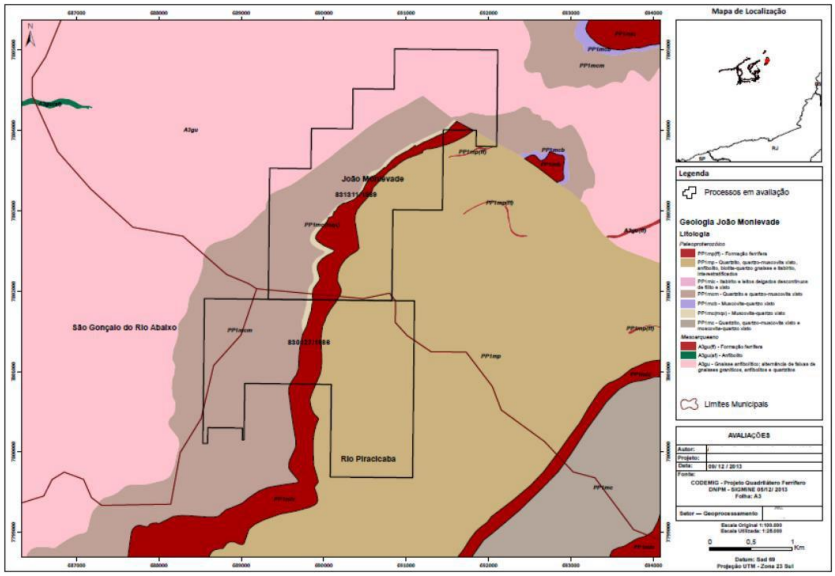
SEARA PROJECT

CHARACTERISTICS OF STUDIES AND CONCENTRATION

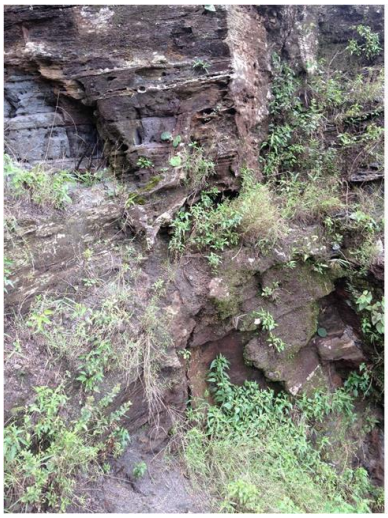
OF ITABIRITO CRISPY SAMPLE

Introduction

The Harvest Project consists in the evaluation of iron formation with approximately 3.6 km long and is inserted in two Mineral Rights in the municipalities of Rio Piracicaba and João Monlevade.



The iron ore is a friable outcropping Itabirite essentially composed of specular hematite and quartz both well grossei particle size ra. There is also a yoke coverage of the area.



Itabirite crispy

yoke

The objective of this study was to evaluate a sample of loose Itabirite which was characterized and subjected to concentration processing route for tests typically applied to this type of Itabirite.

Sampling

For the implementation of the characterization studies and concentration, three replicates of friable Itabirite were collected which after the individual made chemical analysis, it was possible to compose a single sample for testing concentration.

The collection points of the sub-samples were chosen looking materials in geographically distinct locations, with the following coordinates:

. Point 1: Hill - Outcrop Itabirito: 690,704 / 7,803,645

. Point 2: Hill - Outcrop Itabirito: 690,780 / 7,803,710

. Point 3: Road - Outcrop Itabirito: 692,241 / 7,803,370

Also they were sought materials that could be visually distinct and to indicate possible variations in ore characteristics.

Sampling points i tabirito crispy

As showed the ore is quite friable, sub-samples were dried and sieved in
2.00 mm for removal of organic matter and also somewhat more coarse ore particle. This discarded material represents less than 0.5% of sample mass.

Each sub-sample had its specific chemical analysis as presented in the following table.

Chemical analysis of the points

Subsample	Faith	SiO2	Al2O3	P	PPC
	%	%	%	%	%
point 1	50.7	27.6	0.11	0.012	0.09
point 2	43.7	37.6	0.11	0.008	0.04
point 3	41.1	41.4	0.35	0.013	0.06

It is observed that there is variation in the levels of iron and silica, the major components Itabirite but other contaminant levels are shown very low, indicating that the sampled material should follow typical processing studies for itabirites.

Other oxides were near or below the X-ray detection limit: CaO = 0.03%, Mn <0,008% MgO <0.1% TiO2 <0,01% Na2O <0.1% and K2O < 0.01%.

As there was observed no characteristic specifies that would indicate large variation typological between sampled points of the three materials was then made one sample to equal proportions, for the characterization studies and concentration.

Mineralogy

The composite sample, which was already below all 2,00mm, 0,212mm was again sieved on. This screening is designed to generate two distinct fractions of the material, allowing the mineralogy and processing could be done properly.

