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Fe (Ferro) Analysis of Iron Sand for Iron Pellet

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ABSTRACT
Iron sand is the main ingredient of making iron pellets. Iron pellets are the main ingredient of steel plates. Iron pellets for steel industry in Indonesia are still imported from Sweden, Brazil, and Chille. The reason for import that Ferro content in the local production of iron pellets is less than 60% (Fe < 60%). The effect that Ferro (Fe) quality in the local iron sand as the main ingredient of iron pellets is assumed to be less than 60%. This issue should prove that the assumption is incorrect. The research aims to prove that the level of Ferro contained in the local iron sand is more than or equal to 60%. The research also proves that local iron sand can be finished with quality iron pellets. The results showed that Ferro levels contained in local iron sand ranged from 71.03% to 73.05%, compared to Ferro levels outside of iron sand ranging from 61.00% to 68.90%. Based on the results of a comparison of Ferro rates on iron sand, Ferro content on local iron sand is greater than the iron sand content of Ferro abroad. Then it can be concluded that the level of Ferro in local iron sand is less than 60% is not proven, hence the reason steel industry uses imported iron pellets with the reason of Fe level local iron sand is less than 60%, not based on the results of scientific research.

Keyword: *Fe, iron sand, iron pellet*

INTRODUCTION

Iron sand is the main ingredient in the manufacture of iron pellets. Iron pellet is the main ingredient for steel plates. Iron pellets for the steel industry in Indonesia are still imported from Sweden, Brazil, and Chile[1]. The reason for import that Fe content (Ferrum) in the local production of iron pellets is less than 60% (Fe < 60%). The effect that the quality of Fe in the local iron sand as the main ingredient of iron pellets is assumed to be less than 60%.

Table 1. Material Demand of Steel Production 2,5 million ton/year pre dan during 2000s years[2]

Material	Demand (ton)	Sources
Pellet Iron Ore Pellet	3.500.000	Swedia, Chile, Brazil
Scrapt Iron	1.700.000	Eropa, Lokal
Refractory	39.000	China
Limestone Burn	250.000	Lokal
FeSi, FeMn, SiMn	12.750	China
Elektroda	6.500	China
Aluminium	8.000	Lokal
Coke breeze	37.500	China

This problem should be proved that the assumption is not correct. This research aims to prove that the ferro levels contained in the local iron sand are more than or equal to 60%. This research also proves that local iron sand can be finished with quality iron pellets. In the manufacture of iron pellets is different from previous research because this research is very simple with the results of the content of the Fe can be significantly increased, with the reduction process of impurities with the filtering and process Magnetic, after it is washed with water until clean and then dried with sunlight.

In the manufacture of iron pellets, the iron sand must be reduced from the impurities using a sieve, it is the process of smelting of iron or steel[3]. Before use for the manufacture of iron pellets,

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iron sand processed efficiency or increased Fe highest levels, the efficiency is carried out with the magnetic concentration process able to increase Fe levels up to 50%[4].

By doing the grinding process up to 400 mesh to have a particle size < 1 mm, the level of Fe (Ferro) increased to reach 59.6%, but this process can't be directly used for raw materials of iron smelting, so it is necessary to make pellet Iron First[5]. One of the reduction methods is a composite pellet-based reduction, the process uses composite pellet raw materials made from fine iron ore blends, coal, slag-forming materials and adhesive materials. Also known as self-reducing pellet because coal or other carbon material has been in pellet that will reduce iron ore[6].

Composite pellets made from fine iron ore mixtures, coal, slag-forming materials and adhesive materials. Also known as self-reducing pellet because coal or other carbon material has been in pellet that will reduce iron ore[7]. The process of reducing the iron sand into pellet iron using briquette method[8]. And the last is to know the ratio of Fe levels contained in the raw material of iron sand with pellet iron reduced results. Pellets are balls formed by rolling moist concentrates and fines iron ores of different mineralogical and chemical composition, with the addition of additives and binder, in a horizontal drum or in an inclined disc[9].

MATERIAL AND METHOD

There are several methods in making iron pellets among them can be seen in Figure 2 [10]:

Figure 1. Iron Pellet maker Flowchart

There are several benefits associated with iron pellets that allow it to compete effectively with other types of melting iron. The industry must do so with the actual composition of the final product itself. As a sample, the iron type is considered richer than the pig iron, another type of iron is generally produced in the blast furnace. Iron pellets can also be used to produce powdered ores that work very well when blended with other metals in the production of various types of iron-based products[11].

