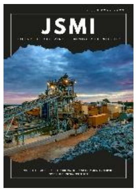

JOURNAL OF SUSTAINABLE MINING AND INDUSTRY

ISSN xxxx-xxxx, Volume 1, No. 1, Pages 7-13

DOI: https://doi.org/xx.xxxxxx/xxxxxxxxx

Management of Iron Ore Beneficiation Process Using Magnetic Separator in Bonto Cani District, Bone Regency, South Sulawesi Province

Jenita Tandiarrang
Institut Teknologi dan Bisnis Nobel Indonesia
*Correspondence: Jenita@nobel.ac.id

Abstract: Iron ore is the second most-weighted metal on earth. To meet the needs of life and the rapid development of technology, the availability of raw materials in the form of metal minerals in large quantities is required. So the appropriate quality of iron ore is needed for use, in this case the intent and purpose of the research is to know the process of obtaining iron ore concentrate using magnetic separator method and know the percentage of iron ore content and recovery most optimally with magnetic concentration using magnetic separator. Based on the literature study of several iron ore journals from Tanjung District Bontocani Regency Bone South Sulawesi Province, it is known the process of obtaining concentrate and percentage levels and recovery of iron ore based on data supporting previous research namely the XRF value of Fe2O3. The acquisition of concentrates using magnetic separator methods is carried out by means of magnetic separation performed on each sample that has been grouped according to the fraction of the grain size. Magnetic separation results in concentrate (magnetic) products and tailings (non-magnetic) products. The percentage of iron ore content and recovery using magnetic separators produces the highest percentage of Fe2O3 levels found in fractions (150 mesh) with a value of 85.429% and the highest percentage recovery rate obtained at fraction (200 mesh) with a value of 96.70%.

Keywords: Fraction, Magnetic separator, Content, Concentrate, and Recovery

A. Introduction

Ore is a rock or sand in the form of metal that contains important minerals. Ore is refined through mining to obtain elements that have economic value and are widely used, from the simplest tools such as needles to large tools such as aircraft carriers and airplanes that can support the achievement of human needs. Currently, most mining products taken from the earth's core have profitable added value. This occurs especially in the mining industry which is mostly carried out by small and medium-scale companies [1].

Iron ore is the second most abundant metal on earth, the characteristics of this iron ore are usually in the form of metal deposits that stand alone but are often found associated with other metal minerals. To meet the needs of life and Very rapid technological developments require the availability of raw materials in the form of metal minerals in large quantities. National steel consumption is currently estimated to have reached 6.3 million tons, while production is only 3.8 million tons, where the shortfall of 2.5 million tons is still supplied by imports [2].

Iron ore During the period 2000 to 2009, this mineral was highly sought after by national private mining companies working together with companies from China, Singapore and Hong Kong, resulting in an increase in iron ore reaching 712,464,366 tons of resources and 65,579,500 tons of reserves in 2012 [3].

Iron ore can be used for various purposes, from making household necessities to mixtures for sophisticated technology-based equipment [4] . The need to increase the ore content to obtain recovery so that it can then be processed and used as a tool that can support human work, increasing the content can be done by removing impurity minerals based on differences in physical properties [5].

In increasing the grade, research has been carried out using a trough to concentrate gold and silver ore so that gold and silver concentrates are obtained with a higher grade compared to the previous ore grade and the concentration of chromite ore is spread using a jig machine which can produce concentrates that can be marketed as refractory raw materials [6].

Iron ore is one of the minerals that is available in sufficient quantities in nature in the form of rocks and some in the form of placer deposits in rivers or estuaries, but its utilization is still not optimized as well as possible due to the lack of research in this field. Iron ore that is exploited without going through detailed investigation efforts has implications for the lack of increasing the added value of the mineral itself, even though iron ore containing magnetic minerals is a fairly commercial raw material to be used in various industrial fields. Local iron ore mining can provide added value if it is processed for refining or making pellets that are ready to be used as raw materials in the manufacture of sponge iron and also pig iron [7].

Beneficiation with gravity, magnetic and flotation processes on ore can be done to obtain metallurgical, refractory or chemical quality concentrates [8]. The beneficiation process using gravity concentration needs to be done first to obtain concentrates that have high specifications that meet market requirements. As conducted by Beattie Consulting Ltd. in its research on gravity concentration and flotation of gold ore from the Spanish Mountain Deposit in British Columbia Canada, it is known that the flotation process carried out after gravity concentration first produces a greater gold recovery percentage compared to the flotation process without gravity concentration beforehand. From the gravity concentration process, concentrate and tailings will be obtained with a certain amount and grade so that the percentage recovery of the gravity concentration process carried out can be calculated

The iron ore deposits found in the research area are oxide types, namely magnetite (Fe_3O_4) which is gray with a metallic sheen, very strong magnetism and hematite (Fe_2O_3) which is gray to reddish, with weak-moderate magnetism. The iron ore is spread on the surface of the hillsides and rivers. The iron ore is in the size of chunks with a volume of hundreds of cubic meters, some are even approximately 500 cubic meters as found on Pakke Hill and Garuppa River. The iron ore deposits spread in the Tanjung area are dominated by magnetite, the results of measurements with a planimeter have a distribution area of 187.5 hectares with a thickness varying between 3 to 14 meters. Latonro Hill located in Pakke Hamlet, the ore deposit is limited by 2 faults, namely faults that lead northwest to southeast and northeast to southwest, forming a graben structure and at the top of the hill is a saddle structure.

