

17 Bauxite

Bauxite is basically an aluminous rock containing hydrated aluminium oxide as the main constituent and iron oxide, silica and titania in varying proportions. Hydrated aluminium oxides present in the bauxite ore are diasporite and boehmite, $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$ (Al_2O_3 -85%; Al-45%); gibbsite or hydrargillite, $\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ (Al_2O_3 - 65.4%; Al-34.6%), and bauxite (containing colloidal alumina hydrogel), $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ (Al_2O_3 -73.9%; Al-39.1%). The iron oxide in bauxite ore is present as haematite or goethite, silica as clay and free quartz, and titania as leucosene or rutile. Bauxite is an essential ore of aluminium which is one of the most important non-ferrous metals used in the modern industry. It is also an essential ore for refractory and chemical industries. The country has abundant resources of bauxite which can meet both domestic and export demands.

RESOURCES

Resources of bauxite in the country as on 1.4.2005, as per UNFC system, are placed at 3,290 million tonnes. These resources include 899 million tonnes reserves and 2,390 million tonnes remaining resources. By grades, about 86% resources are of metallurgical grade. The resources of refractory and chemical grades are limited and together account for about 3%. By States, Odisha alone accounts for 55% of country's resources of bauxite followed by Andhra Pradesh (19%), Gujarat (6%), Chhattisgarh (5%), Madhya Pradesh (4%), Jharkhand (4%) and Maharashtra (3%). Major bauxite resources are concentrated in the East Coast bauxite deposits in Odisha and Andhra Pradesh (Table-1).

EXPLORATION & DEVELOPMENT

Details of exploration carried out for bauxite by State Directorates of Geology & Mining, Governments of Chhattisgarh, Maharashtra and Odisha during 2009-10 are given in Table - 2.

PRODUCTION, STOCKS & PRICES

The production of bauxite at 13,952 thousand tonnes in 2009-10 decreased by 10% as compared to 15,460 thousand tonnes in the previous year owing to lack of demand.

There were 200 reporting mines in 2009-10 as against 198 in the previous year. In all, 93 producers reported production of bauxite in 2009-10. Ten principal producers having 68 mines contributed 78% of the total production. Forty four major mines, each producing more than 50 thousand tonnes per annum, together accounted for about 89% of all-India production.

The contribution of the Panchpatmali bauxite mine of NALCO was 35 % of the total production. The share of 19 public sector mines was about 45 % of the total production in 2009-10 as against 39 % in the previous year.

About 47 % of the total production of bauxite was of grade 40-45% , 20 % of grade below 40%, 11 % of 45-50%, 10 % of other grade, 6% of cement grade , 3% of 50-55%. Remaining 3 % production was collectively reported in 55-60 % . Abrasive, Refractory and Chemical grades during the year under review.

Odisha emerged as the leading producing state accounting for about 35% of the total production. Next in the order of production were Gujarat 19% and Maharashtra 14 %, Chhattisgarh and Jharkhand together 12 %, Madhya Pradesh 7% and the remaining 1% was produced by Goa, Karnataka and Tamil Nadu (Tables -3 to 6).

Mine-head stocks at the end of 2009-10 were 9,197 thousand tonnes as compared to 8,559 thousand tonnes at the beginning of the year. About 96% of total stock was held in Gujarat at the end of the year (Tables - 7A & 7B).

The average daily employment of labour in bauxite mines was 9,575 in 2009-10 as against 8,546 in the previous year. Prices of bauxite are furnished in the General Review on Prices.

**Table – 1 : Reserves/Resources of Bauxite as on 1.4.2005
(By Grades/States)**

(In '000 tonnes)

