

## CHAPTER 9

### MINING AND PRODUCTION OF BAUXITE IN INDIA

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#### 9.1 BAUXITE PRODUCTION

India is endowed with extensive deposits of bauxite commonly associated with laterites which occur as blankets or cappings on the high land forms and plateaus. Aluminium being the only non-ferrous metal in which India can be self sufficient and also become a net exporter, therefore bauxite mining has gained greater importance. Bauxite was first mined in India in 1908 in Madhya Pradesh. Since then the production of bauxite has been increasing in the subsequent years. Bauxite production started gaining momentum after the Second World War and in 1943, the production reached 24,550 t. Thereafter the production rose to 2.17 lakh tonnes in 1959 and 16.84 lakh tonnes in 1972. There was a temporary depression in production till 1977. From 1978 onwards the production has been on rising trend and reached an all time high production of 496 million tonnes during 1990-91. The total production as well as statewise and district wise production during the period 1980-89 1991-92 is given in Table No: 9.1 & 9.2.

#### 9.2 BAUXITE MINES

##### 9.2.1 Leases

Bauxite lease holds in India cover an area of 33075.29 ha. Out of this 13142.7 ha. (39.7 %) is occupied by the captive mines. The statewise list of captive working mines with lease details is given in Table No. 9.3.

##### 9.2.2 Number and size of Mines (22)

A list of Bauxite mines, classified on production range basis for the year 1990 is given in table 9.4. It is found that 62 % of the total annual production during the year 1990 has come from seven important (highly mechanised) mines.

TABLE 9.1 : PRODUCTION OF BAUXITE IN INDIA  
(1980 - 1991-1992)

Year	Production (tonnes)
1980	1,784,699
1981	1,954,650
1982	1,997,508
1983	1,976,055
1984	2,093,330
1985	2,340,747
1986	2,662,200
1987	2,813,878
1988	4,013,427
1989	4,492,433
1989-90	4,833,792
1990-91 (p)	4,977,038
1991-92 (p)	4,737,898

(p) provisional

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TABLE 9.2 STATEWISE DISTRICTWISE PRODUCTION OF BAUXITE DURING 1980 TO 1991-1992

STATE/DISTRICT	1980 to 1982 (yearly average in tonnes)	1983 to 1985 (yearly av. in tonnes)	1986	1987	1988	1989	1989-90	1990-91	( Units in tonnes )	
									1991-92(P)	1991-92(P)
<b>1. BIHAR</b>	563,759	594,918	767,703	869,219	832,329	721,764	856,889	874,797	1,035,750	-
Ranchi	563,759	197,289	-	-	-	-	-	-	-	-
Gumala	-	150,242	352,735	439,354	431,380	359,481	446,144	481,665	537,657	-
Lohardaga	-	247,191	414,968	429,865	400,949	362,283	410,745	393,132	498,093	-
Palamau	-	196	-	-	-	-	-	-	-	-
<b>2. GOA</b>	18,791	14,627	11,547	5,050	7,975	28,245	36,328	14,475	34,111	-
<b>3. GUJARAT</b>	382,012	451,759	467,052	445,435	435,785	558,279	648,975	856,350	806,568	-
Amreli	13	-	-	-	500	-	-	-	-	-
Bhavnagar	1,309	-	-	-	-	-	-	-	-	-
Jamnagar	294,166	377,886	409,370	390,782	380,994	494,502	578,206	778,488	723,839	-
Junagarh	35,092	21,799	6,730	3,804	8,819	13,040	13,442	7,836	5,160	-
Kheda	10,093	12,545	8,456	11,881	13,336	8,259	9,315	7,371	5,708	-
Kutch	33,189	32,728	33,962	29,887	26,640	35,276	39,505	54,759	64,594	-
Saberkantha	8,147	6,510	8,534	9,081	5,496	7,202	8,503	7,896	7,267	-
Valsad	-	289	-	-	-	-	-	-	-	-
<b>4. J &amp; K</b>	1,050	-	19	-	35	12	-	-	-	-
Ugampur	1,050	-	19	-	35	12	-	-	-	-
<b>5. KARNATAKA</b>	59,868	49,579	39,322	30,708	18,501	19,301	35,586	57,944	20,858	-
Belgaum	20,065	20,087	6,865	21,529	18,501	16,103	15,525	20,680	9,406	-
South Kanara	39,802	29,492	32,457	9,179	-	3,198	11,043	37,264	11,452	-
<b>6. MADHYA PRADESH</b>	439,448	560,941	660,121	593,959	566,298	506,177	501,970	583,823	528,145	-
Bastar	2,037	26,789	29,225	18,319	17,604	19,911	24,987	33,254	30,724	-

STATE/DISTRICT	1980 to 1982 (yearly average in tonnes)	1983 to 1985 (yearly avg. in tonnes)	1986	1987	1988	1989	1989-90	1990-91	1991-92
Bilaspur	64,854	98,813	179,245	185,879	151,959	92,437	70,350	105,228	71,940
Jabalpur	44,353	42,391	54,990	58,004	80,281	86,986	99,507	72,043	87,415
Mandla	228,583	252,502	287,546	237,367	204,548	193,300	176,800	145,500	138,500
Rewa	-	9,013	9,119	7,068	5,478	4,374	6,549	3,811	5,051
Satna	34,600	52,693	66,418	67,452	58,116	98,673	107,734	135,299	125,375
Shahdol	63,394	77,638	33,074	18,375	8,804	4,939	13,575	47,090	49,281
Sidhi	1,637	83	219	124	111	110	110	51	2,242
Surguja	-	-	285	1,371	38,397	26,422	2,258	41,547	17,617
7. MAHARASHTRA	331,448	415,907	413,338	368,676	535,715	538,509	532,891	536,881(P)	558,790
Kolhapur	260,746	410,047	399,746	364,322	535,715	538,525	532,756	536,881(P)	558,790
Ratnagiri	70,702	50	-	-	-	184	135	-	-
Raigarh	-	5,810	13,589	4,344	-	-	-	-	-
8. PUNJAB	115,633	22,907	62,534	80,602	76,979	83,170	103,983	141,944	100,185
Salem	100,135	22,907	51,505	41,730	47,298	57,467	71,498	89,904	70,361
Nilgiri	15,497	-	11,029	38,872	29,681	25,703	32,485	52,040	29,824
9. UTTAR PRADESH	255	5,204	1,649	-	-	-	-	-	-
Bonda	255	5,204	1,649	-	-	-	-	-	-



STATE/DISTRICT	1980 to 1982	1983 to 1985	1986	1987	1988	1989	1989-90	1990-91	1991-92 (P)
10. RAJASTHAN	18	37	-	-	-	-	-	-	-
Kota	18	37	-	-	-	-	-	-	-
11. ORISSA	-	827	238,915	420,229	1,539,810	2,045,219	2,126,188	1,910,824	1,653,491
Sundergarh	-	827	615	337	720	2,940	2,350	3,950	6,851
Koraput	-	-	238,308	419,892	1,539,090	2,042,279	2,123,838	1,906,874	1,646,640

Source : Mineral Statistics Division, IBM, Nagpur.

(P) = Provisional

TABLE 9.3 LIST OF CAPTIVE WORKING Bauxite MINES IN INDIA AS ON 1.1.1990

Sl.No.	State/District	Mine Particulars			Address of lessee	Location of Mining Lease		Lease details	
		Name	Category of mines	OMS for 1989-90		Survey Nos.	Village	Lease area in Hect.	Expiry
1	2	3	4	5	6	7	8	9	10
1.	BIHAR Gumla	Shrangdag	A	1.7	Hindusthan Aluminium Corporation Ltd., P.O. Renukot, Distt. Mirzapur(U.P)	30 (Ghaghra)	Sarangdag Tulmu	204.68	15.10.2004
2.	-do-	Jalim & Sanai	B	0.30	-do-	66 (Bishunpur)	Jalim & Sanai	38.44	30.8.2004
3.	-do-	Gurdari	A	0.74	Hindusthan Aluminium Corpn. Ltd., F.O. Richigutta, Distt. Palamanu(Bihar).	-	Gurdari Ambakona	1039.50	22.3.2005
4.	Lohardaga	Maichanpat	A	Not available	Hindusthan Aluminium Corporation Ltd., P.O. Renukot, Distt. Mirzapur(U.P) Pin-231217	-	Barchorgan	82.96	2.1.97
5.	-do-	Fuchinpat	B	-	-do-	85	Semradih Karkrang	96.06	15-5-2003
6.	-do-	Pakhar (84.38,96.25Ac)	-	0.96	-do-	104 Lohardaga	Pakar	88.04	16.4.2005
7.	-do-	Sagru Hill	A	6.12	Indian Aluminium Co. Ltd., 1, Middleton street, Calcutta, West Bengal, Pin 700016.	-	Sagru Hill	96.74	21.1.2004
8.	Gujarat Jamnagar	A.S. Asota	B	4.98	Carborandum Universal Ltd., P.B. No. 1677, 28, North Beach Road, Madras (Tamil Nadu) Pin - 600001.	238(P)	Asota	60.70	7.2.2002.
9.	-do-	Mota Asota (241)	B	-	-do-	341	Mota Asota	1.83	13.2.97

\* Category of Mines is based on MCDR'88.

