Need for utilization of leaner and unmarketable ores of Bihar by innovation in ore dressing and metallurgical process

*** Akhileshwar Singh and ** J. P. Singh**

The State of Bihar is rather unfortunate to have so many leaner and unmarketable mineral deposits. It is endowed with a wide mineral resource base (Table—1) and continue to be a leading state in mineral production accounting for about 25 percent of the total value of minerals produced in India. But this fortunate trend is not going to last long.

The information available in Table—1 indicates that in the last one decade, in case of some important minerals there has been considerable increase in reserves but the rated rise in production has not kept pace with increase in reserves. This trend of production shows that most of mineral reserves in Bihar including new mineral-finds contain generally leaner and unmarketable ores.

Table — 1 : Relative status of Bihar's mineral resources and their production :

	Ore / Mineral	Reserves in million tonnes		Production in tonnes	
		1973	1983	1973	1983
1.	Andalusite	—	4	Nil	Nil
2.	Apatite	1.0	1.094	4507	Nil
3.	Asbestos	0.380	0.403	799	22
4.	Barytes	—	0.11	Nil	57
5.	Bauxite	35	115	4,45,520	5,86,223
6.	Bentonite	0.1	19	12,700	Nil
7.	Chromite	0.28	0.38	745	170
8.	China clay	36	382	53,742	41,803
9.	Coal	35,230	56,049	33,420	53,753
10.	Copper ore	140	216	8,15,017	13,12,183
11.	Fireclay	28	314	2,26,344	1,68,695
12.	Felspar	—	2	758	440
13.	Graphite	2.25	6.2	648	14,212
14.	Hematite	1,137	3,758	4,784	6,900
15.	Kyanite				
	Massive	0.2	0.09	44,745	20,100
	Low grade	5.57	89		
16.	Limestone*	860	1,200	3,021	2,177

*Qty in 000 tonnes.

* *Mineral Development Officer, Govt. of Bihar, Patna*

** *Geologist, Govt. of Bihar, Patna*

A large belt of low grade andalusite bearing rocks (1.3 million tonnes) occurs in the western part of Palamu district. The mineral needs beneficiation.

The beneficiation studies conducted by N.M.L. and I.B M have demonstrated that low-grade apatite of Singhbhum is amenable to beneficiation. Pilot plant tests done by N.M.L. have yielded rich concentrate. However, the deposit is presently not being exploited. There is need to commercialise and economise the beneficiation procedure and improve its mineability.

In Bihar, the reserves of asbestos are small. They are mostly of amphibole variety. Chrysotile asbestos is confined to limited area. There is a modern milling plant only at Roro Mines in Singhbhum district. At other places fibres are separated by hand sorting, resulting in poor recovery of fibres. There is also need to recover chromite and olivine which are available as associated minerals and have greater demand in the market.

Barytes of Singhbhum, Palamau and Ranchi districts are mostly impure and off-colour. These deposits could not be exploited for want of proper beneficiation.

In the last two decades, mainly due to all out efforts of the Department of Mines and Geology, Bihar, the total reserves of all grade of bauxite in Bihar have although been revised from 40 to 115 million tonnes, the production of bauxite within the state has remained steady over the last five years at around 5.4 lakh tonnes per year. In the year 1982, out of the total production of 5,68,903 tonnes, about 40% consisted of over 50% Al_2O_3 and the balance of about 45% Al_2O_3.

In Bihar, the bauxite mining and processing industry is entirely in the hands of private sector. They do not use bauxite containing +40 percent Al_2O_3. Instead of finding utility of high grade bauxite in refractory and abrasive industries, it is being used in cement and alumina industries whereas low grade ore is being dumped with waste material. During inspection of bauxite mines in Bihar State, the IBM has observed that generation of such mineral rejects has been estimated to be varying from 25% to 90% of the marketable grade of ore produced. The I N D A L C O are planning a high-grade refractory unit based on their captive mines at Bagru near Lohardaga and are also recovering vanadium pentoxide as sludge from their alumina plant at Muri. The Department of Mines and Geolog, Bihar have taken keen interest in diversification programme of I N D A L C O.

There is need to further simplify and economise beneficiation procedures. Problems of energy conservation with respect to alumina industry also need serious consideration. Perhaps in near future, the "Blast Furnace route "may replace the " Electrolysis route" of alumina smelting.

In bauxite ore of Bihar, titanium oxide content generally goes up to 12%. There is need to develop a technology for recovery of the scarce raw material from red mud.

On account of exploration efforts of the State Department of Mines and Geology, the reserves of bentonite in Bihar have been revised from 0.1 to 19 million tonnes. The raw material is lying mostly unutilised for want of proper beneficiation procedure. It is calcium bentonite of non-swelling type, usually referred to as fuller's earth.The calcium ions present could be replaced by sodium-ions by adding requisite quantity of soda-ash. Conversion can take place during the process of mixing and grinding. This technology should be commercialised for upgrading such bentonite. Samples have been sent to N.M.L. for suggesting a proper technology for the purpose.

