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EXPERIMENTAL RESEARCH LABORATORY FOR THE PURPOSE OF THEIR OWN RECOVERY WITH MAXIMUM ECONOMIC EFFICIENCY OF FINE FERROUS WASTE

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Abstract: The main objective of these investigations was to establish the optimal technological flows of ferrous waste valorisation predominantly with production of ultrafine iron, strategic materials, but at present and in the future. The process is to use a cheap raw materials (iron ore for example or Krivoy-Rog with 60% Fe and average particle size of less than 60 m), fine iron dust and slam , fine ferrous waste generated in steel mills and other businesses including those that are mixed with fine carbonaceous, such as for example dust of blast furnace slam obtaining of blast furnace, converter, and electric furnace. Features of the new manufacturing process of iron powder are in optimal conditions of thermodynamic performance of reduction reactions: 1. using carbon as a reducing what generates the deployment both by direct reactions and indirect what brings the process as close to idealitate, range = 0,08-0,12 at Fe/at a similar reduction processes with tank and inclined tubular furnace; 2. use of ceramic balls with 8-10 mm diameter, heated to 1.200 ° ;. 3. heating and reaction
Keywords: fine ferrous waste, blast furnace**,** dust, ceramic balls

1. INTRODUCTION

All the instalaților used is shown in Figure1. In the vertical furnace (2) equipped with forced heat a quantity of 1.2 kg balls of ceramic (alumina) with average diameter of 8 mm up to 1200 C measured by a thermocouple Cr-Al with ceramic cladding.

In response the drum (1), previously heated to 550-600 C, electric or a gas burner with CH4, 1000 grams of ore or waste pulverous with up to 2,5 mm grain, mixed with 200-350 grams electrografit to a maximum grain milled 2,5 mm. insert by using a socket trough lined with refractory, ceramic balls of molten mass. Start rotating the furnace and the gas ignites for protection (carbon monoxide) resulting from the reaction of iron with carbon oxides after being passed through filtration plant (3) and flow meter for measuring (4). Mix by turning the oven for 40 minutes to extinguish the flame of encapsulated o-ring, exhaust shall be considered completed when the reduction reaction. The end point of the reaction is indicated by a thermocouple that may indicate lower temperatures in the reduction at a speed greater than the limit of 750 c. Cooling load can be insuflând by nitrogen from front cover encapsulated o-ring or by slow cooling of the load at the same time as the natural cooling of the furnace. After the direct reduction with carbon in the experimental facility specially designed and made for this research were analysed after magnetic separation, i.e. products of iron powder and non iron powder.[3,4]

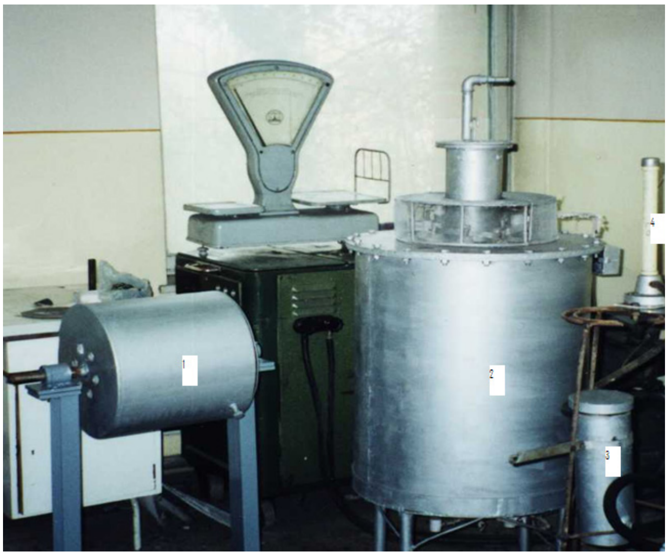

Figure1. Experimental research laboratory installation

2. PRELIMINARY LABORATORY RESEARCH

Tests were performed on a batch of ore and waste prăfoase as follows: table 1-7

Table 1. Experimental results sample 1 (Brazil iron Ore -Socoimex Galați)

