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# FERROUS POWDERY WASTES STORED IN THE PONDS AND THE ENVIRONMENTS ECOLOGY

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**SUMMARY / ABSTRACT**

*The implementation in the industrial practices of the accounting technologies of these ferrous powdery wastes, now stored in the regional ponds of the nearly ferrous industry sectors, assure in time, the repossession of this place occupied by the wastes, from the natural environment. Also, this to technology establishes the elimination of some environment pollution sources, especially the air pollution and the earth and water contamination.*

*In this paper are presented some researches and relevant results, regarding of the obtained of the pellets, through obtaining using the plant dust, agglomerate dust and ferrous powdery wastes in the pelletising charges, resulted for the spathic iron ores processes. The resulted pellets have a sufficient resistance from uses at the charge of the electric arc furnaces.*

## 1. INTRODUCTION

During the technological processes that are specific to ferrous metallurgy and through which the ironstone (undergoing in most of the cases to processing operations) is transformed into siderurgical products and later is processed in machine building industry, in naval industry, in energetical industry, in chemical industry, constructions, etc., we have as product under several different configurations, iron oxide scraps (chemical combinations) know under the generic name of ferrous scraps.

The economical importance of re-using ferrous scraps in ferrous metallurgy is obvious, if we consider that in most cases these scraps can be an important element of steel furnace charges, as they can replace, in a certain proportion, the iron. Iron making requires about 2 tones ore per t of iron, 1 tone close burning coal per tone of iron, 0,5 tone limestone per tone iron which are quite large investments in cokery, agglomerating plant and blast furnace building, and also necessites high exploitation expenses.

It clearly results that any tone of re-used ferrous scraps, which are re-introduced into the siderurgical production, leads to significant investment and exploitation expense savings.

Besides this economical aspect - which is primordial - in ferrous powdery wastes re-usage we can mainly solve the problem of environmental pollution (air - water - soil) through depositing these industrial scraps. In the highly industrialised countries the air, water and soil pollution has a common cause, namely a careless removal of the wastes in the environment by the industrial companies, without taking sufficient preoccupation towards avoiding it.

It is true that the necessary measures in avoiding environmental pollution require considerable and important investments, exploitation expenses, especially in the siderurgical industry. For this reason a high interest is raised by researches leading to solutions which would diminish the expenses through re-introducing the wastes into the economical circuit, minimal expenses in the environment’s ecology, civil and industrial construction maintenance, health, etc.

Dusty ferrous scraps occupy a significant place among ferrous wastes, and originate, in most of the cases, from gas purifying and used water plants, in different siderurgical processes and ore processing in the mining industry. So it is a source of ferrous wastes generated by the avoiding of environmental, air and water pollution.

This action becomes more and more important and obligatory in siderurgy and mining, as two are some of the most polluting industrial branches. Once this action imposed by social factors becomes obligatory and generates by its nature important investments and special maintenance expenses the problem arises to find if possible, an economical efficiency cannot originate but from recovering similarly produced dusty ferrous materials.

In this case, besides the intrinsic value of these wastes as raw materials replacing those produced in the country or imported, another element intervenes: the economical supply in recovering in time the investments for purifying plants.

The researches and experiments presented in the paper had as objective a joining of the economical imperative of maximum recovery of a certain ferrous wastes category: dusty (pulverous) wastes, with the social aspect of eliminating pollution in the environment in order to re-establish and maintain environmental equilibrium, and to assure new jobs in a mono-industrial area, disadvantaged because of economical restructuring.

Figure 1. Ponds in the vicinity of the Siderurgica Company - Hunedoara

Figure 2. Ferrous wastes from agglomerating plants and blast furnaces, deposited in ponds

## 2. EXPERIMENTS, RESEARCHES AND RESULTS

Especially in ferrous industry, but in other industrial areas as well, a large number of dusty, pulverous wastes result and part of them are re-introduced into the economical circuit, but the largest part is deposited into settling ponds, thus representing pollution sources for the environment.

Our researches analysed the possibilities of economical usage in siderurgy, namely in electric arc furnaces, of ferrous pulverous wastes resulting from gas purifying in steel plants, of slimes from the settling ponds resulted form of wastes from steel ore processing equipments.

