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Dolomite Fines Beneficiation

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Abstract:

The increased silica and alumina content is result of total insoluble associated with Dolomite. The high total insoluble (TI), dust pollution and cementing behavior during rains makes it difficult to dispose dolomite fines. A study was necessary to utilize dolomite fines. This article explains the improvements done by study to improve the quality of the dolomite fines.

Introduction:

Dolomite a carbonate mineral of calcium and magnesium $CaMg(CO_3)_2$, is fine grained, crystalline, massive and grey in color. The mineral is highly jointed and cracks are occasionally seen filled with thin veins of quartz. Stone often carries the partings of dark chlorite, phyllite and micaceous material which give a banded and bedded appearance. Dolomite is prominent due to its Total Insoluble association which constitutes significantly towards increased silica and alumina content.

Mode of occurrence, type of mining and processing has a great bearing on the fine generation. Semi-mechanized method of mining and processing 9crushing and dry screening) in a quarry produces approximately 16% of the total ore processed as fines (-6mm) and considered as waste. Additional excavation is necessary to meet the lump requirement. The fines generated have to be dumped at areas where the mining has already been done.

The disposal of fines has been very arduous task due to the dust pollution. Also fines have tendency to absorb moisture and attain cementing properties during rainy season. This results in sticky fines and loses its free flow characteristics. This property of fines creates problem during loading / unloading of this material, therefore no buyers of fines.

Depending upon the grade of ore, association of gangue minerals, mode of utilization and beneficiation characteristics the fines are stacked separately.

Laboratory trials:

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In order to overcome the environmental menace the fines creates and also to fully utilize the production quantity, a study was conducted and remedial actions were taken for economic upgradation and conservation of the fines.

Study conducted at Laboratory established the following:

1. Total Insoluble in the fines (SiO_2 + Al_2O_3) is contributed mainly by quartz, feldspar, mica and clay. These are present in mineral in both locked and in free form.
2. Gangue minerals are mainly quartz liberated at grinds below 60 mesh.
3. Granulometry study indicated that, there is enrichment of insoluble content in finer fractions. Classification of 60 mesh had produced the +60 mesh product with 75% yield and reduction in TI by 25%.
4. Fines generated did not form surface coating and therefore did not show any adverse influence on the froth characteristics.
5. Sink float test suggested that fines had a tendency to settle much faster than the tailings.
6. The study on flowability confirmed that the removal of gangue material and superfine particles (less than 200 mesh) has great effect. The fine became free flow in nature.

Washing Plant:

Based on findings of laboratory study and minerology, it was decided to develop a simple and cost effective method for the beneficiation of the dolo fines. The cost benefit analysis was done considering energy cost, quality specifications and market value of the product.

The process of beneficiation involved simple physical beneficiation, which is washing of dolomite fines by adopting flotation route. Beneficiation plant of capacity 60 t/h capacity was developed.

Site selection:

Selection of site for the beneficiation plant had been critically evaluated. The parameters such as sufficient water availability, power supply, utilization of developed mining area and minimum civil work were the key factors.

Considering the above, the most suitable site was found to be the south eastern part of the quarry, which has already attained the pit limit. The plant was accordingly commissioned without causing any hindrance to the mining activity.

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Process:

Unwashed fines (-6mm) is dumped into the washing chamber through dump platform and chute. Water under pressure is sprayed by means of jets. Fines settles here at a much faster rate but gangue material, liberated due to washing, does not settle and discharged through overflow pipe provided on the top portion of the chamber.

Washed fines are released by opening the gate of the washing chamber and subjected to wet screening through the screens at the end ‘part of the ‘outlet .drain. Overflow (-6mm +1mm) - is taken out separately. Underflow (-1 mm) is diverted to the de-wateriser having screen panel of 60 mesh. Fines -1mm +60 mesh are also collected at a point lower down and the slime (-60 mesh) produced here is allowed to he collected at a slime pond. Finer particles settle down at the pond. Superfine particles (-200 mesh) find their way to the sump inside the quarry -, These particles in course of time further settle down at the sump. Clear water is recovered from the sump and is recycled in the beneficiation plant. Process flow diagram of the beneficiation plant has been detailed in Annexure no. 1

A comprehensive study on the performance of the beneficiation plant was made for ten days. The results obtained have been computed. The results of intensive full load trials are indicated in the Annexure no. II.

The process of beneficiation adopted at dolomite quarry has the following main advantages,
1.Low capital cost.

2. Low operating cost.

3. Consistent product quality.

.4.Easy and fool-proof plant operation

5. Recycling of quarry water.

6. Single man operation.

7 Large scale operation with the existing mining equipment’s only.

8. Beneficiation plant is independent of ore crushing plant.

CONCLUSION

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In conclusion, it is significant to note that, this beneficiation route has achieved considerable quality improvement in dolo fines (considered as waste till date), keeping the cost of production minimum. Consequently the return on investment is high. Comprehensive study on the plant performance has established the following improvements.

1. The process upgrades the quality of dolo fines both in its physical and chemical characteristics.

a. -6mm + 1mm fines product indicated quality Improvement by 30% from 8.93% to 6.26% in -T L content with 54.8% yield.

B -6mm +60 mesh product showed an improvement of 25 % from 8.93% to 6.72% in TI % ,yield being 73%.

2. By discarding “clayey material in ‘the form of Slime the-cementing behavior of fines during rainy season is totally eliminated. Fines thus produced ‘after ‘Beneficiation becomes Free Flow in nature.

3 The quality of the products at various stages of processing has been consistent. These products are dumped separately. for effective utilization.

4 Marginally higher: percentage-of undersize and oversize contents in the products can be attributed to the feed rate and time of flotation etc. These can be regulated as per the requirements.

5. -60 mesh + 200 mesh product (19.6 %of total processing) settles at slime pond. This material reclaimed and stacked separately for use in future.

6 Approximately 7.4% of the total quantity may be considered as loss, since the superfine particles (-200 mesh) finds its way through slurry released to the sump at mines.

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RESULTS

SCREEN ANALYSIS

		+6MM	+3MM	+1MM	+60 mesh	+200 mesh	-200 mesh
Feed:							
Unwashed							
Fines	Rec %	3.8	19.6	36.6	39.8	-	-
TI % 8.93		5.40	5.50	6.58	13.13	-	-
MgO% 18.50		20.50	20.46	20.18	15.79	-	-
Product:							
Washed							
Fines							
A. -6 +1 mm							
Rec% 54.8		5.4	42.5	44.0	8.1	-	-

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T I %	6.26	5.28	5.74	6.22	9.86	-	-
MgO%	20.26	20.52	20.40	20.20	19.28	-	-

B. <u>-1 mm + 60 mesh</u>

Rec %	18.2	-	-	14.6	75.3	10.1	-
T I %	8.10	-	-	6.90	8.16	9.49	-
MgO %	19.68	-	-	20.02	19.70	18.76	-

C. <u>-60 + 200 mesh</u>

Rec %	19.6	-	-	-	14.6	85.4	-
T I %	12.60	-	-	-	10.30	13.00	-
MgO %	17.10	-	-	-	18.28	16.90	-

D. <u>-200 mesh</u>

Rec %	7.4	-	-	-	-	-	100
T I %	20.14	-	-	-	-	-	20.14

<u>Reference:</u>

Kirwan, R. (1794) Elements of Mineralogy, second edition: 1: 111