Grade/State	Reserves				Remaining resources				Total resources (A+B)				
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility		Indicated STD332		Inferred STD333	Reconnaissance STD334	Total (B)	
		STD121	STD122			STD221	STD222						
All India : Total	538945	225424	135015	899384	335	90224	240179	579561	394022	1085576	536	2390432	3289817
By Grades													
Chemical	680	49	199	928	-	4978	234	2383	182	5063	-	12840	13767
Refractory	3370	44937	1146	49453	-	7753	411	2670	208	9368	-	20410	69864
Chemical/refractory, mixed with others	2579	626	1974	5179	-	1854	65	1854	216	8984	-	12973	18152
Metallurgical-1	426501	171854	80313	678668	335	43255	171499	405659	289181	614649	536	1525115	2203783
Metallurgical-2	51247	5092	16812	73150	-	7907	38103	104351	58659	269952	-	478972	552122
Metallurgical, mixed	11363	283	6818	18463	-	2978	2723	38458	500	25843	-	70502	88965
Low	23538	617	16863	41017	-	6729	21418	19856	32487	106081	-	186571	227588
Mixed grade excluding chemical/refractory	15327	1461	9383	26172	-	13969	4676	2320	2651	10290	-	33906	60078
Abrasive	194	505	344	1043	-	802	20	56	-	428	-	1306	2348
Others	191	-	187	378	-	-	85	1949	4848	5042	-	11923	12302
Unclassified	3515	-	712	4228	-	-	720	-	5090	7979	-	13789	18017
Not-known	441	-	265	706	-	-	225	5	-	21896	-	22126	22832
By States													
Andhra Pradesh	199	5	48	251	-	-	2260	188720	135860	288176	-	615016	615267
Bihar	-	-	-	-	-	-	-	-	-	4114	-	4114	4114
Chhattisgarh	30706	46981	11279	88966	-	36759	3823	1262	2572	14933	-	59349	148315
Goa	27037	1097	6492	34626	-	1320	263	5500	-	8646	-	15729	50355
Gujarat	43952	2400	21861	68214	-	40440	27806	12195	328	39354	-	120124	188337
Jammu & Kashmir	-	-	-	-	-	-	-	1323	182	520	-	2025	2025
Jharkhand	13408	5528	12722	31657	-	566	5242	320	17397	61827	536	85888	117545
Karnataka	4576	367	786	5729	-	394	7180	378	2940	32882	-	43774	49503
Kerala	55	-	-	55	-	-	-	2037	9284	2722	-	14043	14098
Madhya Pradesh	13530	1768	1540	16838	-	8316	237	8920	53715	46037	-	117225	134064
Maharashtra	21091	5568	12499	39157	335	515	2598	38831	8354	21852	-	72485	111643
Odisha	380363	161711	65924	607997	-	-	188630	309684	152807	549153	-	1200274	1808271
Rajasthan	-	-	-	-	-	-	-	-	-	528	-	528	528
Tamil Nadu	4029	-	1865	5894	-	1913	2140	-	10084	6814	-	20951	26845
Uttar Pradesh	-	-	-	-	-	-	-	10390	500	8018	-	18908	18908

Figures rounded off.

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Table – 2 : Details of Exploration Activities for Bauxite, 2009-10

Agency/ State/ District	Location/ Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks / Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
Directorate of Geology & Mining, Chhattisgarh							
Kabirdham	Darai Area	1:50,000	356	47	532.95	526	Bauxite occurs as discontinuous lenses and pockets. About 220 thousand tonnes of bauxite resources were estimated.
		1:4,000	2.03				
Surguja	Sarbhansa Area Mainpet Plateau	1:50,000	300	133	1480.30	273	About 0.2 million tonnes of bauxite resources (47% Al ₂ O ₃) were estimated.
		1:4,000	2.34				
Directorate of Geology, Odisha							
Sundergarh	Kusumdihi Rangua Area	–	–	–	–	02	Two bauxite occurrences at 200 m NW of Kusumdihi and 1.9 km of Kusumdihi were reported.
Kalahandi	Around SE of Gunupur	1:50,000 1:2,000	60 0.15	–	–	292	A bauxite bearing plateau was located SE of Gunupur village. 1.6 km strike length with average width of 0.75 km along with 3 sets of joints was also found.
Koraput	Kadalikhol, Munda, Murka, Bagbilmali	1:50,000	125	–	–	218	Eleven bauxite bearing plateaux were delineated. Thickness of bauxite capping varies from 4 to 7 m.
	Nariniguda, Pancharha & Baldigurha	1:50,000	150	–	–	235	Pandrimali, Sembilmali Bhalu Pahar & Bahixi plateaux have small patches of bauxite deposit. Deposit was found elongated in nature and thickness of bauxite horizon varies from 1-5m.
Directorate of Geology & Mining, Maharashtra							
Kolhapur	Ghungur Area Teh - Shahuwadi	–	15	–	–	213	About 2.8 million tonnes of bauxite and 4 million tonnes of laterite resources were estimated..
Satara	Jawali/Jungoti Teh.-Patan	–	50	–	–	114	Laterite was mostly ferruginous. At places low grade bauxite patches were also noticed.
Ratnagiri	Guhaghar	–	40	–	–	–	Whole area comprised of basalt which was overlain by laterite. About 80% of the area shows the existence of low grade bauxite.