In doing experiments samples of iron sand used are samples of iron sand taken in the area of iron sand mine with depth of ±3 meters from the surface of the ground. While the process of making iron pellets in this research, the process is 2 (two) stages:

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Sample preparation of iron sand

Preparation process of iron sand samples is carried out with 4 (four) stages:

- First, the iron sand is filtered using a screen No. 3 Mesh 40 that is the separation of iron sand from impurities.

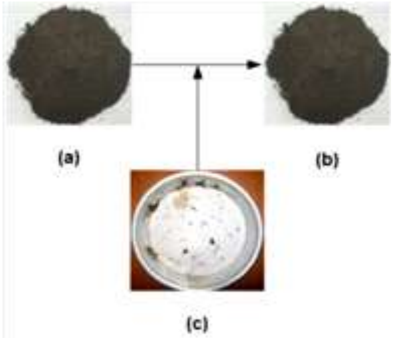

Figure 2. (a) Samples of iron sand, (b) Iron sand of screen No. 3, (c) screen No 3

- Secondly, the iron sand of the screen No. 3 is separated from the impurities using a magnet.

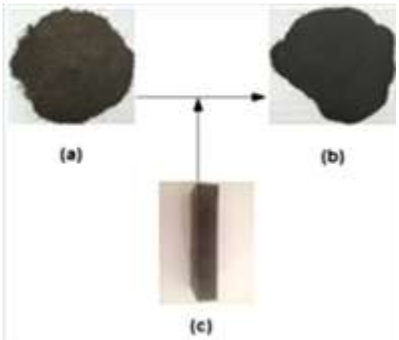

Figure 3. (a) Iron sand from *Screen* No. 3, (b) Iron sand from magnetic Separation, (c) Separator Magnet

- Third, the iron sand that has been separated from the impurities further filtered back with the *screen* No. 2 Mesh 60 to get a smoother result.

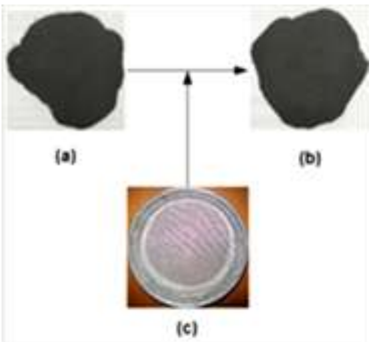

Figure 4. (a) Iron sand magnetic Separation result, (b) sample iron sand from screen No. 2, (c) screen No. 2

- Fourth, the sample of the screen No. 2, again filtered by using the screen No. 1 to get a smoother result.

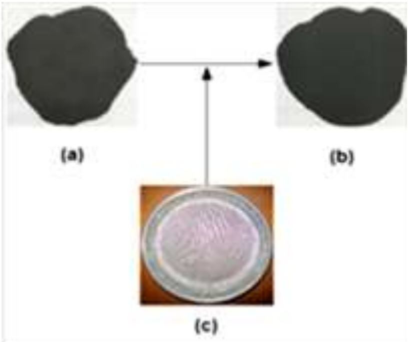

Figure 5. (a) iron sand from screen No. 2, (b) Iron sand from screen No. 1, (c) screen No. 1

Figure 6. Iron Sand Sample Screening Process

Next sample screen result No. 1, washed with water until the impurities mixed with the iron sand is really clean. Then samples of the washing result are further scraped with sunlight of approximately 3 to 4 hours.

Figure 7. Lumajang Iron Sand samples from preparation process

Figure 8. Cipatujah iron sand samples from preparation process

Figure 9. Tanggamus iron sang samples from preparation process

Iron Pellet making process

The iron pellets to be made is a mixture of pure iron sand without the addition of other materials, mixed with a binder (adhesive) made of tapioca starch. Tapioca is heated by mixing it with hot mineral water. After mixing with homogeneous pour the iron sand stir until the tapioca mixture with a flat blended iron sand (homogeneous). Pour mixture over into mold, arrange mold in plate. Insert plate into microwave, setting *microwave* with temperature 400^{o}C, with time 5 minutes. For adhesive material used tapioca starch with a mixture of 5:1.