Figure 3. Pulverous wastes deposited in vicinity the city (Hunedoara)

Figure 4. Pond with deposited pulverous ferrous wastes ( I )

Figure 5. Pond with deposited pulverous ferrous wastes ( II )

The use of these wastes is important not only because the iron is recuperated and the environment is protected, but also because they exist in a large number:

- steel plant dust - 15,000 tones, currently resulting from technological processes;
- ferrous wastes from agglomerating plants and blast furnaces 25,000 tones, deposited in ponds, in some areas dating from more than 15 years;
- steel ore wastes, approximately 12,000 $m^3$, deposited in other two ponds.

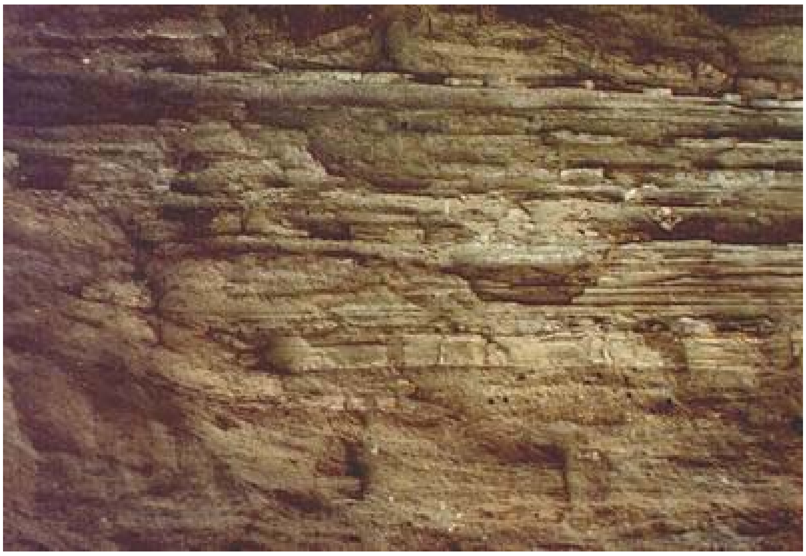

Figure 6. Ferrous pulverous wastes on the bottom of the ponds

Currently, pulverous ferrous wastes are re-introduced into the economical circuit through their use as raw material (2…3%) in agglomerating charges. Steel dust is also used for producing pellets for iron making or for charging in electric arc furnaces (metallized pellets).

Having in view the fine granulation of these ferrous wastes, we consider that the re-introduction into the agglomerating charges is the optimal solution. The pelletising solution is required along the integrated operational flux (raw materials – agglomeration – blast furnaces – steel plant – rolling mills) or where this flux suffered some changes.

Considering the remarks above, as well as the fact that in the area of Hunedoara there is a siderurgical company, which was restructured, we are of the opinion that the use of these pellets is the optimal solution. In this sense, the steel dust - having the finest granulation - suits the requirements for pelletisation.

Our paper presents in the following lines the experiments and the results regarding the re-introduction into the economical circuit of the following ferrous pulverous wastes: steel dust, agglomerating dust and spathic pulverous wastes.

The analysis of the data from Table 1 notices that there is a considerable difference, from the point of view of the chemical composition, between the three types of pulverous ferrous wastes.

The spathic wastes undergo to a magnetically concentrating process, following which a spathic concentrate and a sterile (secondary waste) are obtained. The spathic concentrate, together with the steel dust and the agglomerating dust were subjects of the pelletising process. The pellets were produced in the iron laboratory of the Engineering Faculty in Hunedoara. For the producing of pellets, a number of five recipes were experimented.

After pelletising, the pellets were dried (in air stream) the process being guided in such a way as to reach a resistance of a minimal 100 daN/pellet. The obtained pellets have a their chemical composition presented in Table3.

Table 1. The chemical composition of the pulverous wastes from the ferrous industry

| | Chemical composition, [%] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $SiO_2$ | FeO | $Fe_2O_3$ | **Fe** | $Al_2O_3$ | CaO | MgO | MnO | P | S | C |
| 1*. | 34.39 | 7.01 | 7.84 | **9.12** | 2.87 | 16.39 | 6.68 | 1.35 | 0.12 | 0.23 | - |
| 2*. | 19.86 | 9.92 | 18.64 | **21.03** | 3.16 | 20.22 | 7.56 | 2.29 | 0.13 | 0.24 | - |
| 3*. | 37.60 | 6.30 | 5.58 | **6.45** | 2.87 | 15.16 | 6.58 | 1.41 | 0.12 | 0.23 | - |
| 4*. | 8.41 | 7.12 | 48.45 | **39.61** | 7.11 | 8.43 | 2.02 | 0.71 | 0.11 | 0.11 | 17.7 |
| 5*. | 1.25 | 2.40 | 86.12 | **63.25** | 0.20 | 0.40 | 0.08 | 4.4 | 0.21 | 0.31 | - |