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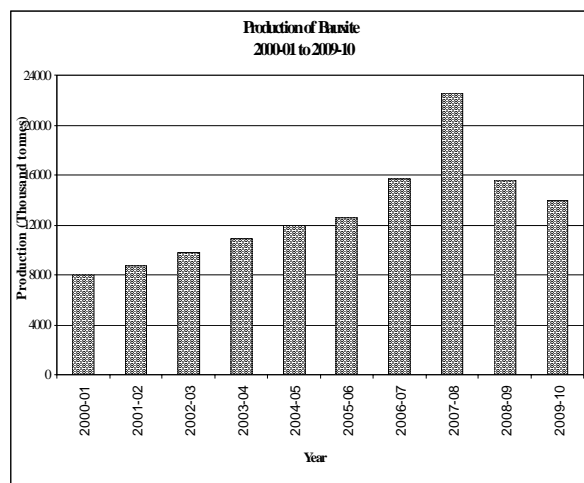


Table – 3 : Principal Producers of Bauxite 2009-10

Name & address of Producer	Location of mine	
	State	District
National Aluminium Co. Ltd, NALCO Bhawan, P/1, Nayapali, Bhubaneswar – 751 0130, Orisha.	Odisha	Koraput
Hindalco Industries Ltd, Century Bhawan, Dr. Annie Besant Road, Worli, Mumbai –400 025, Maharashtra.	Chhattisgarh Jharkhand Maharashtra	Surguja Gumla Lohardaga Kolhapur
Bharat Aluminium Co. Ltd, BALCO NAGAR, Korba - 495 684, Chhattisgarh.	Chhattisgarh	Surguja

(Contd.)

Table - 3 (Concl.)

Name & address of Producer	Location of mine	
	State	District
The M. P. State Mining Corp. Ltd, Paryawas Bhawan, Block No. 1 (A) 2 nd floor, Jail Road, Arera Hills, Bhopal, Madhya Pradesh.	Madhya Pradesh	Anuppur
Bombay Minerals Ltd, Dwarka – Jamnagar Highway, Opposite AshokPetrol Pump, Jam-Khambhalia –361 305, Dist. Jamnagar, Gujarat.	Gujarat	Jamnagar
Gujarat Mineral Dev. Corporation Ltd, Khanij Bhawan, 132 ft. Ring Road, Vastrapur, Ahmadabad.	Gujarat	Kachchh
Orient Abrasives Ltd, G.I.D.C. Area, Porbandar, Gujarat.	Gujarat	Jamnagar.
Swati Minerals Shri. Parvej Adilshah Golandaj, 23-K,"A", Rankala Choupati, Kolhapur - 416 012, Maharashtra.	Maharashtra	Kolhapur
Minerals & Minerals Corp. Bauxite Mine, Vazir Fail, Jamnagar - 361 001, Gujarat.	Gujarat	Jamnagar
Mahavir Minerals "Yashashvi" 66 Malviya Nagar, Durg Chhattisgarh – 491 001.	Chhattisgarh	Kabirdham

Table – 4 : Production of Bauxite, 2007-08 to 2009-10 (By States)

(Quantity in tonnes; value in Rs.'000)

States	2007-08		2008-09		2009-10(P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	22624960	5683866	15460202	4703221	13952002	4563581
Chhattisgarh	1793819	708262	1674427	557371	1686549	551126
Goa	129259	9694	463150	34736	31050	1865
Gujarat	11922675	2272525	3514016	897680	2627819	623648
Jharkhand	1249605	406395	1585356	552684	1669960	634249
Karnataka	161529	31875	127830	24418	123316	34122
Madhya Pradesh	533664	158624	1037724	376581	1026416	248063
Maharashtra	1805366	565635	2053512	625275	1903998	575457
Odisha	4685998	1486174	4734421	1591786	4879552	1894698
Tamil Nadu	343045	44682	269766	42690	3342	353