The overall shape is an ellipse with the upper part being 2 km long, 0.5 km wide, while the lower part is 1 km long and approximately 0.5 km wide. The hill has a height difference, namely from the riverbed to the top of the hill approximately 230 m where the total area is 220.78 ha with a thickness of between 1.5 to 26 meters [10].

Magnetic Separator is an operation of concentration or separation of one or more minerals with other minerals that utilize the differences in magnetic properties of the minerals being separated. Minerals contained in the ore will respond to magnetic fields according to the magnetic properties they possess.

Figure 1. Magnetic Separator

Based on magnetic susceptibility or the ability of minerals to respond to magnetic fields, minerals are divided into three groups, namely:

1. Paramagnetic are minerals that have low magnetic properties such as hematite, ilmenite, pyrrhotite.
2. Diamagnetic are minerals that do not have magnetic properties such as quartz, feldspar, mica, corundum, gypsum.
3. Ferromagnetic are minerals that have high magnetic properties, such as iron, magnetite .

The separation process with the Magnetic Separator tool can be done in wet and dry ways, where in the wet method the bait is inserted in the form of slurry. While in the dry method the bait is inserted without being mixed with water.

B. Materials and Methods

a. Stage Introduction

The preliminary stage is the stage before research activities are carried out to facilitate the next stage. The preliminary stage is a study. literature, In this study, literature study is the main method that the author does to facilitate the completion of the writing of this report. Literature related to the writing of the research is collected from various sources and the data needed, at this stage the author does several things, namely literature studies related to the research object and discussions with parties related to the research object.

b. Stage Retrieval Data

The types of data that will be taken by researchers consist of primary data and secondary data. Primary data is data obtained directly from the field, while secondary data is data obtained from previous research or data obtained directly from the field.

C. Result and Discussion

a. Grand Size Distribution

A total of 14 kilograms of iron ore that has been prepared based on its grain size, with a graduated sieve using a sieve shaker . The number of sieves used is four sieves with sizes of 180 μm , 150 μm , 125 μm , and 106 μm . The result of this sieving process is to group the research samples into five grain size fractions, namely the fraction that passes and the fraction that is retained on the sieve. Table 1 shows the grain size distribution of the sieved iron ore samples:.

Table 1. Distribution of Feed Grain Size Fractions

No	μm Fraction	Mass (grams)	Mass(%)
1	(+180)	11,345.5	81.0
2	(-180+150)	1.196	8.5

No	μm Fraction	Mass (grams)	Mass(%)
3	(-150+125)	912.5	6.5
4	(-125+106)	267.7	1.9
5	(-106)	224.5	1.6
6	*Loss*	53.8	0.4
7	Total	13,946.2	100.0

The determination of the sieve size takes into account the varying fraction sizes from the coarsest to the finest, so that the effect of the grain size distribution of this iron ore sample on the acquisition of concentrate and tailing products from magnetic separation can be known. The sieving results show that more than half of the iron ore sample grains are coarse. Exactly 81% of the total sample weight is the (+180) μm fraction . while the grain size with the smallest percentage is in the (-125 + 106) μm and (-106) μm fractions , with values of 1.9% and 1.6% of the weight of the iron oxide ore sample. While as much as 0.4% of the total sample weight is lost during the sieving process . This is due to the process of separating the sample from the container to the sieve and from the sieve to the sample bag. The following is Figure 4.1 which shows the percentage distribution of the grain size of iron oxide ore samples from Bone Regency:

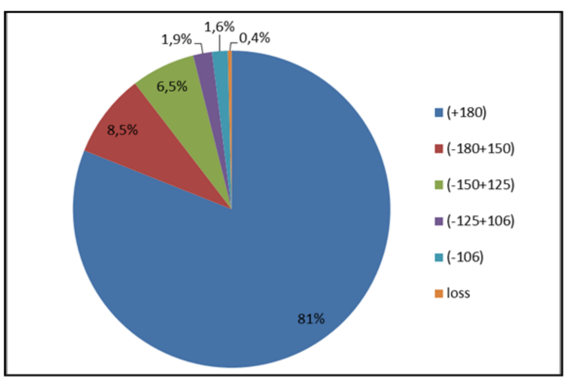

Figure 2. Mass percentage of feed fractions

b. Iron ore Concentrate acquisition

The acquisition of iron ore concentrate is carried out by magnetic separation carried out on each sample that has been grouped according to its grain size fraction. The results of magnetic separation produce concentrate products (magnetic) and tailing products (non-magnetic). During the separation process, there is a loss or weight loss caused by the transfer of material during the separation and weighing process or due to other factors. The following is Table 4.2 which shows the amount of material separated magnetically based on grain size fraction:

