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Recovery of powdery waste results from technological flows in siderurgy

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Abstract**—**In the technological flows of iron and steel results a series of waste. This waste, depending to their grain structure, can be recovery and reuses by different ways, using recovery methods. Due to the very fine structure, a part of the waste may be recovered through pelleting. The powder waste used in experiments in this paper it was processed by pelleting process, following a strength process of pellets using a lot of diagrams, modifying the heating time of their. The results of experiments were processed in Excel program, resulting in a series of graphical and analytical correlations between the diameter of pellets and compressions strength, being presented for each variant.

Keywords**—**Compressive resistance, diameter, pelleting, powder, process.

I. Introduction

In steel production flow, economic agents from metallurgy, generates waste whit iron content in appreciable quantities being continuous and proportional to the achieved production [1].
As a result of technological processes in the form of waste steel appears fine powders, and waste with larger size waste called small waste [1].
This quantities result from the current flows of production is adding to the quantities stored in ponds or tailing dumps [4]. Due to the large quantity of existing waste and useful component of the Fe, have imposed looking for some ways to manage and recycle them [3].
Landfill is used increasingly more in the world and in our country [6]. From all the waste generated in the steel industry, powder wastes have raised problems in their recovery, due to the grain size composition namely the fine scattered being in a big quantity, and on the other hand due to this heavy metals in their composition [1]. Recycling processes refer to reintroduction into the manufacturing fluxes of materials which, either were released into the environment as technological loss,or have exceeded their life cycle[8].

II. Problem formulation

The powder wastes results from the steel industry are: dust and sludge of agglomeration, furnace dust and sludge, dust and sludge of converter, steelworks dust, mill scale and sludge mill scale.
The methods processing of waste, mentioned above, are used: mechanical agglomeration processes: briquetting and pelleting and thermal sintering processes: agglomeration and sintering [4, 5]. It was chosen the way of processing these wastes very fines which tracks the transformation of their in innards through pelleting.
This procedure enables the development of products after recipes that may contain one or more powder waste. This procedure is simple and that doesn't involve too many processing costs. In experiments in this paper we have chosen as raw material for processing this following waste: steelworks dust, blast furnace dust, red mud, ash from thermal power and it was used bentonite as binder.
Waste has undergone surgery for granulation classification and using only particles with size less than 125 μm. As preparation operations in the processing flow of the pellets are: granulation classification, dosing and mixing.
We have processed pellets by following the recipe presented in fig.1, fig.2, fig.3, fig.4 featuring granulation waste compositions used, and the components of each powdery waste in fig. 5, fig. 6, fig. 7 and fig. 8.
Superior waste recovery metals in general and in particular small and powdery, is an important issue, because turning them into products, so in economic goods may lead to a rational exploitation of energy resources and raw materials, thus ensuring the needs of both human society and environmental protection, major problem at the end of the second millennium and early third millennium [7].