Quantity :iron ore–1000 gr ; electrografit–270 gr Granulated: iron ore < 2,5mm; electrografit< 2,5mm Chemical composition initial sample, %									Chemical composition% sample after reduction, %		Degree of reduction
Fe	FeO	SiO_2	CaO	MgO	Al_2O_3	P	S	Mn	Fe	FeO	M %
67,27	-	1,66	0,41	0,15	0,60	0,045	0,012	0,4	48,89	48,69	72,68

Table 2. Experimental results sample 2(Teliuc Hunedoara-iron ore)

Quantity:iron ore 1000 gr; electrografit 200 gr Granulated:iron ore< 1,5mm; electrografit< 2,5mm Chemical composition initial sample, %									Chemical composition% sample after reduction, %		Degree of reduction
Fe	FeO	SiO_2	CaO	MgO	Al_2O_3	P	S	Mn	Fe	FeO	M %
48,28	-	8,95	1,09	3,35	1,89	-	-	2,4	45,96	48,05	95,19

Table 3. Experimental results sample 3(Galați tunder)

Quantity:tunder 1000 gr; electrografit 300 gr Granulated:tunder < 2,5mm ;electrografit< 2,5mm Chemical composition initial sample, %									Chemical composition% sample after reduction, %		Degree of reduction
Fe	FeO	SiO_2	CaO	MgO	Al_2O_3	P	S	Mn	Fe	FeO	M %
72,16	-	0,39	1,11	0,79	-	-	-	0,59	56,14	64,85	77,8

Table 4. Experimental results sample 4(Hunedoara tunder)

Quantity:tunder 1000 gr; electrografit 280 gr Granulated:tunder< 1,5mm ; electrografit< 2,5mm Chemical composition initial sample, %									Chemical composition% sample after reduction, %		Degree of reduction
Fe	FeO	SiO_2	CaO	MgO	Al_2O_3	P	S	Mn	Fe	FeO	M %
74,02	-	2,22	1,92	1,77	0,59	-	-	0,50	60,92	64,92	82,30

Table 5. Experimental results sample 5(Bataga Hunedoara slam)

Quantity:slam 1000 gr; electrografit 190 gr Granulated:slam < 0,2 – 0,3mm; electrografit< 2,5mm Chemical composition initial sample, %									Chemical composition% sample after reduction, %		Degree of reduction
Fe	FeO	SiO_2	CaO	MgO	Al_2O_3	P	S	Mn	Fe	FeO	M %
40,53	-	23,21	2,74	3,15	1,39	-	-	0,55	21,44	24,50	52,90

Table 6. Experimental results sample 6 (Venezuela fine iron ore)

Quantity:iron ore 1000 gr; electrografit 270 gr Granulated:iron ore< 2,5mm; electrografit< 2,5mm Chemical composition initial sample, %									Chemical composition% sample after reduction, %		Degree of reduction
Fe	FeO	SiO_2	CaO	MgO	Al_2O_3	P	S	Mn	Fe	FeO	M %
64,6	-	1,11	0,40	0,03	1,04	0,07	0,07	0,059	54,29	13,21	84,04

Table 7. Experimental results sample 7 (Hunedoara tunder and dust)

Quantity:tunder and dust 1000 gr; electrografit 250 gr Granulated:tunder and dust < 0,5mm; electrografit < 2,5mm Chemical composition initial sample, %									Chemical composition% sample after reduction, %		Degree of reduction
Fe	FeO	SiO_2	CaO	MgO	Al_2O_3	P	S	Mn	Fe	FeO	M %
58,54	-	10,26	1,64	1,57	1,79	-	-	0,53	33,78	31,75	57,70

