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Development of Beneficiation Process for High Alumina Iron Ores of Bellary - Hospet Region

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Abstract

JSW Steel is operating a 4.2 Mtpa capacity Pellet Plant to produce iron oxide pellets from the iron ore fines available in the surrounding Bellary-Hospet region of southern India. Iron ore fines which get generated during mining are soft and rich in alumina with high amount of ultra fines. These characteristics of iron ore fines make it difficult to produce good grade pellets for use in COREX iron making units. Apart from this, high alumina in the pellets increases the slag volume in Corex, which demands additional heat energy, resulting in increased fuel rate. Hence, it was decided to set up a beneficiation plant to reduce the alumina content of the ore fines. Iron ore fines from several sources available in the Bellary- Hospet region were evaluated for their suitability for beneficiation as each source differs in chemistry, particle size distribution and washability characteristics. A technique called "Sizewise Washability Technique" was developed to study the washability characteristics of the ore fines to determine the extent of alumina reduction on washing and corresponding yield of concentrate. Iron ore fines from 13 sources were tested and were classified as Preferable, Tolerable and Not-Washable depending on their suitability for beneficiation. Mineralogical studies were also undertaken to understand the liberation characteristics of gangue minerals to achieve proper alumina reduction during beneficiation.

Considering the washability characteristics, size distribution and mineralogy of iron ore fines, pilot plant scale (2 tonnes/hr and 10 tonnes/hr) tests were conducted and a flow sheet was developed with Spiral Classifier and Hydrocyclones. Based on the pilot scale test data, commercial scale unit of 3 Mtpa was designed and successfully commissioned. The performance of the plant is in accordance with the projected projections from laboratory and pilot scale studies.

Table 1: Washability Characteristics of Different Sources of Iron Ore Fines

Iron ore Source Name	Feed	Classifier			Cyclone circuit			Total circuit			
	Al_2O_3	Al_2O_3	Yield, %	% Drop in Al_2O_3	Al_2O_3	Yield, %	% Drop in Al_2O_3	Al_2O_3	Yield, %	% drop in Al_2O_3	Classification
KMP	2.44	1.21	70.8	50.4	1.64	51.0	69.7	1.28	86.0	47.5	Preferable
TSML	3.83	2.83	41.9	26.1	1.47	54.0	67.8	2.25	73.0	41.3	
VSL-EL	2.01	1.48	43.7	26.4	1.00	57.7	58.8	1.28	76.0	36.3	
VMPL	3.97	2.38	68	40.1	4.62	21.3	37.1	2.58	75.0	35.0	
KFIL	2.64	2.04	51.0	22.7	1.26	64.5	61.5	1.74	83.0	34.1	
FOMENTO (Vesco)	0.84	0.86	9.8	-2.4	0.52	80.5	38.1	0.56	82.0	33.3	

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VSL-AL	1.72	1.53	42.6	11.0	1.02	58.2	45.2	1.31	76.0	23.8	Tolerable
VSL-MINING	1.43	1.35	39.4	5.6	0.91	71.9	38.5	1.12	83.0	21.7	
SWML	2.35	1.93	68.7	17.9	1.53	52.7	53.2	1.85	85.2	21.3	
NMDC (Low grade)	3.82	3.64	52.2	4.7	1.95	53.8	51.5	3.08	78.0	19.4	Not washable
MML	1.72	1.67	48.0	2.9	1.12	68.1	36.4	1.44	83.0	16.3	
DMS	2.02	2.23	49.6	-10.4	1.21	70.8	33.5	1.8	85.0	10.9	
FOMENTO (Skml)	2.54	3.11	45.6	-22.4	1.28	59.9	37.9	2.35	78.0	7.5	

Table 2: Mineralogy of Iron Ore Fines

Minerals	Percentage
Hematite	80 – 85
Goethite	10 – 15
Quartz	2 – 3