Table 2 Number of magnetic separation products for each fraction

Fraction (μm)	Bait (gr)	Product		
		Concentrate (gr)	Tailings (gr)	*loss* (gr)
(+180)	11,345.5	3,102.0	8,228.1	15.4
(-180+150)	1,196.0	847.7	328.2	20.1
(-150+125)	912.5	753.2	128.1	31.2
(-125+106)	267.7	206.5	44.8	16.4
(-106)	224.5	137.8	70.1	16.6
Total	**13,946.2**	**5,047.2**	**8,799.3**	**99.7**

Based on the results of magnetic separation, it was found that the finer the grain size of the iron ore sample, the greater the yield of concentrate (magnetic product). Meanwhile, loss occurs due to the process of moving material from the feed container, left in the magnetic device, weighing process, carried by air, until the loss of sample weight during the magnetic process. The highest amount of loss is in the (-150+125) μm fraction, this occurs because after the separation process the sample in the magnetic separator is not cleaned properly. The following Figure 3 shows a graph of the percentage of magnetic separation products based on grain size fractions:

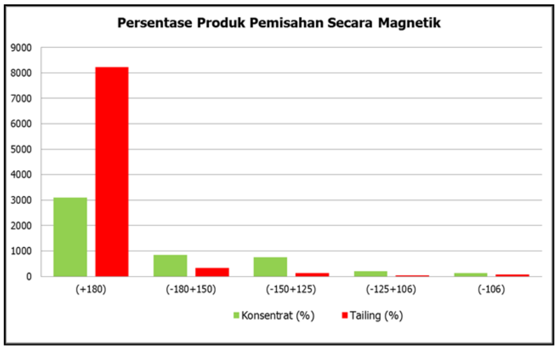

Figure 3. Percentage of Magnetic Separation Products

In the coarsest grain size fraction (+180)µm, the highest tailings yield percentage is 93.5% of the total non-magnetic product. Meanwhile, in the fraction (+150)µm to (-106)µm, the tailings yield percentage decreases, with the lowest tailings yield percentage being 0.5% in the grain size fraction (-125+106)µm. The highest concentrate yield percentage is in the grain size fraction (+180)µm of 22.2% even though it has the highest tailings yield percentage. Meanwhile, in the fraction (+150)µm to (-106)µm, the concentrate yield percentage decreases, with the lowest concentrate yield percentage being 0.9% in the grain size fraction (-106)µm. The feed grain size fraction used greatly influences the yield of concentrate products. The finer the grain size used, the more difficult the sample is to decompose properly and some samples are not affected by the magnetic field, while if the grain size is larger or medium, the greater the magnetic force that affects and can attract it. The products of magnetic separation that produce concentrate (magnetic) and tailings (non-magnetic) have the same appearance. Figure 4 shows the concentrate and tailing products from magnetic separation, in the grain size fraction (+180)µm:

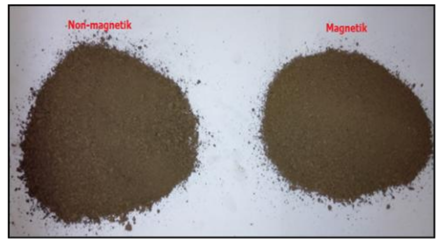

Figure 4. Product separation using magnetic separator

c. Percentage level and recovery

In this case, the chemical composition of the iron ore sample has a major oxide Fe2O3 of 73.863%, Fe2O3 Obtaining from the Magnetic Separation Process is based on the amount expressed by the amount of valuable minerals or metals that can be taken from a mining material in a mining processing operation (expressed in percent). The level of success of a mining material cannot only be based on the amount of recovery obtained , but also determined by the amount of the concentration ratio and the content obtained. These three parameters, one with the other, will influence each other. Obtaining is defined as the amount of valuable minerals or metals that can be taken or obtained, expressed in percent by weight, from a mining processing operation carried out. Obtaining from the processing process always occurs a contradictory thing between quantity and quality, namely the amount of tonnage with the content produced. The following is table 4.3 which shows the results of Fe2O3 acquisition, namely:

Table 3. Magnetic Recovery of Fe2O3 .