The 0,212mm + -2.00 fraction was subjected to quantitative mineralogical made with an optical microscope and polished section.

quantitative mineralogy

Mineral	Area	Pasta
Hematite	50%	66%
Quartz	49%	33%
goethite	0.35%	0.35%
muscovite 0.125%		0.125%

It is noted that the sample consists mostly of hematite and quartz, with small occurrence of accessory minerals is compatible with the levels of the sampled material.

Optical microscopy technique measures the area of the minerals in polished section and then converts it to the mass of minerals, using the typical density of each. The results in area is more consistent with the visual appearance which have to see the ore, but the result by mass is that it is important to assess the production of products, resulting in maximum recovery limit by mass of ore when transformed into concentrate.

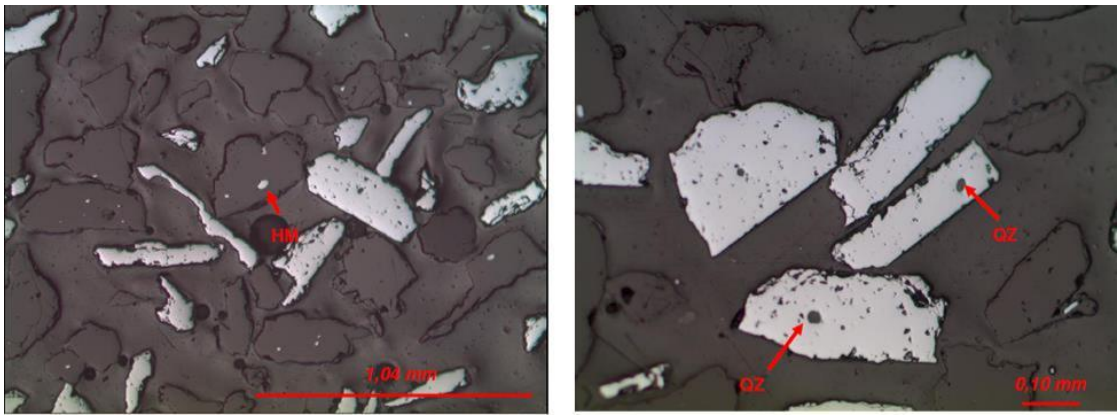
To guide studies concentration were determined degrees of Freedom feed ore in two fractions: 0,212mm + -2.00 and -0,212mm.

Grade quartz release

Fraction	degree of release
-2.00 0,212mm +	98.4%
-0,212mm	99.0%

It is observed that the two fractions the degree of quartz release is very high, showing that the sample crispy Itabirite is ready to be subjected to concentration processes.

The degree of release indicates how the particles of the two main mineral - hematite and quartz - occur and points to possible levels of problems in the concentrates obtained.



The ore particles at the optical microscope: hematite (HM) in light gray and quartz (QZ) gray dark. In the background the resin of the polished section, also in dark gray.

are observed small inlays of hematite quartz grains. This indicates that an efficient concentration process when disposing of waste particles such as quartz, iron loss would be small.

Also observed small quartz inlay in hematite grains. This is an indication that the concentrate may exhibit low levels of contamination silica.

Studies concentration

With the sample characteristics showing essentially be composed of quartz and hematite and also high in 2,00mm release, studies concentration guided by bench testing laboratory which simulate the best suitable for industrial operations such Itabirite.

Therefore, we sought to assess the best technology for each of the size fractions:

. -2.00 + 0,212mm: he studied the possibility of industrial application of magnetic separation of low and high field. To simulate this process, laboratory test was performed with a magnetic separator plates down field sequence (4,000 Gauss) field and high (12,000 Gauss). To this fraction was used an opening of the separator plates matrix
3.8mm.

. -0,212mm: studied only the use of magnetic separation of low and high field (4000 and 12,000 Gauss). To this fraction was used separator plate with 1.5 mm opening.

Chemical analysis of the fractions and initial sample 0,212mm + -2.00 and -0,212mm

sample mass		Faith	SiO2	Al2O3	P	PPC	FeO
		%	%	%	%	%	%
initial	**100.0%**	**44.6**	**35.7**	**0.12**	**0.010**	**-0.01**	**2.27**
+0,212mm	75.0%	42.7	38.4	0.10	0.009	-0.01	1.95
-0,212mm	25.0%	50.3	27.7	0.15	0.010	0.00	3.21

The sample exhibited good initial iron content compatible silica content and low levels of contaminants, low expected by the presence of goethite and muscovite.

PPC levels, negative or zero, are due to the lack of hydrated minerals and also by the presence of some FeO. Other oxides were near or below the X-ray detection limit: CaO = 0.03%, Mn <0,008% MgO <0.1% TiO2 <0,01% Na2O <0.1% and K2O < 0.01%.

Separately, there is an enrichment of the fraction -0,212mm, representing
25.0% of the initial mass of the sample.

