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Recovery of MnO_2 values from fine dumps of Dongri Buzurg Mine of M/s. MOIL

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ABSTRACT

In the Dongri Buzurg Manganese Ore mine of M/s. MOIL, the production of high grade lumpy ores for the iron and steel industry, has resulted in accumulation of about 35,000 tonnes low grade fines over the years. These fines are stacked in the form of unconsolidated dumps. These fines contain significant Mn values, besides creating various environmental problems like air and water pollution, siltation in the adjoining agricultural fields. In addition the dumps occupy a large space, which is scarce in the mining areas. M/s. MOIL is a premier organisation in the field of manganese ore production, conservation and environmental protection, has recognised these important aspects and sponsored a sample to the ore dressing laboratory of Indian Bureau of Mines at Nagpur. The purpose of the study was to explore the possibility of evolving a suitable beneficiation process to obtain manganese concentrate assaying around 72% MnO_2 to be used for dry battery manufacture. The process developed in IBM Mineral Processing Laboratory comprised of desliming, jigging and low intensity wet magnetic separation mainly to reject quartz, silicates and jacobsite. The manganese concentrate thus produced assayed 70.2% MnO_2 with MnO_2 recovery of 78% and weight per cent yield of 63.5. This natural concentrate could be blended with the electrolytic manganese dioxide produced in the EMD plant of MOIL at Dongri Buzurg. This blend can be used in the manufacture of dry cell batteries. Thus the industrial application of this process should produce about 22,000 tonnes of MnO_2 concentrate.

Apart from the additional financial benefit, the recovery of this valuable mineral from the dumps helps in (i) conservation of mineral, (ii) reducing the dump volume by utilisation of waste. It would also reduce air, and water pollution and make available more space at the mine site.

Key words : *Manganese dioxide, Dry cell battery, Desliming, EMD*

INTRODUCTION

Manganese, either in the form of ore or ferroalloy is essential and indispensable for the production of virtually all kinds of steels and cast irons. Iron and steel industry therefore, is the major consumer of manganese ore (97%). High grade manganese ore is considered as strategic mineral required for ferroalloy industry. These industries require Mn ores in the lumpy form.

M/s. Manganese Ore India Ltd. is a premier organisation in the production of manganese ore from their different leasehold mines located in Madhya Pradesh and Maharashtra. Dongri Buzurg mine is one of the oldest operating manganese ore mine of the company. During the production of various grades of lumpy ores for the iron and steel industry over the years, lot of fines have been generated and stacked at the mine site. About 35,000 tonnes of such fines have been accumulated at the Dongri Buzurg mine.

These fine rejects formed huge piles in the course of time and as such the artificial dumps being loose and unconsolidated are subjected to rapid wind erosion and slides and thereby easily choke the surface drainages. During dry seasons, they pollute air (dust) and in rainy reason due to run offs, pollute water and damage the crops in the agricultural land because of inflow of slimes. In addition, a lot of manganese minerals are locked up in these dumps. There has been a change in the concept of conservation over the years from the objective of restriction of use to the one of better utilisation of our resources and at the same time protecting our environment. The judicious use of our resources is the need of the day. M/s. MOIL is actively engaged in the conservation aspect as well as environmental protection in the mining of manganese minerals. Since the principal manganese mineral in the Dongri Buzurg mine is pyrolusite, the party developed interest in assessing the beneficiation potential of these dumps to produce concentrate suitable for use in dry cell battery manufacture (i.e. MnO_2 around 72%). As a follow up action, the authorities of MOIL sponsored a sample of manganese ore fines to the Ore Dressing Laboratory of IBM at Nagpur from the waste dumps of Dongri Buzurg mine. The objective was to develop a suitable beneficiation process for upgrading these fines to about 72% MnO_2.

PROCESS DEVELOPMENT

The Manganese Ore fines from waste dumps of Dongri Buzurg mine assayed 57.4% MnO_2, 12.3% Fe, 15.8% SiO_2, 3% Al_2O_3, 1.1% $BaSO_4$. Mineralogical studies revealed that the sample contained 30-35% Pyrolusite, 30-35% Psilomelane+Cryptomelane, 10-12% Jacobsite, 6-8% Quartz, 5-7% Mica (Manganophyllite + biotite), 2-3% each of Manganite, Hausmanite and Hollandite.

Of the total manganese minerals present in the sample, only pyrolusite and psilomelane/cryptomelane contribute MnO_2. Hence, the test compaign was designed to segregate these minerals in one product.

