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Beneficiation Of Iron Ore Tailings To Facilitate In Downstrean Utilisation

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ABSTRACT

Slimes from iron ore processing plant were gathered and put through a number of tests to see if they could be used to make iron powders that are good for iron making. A reddish-brown, powdery, slimy sample of tails from iron ore beneficiation plants in the Ballari area was studied. It showed 35.64% Fe(T), 23.61% SiO2, 10.28% Al2O3, 6.09% alkalies, and 6.70% Loss on Ignition [LOI]. The iron ore materials were mostly hematite, goethite, and limonite (50–55%). There were also small amounts of ferruginous clay (15–20%), feldspar (20%), and quartz (10–15%). Magnetite that had been mixed with martite was also found. After being hydrocycloned, the sample was split stronger WHIMS at 10,000 gauss. made an O/F and U/F magnetic concentrate blend that met the requirements and helped with the tricky issues of controlling the environment in slimy tails and protecting minerals. The combination test showed that 15% SiO2, 43% Fe, and 78.7% Fe were spread out, with a 65.7 weight percent yield.

***KEYWORDS*:** Iron ore slime processing, Desliming,VPHGMS, WHIMS

1. INTRODUCTION

Typically, Indian iron ore is found in its natural state as oxide. Andhra Pradesh, Jharkhand, Chattisgarh, Orissa, Karnataka, Maharashtra, and Goa have similar deposit distributions [1&2]. The fluctuating Al2O3 to SiO2 ratio renders these ores unsuitable for direct consumption in blast furnaces, necessitating beneficiation prior to industrial application [1-3]. A ball mill separates iron ore minerals from the gangue minerals. WHIMS, hydrocycloning, and gravity concentration are subsequently employed to generate BF-grade concentrates.

During the ore preparation process, a substantial volume of nonmagnetic tails and slimes (-0.050 mm) are generated and used as fuel in a blast furnace. The tails are deposited in the tailing pond after being tested at 30-45% Fe. The iron ore beneficiation process generated millions of tons of slimy tails, necessitating an effective beneficiation technology to recover the iron values while preserving minerals, maximizing tailing pond area use, and extending the mine's operating life. More stringent environmental regulations, the nearimpossibility of leasing new land for tails impoundment, and the simplification of complex tailing pond management to reduce environmental concerns about siltation,

Dust contamination of groundwater is becoming more challenging. Cement manufacturing accounts for 3% of total iron ore use. In light of the preceding and increasing pressure, steel companies have built cement manufacturing facilities to produce slag-based cement, which is formed from granulated BF calcareous slangs and limestone. Iron ores are used in cement manufacturing plants to improve combustion properties, add color, and ensure a balanced composition.

These are the specifications for iron ore used in the cement industry. Maximum Fe (T): 45%; SiO2 (Free): 10%; TiO2: 4%; S and P: 0.1%. The literature examination An detailed literature analysis on the processing of Indian iron slimes includes the use of centrifugal concentration devices, inverse cationic column flotation, selective dispersion-selective flocculation, wet high intensity magnetic separation (WHIMS), and high gradient magnetic separation (HGMS).

To ease the production of cement-grade iron ore concentrates, an inquiry was conducted into the possibility of repurposing tailings from iron ore beneficiation facilities in the Bellary Hospet Sandur area. The final vestiges deposited in the tailing lagoon are untreated slimes and WHIMS spiral tails. To generate pellet grade concentrates, the subgrade iron ore, which is often anhydrous, is cleaned, classified, and milled to liberate the values, gravity concentration, and wet high intensity magnetic concentration that make up the tails. Tailings from the beneficiation plant's tailing ponds were collected to test the sample's capacity to produce iron ore concentrations adequate for cement manufacture.