1	2	3	4	5	6	7	8	9	10
10.	GUJARAT Jammagar	Raja Talan	B	0.78	Corborandum Universal Ltd., P.O. Bhatia Distt. Jammagar (Gujarat) Pin - 361315	211	Mewasa	5.27	1.1.98
11.	-do-	Mahadevia (Kolyanpur)	B	1.90	-do-	-	Mahadevia	7.67	30.7.88
12.	-do-	Ran	B	-	Corborandum Universal Ltd., P.O. Bhatia Distt. Jammagar (Gujarat) Pin. 361315	247 (P)	Ran	30.35	7.5.2001
13.	-do-	New Mewar S.N. (378)	-	0.02	Corborandum Universal Ltd., P.B. No. 2272, Tirvantipur, Distt. Madras.	-	Mewasa	9.46	19.4.90
14.	-do-	Suradhar I (191)	B	8.70	Orient Abrasive Ltd., G.I.D.C. Ind. Area, P.B. No. 13, Porbandar, Distt. Junagadh (Gujarat) Pin - 360575	252	Ran	4.85	24.10.99
15.	-do-	Mandana	B	0.75	-do-	529	Mandana	50.83	4.10.2001
16.	-do-	Viram I (17)	B	4.14	-do-	17	Virpur	1.15	11.2.2000
17.	-do-	Virpur II (72,73)	B	0.95	-do-	78,140	Virpur	5.62	11.2.2000
18.	-do-	Mewase II	B	Development work carried out	-do-	-	Mewasa	8.91	27.3.97
19.	-do-	Suradhar II (190)	B	1.71	-do-	190	Mewasa	0.48	14.10.2004
20.	-do-	Avariya	B	1.51	-do-	362	Mewasa	2.45	9.6.2001
21.	-do-	Varasa II	B	0.93	-do-	330/P	Mewasa	25.88	22.9.2005
22.	-do-	Rathoci (139 part)	B	Development work carried out	-do-	139/P	Mewasa	2.02	17.7.2001



1	2	3	4	5	6	7	8	9	10
34.	GUJARAT Jamnagar	Lamba Bx. Mine No. 2	B	-	Saurashtra Calcine Bauxite & Allied Ind. Head Office, E-9, New SuperMKT. Jamnagar, Distt. Jamnagar (Gujarat)	415/1/P	Lamba	12.89	19.6.2001
35.	-do-	Lamba	B	0.23	Saurashtra Calcine Bauxite & Allied Ind. Kamal Vihar, Station Road, Porbandar, Gujarat.	415/1/P	Lamba	10.19	19.6.2001
36	-do-	Hachmatia	B	0.30	-do-	157/P	Hachmatia	1.21	26.4.2001
37.	-do-	Hachmatia fields	B	-	-do-	199/P	Nandana	2.44	26.4.2001
38.	-do-	Nandana	B	-	Saurashtra Calcine Bauxite & Allied Ind. Kamal Vihar, Station Road, Porbandar, Gujarat.	-	Mewasa	0.81	5.9.2004
39.	-do-	Mewasa No.138 412	B	1.6	-do-	-	Mahadevia	3.24	2.8.2003
40.	-do-	Mahadevia	B	-	Saurashtra Calcine Bauxite & Allied Ind. "Kamal Vihar" Station Road, Porbandar, Distt. Junagadh (Gujarat)	-	Kenedial	32.86	-
41.	-do-	Kenedi Lol	B	-	-do-	-	Mota Asota	32.37	2.8.2003
42.	-do-	Mota Asota	B	-	-do-	227/1, 228(P)	Mewasa Ran	3.12	5.9.2004
43.	-do-	Mewasa field	B	-	-do-	-	-	-	-
44.	-do-	Mewasa Sr. No.138	B	1.50	-do-	-	Mewasa	3.44	2.8.2003
45.	-do-	Mewasa Sr. No.214	B	O/B removal work	-do-	403	Ram	5.27	19.4.1999
46.	-do-	Ram	B	-	-do-	352(P)	Kenedy	17.91	15.6.2000
47.	-do-	Kenedy field	B	-	-do-	768(P)	Khakhanda	29.57	16.4.2000
48.	-do-	Khakhanda	B	-	Western Abressive Industries B-1, 1st floor, New Super Mkt. Bedi Gate, Jamnagar, Distt. Jamnagar, Gujarat.	-	-	-	-

	1	2	3	4	5	6	7	8	9	10
49.	Gujarat Kutch	Rata Talab (275 part)		B	5.30	Orient Abrasive Ltd., P.O. BALCO, Distt. Junagadh Porbandar, Gujarat.	275/P	Motibelechod	110.07	2.3.1999
50.	MADHYA PRADESH Bilaspur	Phutkaphar		A	0.59	Bharat Aluminium Co. Ltd., P.O. BALCO, Township Korba, Distt. Bilaspur, M.P. Pin-495-684	-	Phutkaphar	281.06	29.6.1999
51.	Jabalpur	Tikuri Rd. side		A	1.23	Associated Cement Co. Ltd., Cement House, 121, Maheshi Karve Road, Bombay-M.S. Pin. 400020	188	Tikuri		20.12.2000
52.	Mandla	Hazari- Gedar		A	-	Bharat Aluminium Co. Ltd., P.O. BALCO, Township, Korba, Distt. Bilaspur M.P. Pin-495684	-	HazariGedar Karjia	987.00	29.3.1988
53.	-do-	Nanhoodadar		A	0.65	-do-	01029 to 1037,1041 1942,1944	RaktiGedar	1052.0	1.9.99
54.	-do-	RaktiGedar		A	0.53	-do-	-	-	-	-
55.	MAHARASHTRA Kolhapur	Kasarada		A	23.07	Indian Aluminium Co. Ltd., 1, Middleton street, Calcutta West Bengal, Pin-700016.	16,17,87 89 etc.	Baleni Kekre etc.	319.70	20.5.58
56.	Kolhapur	Nagaraswadi		A	5.20	Indian Aluminium Co. Ltd., 1, Middleton street, Calcutta, West Bengal, Pin-700016.	Chandgarh & Ajora Taluka (Entire area under Forest land)	Nagaraswadi	234.00	20.6.98
57.	ORISSA Korapur	Ranchpatmali		A	18.35	National Aluminium Co. Ltd., 8th floor, ILCO Tower, Jaipath, Bhubaneswar, Distt. Furi, (Orissa).	-	Ranchpatmali	469.058	16.11.2012

TABLE 9.4 CATEGORISATION OF BAUCITE MINES (IN PRODUCTION RANGES) IN INDIA FOR THE YEAR 1990.

Sl.No.	Names of Mines with address	Mines below 75,000 t Nos. of mines (state-wise).		No. of Mine
		Between 50,000 t & 75,000 t	Between 25,000 t & 50,000 t	
1.	Panchpatmali (18,49,707) M/s National Aluminium Co. Ltd., Distt. Koranur State Orissa.	Between 50,000 t & 75,000 t Mines with address.	Between 25,000 t & 50,000 t Mines with address.	25
2.	Kasarada (3,57,600) M/s Indian Aluminium Co. Ltd., Distt. Kolhapur, Maharashtra	1. Movasa (74,755) M/s S.M.D.C. Ltd., Distt. Jamnagar State Gujarat	1. Guruchaxi (37,400) M/s Hindustan Aluminium Co. Ltd., Distt. Gumla, State Bihar.	3
3.	Shrengda (2,12,000) M/s Hindustan Aluminium Co. Ltd., Distt. Gumla State - Bihar.	2. Masidappat (60,800) M/s Hindustan Aluminium Co. Ltd., Distt. Lohardaga State - Bihar.	2. Nagma (32,606) M/s Cheogoresad Pochar Distt. Gumla State Bihar	95
4.	Begru Hill (1,89,381) M/s Madan Mohan Pal Singh Co. Ltd., Distt. Lohardaga, State - Bihar.	3. Raptidehar (99,984) M/s Bharat Aluminium Co. Ltd., Distt. Mandla State M.P.	3. Pokhar (33,000) HINDALCO Distt. Lohardaga State Bihar	2
5.	Nagaraswadi (1,68,774) Indian Aluminium Co. Ltd., Distt. Kolhapur, Maharashtra.	TOTAL 3,41,846 t (7.0)*	4. Manduapat (45,500) M/s Minerals & Minerals Ltd., Distt. Lohardaga, Bihar.	48
6.	Nandem (1,42,023) Bombay Minerals supply Co. Pvt. Ltd., Distt. K. Jamnagar (Gujarat).	TOTAL 1,95,537 t (4.0)*	5. Karan kind (44,265) Bombay Minerals Supply Co. (P) Ltd., State Gujarat	2
7.	Kshoka Meyara (1,00,02-6) M/s Bombay Minerals supply Co. (P) Ltd., Distt. Jamnagar, State (Gujarat).	TOTAL 32,20,221 t (67.2)*	6. Mahadevta (29,144) Carborundum - Universal Ltd., Distt. Jamnagar, State Gujarat.	4
			7. Rata Talab (24,140) M/s Orient Abrasives Ltd., Distt. Kutch State - Gujarat.	4
			8. Burdoor (37,214) M/s Mysore Minerals Ltd., Distt. South Kanara State Karnataka	2
			9. Keshkal (32,000) M.P. State Mining Distt. Bastar State - M.P.	2
			10. Tukuri Rd. Side (39,965) The A.C.C. Ltd., Distt. Jabalpur State - M.P.	2
			11. Amarkantak (40,907) M/s Hindustan Aluminium Co. Ltd., Distt. Shadol State M.P.	3
			12. Alumina (27,840) T.N. Shaik Dawood Distt. Milgiri State - Tamil Nadu	48
			13. Shervroy (43,136) Madras Aluminium Co. Ltd., Distt. Salem, State-Tamil Nadu.	2
			14. Kollihills (36,995) Madras Aluminium Co. Ltd., Distt. Salem, State T.N.	4
			15. Narro Hill (32,655) M/s M.P. State Mining Corp. Ltd., Distt. Satna, State M.P.	2
			TOTAL 7,48,098 (15.4)*	178

\* Production Percentage with respect to total yearly production.

During 1990 number of mines producing between 75,000 t and 100,000 t & 50,000 and 75,000 t were three under each category. Fifteen mines which contributed 11.2 % of the total production in 1990 were in the production range of 25,000 t to 50,000 t. There are in all 178 mines below 25,000 t production capacity, contributed only 15.4 % of the total production in 1990.

### 9.2.3 Captive Mines

The state and districtwise list of captive working bauxite mines alongwith their category (based on MCIER '88), location of mining leaseholds and its details are given in table No: 9.3.

### 9.3 BAUXITE MINING

Around 90 % of world bauxite production comes from opencast mining. In India Bauxite mining is carried out by opencast method only.

Bauxite formation comprising loose pisolites and oolites or sandy matrix are normally easy to mine. These are sometimes ripped and dozed to facilitate digging. Indurated bauxite requires drilling and blasting. Loading is usually done either by front-end-loaders or traxcavators or by shovel/hydraulic excavators into dumpers/rail cars for transporting it to crushing plants or stockpiles. Depending upon the thickness of bauxite deposit mining is done either in single lift operation or several lifts by forming number of benches as required.