Dry Processing

A representative portion of the sample was first subjected to low intensity magnetic separation to reject the jacobsite. The non magnetic fraction was then tested on a high force magnetic separator to reject quartz and other silicates.

Observation on the dry magnetic process :

It was observed that the fines present in the sample stick to the low intensity magnetic drum and affects proper separation of Jacobsite. Likewise, during high intensity magnetic separation, coarse quartz rejection was poor because of heavy coating by the manganese dust with the result that the quartz reported to the magnetic fraction diluting the grade. The concentrate thus obtained assayed only 62% MnO_2.

Wet Processing

The sample was subjected to wet sieving. Results of the sieving test are given in Table 1.

Table 1 : Wet sieve analysis of the as received sample

Size in Mesh (Tyler)	Wt%
+10	8.9
+20	19.9
+48	22.8
+65	8.2
+100	8.2
+200	11.4
+325	6.9
+400	1.7
-400	12.0
	100.0

Desliming

It can be seen from the table that the sample contained around 20% -200 mesh and 12% of -400#. These extremely fine particles have coated almost all the coarser grains. Hence, it was decided to first deslime the sample by simple classification. The test results are given in Table 2.

Table 2 : Results on desliming of the as received sample

Product	Assay %			
	Wt %	MnO_2	SiO_2	Fe
Sand	81.4	59.4	13.0	12.6
Slime	18.6	47.8	27.8	12.8
	100.00	57.24	15.75	12.70

Jigging

On examination of the sand, it was observed to contain lot of free coarse quartz and silicates. Hence, jigging was carried out to reject free quartz. The metallurgical results are presented in Table 3.

Table 3 : Results on jigging test on sand

Product	Assay %			
	Wt %	MnO_2	SiO_2	Fe
Jig Concentrate	73.8	63.67	7.85	13.63
Jig Tails	7.6	21.15	64.1	3.60
	81.4	59.7	13.1	12.7

Low Intensity Magnetic Separation

The Jig Concentrate was subjected to detailed mineralogical examination. The concentrate contained pyrolusite, psilomelane/cryptomelane, jacobsite, hausmanite, manganite, Braunite, and some Mn bearing silicates like Manganophyllite. All most all the above Mn bearing minerals have more or less similar specific gravities and magnetic susceptibilities except jacobsite which is highly magnetic. Hence, the jig concentrate was subjected to low intensity magnetic separation to reject jacobsite. The metallurgical results are given in Table 4..

Table 4 : Results on low intensity magnetic separation

Product	Assay %			
	Wt %	MnO_2	SiO_2	Fe
Non Mag	63.5	70.2	8.23	8.52
Magnetic	10.3	24.34	5.85	46.32
	73.8	63.8	7.9	13.8

DISCUSSION

It is seen from the above table that the non magnetic fraction assayed 70.2% MnO_2 with weight per cent yield of 63.5 and MnO_2 recovery was 78%. The concentrate has the following mineralogical composition.

Pyrolusite	-	40-45%
Psilomelane/Cryptomelane	-	30-35%
Manganite, hausmanite & braunite	-	12-15%
Manganophyllite	-	5%

The mineralogical assemblage i.e. the presence of around 20% of minerals not contributing any MnO_2 is mainly responsible for not achieving the targeted specifications i.e. 72% MnO_2. All the above minerals have almost very similar physical properties which prohibit their separation from the pyrolusite and Psilomelane (main MnO_2 contributing minerals) by physical method of separation. The flowsheet developed is presented in Fig. 1.