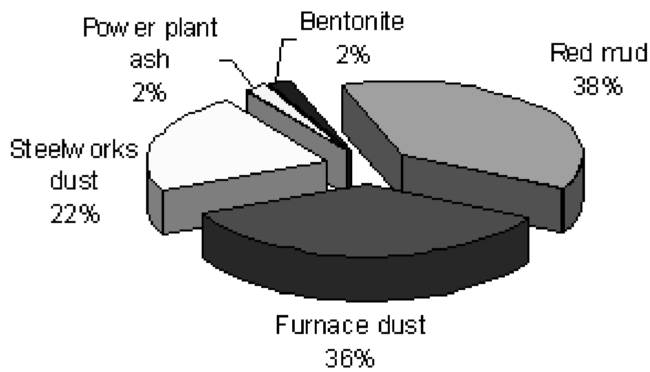

Fig.1. Component of recipe

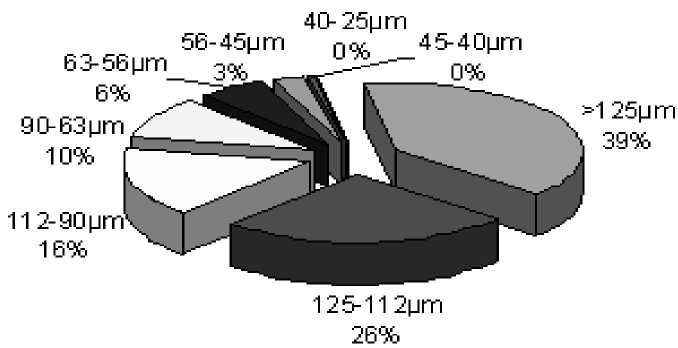

Fig.2. Granulation analysis of furnace dust

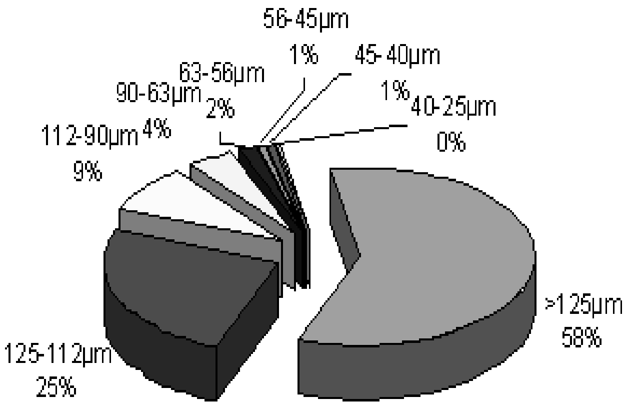

Fig.3. Granulation analysis of steelworks dust

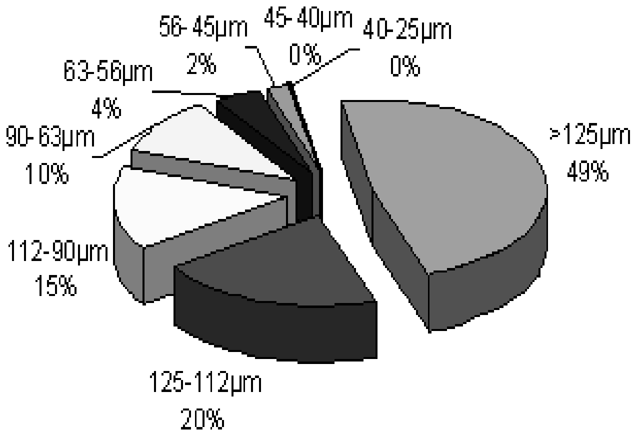

Fig.4. Granulation analysis of red mud

Chemical analysis of the literature, of each component of the recipe, show that Fe and iron oxides predominate in larger quantities than other components.

These components unused and uncontrolled stored, leading to pollution of soil, water and air.

Furnace dust concentration of heavy elements such as Cu, Pb, Cd, Zn are beyond the limits permitted by rule in materials used throughout the steel requiring special attention in the case of recycling their steel industry, it would be more appropriate in their processing non ferrous production.

The most important feature of steelworks dust is the content of Zn. Steelwork dust is very fine, excellence through 90% of less than 60% µm [1].

From burning fuel, mineral substances contained within it form the ashes.The ashes of mineral substances in fuel, in which are found: mineral salts, shale-clay, rocks, etc. As a result of the combustion of fuels at thermal stations a quantity of ashes to be deposited, having negative effects on the environment.

Pulverous ferrous wastes are present in all cases in the form of oxides [9].

