Necessity of particle size studies of ores from Bihar by the mineral industry

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The measurement of particle size of various minerals, specially of the friable ores, which are commonly found in Bihar and the study of properties of material as a function of size have applications in several fields. Recently, the subject has attracted the attention of industrial researchers. In this paper the necessity of particle size studies of ores of Bihar as applicable in general to the mining and mineral industries is discussed.

It is well known that a decrease in particle size of matter implies an increase in surface area for the same volume of matter. On breaking a mineral into two parts, new surface is created without changing the volume of ore/mineral. This necessitates handling of ore and environmental pollution problems.

Minerals are prone to breakage at all stages of their production and utilisation. The range in size of minerals produced during mining may vary from a cube of say 30 cm. or more to smaller size particles within the range of microscopic visibility. Screening is perhaps the simple way of separating the minerals into close size groups for their marketability.

Among the three interfaces of ore/matter viz. solid, liquid and gas, the particle size studies in general have a direct bearing/application in the mineral industry. For the purpose of this paper, bauxite, chromite, iron ore, kyanite and manganese ore of this state are considered.

Bauxite :

Bauxite occurs in Bihar in the districts of Palamu, Lohardaga, Gumla, Munger, Santhal Pargana and Rohtas in the laterite cappings on the plateau. The total reserves of all grades of bauxite are placed at 115 million tonnes out of which, nearly 80 million tonnes are of metallurgical grade. The reserves of bauxite have significantly been revised in recent years. But the production of bauxite within the state has remained steady over the last five years at around 5.4 lakh tonnes per annum. In Bihar, the bauxite industry is mainly owned by private sector who are shy of conservation and investment for proper processing of the ore.

During the inspection of some of the bauxite mines in Bihar state by various teams of the I. B. M. and the State Department of Mines & Geology, it was observed that appreciable quantity of low-grade material was being dumped along with waste material. The generation of such mineral rejects has been estimated by the I. B. M. to be varying from 25 to 90% of the marketable grade ore produced in the mine. There is need to beneficiate low grade bauxite. Therefore, it is suggested that a wet screening plant be installed preferably located in between Netarhat and Serendag. This will involve a financial outlay of Rs. 50 lakhs or so. This would certainly increase the utility and value of bauxite produced in the area.

Application of ore sorter technology for ore concentration and its recovery is gaining importance. It will increase the total potentiality of bauxite and its mineable reserves. The I. B. M. has carried out some useful study and BALCO has also got some samples tested in Australia. Their tests have shown good results.

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Chromite :

The total reserves of chromite in Bihar are in the order of only 0.38 million tonnes. While there has been a steady increase in production in Orissa, chromite production in Bihar is rather neglegible This is attributed to —

— depletion in mineable reserves within economic limits in the existing leases,

— slackness in demand for the grade and size of chromite produced and

— lack of beneficiation facilities.

Hither to only lumpy ore is preferred by the industry, as there is no demand for fines. In Bihar, three-fifth of the production of ore though high in Cr_2O_3 is rejected as fines.

Chromite ore of this state, generally analyses below 35% of Cr_2O_3 ranging between 35 and 52% are confined to certain lease holds only. For refractory industry, the selection of chromite depends more on the control of deleterious elements mainly silica and alumina rather than on high Cr_2O_3 content. R & D has, therefore, to concentrate on the need for lowering silica and alumina.

There is need to develop suitable technology for agglomeration and pelletisation of chromite fines.

Iron ore :

In Singhbhum district, Bihar, the reassessed total reserves of iron ore of all categories have been placed at 3759 million tonnes. The details of the reserves is givenin Table—1

The figures of despatch of iron ore lumps during the last five years, from Singhbhum district of Bihar is given in Table—2 :

Table—1 : Iron ore reserves of Bihar

Name of Sector	Reserve (in million tonnes) of Lumps (−40+10 mm)	Fines (−10 mm)
i. Noamundi - Jamda	152	173
ii. Kiriburu - Meghahataburu	192	313
iii. Gua-Ghatkuri	268	329
iv. Chiria-Manoharpur	697	1635
	1309	2450

Table—2 : Iron ore despatches from Bihar

Despatch Year	Despatch of iron ore lumps (in million tonnes)
1979	2.61
1980	2.18
1981	2.71
1982	2.97
1983	2.92

So far, there has been no production of washed fines in the Singhbhum iron ore belt, the fines generated at the rate of one million tonnes per annum are stacked. The accumulation of unprocessed fines has reached more than 20 million tonnes. The problem can be solved by processing the fines generated in mines of both public and private sectors and its proper utility.