Bauxite mining involves three stages.

- i) Removal of top soil and morrum which normally varies in thickness from 0.3 m to 3 m.
- ii) Mining of hard lateritic overburden (OB) by drilling and blasting. Holes are drilled manually by crawbars in manual mines.



- iii) After removal of O.B. mining of bauxite is taken up. In case of semi-mechanised/mechanised mines drilling is done by Jack hammer drills and where large quantity of overburden/bauxite are required to be mined, drilling is carried out by larger diameter (100 mm diameter) drills. Bench height in overburden/bauxite is normally kept between 3.0 m to 5 m.

#### 9.3.1 BIHAR

Bauxite mining in Chhotanagpur Plateau, Bihar is restricted mainly to Lohardaga and Gumla districts. Bauxite from this region contributed about 16% & 19% of total Indian production during 1989 and 1990 respectively. Towards south of Netarhat plateau, float ore mining is carried out in the upper middle western part in mouza Amtipani in district Gumla.<sup>(1)</sup>

#### Bauxite Mining Scenario in Bihar

M/s Hindalco Industries Ltd., M/s Indian Aluminium Company Ltd. (INDALCO), and M/s Minerals and Minerals Ltd., a sister concern of HINDALCO are captive mine owners in the region. The working mining leases cover a total of 3891.21 ha area in the state, out of which captive mines cover a total M.L. area of 1707.12 ha; (Table 9.3), produced 4,06,950 tonnes i.e. 8.4% of total Indian production during 1990. Total idle M.L. area in the state was 827 ha as on 1.1.90. Bauxite from the region was mainly supplied to the aluminium industry although some quantities of bauxite were supplied to refractories, steel and chemical industries. In the mines of M/s Hindalco Industries Ltd., mining operation is carried out by partial deployment of machinery whereas in Bagru Bhusar mine of M/s Indian Aluminium Co. Ltd., entire operation is carried out by mechanisation mainly because of uniform nature of deposit. In other private small mining leases mining is done by manual method with chisel, crow bars, hammers and spades as nature of the deposit is erratic. In mechanised mines ore to waste ratio varies from 1:2 to 1:3<sup>(1)</sup>.

In Lohardaga district Manduapat Bauxite lease owned by M/s Minerals and Minerals Ltd. Mining is continuing since last 30 years. Method of mining adopted is semi-mechanised

opencast mining. Maidanpat mine of M/s Hindalco Industries Ltd., is worked by semi-mechanised opencast method of mining. Bagru Hill mine of M/s Madan Mohan Pd. Singh is mostly worked by manual opencast method.<sup>(1)</sup>

Jalim Senai, Gurdari and Shrengdag Mines of M/s HINDALCO

In Gumla district Jalim Senai, Gurudari and Shrengdag mining leases of M/s HINDALCO Industries Ltd. are worked by manual and semi-mechanised opencast method. The production in 1990 as recorded was 2000 t from Jalim Senai, 37000 t from Gurdari and 2,12,000 t from Shrengdag mines respectively.<sup>(2)</sup>

Bagru Hill Mine of M/s, INDAL

Bagru Hill mine of M/s INDAL has much less M.L. area than the M.L. area in the Gurdari and Shrengdag mines of M/s HINDALCO. But the Bagru Hill mine is worked by mechanised opencast method and it has given maximum OMS, 6.12 t/manshift during the year 1989-1990, in the state. Mining operation in these mines is carried out by opencast method. Overburden is worked in benches in stages, top soil bench 1 to 1.5 m height, loose overburden bench (2 to 3 m height), laterite bench (2 to 3m height), bauxite is mined in one or more benches each of 1.5 m to 3m height.

In case of small mine bauxite is mined manually for better quality control. Blasting is carried out by special gelatine 80%, LOX and ANFO in shallow Jack Hammer drilled holes. The overburden is loaded into the dumpers either by Terex wheel loader or Poclain hydraulic excavator and dumped in the worked out areas. In case of manual mining blasted ore is manually sized and sorted at faces. These are then stacked gradewise and sizewise and despatched to the railway siding.<sup>(2) (4)</sup>

Performance of Mining equipments

The performance of the drilling equipments and the dumpers during 1990 for the different mines of M/s HINDALCO & Minerals & Minerals Ltd. are given in Table No.9.5.<sup>(2)</sup> Performance of drilling equipments and the dumpers for 1990-1991 for the Bagru Hill mine of M/s INDAL are given in Table 9.6 & 9.7.<sup>(4)</sup>

TABLE 9.5 PERFORMANCE OF EQUIPMENT IN MINES OF M/S HINDALCO

MINEALS & MINERALS LTD  
Mandapat Pekar

Maidapat Pekar Ruch. at Shrengdag Jalim & Senai Gurdari  
1. 2. 3. 4. 5. 6. 7. 8.

PERFORMANCE OF DRILLING EQUIPMENTS DURING 1990:

	1	2	3	4	5	6	7	8
Machinery Atlas Compressor (nos.in use)	1	2	3	4	5	6	7	8
Wagon Drill (100 mm dia)	1	-	-	2	-	-	4	-
Scheduled hour of working	6400	2852	1350	6400	1350	2650	6826	2852
Break Down hours of working	1083	456	525	1390	525	213	1043	252
Available hours of working	5317	1810	825	4990	825	2110	5614	1530
Operated hours of working	2859	1252	665	4002	665	1923	2249	1370
Idle hours of working (due to bad weather & absent among the Operators etc.)	585	558	185	998	185	197	3165	160
% of availability	83%	63%	62%	78%	62%	80%	83%	54%
% of utilisation	53%	69%	81%	80%	81%	91%	40%	90%
Meterage Drilled/hr. of operation	23	24	28	31	28	14	25	30

PERFORMANCE OF DUMPERS DURING 1990:

	5	4	5	5	3	3	3	3
Number of Dumpers	5	4	5	5	3	3	3	3
Schedule hour of working	13800	8540	10750	10750	8001	8001	8001	8001
Break Down hour of working	915	1075	3375	3375	1050	1050	1050	1050
Available hours of working	8890	6690	7375	7375	6951	6951	6951	6951
Operated hours of working	8508	6274	7139	7139	4448	4448	4448	4448
Idle hours (due to bad weather & absenteeism among Operators, etc.)	382	416	242	242	2603	2603	2603	2603
% of availability	83%	78%	69%	69%	87%	87%	87%	87%
% of Utilisation	96%	94%	97%	97%	64%	64%	64%	64%

TABLE 2.6 PERFORMANCE OF DRILLING EQUIPMENTS IN BAGRU HILL MINE OF JINDAL FOR 1990-1991

YEAR	DRILLING MACHINERY	SCHEDULE HRS.	BREAKDOWN HRS.	MACHINE AVAIL. HRS.	POWER FAIL- URE HRS	PRODUCTION OPERATED HRS	IDLE HRS	MACHINE AVAIL- ABILITY %	UTILISATION %	METERAGE DRILLED	METER / OPER- ATING HRS.
1990-91	F01	663	188.00	623.00	N.A	623.00	48.50	77.58	92.22	5248.51	9.51
						574.50	1.00(EH)			231.28	
	P02	258	65.00	173.00	N.A	173.00	23.00	67.65	84.71	1528.88	18.14
	BTH	1846	43.25	1802.75	N.A	1802.75	75.00	95.87	92.07	11264.91	12.14
						927.75	3.5(MH)				
	JACK HARMEK					436.75				4688.92	
						5.50					

E H = EXTRA HOUR

M H = MISCELLANEOUS HOUR

TABLE 9.7 : PERFORMANCE OF DUMPERS IN BAGRU HILLS BAUXITE MINE OF  
M/S. INDAL LOCATED IN LOHARDAGA DISTT. BIHAR IN 1990-91

SL. No:	SCHEDULE HR	BREAKDOWN HR	AVAILABLE HR	OPERATED HR	IDLE HR	MACHINE AVAILABLE %	UTILISATION %
TEREX 1	2420.00	389.00	2031.00	1602.00 +35.00 (M.H) + 1.50 (E.H)	394.00	83.93	80.60
TEREX 2	2441.00	833.25	1607.75	1282.25 +20.00 (M.H) +4.30 (E.H)	305.50	65.86	81.00
TEREX 3	2452.00	328.50	2125.50	1774.00 +43.50 (M.H) + 9.50 (E.H)	306.00	86.60	85.50
TEREX 4	2456.00	603.00	1853.00	1531.00 +21.00 (M.H) +16.00 (E.H)	301.00	75.45	83.76
TEREX 5	2462.00	147.00	2315.00	1994.25 + 3.00 (M.H) +41.00 (E.H)			

NOTE : M.H = MISCELLANEOUS HOUR

E.H = EXTRA HOUR

### Conservation of Mineral

So far as the conservation of mineral is concerned M/s INDAL is taking care by following systematic exploration programme. They have adopted proper blending programme by mixing the bauxite of Bhusar and Bagru north-east quarries. The advance drill hole system has helped them to achieve effective blending. From bauxite horizon, they do not reject any material, even the powdery ore are also being utilised as observed in Bhusar quarry.<sup>(4)</sup>

Although M/s Hindalco have carried out initial exploration, to know the quality of the ore, but they could not adopt any suitable blending programme, because of high proportion of low grade bauxite in some of their quarries, and even they had to surrender Birhnipat lease because of this reason.<sup>(1)(2)(3)</sup>

#### 9.3.2 MAHARASHTRA

In Maharashtra Bauxite is mined mainly in Kolhapur district, by M/s Indian Aluminium Co. Ltd., (INDAL). INDAL operates two opencast mechanised mines viz. Nagrtaswadi and Kasarsada bauxite mines. Two other small leases are operated manually by M/s Padmavati Mining Co. and M/s Swati Minerals at their Kasarde and Udagiri leases respectively over the Udagiri Plateau.