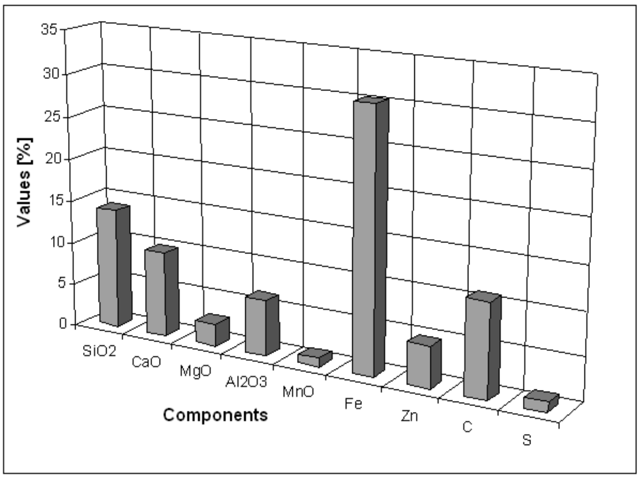

Fig.5 The components of furnace dust

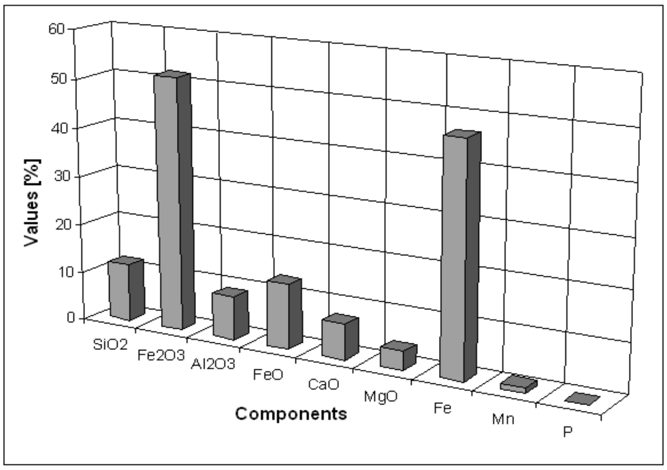

Fig.6 The components of power plant ash

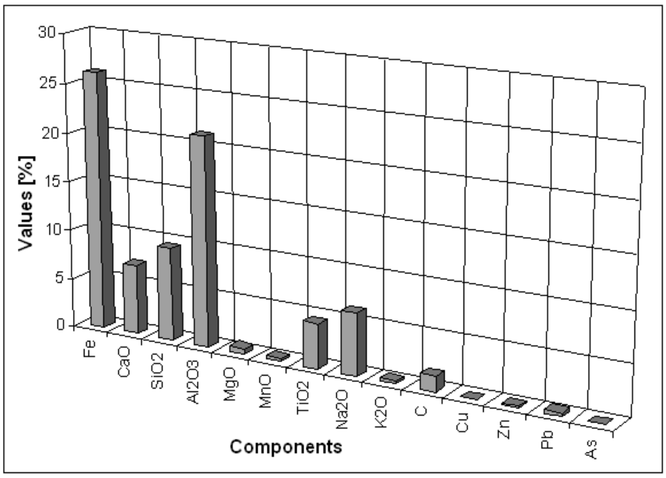

Fig.7 The components of red mud

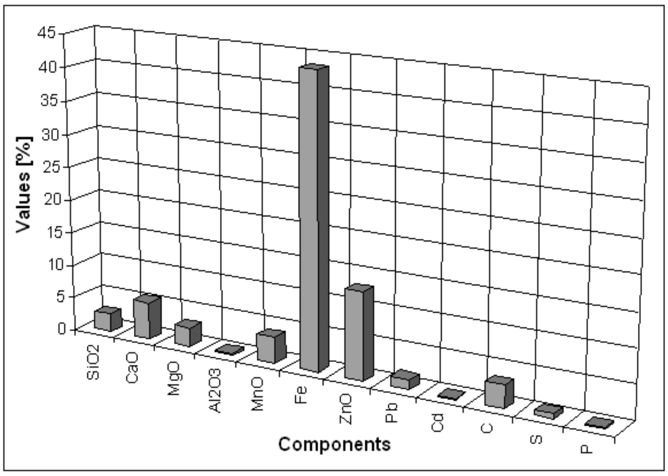

Fig. 8. The components of steelworks dust

III. PROBLEM SOLUTIONS

From the total polluting emissions, over 90% are generated during the technological operations of melting and refining [13].