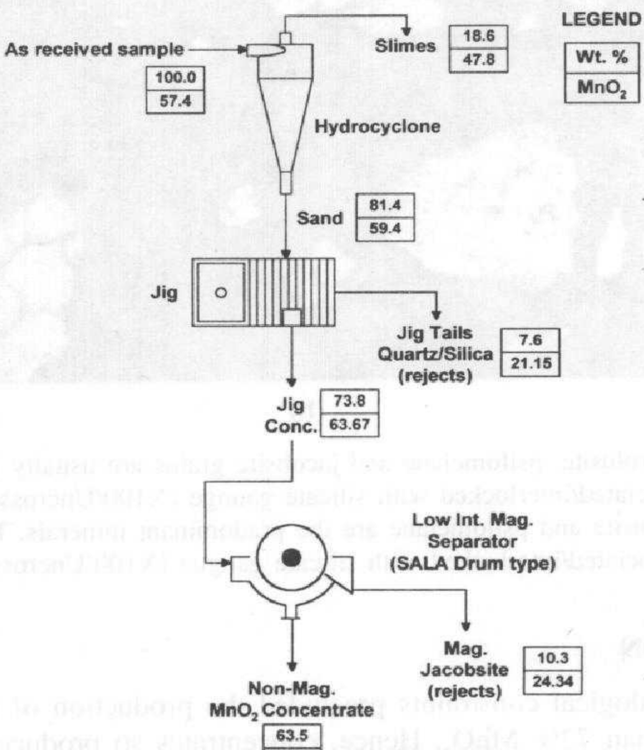
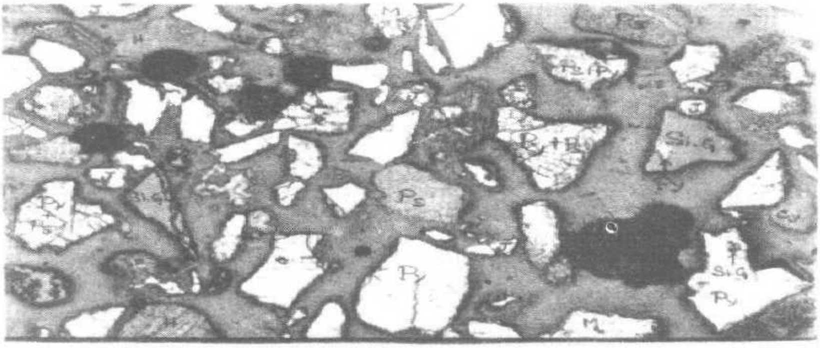
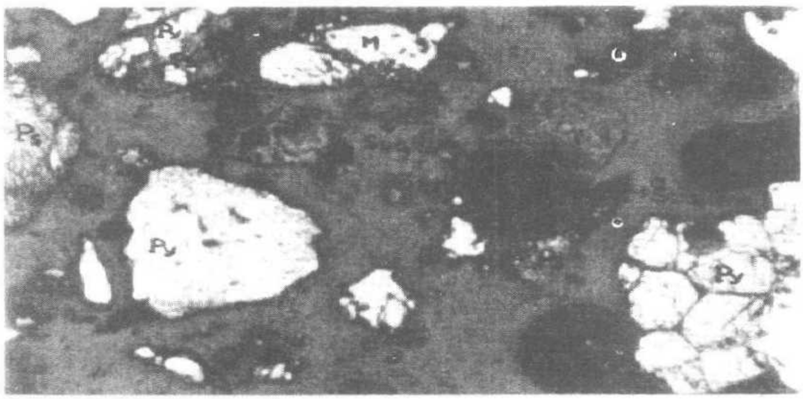


Fig. 1 : Flowsheet developed for the recovery of battery grade MnO_2 from the dump fines of Dongri Buzurg Mine of MOIL

The photomicrographs showing the various mineralogical phases present in the as received sample and the final concentrate are presented in Fig. 2.



(a)



(b)

Fig. 2 : (a) Oyrolusite, psilomelane and jacobsite grains are usually free except a few grains are associated/interlocked with silicate gaunge (X100/Uncrossed/- 65# originL) and (b) Pyrolusite and psilomelane are the predominant minerals. They are free as well as associated/interlocked with silicate gangue (X100/Uncrossed/Conc. 77)

CONCLUSION

The mineralogical constraints precluded the production of concentrates assaying more than 72% MnO_2. Hence, concentrates so produced cannot be directly utilised for dry cell battery manufacture but could well be utilised after blending with the synthetic electrolytic manganese di-oxide produced in the EMD plant of M/s. MOIL at Dongri Buzurg. Thus the simple process developed could upgrade the Mn fines from 57.4% MnO_2 to yield beneficiated concentrate assaying 70.2% MnO_2 with a weight per cent yield of 63.5, MnO_2 recovery being 78%. The industrial application of this process can recover about 22000 tonnes of high grade MnO_2 concentrate from the waste dumps.

The recovery of MnO_2 from these waste dumps can generate revenue, reduce (i) dump volume, (ii) air and water pollution and makes available additional space in the mining area.

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REFERENCES

1. Indian Mineral Year Book, 1998-99.
2. Manganese Ore Monograph, Revised Edition - IBM Publication.
3. Manganese Ore - A Market Survey, IMB Publication.
4. Report of Department of Steel, Ministry of Steel & Mines,September, 1992.
5. Private communication with MOIL Officials.