Using a waste product containing iron

D. Georgiev, Iv. Gradinarov, Iv. Petrov, T. Mihalev, Iv. Peytchev

Using a waste product containing iron: *Copper can be recycled without any loss of its outstanding properties in terms of electrical and thermal conductivity, making it the ideal material for energy generation and transmission, the electronics industry, the automotive sector and telecommunications needed to ensure the sustainable development of societies and economies. As a result of copper production in Aurubis and flotation process in Slag Flotation Plant in Pirdop (Aurubis Bulgaria), iron silicate powder is generated. The main activity of this paper is to present the iron powder waste as a product that can be used in black metallurgy.*

Keywords*: fayalite, pelletizing, briquetting , blast furnace.*

INTRODUCTION

In Pirdop smelter the FSF and PS converters slags are transported to the Flotation Plant crystallisation pits by railway wagons. After pouring the slag into the pits, they are subject to crystallization, consecutively by air and by water-cooling for at least 24 hours. After the end of the cooling process the slag is collected from the crystallisation pits and transported to the Jaw Crusher's reception bin. Single-stage crushing is performed by the Jaw Crusher and then the slag is fed to Grinding section for grinding and classification. Grinding is performed in two stages through an autogenous mill (AM) and a ball mill (BM). The final product from hydrocycloning is subject to flotation by the classic circuit: rougher, scavenger and two cleaning flotations[1, 2].

As a result of the flotation process, flotation tails, iron silicate powder also called fayalite is generated. The iron fines originate from the slag flotation process of the copper smelter with minimum variation in chemistry. Unexpected for someone, their main components are iron 45-50% and silica – 26-32%. The mineralogical structure consists mainly of magnetite Fe_3O_4 and fayalite Fe_2SiO_4 and pyroxene, traces of other metals silicates and some free silica (<5%), the rest are some oxides such as Al_2O3, MgO, CaO etc [1]. The iron fines are classified as non-hazardous industrial waste. The chemical and mineralogical components of the non-hazardous flotation tailings show properties of interest for different industrial applications. Therefore, the flotation tailings can be legally used in other industries, i.e. cement industry and building construction as filler, road construction as sub-ground filler or as filler in pavements, raw material for steel making, abrasive, etc. Part of the flotation tailings produced in Pirdop is already used accordingly.

Exposure and discussion

One way to use the fayalite is directness sinter production of blast furnace. Fig.1 shows a scheme of a blast furnace, used for this purpose

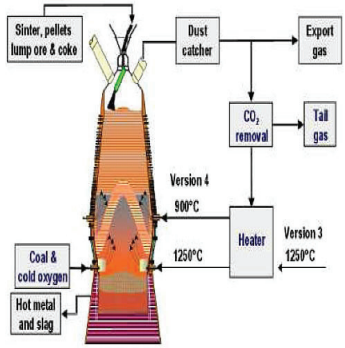

Fig.1 Scheme of Blast Furnace

The fayalite can be used directly in blast – furnaces, after briquetting and pelletizing. The component in fayalite will effects in process as:

- because of the lower iron content in the fayalite (50 %) from that of the conventional iron ores and concentrates (65 %) in the input of 3 % fayalite the iron content in agglomerate decreases with maximum 0,5 %. Need of neutralizing of $Si0_2$ with CaO and MgO the iron content in the agglomerate falls with another 0,5 %. Or totally the iron content in the agglomerate falls up to 1%. This can be compensated with an increase of the per cent participation of pellets with higher iron content or other additives in the batch of the blast furnace. At the end the whole amount of iron in the fayalite passes into the pig-iron and the whole amount of $Si0_2$ passes into the blast-furnace slag.

- if we accept that 100 % of the containing in the fayalite copper (we take its max. content - 0,8 %) passes into the pig iron - respectively into the steel and from here into the steel sheet, if we have 3 % participation of fayalite into the batch for agglomerate in the sheet maximum 0,018 % Cu will pass as we have 0,030 % for norm. If we take into account the average Cu content in the fayalite which is 0,43 % the situation becomes even more acceptable because the Cu in the metal will reach maximum values of 0,011 - 0,013%.

- As in the fayalite is maximum 0,10 % and even if the whole amount passes into the steel it will not exceed 0,003 % which is far below all norms for conventional steel.

- Sulfur in its maximum rise with 0,02 % in the agglomerate in 3% participation of fayalite in the burden (charge) will be extracted by the blast-furnace slag and will not pass into the metal.

- Zinc circulates into the blast furnace and it is constantly thrown away by the throat gases and it is caught by in the scrubbers and the dust-catcher. If we have 3% participation of fayalite into the burden its concentration will not exceed the Occupational exposure limits (OELs) which can lead to interferences and troubles in the work of the furnace and the control and measure instrumentation. In average content in the fayalite of 1,8% Zn the concentration in the burden (charge) can reach about 0,050 - 0,060% which is almost two times below 0,10% which is accepted as maximum norm.

