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Quality Improvement of An Iron Ore Jasper by Selective Milling

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Abstract: One of the most important factors during the process of comminution of minerals is their power consumption rate, which is determined by calculating the WI (work index), which in short is to analyze the amount of kWh consumed per ton of material, to reach a certain particle size and achieve the desired. Along with the quality of the ore is defined and use the classification of the ore. Ores of jaspelite type, high hardness, and with lower iron content 60% with silica content above 10.5%, tends to be considered economically unsuitable for merger cases in the Brazilian market. The work presented here consists of a technique that acts by transforming this type of ore at an acceptable quality product and with a lower power consumption than the previously calculated by WI analysis. The procedure presented here recovers a quantity of more than 75% by weight, taking an ore 56% Fe, for an average content of 65% SiO_2 and lowering the 10% to 4.5%. Although reducing by 50% the amount of phosphorus present. The procedure presented here using known methods, but with a variation with respect to the operation, which gives you innovative character, acting together with a selective screening.

Key words: selective milling, Jasper Ore, quality improvement

1. Introduction

Iron ore coming from Corumbá, Brazilian middle west region, are presented in various ways, lump, medium grained and jaspelitos. The latter, even with a significant iron content, present in coarse particle size and silica layer interleaved and some cases even higher iron content with “pockets” (or Jaspers) silica. The presence of intercalated material and the size of the material leads to the need for treatment for mechanical processing of this ore.

The material studied initially presented a WI curve leading to an average of 18 kWh/t of processed material. At levels ranging is from 64% to 48% of Fe, with the silica ranging from 7.5% to 12.5%, and phosphorus often in the range around 0.16%. The grinding has become a problem because the fines generated were high and with great loss of metal content. This led to the study that resulted in the work presented here.

2. Studied Materials

The material used was the jasper ore with low iron content. The prevailing geology in the region of the city of Corumbá, MatoGrossodoSul, Brazil, can be seen in the Fig. 1.

The geology of the western region of Brazil, specifically the city of Corumbá, MatoGrosso do Sul, is predominantly composed of a rocky complex called Urucum Massif. Famous for being the largest and most culminating rock formation of the region, with an

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altitude of 1065 meters. Because of the nature of its rocks, the Urucum Massif has large mineral reserves, which pyrolusite and cryptomelane (has the largest reserve of Brazil and one of the world's largest and can be extracted 30 million tons) and specially a type iron hematite and itabirite (third largest in Brazil), non-metamorphosed, jaspelite ore, object of this work. The ores used in this work is the jaspelite ore, with high hardness and medium iron content, Showed in Fig. 2.