The tendency,manifested in the world is of increasing the production capacity on different procedures, is restricted by the requirements and regulations of the European environment directives. Thus the have to develop new technologies for producing materials, to valorize and develop to the highest level the raw materials but also the existent resources and simultaneously to develop recycling technologies and "clean" technologies to use as raw materials primary scraps, thus these technologies to contribute to the re equilibrium of the ecosystems and to prevent destroying ecosystems [12].

For a more stringent control of exhaust waste for processing pellets, previously have been placed in the oven to remove moisture, for five hours at a temperature of 120˚C increase the temperature making gradually in these 5 hours.

For the forming of pellets, has been used water in a proportion of about 20%, and the addition of binder in this case is 2%. The pellet was subjected to the sieving process, with a site where the diameter of mesh is 10 mm.

Further experiments took two directions: a part of these pellets have undergone the process of drying naturally and the other part has been subjected to the process of drying in the oven at a temperature of 100 °C.

Both parts of pellets dried in oven and dried naturally were hardened in a furnace with resistance. Aspects from the phase of laboratory experiments are shown in fig.9, fig.10, fig.11, fig.12, fig. 14, fig. 15, fig.16, fig. 17, fig. 18, fig. 19.

Fig.9 Apparatus for waste classification

Fig.10 Steel workdust

Fig.11. Drying the mixture

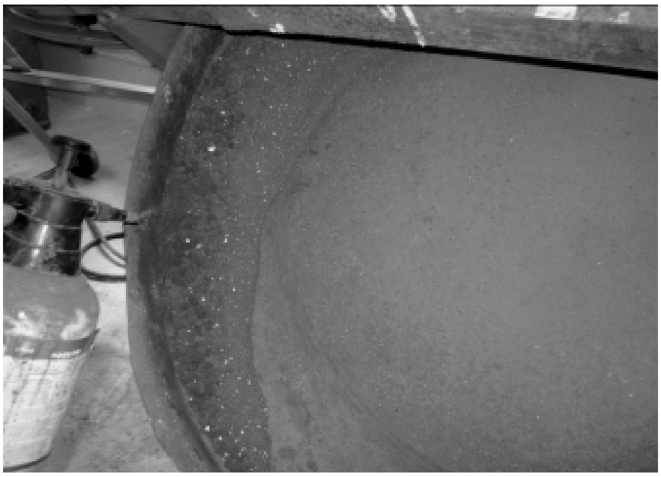

Fig.12 Pelleting plant

Fig.13 Pelets

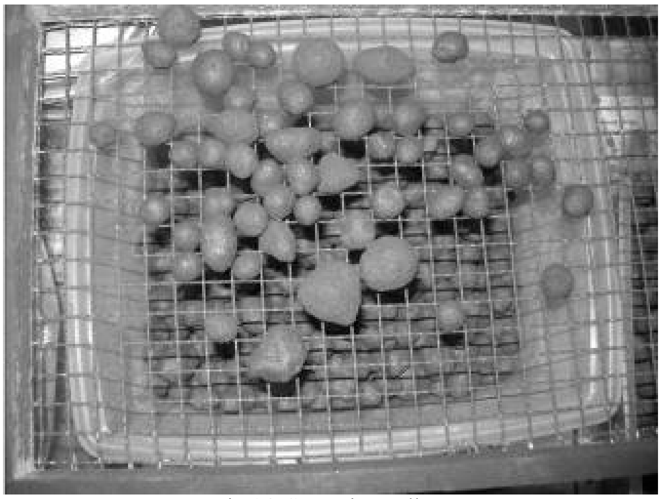

Fig.14. Screening pellets

Fig.15. Drying pellets

Fig.16. Hardening pellets

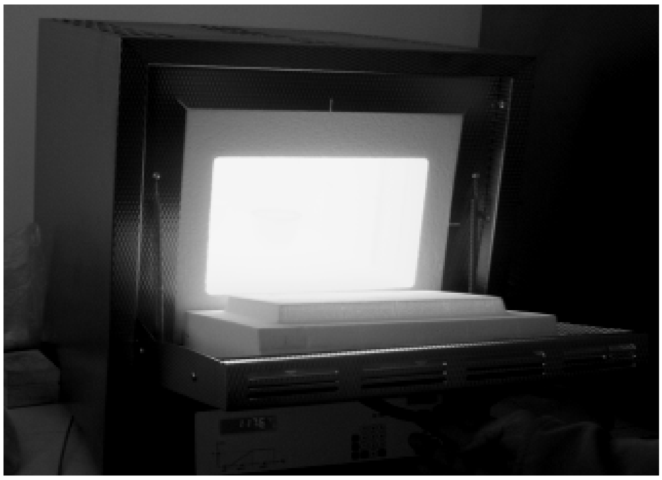

Fig.17. Oven

Fig.18. Metalized pellets

Fig.19. Metallic pellets tested in compression

For both variants of hardening process was performed after five diagrams of hardening, varying the heating time and for each version was determined resistance of the pellets depending on their diameter.

Variant 1: - temperature set for the first attempt is 1220˚C, heating time is 5 hours and the maintenance is 30 minutes. Heating speed in this case is 244° C/h. In fig. 21 is shown the diagram heating after which made these strength pellets and in fig. 22 is restored the compressive resistance variation depending on the diameter of pellets.

Fig.20. Dynamometer

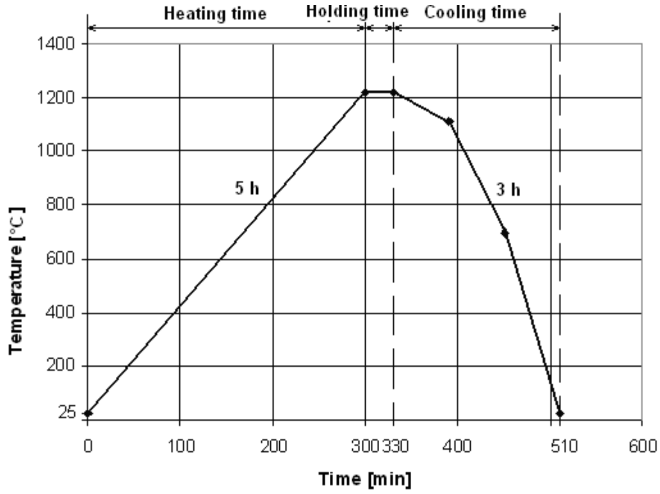

Fig.21. Diagram of hardening of the pellets

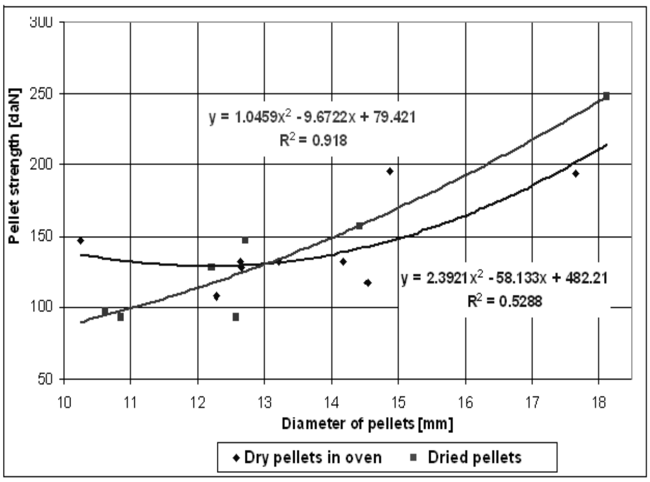

Fig.22. Resistance variation depending on diameter

Variant 2: - temperature set for the first attempt is 1220˚C, heating time is 4 hours and the maintenance is 30 minutes. Heating speed in this case is 305° C/h. In fig. 23 is shown the diagram heating after which made these strength pellets and in fig. 24 is restored the compressive resistance variation depending on the diameter of pellets.

