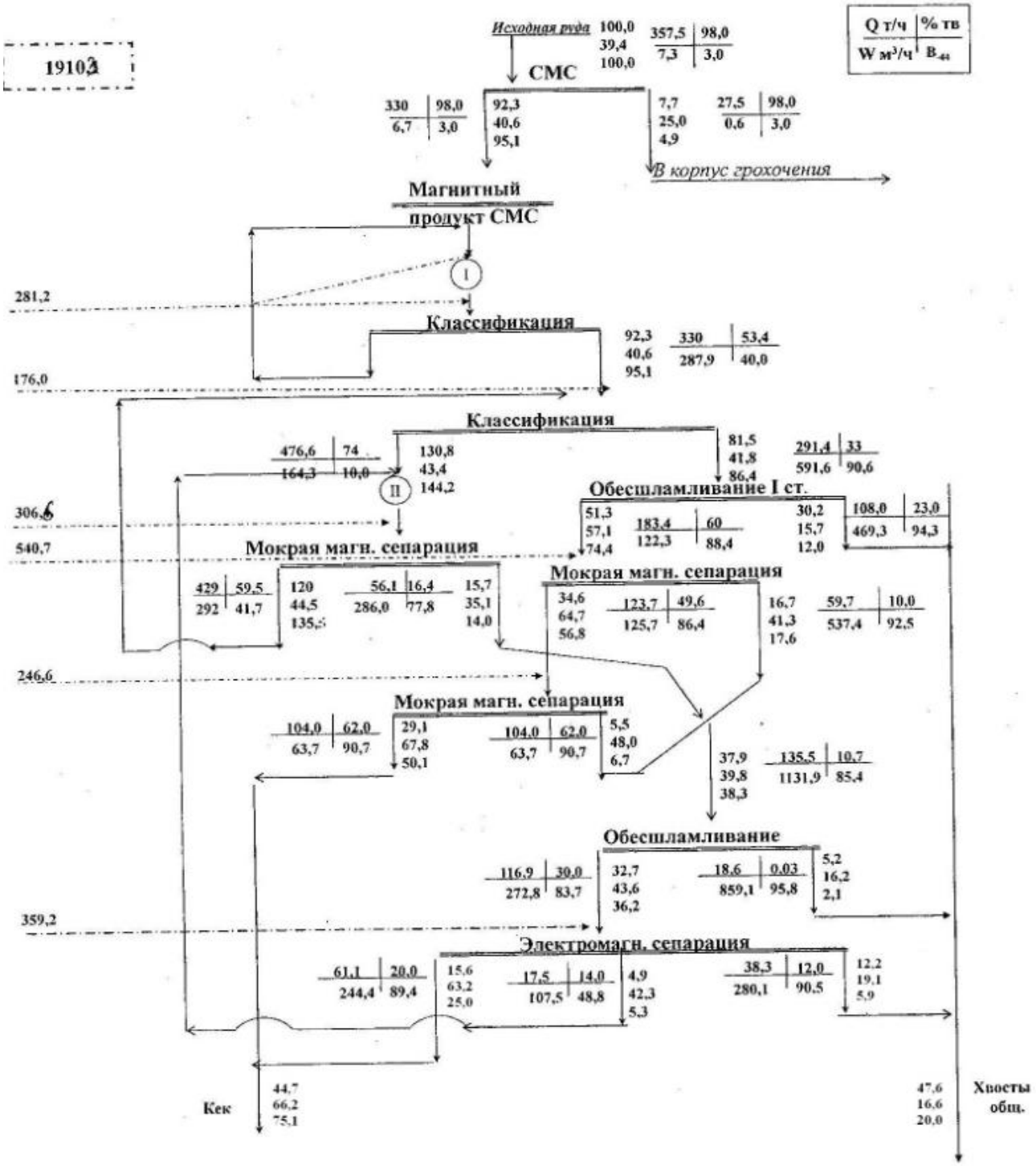

Fig. 2. The recommended circuit of enrichment ferruterous quartzite on Mihaylovskiy MDF

The executed researches have allowed to develop and recommend introduction of new technical decisions of complex processing mixed (semi- oxidized) iron ores, providing, thus, reception of a high-quality commodity concentrate from mass iron fractions of 65-66,2 %.

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