3. DISCUSIONS OF LABORATORY RESEARCH

In the course of experiments for reducing ore Brazil – Karajos and slam measurements were made of the gas flow and rotate the drum manually stopped. It was observed an increase in the flow of gas to rotate. The mean difference is aprox. 0,5 l/min the amplification reaction of reduction may be seen by the ratio [%], where:-the reading speed of reaction, rotating tail [lCO/min]; -speed of reaction to stationary drum [lCO/min]. Have obtained the value of 110%, 120%, 50%, 30%. Note that large percentages are obtained in the incresingbranch of the curve of the exhaust gas flow corresponding to higher degrees of oxidation ore. Descending branch are lower values of the amplification reaction and corresponds to the degrees of oxidation. 2. the average temperature reduction reactions starting with C is 770-790 C. Exceptions are Brazil and Venezuela ores-Karajos rich iron 64.2% respectively for the first 67,4% of gas appeared at 830 C. 3. the quantity of gas phased out during the experiment can be measured and provides useful information on the degree of oxidation (or reduction) of ore at the end of the experiment and the dynamics of his function of various factors: temperature, nature, intensity of ore blending. 4. voltage reducers used in this series of experiments – electrografit – was chosen for the following reasons: to minimize the excess ash in the sample of ore reduced; to represent an alternative use for the production of iron powder with the couple that there are relatively large quantities of such material. 5. quantities of soot filters of gas held in resulting from reactions was averaging 0.27-0.41 grams, which leads to the conclusion that a change can take place of its composition but very low limits; 2CO CO2 + C processing takes place only for 1-3 l of gas produced in the whole process that occur between 140 and 290l of gas. 6. as a result of the determinations of the laboratory was based the need for the use of special ceramic balls and their importance both as a source of heat and mass lenses. Experiments made in the laboratory and small-scale confirms forecast of unconventional possibilities proposed for obtaining technology on iron:

4. CONCLUSIONS

The Romanian metallurgy records nowadays technological inequalities concerning the gathering, the transport, the storing and especially the capitalization of the entire wastes categories. Internationally it capitalizes about 80% from the iron and steel wastes, while in Romania, it capitalizes maximum 48%, the rest being stock-piled.[2,3]

That wastes stock-pile leads at the environment pollution by diffusive emissions of the noxious compounds, and at the top and underground water impurity, on surfaces which exceed the stock-pile areas.

At the ferrous ores agglomeration (inside the integrated traditional flux agglomeration – blast furnaces - steelworks), the pollutant wastes are preponderant represented by the powder collected into the purification installations with electro-filters.

The quantity obtained and used through the classic technologies is about 250.000 tones by year, in the conditions of an actual legal limitation of about 50 mg powder at m^3N evacuated gases into the atmosphere, being estimated at 950.000 tones by year in the conditions of some limits imposition of 25 – 30 mg/ m^3N. A noticeably problem concerning this area is that of this powdery wastes processing before its recycling in order to not be found again into the powder collected at the purification. [4]

As regards the pyrite ashes, sub-product obtained as remnant at the sulphuric acid fabrication, those have totally been stock-piled, angle which constitutes a dominant factor of the environment pollution into the respective areas. The pyrite ashes wastes storing augments a series of problems tided by the agricultural circuit disablement of some important areas, in order to broaden the storing stock-piles, transport and ashes storing expenses and also the stock-piles maintenance. Major negative effects are especially owed to the fact that the ashes are easily taken by the wind and this way it affects very large ground areas which become non productive. The fine powder creates into the area an environment strongly polluted, having the most unwanted effects (including the own industrial platform, by the industrial equipments corrosion and especially on the measure and control equipments).

To fully justify the necessity of the experimental researches development proposed by the present new technology, it has to be mentioned the fact that in Romania the scrap iron became an impercipient raw material, because of the exports liberalization and the acquisition impossibilities by the internal steel producers economic agents because of their financial difficulties.

For those reasons it is necessary the finding of some unconventional technological solutions wherethrough it obtains cast and steel, technologies which allow a flexible and economic functioning way, with investments low expenses. One of those technologies is the sponge ironobtaining by the ore direct reduction with solid reducing agent and its melting in order to obtain cast or steel.

The previous presentation proves the possibility of the capitalization with very low costs of a ferrous sub-products wide range, through an unconventional technology which anticipates, into the technological wave, few technological operations (which implies low costs).

By reason of the fact that the experimental effects, which will be first obtained into the laboratory, it can be extrapolated with perfect similarity at industrial and pilot level.

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