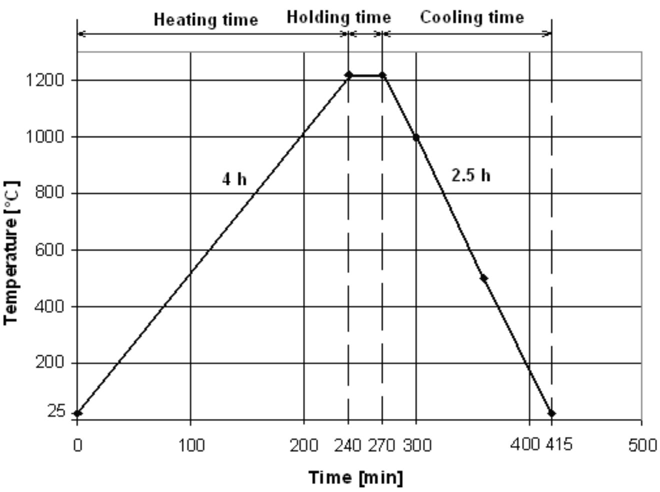

Fig.23. Diagram of hardening of the pellets

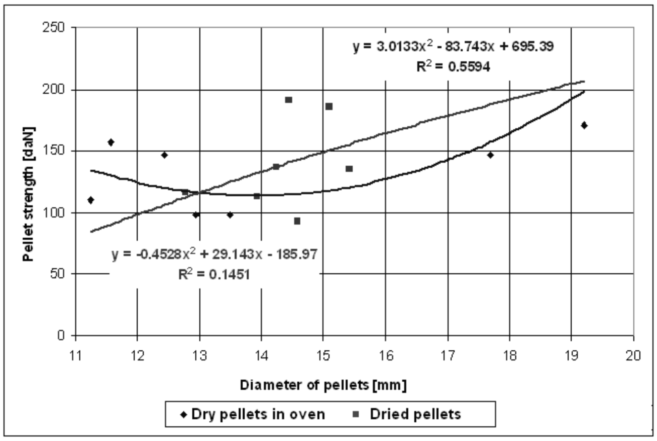

Fig.24. Resistance variation depending on diameter

Variant 3: - temperature set for the first attempt is 1220˚C, heating time is 3 hours and the maintenance is 30 minutes. Heating speed in this case is 406° C/h.

In fig. 25 is shown the diagram heating after which made these strength pellets and in fig. 26 is restored the compressive resistance variation depending on the diameter of pellets.