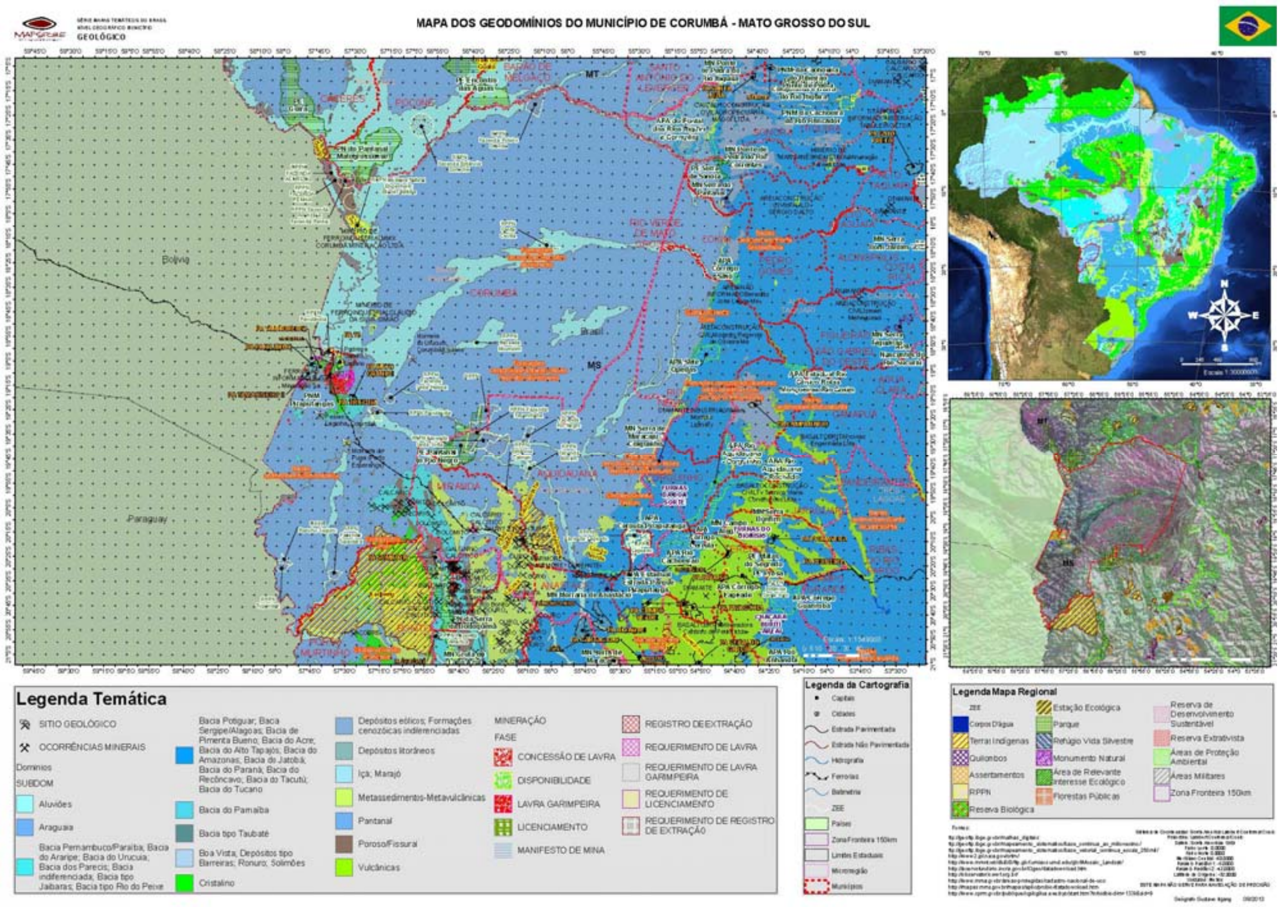

Fig.1 Map of geological domains of the city of Corumbá, MS, Brazil [7].

Fig. 2 Samples in the jasper used in the tests [1].

The analyzed ore found in this region has a low iron content compared with the equivalent most used iron ores. Even when its content reaches range considered applicable to economic viability, the hardness and high Work Index makes it initially impractical to use for processing the concentration of the metallic content. The Table 1 illustrates the average analysis of the studied ore.

Figs. 3 and 4 illustrate, respectively, the Work Index analysis of the work done for this type of ore and the granulometric analysis by milling time for this ore. The test determines the Work Index or grindability (Work Index) for ball mills. The BWI is used with the third

Table 1 Table showing the initial composition of the tested material [1].

W.I.	Fe	SiO_2	Al_2O_3	P	Mn	Limonite	Density	Humidity	L.F.
17.75	48.40%	11.27%	2.59%	0.184%	0.010%	2.16%	2.15	3.8%	3.3%

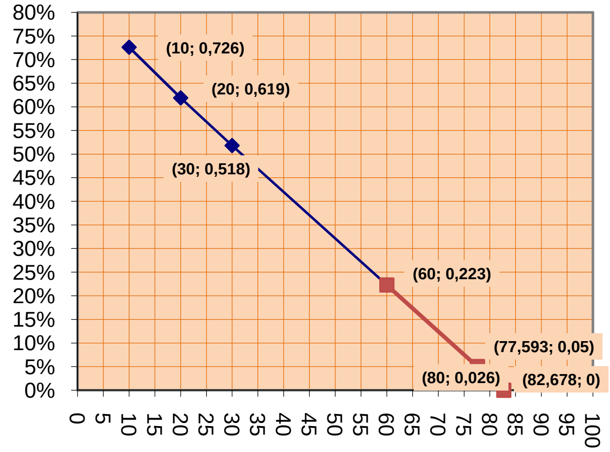

Fig. 3 Time Analysis for definition of Work Index: X-axis: time in minutes; Y-axis: % pass by[1].

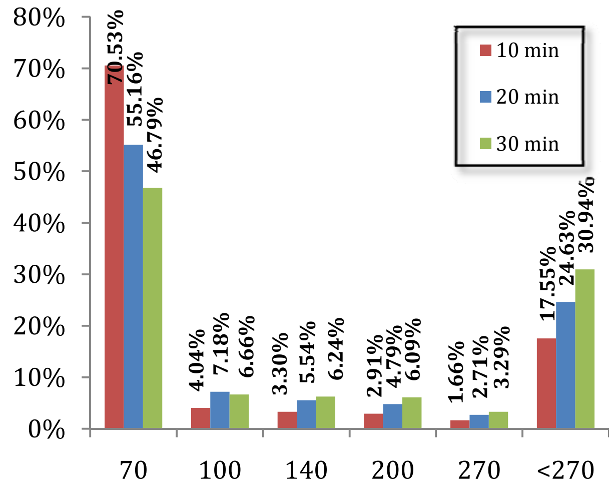

Fig. 4 Comparative graph of the effect of milling time on the comminution of the samples [1].

comminution theory of Bond to calculate what is the net power requirements for grinding. However, several correction factors may have to be applied.

3. Analysis Procedure

The analysis of the milling time shows that the material was concentrated, however, also be realized that the iron content in the thin particles was increased with increasing milling time.

The Table 2 shows that more time grinding increases the iron content in the fine and less of impure.

4. Methodology

4.1Analysis of the Jasper Ores Milling

The analysis of the behavior of the material during the milling led to the calculation of average rate of W.I. around 17.8 kWh/t, led the concentration of this product not economical.