2. MATERIAL AND METHODS

A pair of slime samples were gathered, dehydrated, and mixed from the tailing dams of the iron ore beneficiation plants situated throughout the Bellary district, which are owned by M/S BMM Ispat Ltd. of Danapur and M/S JSWL of Vaddu. When the homogenization process was complete, the coning and quartering technique was used to draw subsamples. Researchers looked into the composite feed's chemical, physical, and mineralogical characteristics.

A Mozley hydro cyclone test rig was utilized for desliming, with diameters of 10.25 and 50 mm. The conventional method was used to examine the particle size. The lab tests were conducted using the WHIMS lab model. Experiments were conducted with different solids percentages, desliming levels (both as-is and 10 microns), intensities, and matrices in an effort to improve grade and recovery. Subsequently, a scavenger and cleaner step was implemented.

3. RESULTS AND DISCUSSION

For this experiment, we looked at four different samples of iron ore slime first, then we looked at how desliming and different WHMIS machine settings affected them. Scientists looked at what happened when scavenging, cleaner stage processes, and split arrangements were used.

Characterization studies

The investigation of conventional samples involved the use of mineralogical research, fine-sieve examination for particle size analysis, and normal sub-sieve examination procedures. The example sample has a reddish brown powder with a specific gravity of 3.7. Analysis of the elements: The sample consisted of 35.64% Fe(T), 23.61% SiO2, 10.28% Al2O3, 6.09% alkalies, and 6.70% LOI. The sizes D100, D80, and D50 were determined to be 0.250 mm, 0.040 mm, and 0.012 mm, respectively, during the size investigation. The sample mostly consisted of the iron ore minerals limonite, hematite, and goethite, which accounted for the bulk (50-55%) of the composition.

Additionally, there were small amounts of martitized magnetite present. Low amounts of ferruginous clay, feldspar, and quartz were found, ranging from 15% to 20%. The material is suitable for the previously mentioned combination method of iron enhancement and silica reduction, as supported by the characterization results. This method entails the process of separating and concentrating splits by employing gravity and magnetic separation in a predetermined sequence. The amiability tests, consisting of screening the particles using a 500-mesh sieve, heavy liquid separation, and isodynamic separation, were conducted and the results were reported in references 10 and 17.

3.1 Effect of Desliming

The de-sliming studies took place in a laboratory-grade Mozley cyclone test apparatus outfitted with a 25mm hydro cyclone. The vortex finder and spigot diameter were modified during testing. The feed consistency employed in the testing was around 12% solids, with an intake pressure of roughly 25 psi. To assess the quantity and quality of the objects, we collected and evaluated all of the test items. The results are presented in Table 1.

The results show that the overflow contains more than 15% SiO2, despite the fact that 36.3% of the sand samples in the underflow have a high concentration of silica. Researchers have previously published similar results for desliming iron ore slimes. Ten thousand gauss was the ideal intensity for the numbers [6, 8, 10, and 13]. Clay-like impurities, such as iron, build in materials exposed to magnetic fields with intensities greater than 13,000 gauss, reducing their quality. These findings are consistent with previous investigations

Table -1: Effect of intentsity

Products	Wt.%	% SiO_2	
		Assay	Distn.
Cyclone O/F	63.7	15.79	42.6
Cyclone U/F	36.3	37.31	57.4
Head Cal.	100.0	23.60	100.0

3.2 Effect of gradient

WHIMS testing was performed on ball matrices ranging in size from 6 to 9 mm. The results are summarized in Table 4. According to the findings, the weight% yield decreases, the SiO2 distribution percentage decreases somewhat, and concentrate quality improves as ball diameter grows. More importantly, tail losses due to Fe quality increase dramatically for ball diameters larger than 6 mm. The findings are consistent with previous studies

Table -2: Effect of Gradient

Ball dia mm	Products	Wt.%	% SiO_2	
			Assay	Distn.
6mm	Mag conc	32.6	12.20	17.2
	Non mag tail	67.4	28.38	82.8
	Head Calc	100.0	23.10	100.0
9mm	Mag conc	24.0	11.50	12.0
	Non mag tail	76.0	26.63	88.0
	Head Calc	100.0	23.00	100.0