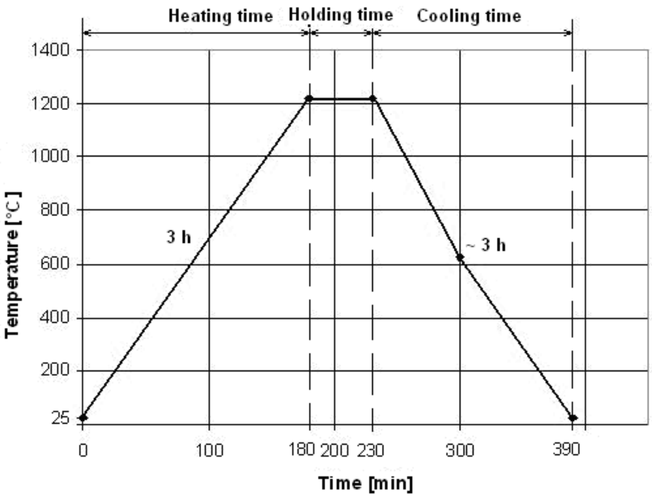

Fig.25. Diagram of hardening of the pellets

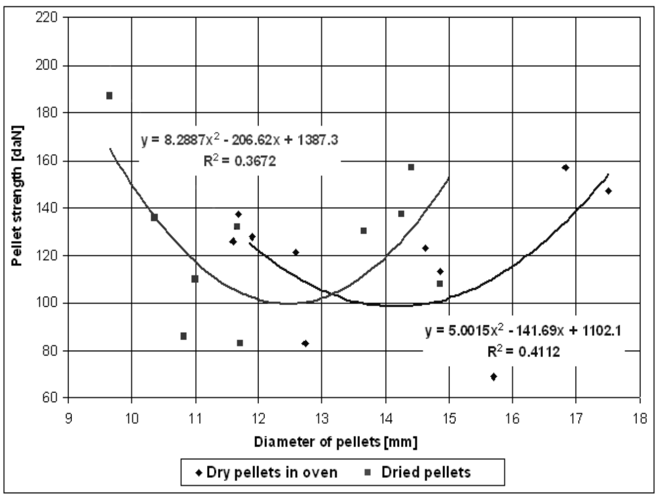

Fig.26. Resistance variation depending on diameter

Variant 4: - temperature set for the first attempt is 1220˚C, heating time is 2 hours and the maintenance is 30 minutes. Heating speed in this case is 610° C/h.

In fig. 27 is shown the diagram heating after which made these strength pellets and in fig. 28 is restored the compressive resistance variation depending on the diameter of pellets.

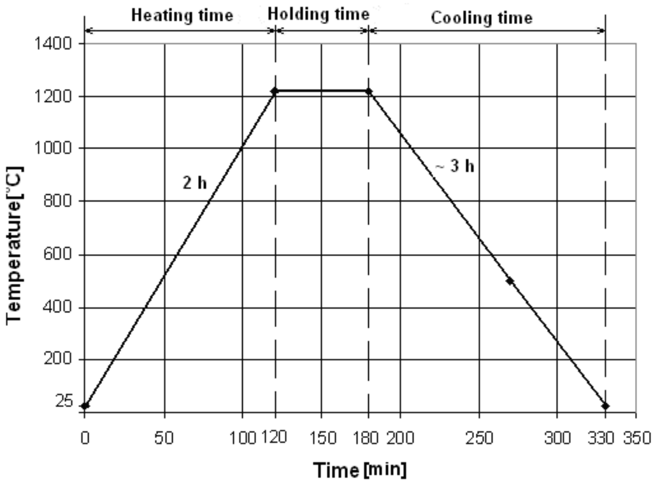

Fig.27. Diagram of hardening of the pellets

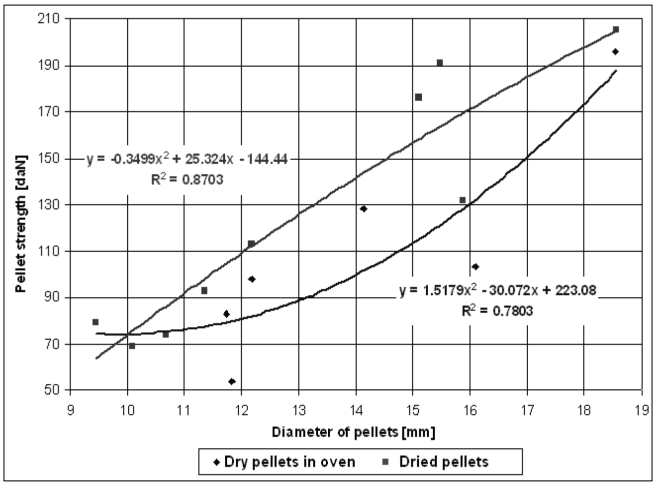

Fig.28. Resistance variation depending on diameter

Variant 5: - temperature set for the first attempt is 1220˚C, heating time is 1, 5 hours and the maintenance is 20 minutes. Heating speed in this case is 813° C/h. In fig. 29 is shown the diagram heating after which made these strength pellets and in fig. 30 is restored the compressive resistance variation depending on the diameter of pellets.