However, the analysis of the background grinding, created a highlight atypical behavior of the sample. It was expected ease in secondary crushing, however, the sample recovered, above 70#, it became more difficult to grind than the initial sample. How is showed in Fig. 5.

After milling it was found that the material was difficult to be ground. So one could deduce that two types of materials were being processed. The softer first and harder second.

The chemical particle size analysis (Table 2) shows levels of up to 68% Fe in the retained, indicating that silica present in the ore was crushed first.

4.2 Equipment and Process

This process works with a processing line, created to return the grinding material above 100# for milling;

Table 2 The relationship between the grinding time, content and weight distribution of the sample[1].

Moagem	Malha	R. Massa	%Fe	$\%SiO_2$	$\%Al_2O_3$	%P
10'	70#	70.5%	68.350%	2.973%	0.340%	0.080%
10'	100#	4.0%	65.817%	4.220%	0.688%	0.086%
10'	140#	3.3%	64.220%	5.006%	0.907%	0.090%
10'	200#	2.9%	64.138%	6.720%	1.261%	0.090%
10'	270#	1.7%	64.080%	7.936%	1.512%	0.090%
10'	< 270#	17.554%	**54.462%**	**6.664%**	**7.352%**	**0.382%**
30'	70#	46.787%	67.570%	2.588%	0.265%	0.060%
30'	100#	6.658%	66.184%	3.821%	0.150%	0.072%
30'	140#	6.240%	65.310%	4.599%	0.077%	0.080%
30'	200#	6.088%	65.907%	4.975%	0.623%	0.086%
30'	270#	3.285%	66.330%	5.241%	1.010%	0.090%
30'	< 270#	30.943%	**62.028%**	**5.503%**	**4.654%**	**0.284%**

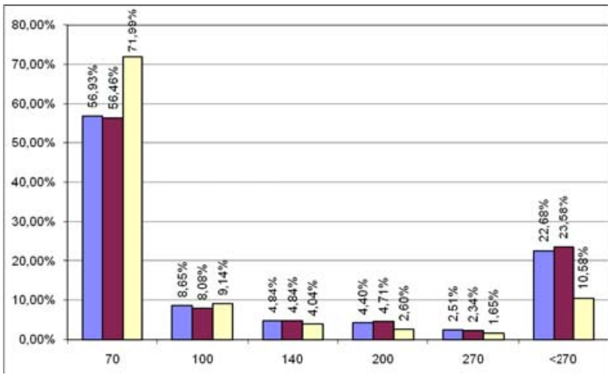

Fig. 5 Graph showing the comparison of the particle size distribution of the primary milling (red and blue) and the second milling (yellow) [1].

discarding material undersize 270#; and directing the material in the range between 270# and 100# as product, which corresponding to an average of 70% of the mass of the milling feed.

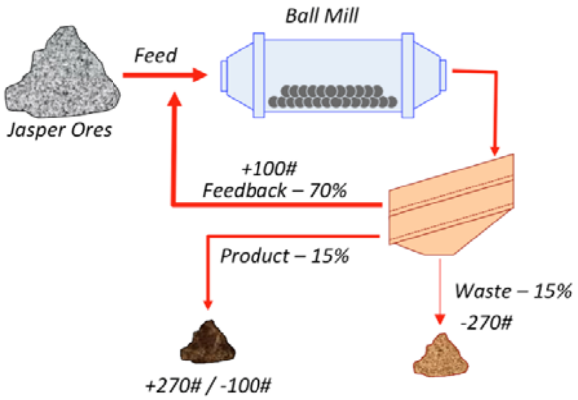

Fig. 6 Flowchart of selective milling [1].

Fig. 7 Adjustable plant used for testing in Gorceix Foundation [1].

Table 3 The final composition after selective milling[1].

W.I.	Fe	SiO_2	Al_2O_3	P	Mn	Limonite	Density	Humidity	L.F.
11.85	68.5%	2.28%	0.59%	0.076%	0.016%	1.04%	3.65	1.8%	2.1%

5. Results and Discussion

5.1 Quality of Product

A longer milling reduced the iron content in the retained it increased and the thin, allowing to deduce that the silica was acting as an abrasive, leading to iron ore fines, but this abrasion also carried in the first instance phosphorus for fine, reducing it in retained.

To then get a retained with a high iron content, good recovery and decrease in phosphorus, 20 minutes mills were made, separating the part below 270#, passing by 15% every grinding, where the mass retained 100# was 70% allowed in the context of four straight milling, 20' in the range +270#/–100# to recover more than 68% by weight, with an enrichment of the metallic content of 48 to 67% 5%. Fall of 10% silica content to about 2.28%. Phosphorus reduction from 0.18% to 0.076%. This is all about 11.85 kWh/t. This process makes this ores viable for commercial use.

5.2Efficiency in Use of Time and Milling Capacity

Each intermediate stage, after 20 minutes of grinding, only 70% of the mass is directed to the next step, the power consumption is significantly reduced in direct relation to milling for 80 minutes.

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