The maximum elevation of the plateau above M.S.L. is 1028 m. The thickness of overburden varies from 1.5 m to 4.5 m (average 3m). The development work is mainly concentrated in eastern part of the leasehold since main plateau has almost been depleted. Gibbsite (major), Haematite, Goethite, Bohemite, Kaolinite, Limonite are the constituent of Ngarataswadi bauxite. The dip of laterite bauxite bed is almost horizontal.<sup>(1)</sup>

#### Ngarataswadi Mine<sup>(6)(7)</sup>

In this mine, mining is carried out by mechanised opencast method. Two benches have been developed, one in

overburden with an average height of 3 m, length 500 m and 20 m width. The bauxite bench has an average height of 5m, length -400 m and width -20 m. The bench slope has been maintained between 10 to 15° from vertical. The working cycle is one shift for production of bauxite and two shifts for maintenance. Mining activities are in progress in eastern block.

Bauxite is mined in both Ngarataswadi and Kasarsada mines in dry seasons i.e. from Oct. to May. Average daily production of Ngarataswadi mine is between 800 tonnes to 1000 tonnes of bauxite. Bauxite face is exposed after the overburden is ripped and dozed for loading. When ripper (Komatsu D-355) is not available then drilling is done by ATLAS Copco - BVB - 25 (115 mm dia) drill upto a pre-determined depth in bauxite strata, maximum upto a depth of 7 m with an average spacing and burden of 3.5 m x 3m. Site-mixed Ammonium Nitrate Fuel Oil Mixture with slurry explosives are used for blasting. Electric delay detonators are used for the initiation of charge. Boulders generated in primary blasting or during ripping, which are likely to create problems in Jaw crusher are drilled by Jack Hammer, charged with 25 mm dia. slurry explosives and blasted. DEEMAG (H40) Hydraulic excavator of 2m<sup>3</sup> bucket capacity and CATERPILLER (977L) trackavators are used for loading broken bauxite ore into TEREX (25 tonne) dumpers to haul the ore from mine face to the double Pitman Jaw crusher (crushing capacity - 250 tonnes per hour). Crushed bauxite ore -130 mm is conveyed to the storage bunker (1000 tonnes capacity) by a 750 mm conveyer belt. Crushed ore is transported by trucks (10 tonne capacity) to the alumina plant (1,80,000 tonnes/year) of the company, situated at a distance of 57 kms from mine. Cost of ore transport from Ngarataswadi crusher to the alumina plant is approximately Rs.51 per ton. 60,000 tonnes alumina produced from the Belgaum plant is exported annually to the foreign countries.



Till March, 1991, M/s INDAL has mined from Ngarataswadi mine 55.3 lakh tonnes of bauxite and 50.5 lakh tonnes of overburden since 1969. The marginal grade ore of  $-10\% \text{SiO}_2$  and  $-45\% \text{Al}_2\text{O}_3$  termed as 'Aluminous laterite' is found suitable for application in the cement plants. These are sorted out from the overburden mined so far and sold to the interested buyers. Aluminous laterite sold by M/s INDAL has been of the order of 1.878 lakh tonnes (as on 1.4.1991).

KASARSADA MINE (8)(9)

The mining lease is in forest land in Kolhapur distt., has a maximum elevation of 1056 m above MSL. The development work was started from 1980. The main working pit measures 480 m (L) x 200 m (W) with a varying depth from 9 m to 12 m. There are two separate benches, one in overburden and the other one in bauxite. The maximum height of overburden bench and ore bench is 6 m and the width of benches being 20m. The bench slope is approximately  $10^\circ$  from vertical. The ratio ore to overburden is 1:0.8. The pattern of drilling is same as that followed in Ngarataswadi mine. During monsoon about 2000 t of overburden is mined daily by CK-90 (POCLAIN) traxcavator.

Performance of Mining Equipments

The performance of drilling equipments at Kasarsada and Ngarataswadi mines are given in Table 9.8 & 9.9 respectively. The average rate of drilling varies from 11.10m/hr. to 12.75m/hr. Performance of loading equipments at Ngarataswadi and Kasarsada mines are as indicated in Table 9.10 & 9.11. Productivity of heavy earth moving machineries for Ngarataswadi and Kasarsada mines are given in Table No. 9.12 & 9.13 respectively. On an average Kasarsada mine transports about 2,200 t bauxite daily to the Belgaum Alumina Plant by hired/company's trucks. The average cost of transport from the ore bunker of the mine to Alumina plant is Rs. 47/t. Production is carried out in one shift







TABLE 9.10 PERFORMANCE OF LOADING EQUIPMENT OF NGARTASWADI MINES (M/S. INDAL)

Period	Shovel	Schedu- led Hours	Break- down Hours	Machine Avail- able Hours	Operating Hours	Idle Hours	Machine % Availability	Utilisation of availa- bility
1990	Poclain CK90	967	253	714	557.	158	73.87	77.94
	Demag H40	1841	580	1261	1089	172.5	68.50	86.32
	Traxcavator	1384.5	640	745	711	34	53.77	95.43

TABLE 9.11 PERFORMANCE OF LOADING EQUIPMENT AT KASARSADA MINES (INDAL)

Period	Shovel	Schedu- led Hours	Break- down hours	Machine Avail- able Hours	Operating Hours	Idle Hours	Machine % Availability	Utilisation of availab- ility
1990	Demag H 36	2159	858	1302	1216	86	60.28	93.43
	Demag H 40	2494	505	1989	1936	53	79.75	97.36
	Traxcavator	1395	609	696	678	18	53.33	97.41

TABLE 9.12 PRODUCTIVITY OF HEAVY EARTH MOVING MACHINERY AT NCARTASWADI MINE (M/S, INDIA)

Sl.No.	Name/Type of Equipment	Capacity	Tonnage Handled for last 3 years upto March'91	Operating Hours upto Mar. 1991.	No. of Units Available for work	Productivity		Productivity of Equipments		
						1988/89	1989/90	1988/89	1989/90	
1.	Ripper Dozer 355D	200T/HR	632302	9575	1	1	200	172	141	186
2.	Hyd. Shovel M40	3 cub.mtr	687849	6648	1	1	200	171	154	112
3.	Hyd. Shovel CK-90	1.2cub.mtr.	78625	815	0	0	125	-	-	96
4.	Traxcavator	2.5cub.mtr.	4349	160	1	1	150	NA	NA	27
5.	Terex Dumper1	25 T	255854	17672	1	1	75	75	74	71
6.	Terex Dumper2	25 T	295090	18059	1	1	75	93	68	68
7.	Terex Dumper3	25 T	237926	7735	1	1	75	68	83	66
8.	Crusher (Double Pitman Jaw Crusher)	250T/HR	743905	30562	1	1	250	178	152	116

TABLE 9.13 PRODUCTIVITY OF HEAVY EARTH MOVING MACHINERY AT KASARGADA  
BINES (INDIA)

Sr.No.	Name/Type of Equipment	Capacity	Tonnage Handled for last 3yrs. Upto March '91	Operating Hours Upto March '91	No. of Units Available for work 1988-89 89-90 1990-91	Productivity Norm T/HR	Productivity of Equipments Achievements per hour		
							198-89	1989-90	1990-91
1.	Hyd Shovel 1 H36	3 cub.mtr.	869539	11235	1 1 1	200	193	170	178
2.	Hyd. Shovel H-40	3 cub.mtr.	647546	3421	0 1 1	200	—	206	179
3.	Hyd. Shovel CK.90 (Poclain)	1.2 cub.mtr.	8590	122	0 0 1	285	—	—	70
4.	Traxcavator	2.5 cub.mtr.	295977	9665	1 1 1	150	98	75	43
5.	Terex Dumper 1	25 T	443442	14715	1 1 1	100	117	109	111
6.	Terex Dumps 2	25 T	386995	11512	1 1 1	100	59	114	125
7.	Terex Dumper 3	25 T	587589	5967	1 1 1	100	78	102	114
8.	Terex Dumper 4	25 T	367084	4089	1 1 1	100	50	78	100
9.	Crusher (Single Pitman Jaw)	250 T/HR	1097861	8384	1 1 1	250	2197	188	206

9.3.3

ORISSAPANCHPATMALI BAUXITE MINE OF M/S. NATIONAL ALUMINIUM COMPANY LIMITED

Panchpatmali Bauxite Mine is the Asia's largest bauxite mine. 'Panchpatmali' means five flat-topped hills. These hills hold the world's largest single-capping bauxite deposit. With reserves around 377 million tonnes, Panchpatmali can be easily compared to Boke in Guinea and Weipa of Australia. (13)

There are two contiguous blocks of leaseholds totalling 7204.74 hectares area. The deposit in the area has been further divided in two parts, sector-I and sector-II, which are connected by a narrow strip called the 'chicken neck'.

This high-level lateritic bauxite deposit occurs as a capping over the plateau top 1204 m above sea level. It has been formed by residual weathering of parent rock Khondalite of Eastern Ghat series. The deposit extends over a length of 21 km in general NNE-SSW direction and attains an average width of 800 metres. Average thickness of Bauxite is 14 m.

The fully mechanised Panchpatmali mine owned by M/s NALCO is designed to produce 2.4 million tonnes of bauxite per year, which is more than 60% of India's total bauxite production. The average grade of bauxite is  $Al_2O_3$  44.6%,  $SiO_2$ -2.3%. (14)

The overburden measuring upto 3 metres in thickness is ripped almost entirely by 700 HP CATD - 10 ripper-dozer. Drilling and blasting in ore zone is carried out with 150 mm dia. holes drilled by track mounted rotary blasthole drills in grids of 4.7 m x 4.7 m. Benches are 8-10 m high. Site mixed ANFO explosive is used for blasting. At the mine top, a single stream double roll toothed crusher of 900 TPH capacity crushes the ore from 85% minus 800 mm down to 85% minus 150 mm. Backhoes are used to excavate and load bauxite from the crevical portions in the floor of the deposit.

Productivity during the year 1990-91 for Blasthole drill machine, dumpers and heavy earth moving equipments were 14.75 m/hr. 138 tonne per hour and 313 tonnes per hour respectively, which can be considered to be quite satisfactory. The details of earth moving machineries deployed in Panchpatmali mine with their make and model etc. is given in Table-9.14

#### Trench mining (14)

NALCO has employed a new mining system, i.e. trench mining, in which bauxite mining is carried out by developing parallel trenches of varying widths and staggered faces, where the trench normally has an advance direction along the axis of the plateau (Fig.No.9.1) The levels of the trenches vary depending upon the thickness of bauxite. These trenches are planned in such a way that they follow the contour and topography of the plateau of bauxite without much loss or dilution. They also help in proper blending, grade control and to mine bauxite with a cut off grade as low as 20%  $Al_2O_3$ .