Hitherto, chromite used in the production of high-carbon ferrochrome, low carbon ferro-

chrome, had to be lumpy, with a Cr_2O_3 content of 48% minimum and Cr/Fe ratio of 2.8:1. This resulted in rejection of three-fifth of the high grade ore produced because of size restriction. A lot of R&D work has been done to over-come the above problems but so for no satisfactory result has been achieved.

In SRC (Semi Reduction Charge) process developed by Showa Denko (Japan) and Outokompa process of Finland, ferro-chromite is satisfactorily produced from fines of chromite containing:

— as low as 42 to 44 Cr_2O_3
— Cr/Fe ratio of 1.6:1

The above technological innovations may increase the reserves of usable chromite ore of the state.

Reserves of china clay available in Bihar are of the order of 382 million tonnes. Nearly 20% of the reserves contain inferior quality of china clay, mainly located in Ranchi district. Inspite of the inherent good qualities of china clay in the state, the production has remained stagnant in last one decade, mainly due to :

— appreciable variation in chemical and physical characteristics from area to area and also in depth and that no single process of beneficiation has been found effective.
— monopoly of private sector who are shy to undertake beneficiation process.
— high cost of processing which perhaps works out to be Rs. 120 to Rs. 200 per tonne.

For optimum utilisation of copper ore of Bihar and its bye-products, the suggested R & D work to be undertaken are—

— acid leaching of oxide ores and bacterial leaching of low grade ores,
— recovery of bye-products like magnetite. Presently gold, silver, selenium, nickel sulphate and tellurium are being recovered as by-products (HCL — ICC) and
— study of mine-water with a view to utilise it for industrial purposes.

Against all India coal reserves of 1,22,223 million tonnes, Bihar has a reserve of 56,049 million tonnes although the production of coal and its value-added utilisation is in-adequate. This requires attention in a collective way.

There should also be effort to collect by-products. The coal-ash contains titanium oxide to the level of 1.6 to 3.6% and phosphorous 0.6 to 2.6 percent. The technology and the economics need to be worked out.

The glass and ceramic industries are the major consumers of felspar and account for 34 percent of total consumption. Felspathic pegmatites are wide spread in Bihar and the total area under mining lease is of the order of 1994 hectares. The production has declined by 40% in last one decade. The deposits should be thoroughly assessed for their reserves and grade. Intergrowth of other minerals along with felspar in the pegmatite body needs specific study. Such intergrowth constitutes intimate mixture rendering the separation diffucult. And lastly the cost of mining, crushing and grinding generally do not commensurate with prevalent market price of the mineral felspar from economic point of view. There is scope for specific study of cost structure.

The beneficiation plant is the basic need for graphite industry. There are presently 4 beneficiation plants in Palamau district of Bihar with aggregate capacity of 70,000 tonnes per year. The fifth beneficiation plant of B.S.M.D.C. based on N.M.L. know-how is also likely to be set up shortly. On an average, in the existing plants, the percentage of recovery is only 15% as against 90% arrived by N.M.L. in their experiments. Secondly the cost of processing is Rs. 300 per tonne as against Rs. 106.40 per tonne of selling price of r.o.m. graphite. This gap in experimental and actual practice needs to be narrowed down for proper conservation of graphite resources.

Two varieties of garnets viz, gem and industrial occur as associated mineral in Hazaribagh district. For winning both varieties, the technology need to be worked out. This would certainly be a low investment project and would help weaker sections of the region to get quick returns.

The total hematite reserves in Bihar, as reassessed by the Department of Mines and Geology, Bihar is of the order of 3758 million tonnes. These are reserves of hematite with +55 iron content. Bihar ore is also relatively more friable. Presently fines generated at the rate of one million tonnes per year are stacked. Thus accumulation of fines has reached more than 20 million tonnes. There is need for a central crushing, washing and screning plant in the region.

The reserve of low-grade kyanite in Bihar occuring in quartz-kyanite rock is estimated at about 89 million tonnes. So far, these reserves have not been exploited for lack of suitable process for recovery of kyanite. The technology of C.G.C.R.I, I.B.M., and N.M.L. for the purpose have not perhaps crossed the experimental stage.

Before independence, for manufacture of portland cement by wet-process, the minimum CaO content in limestone was considered at 40%, thereby allowing utilisation of marginal grade limestone without beneficiation. After independence, the cut-off grade of CaO for Mega, Mini and Tiny cement plants is 42, 44 and 46 percent respectively. Such upward enhancement of "cut off grade" by the modern technology is detrimental and against the theme of conservation.

Most of Bihar limestone are of marginal grade. M/s ACC's plants, located in Singhbhum and Ranchi districts are consuming limestone after flotation treatment. Same is the case with M/s R. I. Ltd. plant at Dehri-on-sone.

Therefore, there is need to develop a technology for cement manufacture best suited to Bihar limestone.

Conclusively, serious consideration has to be given for utilization of leaner and unmarketable ores of Bihar by innovation in ore-dressing and metallurgical processes.