*1*. Settling ponds wastes*
*2*. Spathic concentrate*
*3*. Sterile after concentration*
*4*. Ferrous wastes (agglomerating blast furnace)*
*5*. Steel plant dust*

Table 2. The recipes for the pellets

| No. recipe | Steel plant dust | Spathic concentrate | Ferrous wastes | Furnace slag | Lime | Cement | Bentonite |
|---|---|---|---|---|---|---|---|
| 1. | 10 | 50 | 20 | 2 | 8 | 8 | 2 |
| 2. | 50 | 10 | 20 | 2 | 7 | 9 | 2 |
| 3. | 45 | 15 | 20 | 2 | 9 | 7 | 2 |
| 4. | 40 | 20 | 20 | 2 | 8 | 8 | 2 |
| 5. | 30 | 25 | 25 | 2 | 8 | 8 | 2 |

Table 3. The chemical composition of the pellets/no. recipes, [%]

| No. | Chemical composition, [%] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $SiO_2$ | FeO | $Fe_2O_3$ | Fe | $Al_2O_3$ | CaO | MgO | MnO | P | S | C |
| 1. | 15.18 | 6.62 | 27.83 | 24.76 | 6.86 | 24.31 | 4.55 | 1.74 | 0.11 | 0.18 | 3.54 |
| 2. | 7.97 | 3.61 | 54.81 | 41.65 | 5,52 | 15.94 | 1.54 | 2.58 | 0.14 | 0.21 | 3.54 |
| 3. | 8.43 | 3.99 | 51.46 | 39.53 | 5.83 | 12.03 | 1.81 | 2.47 | 0.14 | 0.20 | 3.54 |
| 4. | 9.59 | 4.37 | 48.07 | 37.43 | 5.97 | 18.76 | 2.31 | 2.37 | 0.13 | 0.20 | 3.54 |
| 5. | 10.86 | 4.98 | 42.81 | 34.13 | 6.46 | 19.76 | 2.78 | 2.08 | 0.12 | 0.18 | 4.42 |

Considering the chemical composition of the pellets it is clear that from the point of view of the iron content, the most convenient are the pellets produced with recipes 2 and 3 – is a normal fact, if we take into account the presence steel dust, which is the component with the highest content of Fe. The pellets resulting from the use of recipes 1, 4 and 5 are poorer in Fe, but richer in CaO.

Besides these wastes, we cannot eliminate the possibility of introducing into the pelletising charges of a larger number of wastes. Good results in the experimental phase makes possible the transposition of the results into industrial use.

## 3. CONCLUSIONS

The researches and experiments put into practice, leaded to the following considerations:

- the three types of pulverous wastes can be processed through pelletising;
- according to the target had in view (recuperated iron, the slag frothing degree, correction of the slag's chemical composition) the quality of the pellets and the adequate recipe is chosen;
- the utilisation of these wastes presents an important interest considering the large quantities which are deposited in the ponds. Due to these large quantities there is the danger of their break-down, having severe consequences upon the environment;
- on international level, these wastes are re-introduced entirely into the economical circuit, either through agglomeration; On national level not more than 25% of these wastes are re-used;
- the results allow the re-introduction into the economical circuit of some ferrous wastes which can replace a part of the waste iron, shortly to be a deficitary raw material in Romanian siderurgy;
- we establish that through extension of the results to industrial scale will make possible the re-introduction into the circuit of 25,000 – 30,000 tones of wastes per year, thus in 10 – 15 years the ponds would be given back to their natural medium;
- also a decrease of environmental pollution would be possible in the vicinity of these ponds, and this would an action of considerable social impact (dust draws disappear through air streams, the risk of falling ill decreases, as well as that of soil sliding and underground water pollution);
- new opportunities for jobs will be possible – we estimate 20…25 jobs in the pilot phase and 80…100 jobs in the industrial phase.

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