In a trench, after removal of the overburden, ore recovery is carried out in two separate phases -

- mass mining of most of the bauxite layer,
- selective mining of the remaining bauxite in contact with the wall for highly mineralized areas.

During the first phase of mining, trench floors are kept slightly sloping through temporary leaving of ore. Slopes do not exceed 3% length wise and 1.5% crosswise. This practice is adopted to ensure adequate working space for the equipment and proper drainage of trenches. Water drains from the upstream trenches to the downstream mining areas.

#### Advantages

The following advantages are significant in trench mining-

- \* Numerous mining sites are available and can be worked concurrently.
- \* Maximum mining depth is within mineralized zone.
- \* Adaptability to geological disturbances in the deposit, results in lower losses and dilution factors.
- \* Convenient worksite dimensions permit to concentrate mining equipment in a working area and minimise travel





A Panoramic View of Panchajalmi Bauxite Mine of NALCO

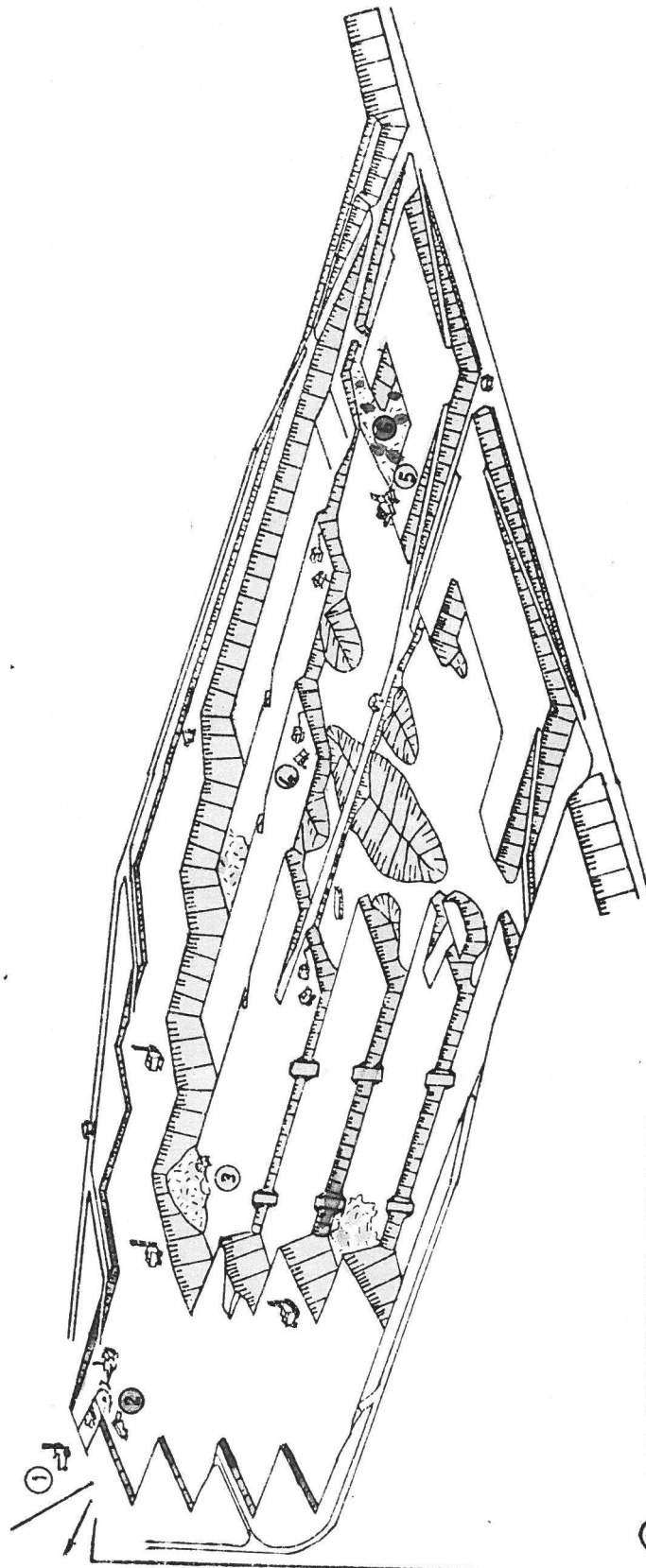
TABLE 9.14 PANCHPATMAL BAUXITE MINE (NALCO)  
DETAILS OF HEAVY EARTH MOVING MACHINERIES

Sl.No.	Model/HP	Make, Machine Sl.No., and capacity
(1)	(2)	(3)
1.	H-51 Back Hoe 256 HP	Hind Motors Sl.No.51026 Demag Hydraulic shovel, 3m <sup>3</sup>
2.	PC-650 Hydraulic Front End Loader, Shovel 410 HP	B.E.M.L. Sl.No. 10077 Front end Loader, 4.8m <sup>3</sup>
3.	325/HP	L & T Sl.No.-8070 300 CK Poclairn 3m <sup>3</sup>
4.	325 HP	L & T Sl.No.8071 300 CK Poclairn 3 m <sup>3</sup>
5.	325 HP	L & T Sl.No. 8077 300 CK Poclairn 3 m <sup>3</sup>
6.	103 HP	L & T Sl.No.C039 Hydraulic Rock Breaker
7.	72-718 Terex 380 HP	Hind Motors Sl.No.226032 Wheel Loader 5.7m <sup>3</sup>
8.	988 B Model 375 HP	Caterpillar Chassis No. 50W06420 Wheel Loader 5.7m <sup>3</sup>
9.	988B Model 375 HP	Caterpillar Chassis No. 50W06421 Wheel Loader 5.7m <sup>3</sup>
10.	988B Model 375 HP	Caterpillar Chassis No. 50W07116 Wheel loader 5.7m <sup>3</sup>

1	2	3
11.	9888 Model - 375 HP	Caterpillar Chassis No. 50 W 07122 Wheel Loader 5.7 m <sup>3</sup>
12.	9888 Model - 275 HP	Caterpillar Chassis No. 50 W 07118 Wheel Loader 5.7 m <sup>3</sup>
13.	9888 Model - 375 HP	Caterpillar Chassis No. 50 W 07127 Wheel Loader 5.7 m <sup>3</sup>
14.	-	B.E.M.L. Sl.No. - 097 Mdl.G1420 Front End Loader
15.	ADM-01 260HP	D.J.B. Sl.No.35 DT 68302 Dumper
16.	ADM-02	D.J.B. Sl.No.35 DT 6831 Dumper
17.	130HP	INGERSALL Sl.No.77DM76 IDM-15 (100mm dia)
18.	130 HP	INGERSALL Sl.No.77DM77 IDM - 15 (100mm dia)
19.	274 HP	INGERSALL Sl.No.77DM77 IDM - 30 (150mm dia)
20.	274 HP	INGERSALL Sl.No.840628 IDM-30 (150mm dia)
21.	274 HP	INGERSALL Sl.No.8406258 IDM-30 (150mm dia)

1	2	3
22.	380HP 850000000 each	35t Rear Dumpers (3 EML)
23.	D-355 Dozer/ 410 HP	8 EML 2 Nos.
24.	D-155 Dozer/ 320 HP	8 EML 2 Nos.
25.	Motor Grader 165 HP	8 EML 1 No.
26.	D.-10 Dozer/ 700 HP	Catterpillar

KH /



- ① PRE-PRODUCTION DRILLING
- ② OVER BURDEN STRIPPING
- ③ MAIN BAUXITE MINING
- ④ BOTTOM BAUXITE MINING
- ⑤ WASTE DUMP/BACK FILLING AFTER BAUXITE MINING
- ⑥ PLANTATION IN BACK FILLED AREA AFTER BAUXITE MINING

FIG. 9.1- SCHEMATIC DIAGRAM OF TRENCH MINING METHOD

The production of bauxite from Panchpatmali mine during 1989 and 1990 was 2.0 million tonnes and 1.85 million tonnes respectively. The overburden excavated from the mine from 87-88 to 90-91 is given in table No. 9.15. The area covered by pits/quarries and dumps in the mine is 60 ha. and 70 ha respectively. So far NALCO has reclaimed 2 ha area.

A stockpile with a capacity of about 80,000 tonnes is maintained during monsoon. Transportation of bauxite from the Panchpatmali mine to the Alumina refinery at Damanjodi having a difference of altitude of 340 m over a very difficult undulating terrain is by a cable belt 14.6 kms, the longest in world. The long-distance single flight conveyor has been provided with a variable speed drive arrangement with speed up to 4.5 m/sec. corresponding to the conveying capacity of 18000 TPH or 4.8 M TPY. The conveyor belt is supported entirely by two endless steel wire ropes, one at each side of the belt that transmits the driving tension. The bauxite is spread on two stockpiles in the Alumina Plant stockyard by a 1200 tph stacker from where it is reclaimed for crushing by a reclaimer (700 TPH capacity) of bucket wheel type. The bauxite supply and reclamation system operates for 12 hours a day. (10) (11)

TABLE 2.15. FINANCIAL YEAR WISE OVERBURDEN EXCAVATION FROM PANCHPATWALI MINE

<u>Year</u>	<u>OB Excavation</u>
87-88	4,47,755
88-89	2,71,990
89-90	4,92,078
90-91	6,60,970
Total	18,72,791

MINE DESIGN (10) (11)

Mine design concept is in keeping with the latest trends in the world. NALCO has introduced the concept of geostatistics, deposit modelling, mine modelling, operations simulation and computerised mine planning in the initial stage of mine design. HCL computers have been introduced in the mine for the jobs of mine planning. A flow chart of computer aided mine planning is shown in Annexure-I.

Pre-production drilling data are used for analysing the deposit behaviour and obtaining reliable estimates in 25 x 25 m blocks by applying advanced computerised geo-statistical methods. These estimates are made taking into account local features in the deposit and behaviour of ore-body in 3 dimensions. The parameters thus obtained like overburden thickness, ore thickness, reserves and grade in each block with roof and floor levels of bauxite are considered for mining studies using the software programmes. This helps in selecting different levels and bench height for effective mining operations. It gives mineable reserves and ROM quality for each bench. Based on these parameters of different blocks, detailed operational plans are prepared.