To-day, processing of ore is a necessity in most of the iron-ore mines of the state. It aims at :

— *Size reduction* : Such studies are being carried out in Japan and have shown that 1% decrease in the proportion of lump of the size larger than 35 mm corresponds to a decrease in the coke of approximately 2 Kg/tonne and 1% decrease in the fines of less than 60 mm leads to a decrease in the coke rate of 1 Kg/tonne.

— *Improvement of chemical properties*: Experiments carried out in USSR have shown that for an increase of 1% Fe in ore, productivity increases by 2% while consumption decreases by 3%.

— *Utilisation of fines* : Ore lumps are reduced to the top size of about 1000 mm in the R. O. M. to 50 mm. In this processes fines are generated.

In view of the increasing demand for processed ore material in the export market and internal consumption, it will be useful to process the stockpile of reject fines now existing in the mine workings in Singhbhum sector, This would need a central crushing, washing and screening and agglomeration plant for which the best site would be Barajamda.

Kyanite :

Users in India are not keen to buy beneficiated kyanite fines (−40 mesh size) as it would be difficult to calcine in the same kiln utilised for calcination of lumpy ore. In that case, the fines have to be either agglomerated or the kilns are to be changed.

The production of kyanite from Bihar has been continuously declining. The present reserves of high grade kyanite are inadequate to meet the demand. All researches conducted so far to utilise kyanite, quartz rock and kyanite fines are of laboratory or pilot plant scale. Therefore, there is an urgent need to assess the economic viability of the process.

Manganese :

Manganese ore of Barajamda sector in Bihar occurs in pockets and is quite different from the ones occuring in Madhya Pradesh, Maharastra and Karnataka. The problems associated in exploitation of such manganese ores are quite immense. Peculiar nature of occurrence, enormous overburden, low output per man per shift and high cost of production, etc. are the glaring problems in working for manganese ores. The production of manganese ore in Bihar has been declining steadily from 36740 tonnes in 1972 to 3500 tonnes in 1983,

The problem is more because the entire manganese industry in Bihar is in the hands of private sector who are :

— not adopting the beneficiation procedure

— using low grade fines and

— considering investment in R & D efforts for conservation.

Conclusively, the efficient utilization of particles of different sizes, especially fines is a problem that needs careful consideration and special study. Success largely depends on the thorough knowledge of the properties of various sizes of minerals and their comparative studies, Recently, the mineral processing has been declared an industry.

Finally, it could be concluded that suitable investment in particle size study by the mineral industry to gain adequate knowledge will be of utmost benefit in —

i) economically utilising the fine size minerals and

ii) reducing and gradually eliminating the dust problem of mines.

Since minerals' particle size study is a specialized field involving an expenditure on staff and equipment, it could be best carried out on co-operative basis by the mineral industry as a whole, rather than on a piece-meal basis by the individual mineral enterpreneurs

DISCUSSION :

M. S. Prakasa Rao
Manager (OD), NMDC Ltd., Hyderabad.

Question 1 : You have given the despatches of lumps. What is the average grade and where they are despatched ?

Author : The average grade of lump is
75.60% of (+) 62% Fe
20.40% of (−) 62% Fe

Question 2 : What is the average grade of Fe, Al_2O_3 , SiO_2 ?

Author : The average perecentage of Fe is 62.
SiO_2 vary from 2 to 5%
Al_2O_3 vary from 5 to 7%.

Question 3 : Any efforts made by laboratory studies for beneficiation of these fines ?

Author : N. M. L. has examined the problem. A central crushing, washing and screening plant is proposed at Barajamda by the Central Government.

Dr. J. J. Rao
Chief Engr. (Ore dressing), ORIND, Rourkela.

Question 1 : Wet screening of bauxite has been suggested. At what size range ? What are the results of studies ? How does wet screening help in utilisation of fines ?

Author : Beneficiation tests were carried out by I. B. M. The samples as received analysed L. O. I. — 22.94, SiO_2 — 6.92, TiO_2 — 7.30 Fe_2O_3 — 17.47, Al_2O_3 — 46.52.

Simple wet screening of the sample yielded bauxite cf (+) 200 mesh size containing 3.4 to 4.41% SiO_2 and 46.47 to 47.75% Al_2O_3 .

Question 2 : Mention has been made of BALCO's tests in Australia and said to be encouraging by the authors. What are the results ? Kindly elaborate.

Author : Due to unavoidable reasons I cannot give you the details of BALCO's test results. You would like to contact BALCO.

Question 3 : What are the details of particle size studies as given in the title of paper ? Stress has been laid on utilisation of fines only in general.

Author : We have only highlighted the problems. Our suggestions are that private sector should also contribute in R & D efforts. They are main defaulters. Hitherto only Govt. & Govt. agencies have contributed.