-Lead (Pb) its average content in fayalite is around 0,40 %. In 3 % participation of fayalite in the burden, the concentration of lead will reach up to 0,012 %. With such a concentration of it leaves the furnace and during the converting it flies away with the outcoming gases and it is caught by the scrubber installation.

- All the other components CaO, MgO; Na_20 and K_20 pass into the blast-furnace slag due to their low content in the fayalite and will not bring any negative consequences.

DIFFICULTIES

This is for sure an innovative method which hides some risks and requires continuous experiments. In the functioning of the blast-furnaces there is a compulsory recipe book elaborated by the technologists of the producer of the blast-furnace equipment This makes the potential buyers with whom we have negotiated to be cautious but at the same time interested because of the potential economic effect.

The fayalite that Aurubis factory emits has a very tine granulation and in fact it has the form of dust. For the steel-producing companies fayalite could be difficult for transportation and make difficulties with some of the measuring devices in blast-furnaces, so the fayalite has to be enriched and sold in the form of iron-containing pellets.

In its present state fayalite has a very high humidity (12-16%). This limits its use before it is dried to 5-8% humidity. On the other side after drying it has to be stored in certain conditions (for example during strong wind it can be easily dispersed if stored in open-space) because it can easily pollute the environment. Drying in the range between 0,5 to 8% humidity (depending on the market demand), briquetting or granulation according to the market goals.

Preliminary design for construction of installation for drying, pelletizing and briquetting of

Point I - The material is received directly from the enrichment factory with humidity of 50-60% and with constant granulation of 0-1 mm and passes directly into a working filter-press (fig.2) where the humidity is reduced to 5-6%. Thus the partly dried material passes into an installation for briquetting (pelletizing or granulating) with maximum granulation of the agglomerates - 30mm in which for linkage is used molasses at the amount of 0,2 - 0,3%. After that the beaded products pass into a drying aggregate for gaining mechanical strength.

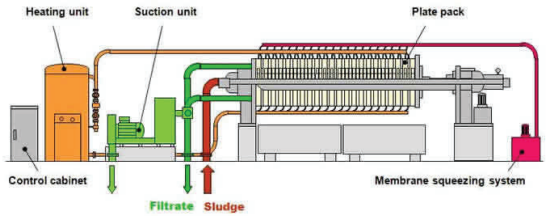

Fig. 2 Scheme of Filter press

Point II - The material is received directly from the enrichment factory with humidity 50-60% and with constant granulation of 0-1 mm and passes directly into a working filter press where a humidity of 5-6% is reached. Thus the partly dried material passes into a drying aggregate till drying in the range between 0,2 -0,8% is obtained. Thus the partly dried material passes into an installation for briquetting (pelletizing or granulation) with maximum granulation of agglomerate 10mm where we use molasses as linkage at the amount of 0,2 - 0,3%.

Point III - The material is received from the so called "beach" of the depot for fayalite with 10-12% humidity and passes directly into a drying aggregate after reaching of 6% moisture, the dried material goes into a briquetting installation (pelletizing or granulating) with maximum granulation of the agglomerates - 100mm where we use molasses for linkage at the amount of 0,2-0,3%. In this model filter-press is not used.

Point IV - The material is received from the so called "beach" of the depot for fayalite with 10-12% humidity and passes directly into a drying aggregate. After reaching of 5% humidity the dried material goes into a briquetting installation (pelletizing or granulation) with maximum granulation of the agglomerates 30mm, where molasses is used for linkage at the amount of 0,2 - 0,3%. Thus the pressed products are roasted into a furnace for reaching of mechanical strength. In this model filter-press is not used.

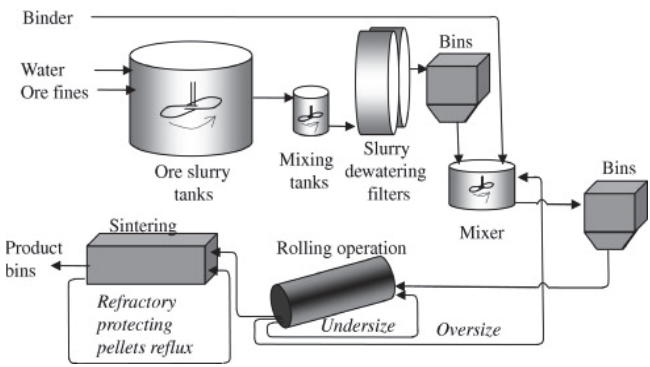

Fig. 3 Scheme for production of pellets, briquettes and granules

CONCLUSIONS

According investigation fayalite can be used as product in blast – furnace installations. To processes briquet (pelletizing and briquetting) of the waste material (fayalite) from flotation plant is necessary to be construct and install different aggregates. Because of the high percent of iron in faylite the most successfully used of material will be in black metallurgy, and future research will be focus in these possibility.

REFERENCES

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For correspondence:
Assoc. prof. D. Georgiev, University "Prof. Dr. Ass. Zlatarov "- Burgas, Department Material Science, Tel. 359 56 716 988; Fax. + 35956880249; e-mail address: dgeorgiev@btu.bg.

This paper has been reviewed