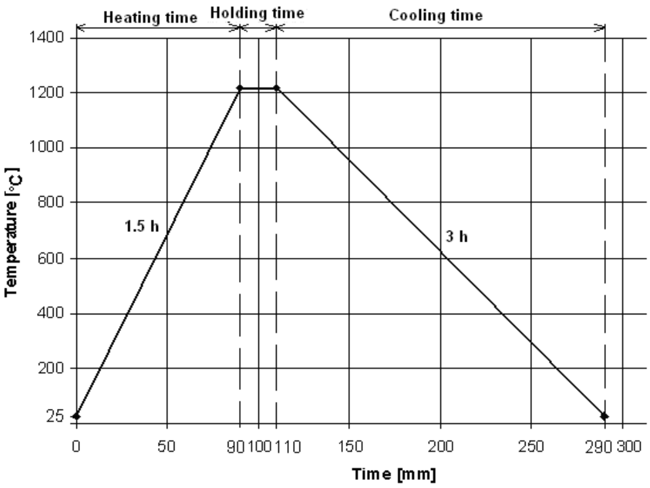

Fig.29. Diagram of hardening of the pellets

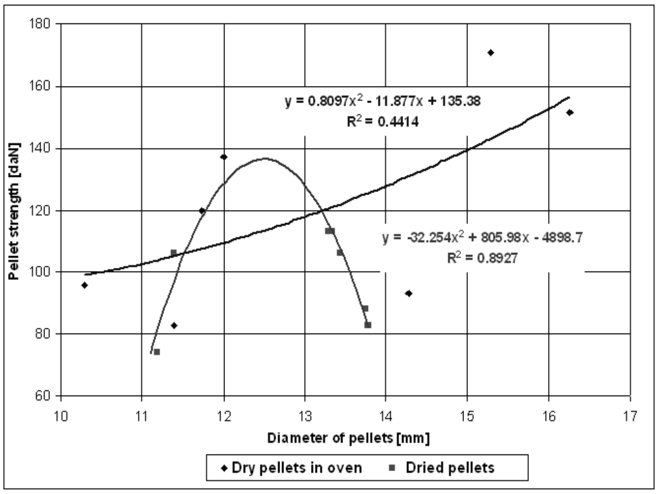

Fig.30. Resistance variation depending on diameter

IV CONCLUSION

The three types of ferrous powder waste: steelworks dust, dust furnace, red mud are appropriate in terms of granulation processes through pelleting.

Content of carbon (C) from the furnace dust and ashes used as bonding agent with bentonite, has led to a reduction of oxides of Fe.

During the strength of pellets, the alumina from red mud with bentonite and ashes of the thermo power-station fulfilled the role of a binder.

The mixture of waste subjected to pelleting process behaved well.

Concerning the diagrams of pellet was found that the best results are obtained when heating, respective the maintenance of the landing, is made between 1215-1225 °C and for maintaining about 30 minutes.

Working on such a diagram, besides the strength process takes place a reduction in all mass of pellets resulting metalized pellets.

Metalized pellets have a similar structure of sponge iron (fig. 10), pellets tested in compression.

Warming pellets up to 1200 ° C regardless of time of maintenance in landing does not derive the corresponding resistance to compression results being unsatisfying.

A heating temperature more than 1240 °C-1250 °C has led to slag pellets. On the basis of submitted I think the optimal chart of strength is presented in fig. 30.

Research carried out shows that the waste can be processed together which from the point of ecological view lead to several storage areas occupied (dumps, ponds) natural flow.

By processing these wastes and transforming them in pellets fit to be used as raw or auxiliary materials in the iron and steel industry, the areas current covered by them can be given back to nature, contributing in this way to the greening of the environment [10].

Minimizing the amount of waste through internal processing or exploitation in various industrial sectors establishes itself also in other important objectives, not only ecologically. Environmental protection is provided both directly, waste being recycled at source and there will not be dumps, and also indirectly through the conservation of the natural resources. Such simple procedures must be developed in order to recycle small and pulverous waste having the lowest level of pollution possible [11].

Considering that processing the powdery materials resulting from steel making in view of recycling and/or re-using them represents an issue with real ecological and economical implications we found it appropriate to carry out researches in the field of their superior valorization [8].

Granulation of the materials brought in the furnace for reducing is determined for advance reducing of the iron oxides.

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