Fraction (*Mesh*)	Concentrate		Bait		*Recovery* (%)
	%Fe2O3	Mass (gr)	%Fe2O3	Mass (gr)	
(-100)	83,656	272.1	73,863	500	61.63
(-150)	85,429	287.5	73,863	500	66.50
(-200)	83,291	428.8	73,863	500	96.70

recovery value is found in the fraction (200 mesh) with a value of 96.70% while the lowest recovery value is found in the fraction (100 mesh) which is 61.63%. For the mass of concentrate, it has a very significant effect on the percentage value of the iron ore recovery obtained and the Fe2O3 content in the beneficiation concentrate has a small range . The following is Figure 4.4 which shows the graph of the relationship between Fe2O3 content and recovery :

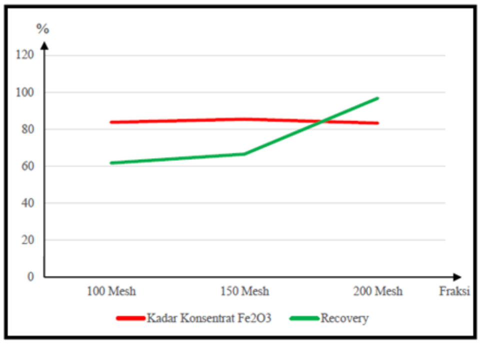

Figure 5. Graph of the relationship between concentrate content and Fe2O3 recovery and grain size distribution.

From Figure 5, it can be seen that after beneficiation using the magnetic concentration method, there is an increase in recovery along with the increase in the grain size fraction used, but its relationship with the percentage value of the concentrate content is inversely proportional to the percentage value of recovery. The increase in recovery is also greatly influenced by the amount of concentrate mass obtained. This can occur because the highest concentrate mass obtained from beneficiation using a magnetic separator is in the fraction (200 mesh).

D. Conclusion

Based on the research that has been conducted, it can be concluded that:

1. The process of obtaining iron ore concentrate using the magnetic separator method is carried out by magnetic separation which is carried out on each sample that has been grouped according to its grain size fraction. The results of magnetic separation produce concentrate products (magnetic) and tailing products (non-magnetic). During the separation process, there is a loss or weight loss caused by the transfer of material during the separation and weighing process or due to other factors. The finer the grain size used, the more difficult it is for the sample to decompose properly and some samples are not affected by the magnetic field, while if the grain size is larger or medium, the greater the magnetic force that affects and can attract it.
2. Percentage of iron ore content and recovery using magnetic separator Beneficiation using magnetic separator produces the highest percentage of Fe2O3 content in the (150 mesh) fraction with a value of 85.429% and the highest percentage of recovery rate obtained is in the (200 mesh) fraction with a value of 96.70%.

References

[1]. Haryadi, H., Saleh, R. 2012. Economic Analysis of Indonesian Iron Ore . Mineral and Coal Technology. Volume 8., pp.1-16.

[2]. Koesnohadi, and Sobandi, A. 2008. Potential of Local Resources to Build Independence and Competitiveness of National Steel Industry. Tekmira Colloquium Paper. “Increasing Added Value of Environmentally Conscious Minerals as Anticipation of Export Policy of Raw Materials”. Puslitbang Tek Mira. Bandung

[3]. Ishlah. 2014. “ Characteristic salteration and Mineralization Of Iron Ore”. Hasanuddin University. Makassar.

[4]. Evans. 1993, “ Ore geology and industrial minerals” an introduction, third edition, Blackwell scientific publications, oxfard , 389, pp

[5]. Dahlan, Pramusanto Saleh, Wahyudi A, Rodliyah I, Setyatmoko E, Somantri S, 2008. “Making zirconia from zircon

sand". Research Report of the Center for Research and Development of Mineral and Coal Technology. Bandung.

[6]. Supriadidjaja, A., Priyo, H., 2012, "Increasing the Chromite Content of Barru, South Sulawesi Using a Jig Machine", UPT Mining Engineering Testing Center Jampang Kulon-LIPI, Sukabumi

[7]. Nurhakim., Dwiatmoko, MU, Romla, NH, Adip, M., 2011., Identification of Potential Laterite Iron Ore Deposits in the Middle of Sebuku Island, South Kalimantan Province., Jurnal Info Teknik., Volume 12 No. 2. pp.48-53.

[8]. Seifelnasr, A, Tammam, T. and Abouzeid, A. 2012. Gravity concentration of Sudanese chromite ore using laboratory shaking table. Physicochemical problems of mineral processing .48(1). Matter. 271-280.

[9]. Seifelnasr, A, Tammam, T. and Abouzeid, A. 2012. Gravity concentration of Sudanese chromite ore using laboratory shaking table. Physicochemical problems of mineral processing .48(1). Matter. 271-280

[10]. Utoyo. 2008, "Bontocani Iron Ore, Bone Regency, South Sulawesi" Journal of Geological Resources.