Monitoring through Computer (21)

To achieve high productivity and reduce mounting cost of down-time of mining equipments, various data are recorded and stored in the computer in a basic data file and retrieved or processed in different ways for their performance evaluations. These cover the following areas -

- 1) Monitoring of mining activities -



- Performance of the mine is analysed on daily, weekly and monthly basis.
- The productivity of every major mining equipment in their respective fields are calculated on day today basis. Efforts are made to improve the productivity of the equipment as per the basic engineering norms.
- Idle time analysis of every mining equipment is carried out. For this purpose, all the idle time is divided in five different groups such as fuel filling, person not available, materials not available, complementary equipment not available, stand by, operational delay, and bad weather. Then the maximum idle time of each equipment is analysed and efforts are made to reduce it.
- For every blast all relevant data are recorded which helps to optimise the blasting pattern and cost of the blast.
- The operator's efficiency is also analysed.

ii) Mechanical

- The historical record of all mining equipments are stored which helps for preparing maintenance schedule of the equipment.
- Down time analysis is also made to reduce the frequent breakdown of the equipment.

iii) Miscellaneous

- Comparison of target with achievement as per the production planning and analysis of shortfall is made and analysed for future improvement.
- The availability and utilisation hours of the mining equipment are also computed and compared with the monthly planning figures.

- Calculation of OMS and cost per tonne of bauxite produced are done.

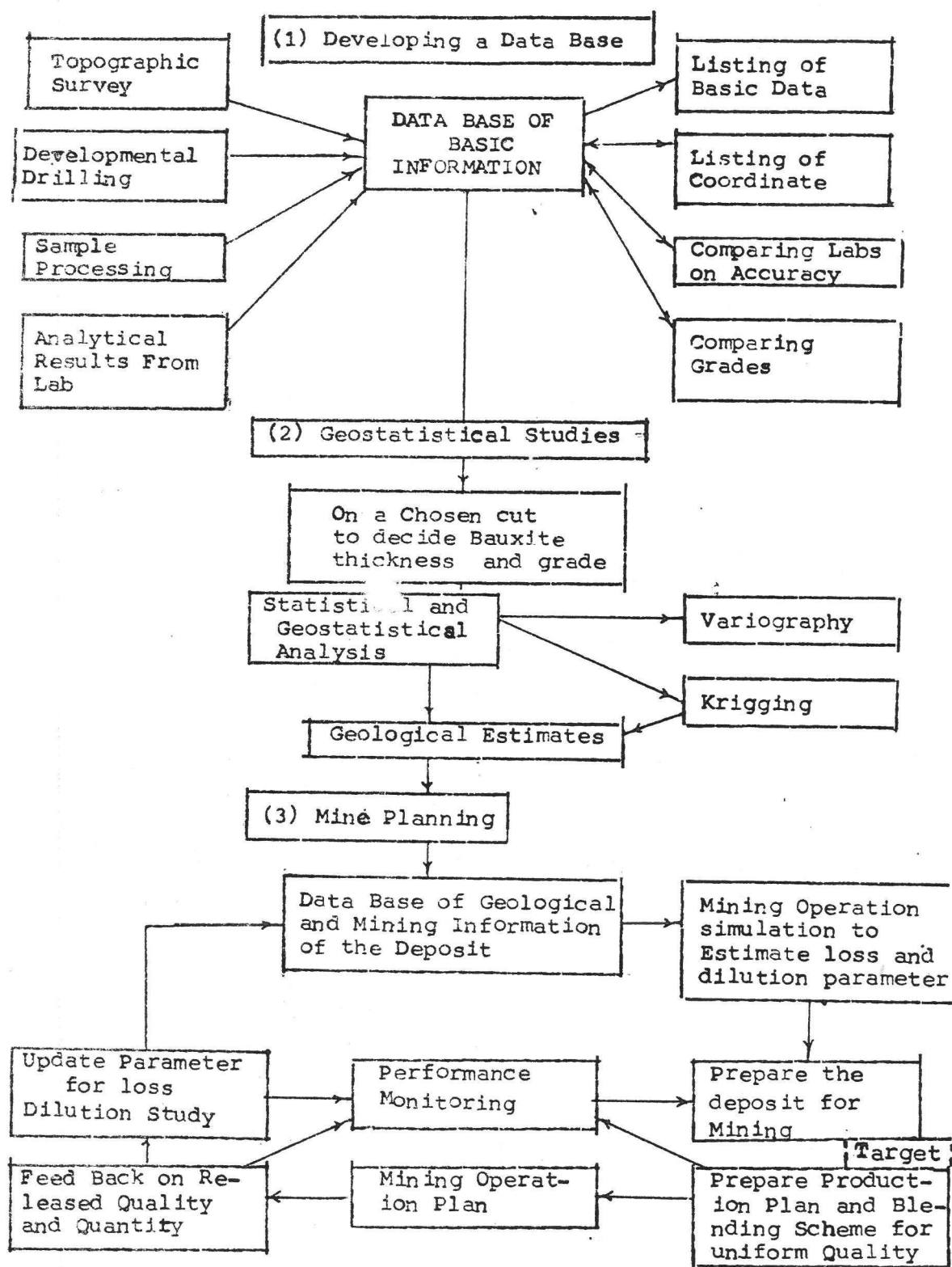
Analysis performance of mine include the activities of all concerned departments such as production, mechanical, electrical, finance, geology, materials, environmental/horticulture and personnel administration, which render a great help for reducing downtime, cost of transportation and optimising the use of equipments in the best possible way.

#### Expansion of Integrated Aluminium Complex<sup>(12)</sup>

Government of India has approved the preparation of a Detailed Project Report for the expansion of NALCO's integrated aluminium complex including following units :-

- Bauxite mines from 2.4 million tpa to 3.6 million tpa.
- Alumina refinery from 8 lakh tonnes to 10 lakh tonnes.
- Aluminium smelter from 2.18 lakh tpa to 3.33 lakh tpa.
- Captive Power Plant - addition of 7th and 8th Units of 120 MW each.
- Semi fabrication facilities for 40,000 tpa of rolled products.

COMPUTER AIDED  
MINE PLANNING  
SYSTEM OF FLOW CHART



9.3.4 MADHYA PRADESHAMARKANTAK MINE OF M/S HINDUSTHAN ALUMINIUM COMPANY LTD. (HINDALCO) <sup>(2)</sup>

Amarkantak Bauxite mine, situated 1050 m above MSL in the district Shahdol (M.P.) is owned by M/s Hindusthan Aluminium Co.Ltd.(HINDALCO). The total lease area is 500.27 ha spread in 3 blocks. The lessee has applied for renewal of mining lease. Bauxite in this area occurs as pockets. Average thickness of top soil and overburden of laterite, aluminous laterite vary from 5-8 m. Bauxite thickness varies from 1 to 3 m having an average grade of 44%  $Al_2O_3$  content. Out of the total 158 ha. mined out area, 125 ha. area has been backfilled.

Mining involved removal of vegetation and overburden over a large area of land. Mining in Amarkantak now is in its last stage and is being continued in areas, which were hitherto not considered for economical mining.

Overburden is manually mined and kept separately. Out of the three blocks, Block-A and Block-B are under operation, whereas Block-C is virgin area. Block-A, which is under operation consists of 60% of Jhohilla reserve forest area and 40% is non-reserve forest area. Mining in the forest area has been discontinued. The main working pit was quarry No.1 which is 200 m in length along NE-SW and 62 m. in width. The quarry is being developed along SE & NW faces. An area of approximately 9 ha. has been reclaimed but not afforested. As the quarry faces advance, it is back filled with the overburden. Block B is under reserve forest area where 4 ha. of the area has been mined out and also reclaimed.

In case of hard formation primary drilling is done by 100 mm diameter wagon drills. 30-40 holes each 3 m depth are drilled continuously for 3 days depending upon the quality of the bauxite to be mined. Pattern of drill holes in ore and overburden is as given below :-

<u>Ore</u>	<u>Overburden</u>
burden 1.5 m	2.0 m
spacing 2.0 m	2.5 m
depth 3.0 m	3.5 m

Drilling is also done by Jack hammers (25 mm dia). Explosive used are 80% S.G. and ANFO. Blasted ore is stacked sizewise and gradewise and transported by trucks to Pendra Road Railway station.

NANHOODADAR MINE OF M/s BHARAT ALUMINIUM CO. LIMITED (BALCO) (15) (16)

The lease area of the Nanhoodadar mine of M/s BALCO is spread over 1052 hectare in Mandla distt. (M.P.). The bauxite in the leasehold, is underlying the soil (0.5-3m thick) and laterite capping ( 2m to 6 m thick).

Three pits are being worked at present. The pit No. 1 measuring 250 m x 100 m x 5.7 m is located in the central part of the leasehold.

Soil and overburden is removed by Dragline of 2.3 cu.m. capacity and stacked separately. The soft laterite is dozed sufficiently ahead by Dozer ( 25 H.P. ), whereas the hard laterite and bauxite zone below are drilled (100 mm dia holes, 2m x 2m - burden x spacing) and blasted with slurry explosives and electric detonators. Top soil is spread over the back-filled areas.

There are two more pits located south of the first pit and adjacent to each other. The sizes of pits are 200 m x 75 m x 6 m and 175m x 90 m x 7 m. Ore to overburden ratio is 1 : 10 approximately.

The ore is sized to 150 mm size and despatched by aerial ropeway to Chuktipani Railway Siding for further transportation to Korba.