Figure 10. Iron Pellets of microwave process Results

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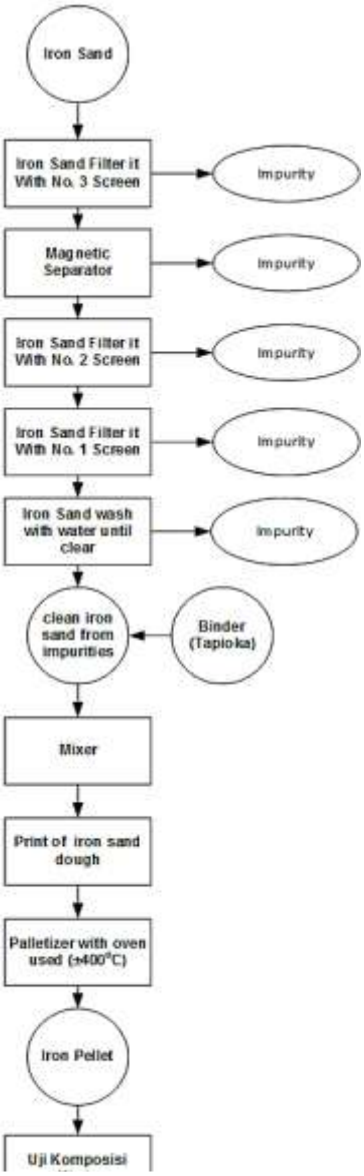

Figure 11. Experimental process of iron pellets making

RESULT AND DISCUSSION

Laboratory tests in the form of chemical analysis are conducted at Development and Engineering Center for material and technical products, while the samples are tested consisting of 3 (three) samples namely Iron sand A (Lumajang), B (Cipatujah) and C (Tanggamus). Based on the results of laboratory tests conducted by Development and Engineering Center for material and technical products, research agency for Industrial Development-Ministry of Industry of the Republic of Indonesia, then the results of chemical analysis test with ASTM C 575-05 method for Samples A, B, and C are as follows.

Table 2. Chemical test result of iron sand samples

Elements	**A**	**B**	**C**
SiO_2	3,05	2,05	1,09
Fe_2O_3	90,09	89,09	85,05
Al_2O_3	1,02	1,02	0,92
Fe	73,05	72,02	71,03

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Elements	A	B	C
Mn	0,94	0,93	0,84
TiO_3	15,03	13,05	12,85

*) Result of the Chemical Analysis Based on dried sample (105°C) in % weight

The iron sand chemical test results are made, then validated by comparing it to the chemical iron sand test results of overseas. The results of such validation are:

Table 3. Chemical test result of foreign iron sand samples

Element	Brazil	Sweden	Chille
SiO_2	0,35	1,90	-
Fe_2O_3	-	-	-
Al_2O_3	0,60	0,5	-
Fe	68,90	66,5	61,00
Mn	0,05	0,10	-
TiO_3	-	-	-

Sources: Metallugy and Material Engineering UI, 2004

The result of validation between local iron sand Chemical element level with state iron sand is comparing the level of ferrum contained in iron sand salted (local than overseas). The comparison results can be seen in table 3 below.

Table 4. Comparison of Fe levels (Ferrum) in local iron sand with overseas iron sand

Element	Local iron sand			Overseas Iron Sand		
	Lumajang	Cipatujah	Tanggamus	Brazil	Sweden	Chille
Fe (ferrum)	73,05	72,02	71,03	68,90	66,50	61,00

The comparison of Ferrum levels indicated that the Ferrum levels in the local iron sand were greater than the Fe levels in the iron sand abroad (see table 4).

CONCLUSIONS

The result of this research that the Ferrum levels (Fe) resulting from the local iron sand is: The Lumajang iron sand with Fe = 73.05%, Cipatujah iron sand with Fe = 72.03%, and Tanggamus iron sand with Fe = 71.03%. While the iron sand abroad is the Brazilian iron sand with Fe = 68.90%, Sweden with Fe = 66.50%, and Chile with Fe = 61.00%.

Based on the results of a comparison of Fe content in iron sand, the content of Fe in local iron sand is greater than the content of Fe of foreign iron sand. It can be concluded that the Fe level in the local iron sand is less than 60% is not proven, hence the reason Krakatau Steel uses imported iron pellets with the reason the Fe content of local iron sand is less than 60%, not based on the results of scientific studies.

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