3.3 Effect of field intensity

Tests were carried out by varying the intensities at 7000, 10000 and 13000 gauss at 25%S in a lab model WHIMS. The results are given in Table 2. The results indicate that an increase in intensity increases the wt% yield, % silica and % Fe distribution of concentrate. The tails value decreases significantly with increase in intensity. The magnetic The above split VPHGMS process yielded a composite concentrate analyzing 47.07% Fe and 9.90% SiO_2 with 54.4% Fe Dist. at, 41.4 wt% yield meeting the cement grade specs.

On the contrary a single stage split rougher HGMS yielded a composite concentrate assaying 15% SiO_2, 10.2% Free silica 43% Fe with 78.7% Fe distribution at 65.7 wt.% yield, just meeting the specifications.

Table -3: Effect of intentsity

Intensity Gauss	Products	Wt.%	% SiO_2	
			Assay	Distn.
7000	Mag conc	24.0	12.18	13.2
	Non mag tail	76.0	26.50	86.8
	Head Calc	100.0	23.20	100.0
10000	Mag conc	32.6	12.20	17.2
	Non mag tail	67.4	28.38	82.8
	Head Calc	100.0	23.10	100.0
13000	Mag conc	35.6	12.85	19.6
	Non mag tail	64.4	29.02	80.4
	Head Calc	100.0	23.36	100.0

3.4 Amenability of samples to final split process

The final process flow chart comprises two phases of cleaner Wet High Intensity Magnetic Separation (WHIMS) for the rougher concentrate, using magnetic field strengths of 9000 and 8000 gauss for both the cyclone overflow and underflow. This is followed by hydrocycloning. The findings are summarized in Table 4

Table 4 ;Final split HGMS test

Products	Wt.%	Assay		Distn.	
		% SiO_2	Fe(T)	% SiO_2	Fe(T)
IICl mag CyOF	21.3	10.00	45.16	9.1	26.9
II Cl Non mag CyOF	9.6	14.35	41.25	6.1	10.9
I Cl Non mag CyOF	10.5	18.10	38.94	8.0	11.4
R Non mag CyOF	22.5	19.83	30.49	18.7	19.0
IICl mag CyUF	20.1	9.73	48.96	8.3	27.5
II Cl Non mag CyUF	1.3	43.67	24.50	2.4	0.9
I Cl Non mag CyUF	3.1	59.80	12.17	7.9	1.1
R Non mag CyUF	11.8	78.98	6.87	39.5	2.3
Head Calc	100.0	23.60	35.64	100.0	100.0
Comp. IICl Split mag conc	41.4	9.90	47.01	17.4	54.4
Final tails	58.6	33.27	27.73	82.6	45.6

4. CONCLUSIONS

The purpose of collecting these samples was to determine if it would be possible to create cement-grade iron concentrate from composite samples of tailings from iron ore beneficiation plants that contain less than 15% silica. As demonstrated by testing at 35.64% Fe(T), 23.61% SiO_2, 10.28% Al_2O_3, 6.09% alkalies, and 7.70% Loss on Ignition [LOI], the composite tails sample from iron ore beneficiation plants in the Ballari area mainly consisted of iron ore minerals (50-55%), hematite, goethite, and limonite, with small amounts of martitized magnetite, ferruginous clay (15-20%), feldspar (20%), and quartz (10-15%). Using hydrocycloning and a harsher WHIMS at 10,000 gauss, the sample created a composite of O/F and U/F magnetic concentrates.

This composite just scraped by, with a yield of 65.7% weight percent, having a composition of 15% SiO2, 43% Fe, and 78.7% Fe. In addition to safeguarding minerals and the environment while making money, the previously described technology also lowered the tailing pond's area by 33%, making maintenance much easier. Current industrial practices are based on the discovered outcomes, which lend credence to the optimistic preliminary conclusions.

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