PHUTKAPAHAR BAUXITE MINE, M/S. BHARAT ALUMINIUM COMPANY LIMITED  
IN DISTRICT BILASPUR (M.P)

Bauxite occurs here as float ore. The deposits have almost been depleted. However life of the mine is being prolonged by mining of left over patches of marginal/submarginal grade bauxite. Presently mining is carried out in three blocks i.e. East, central and West Phutka block. Extent of Mine workings in different blocks are given below :

Name of block	Dimension	No. of benches	Bench height
East Phutka (insitu)	100mx100m	1	0.5 - 3m (soil/murrum) 1.5 to 2 m (Bauxite)
East Phutka (Float)	200mx150m	1	0.3-1m (Soil/Murrum) 0.3-1m (float ore)
Central Phutka (Insitu)	100mx50m	1	1-2m (soil/murrum) 1-3 (Bauxite)
West Phutka (Float)	250m x200m	1	0.3-1m (Soil/Murrum) 1-2m (Bauxite)

Mining is carried out in single bench. There is no separate bench in the overburden. No specific hole-pattern as such is in practice for drilling. The holes are drilled, as and when required manually using hand, jumpers. Hole lengths are 45 cm, charged with 137 gms. of SG (80%) cartridges and blasted by safety fuse with plain detonators. Blasted ore is manually sorted and sized (+25 mm to -150mm). The sorted and sized bauxite is stacked, sampled and analysed for onward transportation to Korba plant. Overburden material mined is being back filled into worked out pits, Top soil whenever available is excavated and stacked separately for reuse.

Contract system is under practice, which includes mining, sorting, sizing and transportation of ore upto the plant at Korba.

MAINPAT BAUXITE MINE OF M/S. M.P. STATE MINING CORPORATION IN  
DISTRICT 'SARGUJA (MADHYAPRADESH)' (18)

Mining in Mainpat area has been carried out intermittently depending upon supply order received from BALCO and adhoc working permissions over specified area granted by the State Government.

Of late, mining was taken up in Kesara block. Prior to this, sporadic activities were carried out in the two blocks, Sapnadand and Kudardih over an area of 4 hectares and 0.5 hectare respectively by opening small and shallow pits of 0.6 m to 1 m depth. Also sorting out of usable grade bauxite ore was done from old stocks of exploratory mining carried out by MECL during the period Nov. 79 to Dec. 80, over an area of 300m x 300 m.

The workings in Kesara block are spread over an area of 60 m x 30 m comprising a number of pits. Soil cover is almost negligible. The working is carried out on a contract system, labourers being engaged on piece rate basis for raising and sorting of Bauxite ore. Piece rate workers are paid Rs. 16.25 per tonne. The OMS is 2 to 2.5 tonnes.

The ore transport is by trucks to Korba Alumina plant, which is located at a distance of about 150 km. Generation of reject is negligible, as the grade is above 50%  $Al_2O_3$ .

### 9.3.5 GUJARAT

In Gujarat, mainly the high grade bauxite suitable for chemical, refractory and abrasive industries is produced, but a considerable quantity of metallurgical grade ore is also produced, as a co-product. Although the active bauxite leases are in the districts of Jamnagar, Junagarh, Kheda, Kutch, Sabarkantha, the mining of high grade bauxite is confined to Jamnagar, Kutch, Sabarkantha and Kheda district. The production of low grade and also metallurgical grade bauxite comes from the districts of Junagarh, Bhavnagar, Valsad and Amreli<sup>19</sup>.

#### Jamnagar district

Mining is confined to a NE-SW bauxite belt (about 52 km long) located near Bhatia in the western part of the district. Out of the total 65 active lease holds, there are 41 captive lease holds. Except one lease, which is being worked by the Gujarat Mineral Development Corporation (GMDC) all other mining leases are being worked by private organisations<sup>19</sup>.

Generally, mining is carried out by manual open cast method, and there are a few semi-mechanised mines. The overburden consists of soil, low grade Gaj-Limestone and laterite. Details of a few important mines are as follows :

#### (i) VIRPUR BAUXITE MINE OF M/S PRABHUDAS VITHALDAS

Fifty percent of the estimated reserves is of high grade (alumina 55-60%), remaining being of low grade. Mining is carried out by opencast method. The holes are drilled up to a depth of 0.75m to 1.5 m with the help of S.L. 90-holman rock drill and blasting is carried out using special gelatine and ordinary detonators. The average powder factor is 6 tonnes per kg of explosives.



**(ii) MAHADEVIYA BAUXITE MINE OF M/S CARBORANDUM UNIVERSAL**

Mining is done by opencast manual method. The face length is 40 to 90 m. with a height of 8 m having two benches. The first bench is of 2 m height in overburden and bottom bench is 6 m in the ore body. Selective mining of high grade appears to be under practice. Holes of 32 mm dia, 0.75 to 1.5 m depth are drilled with Jack hammers on a pattern of 0.8 m x 0.9 m spacing which yields 8 t/kg. of explosives. Holes are charged with 200 gm. ANFO and 40 gm. special gelatine explosives<sup>20</sup>.

**(iii) ASOTA MEWASA MINE (KARANDHAR) OF M/S BOMBAY MINERALS SUPPLY CO.LTD.**

Mining is done manually by making benches in OB and Ore. In Pit No.1, two benches have been made, the top bench is in soil and limestone with 3 m. height and bottom bench is in bauxite (3.2 m height and 3 m width). Pit No.2 has 2 benches, the top one is of 1.5 height, in marl and clay and bottom bench is of 2.0 m height in ferruginous bauxite.

Usually 32 mm dia holes of 0.75 m depth are drilled in a 0.90 m x 0.90 m. pattern, manually with jumpers. Holes are charged with special gelatine and blasted with the help of ordinary detonators<sup>20</sup>.

**Junagadh District**

There are five working lease holds in Porbandar sub-division. These are leases of Aluminous laterite. Mining is done manually on seasonal basis mainly for export purpose in view of close proximity of the deposits to the Porbandar sea port. Sporadic small pockets of high grade bauxite have been found to occur below this Aluminous Laterite.

**Kutch District**

Here the bauxite deposit has highly variable widths, varying from 50 mt. to 2 km. There are only 3 working mines in this area, of which one is a captive mine belonging to Orient, Abrasive Ltd. The other two mines are being worked by GMDC. Method of mining is by both manual and semi-mechanised means.

**Sabarkantha District**

There are nine working lease holds in the district which are intermittently worked manually for high grade, emery grade and low grade ore, depending on the demand in the market.



## 9.4 COMPANY PROFILES - PRIMARY ALUMINIUM PRODUCERS<sup>24</sup>

### 1. NATIONAL ALUMINIUM COMPANY LIMITED

(A Govt. of India Enterprise)  
 Regd. Office : IDCO TOWER, 8th floor, Janpath  
 BHUBANESWAR-751007

National Aluminium Company Limited (NALCO) was set up by the Government of India in 1981 to implement one of the largest integrated Aluminium Projects of the world with its own Captive Power Plant. NALCO was formed in the wake of the discovery of large reserves of Bauxites in East Coast. With the technical collaboration of Alluminium Pechiney of France and the support of Euro-Dollar loan the project was most expeditiously implemented under difficult logistics.

The Project segments and their special features

Segment	Capacity	Special Technological Features
Bauxite Mine Panchpatmali, Orissa	2.4 Million tpa.	<ul style="list-style-type: none"> <li>- Fully mechanised Open Cast Mine</li> <li>- 370 million tonnes deposit estimated</li> <li>- 14.6 km long Single Flight Multi-curve 900 tph capacity computerised conveyor system for transportation of ore to Alumina Refinery</li> </ul>
Alumina Plant Damonjodi, Orissa	800,000 tpa.	<ul style="list-style-type: none"> <li>- Chemical Plant</li> <li>- 2 production stream of 400,000 tpa, capacity each</li> <li>- Atmospheric Pressure digestion process.</li> <li>- Energy efficient Fluidised Bed Calciners of 1250 tpa. capacity.</li> <li>- Co-generation of 3x18.5 MW power by use of back pressure turbine in steam Generation Plant</li> </ul>
Aluminium Plant Angul Orissa	218,000 tpa	<ul style="list-style-type: none"> <li>- Metallurgical Plant.</li> <li>- 2 pot lines of 109,000 tpa capacity each</li> <li>- Advanced 175 KA Cell voltage technology</li> <li>- Micro-Processor based Pot Regulation System</li> <li>- Fume treatment plant with dry-scrubbing system for pollution control</li> <li>- Integrated facility for manufacturing anodic &amp; cathodic carbon</li> </ul>

Segment	Capacity	Special Technological features
Power Plant Angul, Orissa	600 MW	<ul style="list-style-type: none"> <li>- 4 x 35 T Furnace and 2 x 15 tph. ingot Casting Machines</li> <li>- 4 x 45 T Furnace and 2 x 9 tph. wire rodmill.</li> <li>- Coal fired thermal power plant</li> <li>- Micro-processor Based Burner Management System for boilers.</li> <li>- Automatic turbine run up system</li> <li>- Specially designed barrel type high pressure turbines.</li> <li>- Electrolytic Precipitators and ash ponds</li> </ul>
Port Facility Vizag, A.P.	375,000 tpa. Alumina export 146,000 tpa. caustic soda import	<ul style="list-style-type: none"> <li>- Mechanised storage facility of 2 x 15000 T capacity</li> <li>- Mechanised Mobile ship loader of 2200 tph. capacity</li> <li>- Capacity to handle Maximum Ship size 35000 DWT.</li> </ul>

Different segments of NALCO went into production in a phased manner starting from November, 1985. Within a span of 4 years the Company has emerged as a leader in the field of Aluminium production in the country and has made significant impact abroad. NALCO has helped the country to be self-sufficient in Aluminium and has earned substantial foreign exchange through creditable export performance year after year.

Upto the end of the financial year 1989-90 NALCO produced 4862,000 tonnes of Bauxite, 1462,000 tonnes of Alumina and 239,200 tonnes of Aluminium. From the export of Alumina and Aluminium the Company had earned a cumulative foreign exchange of above Rs.660 crores between 1987-88 and 1989-90.

#### Product Mix

At the current stage of the Company, the product mix consists of :

1. Calcined Alumina - Metallurgical Grade
2. Hydrate Alumina
3. High Purity Aluminium Metal
4. Commercial Grade Aluminium in 20 kg. ingots
5. Aluminium Alloys Rods (experimental production).

The quality assurance associated with NALCO metal received international acclaim with NALCO's admission into London Metal exchange in May, 1989.