To the fraction was 0,212mm + -2.00 evaluated the possibility of concentrating ore to magnetic separation. With the presence of some FeO, indicating the possibility of some martite (polymorph magnetite), a test was developed in which the sample is first run through a low magnetic field to remove magnetic particles with some

remainder, reducing the mass which a second feed step at high magnetic field, to recover the less magnetic particles mainly hematite.

Mass balance for the magnetic separation of the coarse fraction testing 0,212mm + -2.00

Sample	Pasta	Retrieval. metal. Faith	Faith %	SiO2 %	Al2O3 %	P %
initial	100.0%		42.7	38.6	0.12	0.010
tailing end	34.0%	2.4%	3.0	95.8	0.05	0.008
Conc. low	33.9%		65.8	5.4	0.12	0.011
Conc. high	32.1%		60.4	13.2	0.18	0.010
Concen. End	66.0%	97.6%	63.2	9.2	0.15	0.011

The test also showed a concentrate with very good quality and with high metallurgical recovery of iron, but slightly worse than that obtained in the test with dense liquid. Observe the large content of 13.2% silica in the high field concentration.

The FeO was close to zero or slightly negative and the other oxides were near or below the X-ray detection limit: CaO = 0.03%, Mn <0,008% MgO <0.1% TiO2 <0.01 %, Na2 O <0.1% and K2O <0.01%.

For size fraction -0,212mm the studied concentration of magnetic separation was Alternatively, it is most applicable for treating this kind itabirites. The test followed the first pass procedure ore field below, followed by high field.

Mass balance of the magnetic separation test of fine fraction -0,212mm

Sample	Pasta	Retrieval. metal. Faith	Faith %	SiO2 %	Al2O3 %	P %
initial			50.3	27.7	0.15	0.010
tailing end	29.4%	5.8%	10.0	85.4	0.05	0.009
Conc. low	51.6%		68.6	1.3	0.12	0.010
Conc. high	18.9%		63.3	9.6	0.40	0.010
Concen. End	70.6%	94.2%	67.2	3.6	0.20	0.010

The ore in this fine fraction had a performance similar to the coarse fraction, with good metallurgical recovery and concentrate diets also good in spite of 3.6% silica.

The FeO was close to zero or slightly negative and the other oxides were near or below the X-ray detection limit: CaO = 0.03%, Mn <0,008% MgO <0.1% TiO2 <0.01 %, Na2 O <0.1% and K2O <0.01%.

The tests performed in 0,212mm + -2.00 coarse fraction and fine fraction -0,212mm allow the evaluation of the complete route to the industrial concentration of ore to magnetic separation.

This route has been used frequently in processing plants dealing with itabirites high degree of release. The settings of industrial circuit can vari air, but the use of an early stage of low-field separation has been applied with great advantage, at low cost and by reducing the mass that would feed the second stage, high-field equipment they need more operating accuracy and are more expensive.

Importantly, it has also been applied industrially to magnetic separation all -2,00mm material. In tests, however, we tried to make a classification into two fractions - thick and thin - because the performances of concentrations usually better for more defined size ranges.

Balance masses route to magnetic separation for the two fractions

Sample	Fraction	Pasta	Retrieval. metal. Faith	Faith %	SiO2 %	Al2O3 %	P %
initial		100.0%		44.6	35.9	0.12	0.010
Rej. Sep.Mag.	-2.00 0,212mm + 25.5%			3.0	95.8	0.05	0.008
Rej. Sep.Mag.	-0,212mm	7.3%		10.0	85.4	0.05	0.009
reject all		32.8%	3.4%	4.6	93.5	0.05	0.008
Concen. Sep.Mag 0,212mm + -2.00 49.5%				63.2	9.2	0.15	0.011
Concen. Sep.Mag	-0,212mm	17.6%		67.2	3.6	0.20	0.010
Concen. Total		**67.2%**	**96.6%**	**64.2**	**7.7**	**0.16**	**0.010**

It is noted that in this configuration the tests proved possible to obtain a final concentrate with high quality and high metallurgical recovery.

The 7.7% silica content is strongly affected by the performance of magnetic separation of the coarse fraction (0,212mm + -2.00), which participates with more than 70% of the mass of the final concentrate, more particularly made by the step at the top magnetic field, which alone had 13.2% for a significant amount of mass.

conclusions

The study sample showed brittle Itabirite iron content of about 45% and 36% silica. The remaining contaminants were much lower.

The mineralogy of the ore sample confirms the composition as being mainly hematite and quartz, with a high degree of release to the natural crispy sample.

The study was based on the concentration of the more common industrial applications for this type of Itabirite, being made to test the coarse fraction -2,00mm + 0,212mm and the thin fraction -
0,212mm in magnetic separation.

The results showed good performance for the evaluated route, metals showing high recoveries and high quality in the concentrate, indicating that magnetic separation can be applied industrially to treat this ore.

It is recommended to further tests with other samples and other processing conditions to ensure good performance in concentration.