The Company is growth oriented with significant thrust on research and development and downstream facilities. NALCO has already obtained Govt. approval for preparation of detailed Project Report for expansion of production capacities between 25-60% above the present levels in different segments. The marketing and commercial network of the Company covers all major metropolitan cities of the Country like Delhi, Bombay, Calcutta, Madras, Bangalore & Vizag.

## 2. BHARAT ALUMINIUM CO. LTD.

Aluminium Sadan, Core 6, 3rd Floor, Scope Office Complex  
7, Lodhi Road, New Delhi 110003

Bharat Aluminium Co. (BALCO) is the first public sector Unit in aluminium industry. Established in the year 1965 and the company celebrated its Silver jubilee year during November, 1990. The Company's production facilities are located at two places - at Korba in Bilaspur, District of Madhya Pradesh and other at Bidhanbagh, Burdwan district near Asansol, West Bengal. The unit at Korba is an integrated aluminium complex operating from bauxite mining to downstream products whereas the second unit at Bidhanbagh produces downstream products.

The Korba Aluminium Complex comprises the following production facilities :-

- 200,000 tonnes per year capacity Alumina Plant.
  - 100,000 tonnes per year capacity smelter.
  - Two properzi mills for manufacture of 35,000 tonnes of Aluminium Re-draw wire rods.
  - Three Extrusion Presses.
  - Hot and Cold Rolling mills.
  - A captive Thermal Plant of 270 M.W.
- The facilities at BEU are as follows :
- Hot and Cold Rolling Mills.
  - One Extrusion Press.
  - Foil Mill.
  - Conductor Plant.

Production capacities for saleable products are as follows:

<u>KORBA PLANT</u>	<u>Tonnes/Annum</u>	<u>BIDHANBAG</u>	<u>Tonnes/Annum</u>
Rolled products	40,000	Rolled products	36,000
Extruded products	7,000	Extruded products	1,000
Properzi Re-draw Wire Rod	35,000	Foils AAC/ACSR	600
EC Grade/Alloy/CG		Connectors	1,200
Ingots, Billets, Casting Alloy Ingots etc.	18,000	-	-

(A project to produce 700 tonnes of aluminium alloy conductors is in final stage of commissioning).

Balco has developed capacities for production of sophisticated alloys with copper, zinc and other harder groups required for Aircraft, Defence, Space and other industries. Billets and some of the rolled and extruded products can be manufactured by these alloys. Balco has the pride of place in supplying aluminium to prestigious missile projects like 'PRITHVI' and 'AGNI'.

Dimensional tolerances chemical composition and mechanical properties conform to relevant Indian Standards. However, material can be supplied to other international standards like GOST, BS, ASTM, DIN etc. and /or customer's specific requirements.

The Company having commenced its production in 1975 with energising first phase of the smelter languished for want of adequate power until 1984-85. Once the power was made available there was no looking back and in the same year it has attained a capacity utilisation of 87% and thereafter strived continuously to improve upon. In the very next year the capacity utilisation reached 95% level and thereafter it has maintained that level upto now. With a total capacity of 100,000 tonnes of saleable products Balco shares 16% of the market alongwith four other primary producers in the country.

Recognising the importance of un-interrupted and adequate power supply to its smelter the Company established captive power plant 270 MW capacity at Korba Unit with an outlay of Rs.520 crores.

Starting with a modest level of Rs.14 crores turn over in the first year of metal production namely 1975-76 the same has increased to Rs.416 crores in the year 1989-90. The projected turn over for the year 1990-91 was Rs.484 crores.

Apart from high production and productivity Balco has set up over the years facilities for applied research and development in aluminium.

Balco is a modern, socially conscious welfare oriented company having more than 8,000 employees on its current rolls.

Balco looks forward to the future with scheme for modernisation and expansion programme of the smelter from the present level 100,000 tonnes to 150,000 tonnes during the eighth Five Year Plan with the supporting facilities of bauxite mines, aluminium plant and power unit.

The Company's marketing activities are spread over the country with 4 regional offices located at Delhi, Bombay, Calcutta and Madras in addition to a small area office at Hyderabad.

### 3. HINDALCO INDUSTRIES LIMITED

P.O. Renukoot, Dist. Sonbhadra, Uttar Pradesh 231217

Hindalco Industries Ltd.(Hindalco) is one of the largest industrial enterprises in the State of Uttar Pradesh. The company was incorporated in the year 1958 as Hindustan Aluminium Corporation Ltd. Shri G.D. Birla was its founder Chairman.

The Company is a leading aluminium producer in the country. The Company's integrated aluminium plant is situated at Renukoot, which is about 160 kms from Varanasi in district Sonbhadra. Commercial production started in the year 1962 with an installed capacity of 20,000 tonnes per annum primary

aluminium metal together with corresponding alumina facilities. Over the years Hindalco not only expanded its capacity but also added semi-fabrication facilities.

The present licenced and installed capacity for primary aluminium and semi-fabricated products (Rolled & extrusion is 1,50,000 tonnes and 33,700 tonnes per annum respectively. The operation of Hindalco consists of mining of bauxite, extraction of alumina from bauxite, production of primary aluminium by electrolytic process and manufacture of wire rods, Rolled products and Extrusions. Hindalco has a captive power plant (Renusagar Power Co.) with 250 MW capacity<sup>23</sup>.

The Company has its own full-fledged Design and Construction Division. Most of the expansion, modernisation and diversification programmes were undertaken and completed by the Company by its own facilities.

#### R & D Backup

In consonance with science and technology policy of the Government of India, energy conservation, manufacturing cost reduction, import substitution and recovery of by-products constitute the basis of Company's present R & D programme. Efforts are also directed towards technology absorption and adaptation and development of special alloys and products for meeting the critical requirements of important sectors of national economy like defence, aerospace, transport etc.

#### Modernisation and Energy Conservation

With emphasis on energy Conservation various production processes have been modified so as to make them energy efficient. A gas suspension calciner to replace the old rotary calcination kilns, a computerised firing system for the anode baking furnances and microprocessor based control system for the electrolysis cells have been recently commissioned. The company is also installing dry scrubbing system to reduce fluorine emission. For semi-fabricated products also production processes have been made more energy efficient by the induction of continuous strip caster and the conform machine. These measures will go a long way in making the plant more energy efficient and pave the way for higher productivity and product quality.



## Expansion and Diversification

### Aluminium Plant

The Company has applied for an industrial Licence for additional 1,00,000 TPA of primary aluminium metal capacity together with corresponding alumina and fabrication facilities at Renukoot. The power plant is also proposed to be expanded suitably.

### Foil Plant

Hindalco is installing a 5,000 TPA aluminium foil plant at Jagdishpur in association with PICUP at a cost of about Rs.110 crores. The foil plant is likely to start its operation in 3 years time.

With excellent manpower resources, a sound infrastructure and performance record, the company is well on the move to meet the country's growing requirement of sophisticated aluminium products and also proposes to step up exports in near future.

#### 4. THE INDIAN ALUMINIUM COMPANY LIMITED 1, Middleton Street, Calcutta 700071

Indal was incorporated as a Private Limited Company on 17 December 1938 under the name of Aluminium Production Company of India Ltd. In 1944, the name changed to Indian Aluminium Company, Limited and in 1954, the company became a Public Limited one.

Indal's first plant was set up at Belur, near Calcutta. The rolling mill began operations in 1941, using imported aluminium ingot as raw material and its products were almost entirely consumed by utensils and hollow-ware manufacturers. In 1943, India's first primary aluminium ingot was made by Indal at Alwaye, Kerala where the Company had set up its first smelter. Backward integration of Indal's operations after the construction of the smelter was achieved in stages with setting up of an alumina plant and bauxite mines.

In 1955, at the Alwaye (later renamed Alupuram - "the place of aluminium") smelter, India's first extrusion press was installed and at Kalwa the country's first aluminium paste

and powder plant was commissioned. In 1963, a foil plant was also set up at Kalwa. Today Indal has capacity to produce 117,000 tonnes of Aluminium ingot from its three smelters at Alwaye (Kerala), Belgaum (Karnataka) and Hirakud (Orissa), 54,000 tonnes of rolled products at its sheet mills at Belur (West Bengal) and Jalgaon (Maharashtra), over 7,400 tonnes of extruded products at its Extrusion Plant in Alwaye, 5,900 tonnes of foil, 10,000 tonnes of properzi rod and 800 tonnes of paste and dried filtered cake. In 1988 Indal commissioned its first non-aluminium diversification project, a printed circuit board plant at Manjangud, Karnataka which has capacity to produce 30,000 sq.m. a year. Indal also produces vanadium sludge and calcined alumina.

Since inception, Alcan Aluminium Limited of Canada has been Indal's principal shareholder. In 1987, Alcan reduced its equity stake from above 50% to below 40% but continues to give technological and other support to Indal.

#### PRODUCTS/SERVICES

Indal manufactures the largest available variety of sheet, foil and extrusions available in India. From pilfer proof caps to pre-fabricated houses, roofing sheet in various specification to lamp caps, Indal sheet products find their way into a variety of industries. Similarly, extruded products like heat sinks and heat exchangers motor housing, window and door frames, bus and truck bodies, curtain walling, textile components and automobile manifolds are rapidly replacing conventional items which are less economical in the long run. Indal foil goes to pack a variety of products like pharmaceuticals and medicines, soap and toothpaste, confectionery and ready-to-serve food. Indal chemicals, apart from earning foreign exchange, help in the manufacture of table china, ceramic, tiles, electricals insulators, spark plugs, refractory bricks and fire retardant cables.

#### EXPORTS

Indal lays great stress on Exports which earned Rs.69.9 crores in foreign exchange for the country (1989-90 figure). Products exported are aluminas, hydrates and semi-fabricated



items while countries exported to include the Soviet Union, the USA, Australia, West Asia, the Far East and closer home, to Sri Lanka, Bangladesh and Pakistan.

#### NEW PROJECTS

INDAL is investing more than Rs.700 crores over the next five years in consolidation, expansion and modernisation. On the anvil are captive power plants to ensure steady production of metal, an enhanced alumina capacity which will both feed the Company's own smelters and have export potential, a modern cold rolling mill which will permit higher production with improved quality and upgradation of Indal's foil plant by installation of new equipment with a view to further enhance the quality of foil products, giving greater value to customers.

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