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Table – 5 (A) : Grad wise Production of Bauxite, 2008-09
(By Sectors, States and Districts)

(Qty in tonnes; value in Rs.'000)

State/District	No. of mines	Production by Grades : Al ₂ O ₃ content										For use other than Alumina & Aluminium extraction					Total	
		For use in Alumina & Aluminium extraction					Below 40%	Cement				Abrasive	Refractory	Chemical	Others	Quantity	Value	
		60% & above	55%-60%	50%-55%	45%-50%	40%-45%		60% & above	55%-60%	50%-55%	45%-50%							
India	198 (5)	-	124504	329599	2988127	2806948	5352746	1470718	107826	200312	7168	2072254	15460202	4703221				
Public sector	19	-	47472	267278	707830	117432	4812873	-	-	-	-	-	5952885	2057469				
Private sector	179(5)	-	77032	62321	2280297	2689516	539873	1470718	107826	200312	7168	2072254	9507317	2645752				
Chhattisgarh	14	-	-	-	1530216	144211	-	-	-	-	-	-	1674427	557371				
Kanker	2	-	-	-	-	90	-	-	-	-	-	-	90	32				
Kawardha	2	-	-	-	299956	126835	-	-	-	-	-	-	426791	90584				
Sarguja	10	-	-	-	1230260	17286	-	-	-	-	-	-	1247546	466755				
Goa	2	-	-	-	-	-	-	463150	-	-	-	-	463150	34736				
South Goa	2	-	-	-	-	-	-	463150	-	-	-	-	463150	34736				
Gujarat	101	-	119912	310599	19718	109021	33300	699066	107826	193197	1921377	3514016	897680					
Amreli	1	-	-	-	-	-	-	85454	-	-	-	-	85454	20424				
Jamnagar	85	-	4860	-	19718	95550	-	509361	102957	193197	-	1830261	2755904	684473				
Kachchh	9	-	115052	310599	-	-	-	-	4609	-	-	25571	455831	147500				
Porbandar	5	-	-	-	-	-	-	104251	260	-	-	65545	170056	39670				
Sabarkantha	1	-	-	-	-	13471	33300	-	-	-	-	-	46771	5613				
Jharkhand	34	-	-	-	37465	1545859	2032	-	-	-	-	-	1585356	552684				
Gumla	20	-	-	-	32225	846059	2032	-	-	-	-	-	880316	289031				
Latehar	1	-	-	-	-	47	-	-	-	-	-	-	47	11				
Lohardaga	13	-	-	-	5240	699753	-	-	-	-	-	-	704993	263642				

(Contd.)

Table - 5 (A) (Concl.d.)

State/District	No. of mines	Production by Grades : Al ₂ O ₃ content										For use other than Alumina & Aluminium extraction					Total	
		For use in Alumina & Aluminium extraction					Below 40%	Cement	Abrasive	Refractory	Chemical	Others	Quantity	Value				
		60% & above	55% - 60%	50% - 55%	45% - 50%	40% - 45%												
Karnataka	2	-	-	-	-	113134	14696	-	-	-	-	-	-	-	127830	24418		
Belgaum	1	-	-	-	-	-	13350	-	-	-	-	-	-	-	13350	1522		
Dakshin Kannad	1	-	-	-	-	113134	1346	-	-	-	-	-	-	-	114480	22896		
Madhya Pradesh 24(5)		-	4592	-	606786	94691	308925	8447	7115	7168	-	-	-	1037724	376581			
Jabalpur	1	-	-	-	-	40	-	-	-	-	-	-	-	40	25			
Katni	5(1)	-	-	-	3526	77369	165650	332	-	-	-	-	-	246877	48514			
Rewa	3	-	-	-	50375	4888	-	-	-	-	-	-	-	55263	17975			
Satna	10(4)	-	4592	-	16385	12394	31775	8115	-	7168	-	-	-	80429	22894			
Shahdol	2	-	-	-	536500	-	111500	-	-	-	-	-	-	648000	286212			
Sidhi	3	-	-	-	-	-	-	-	7115	-	-	-	-	7115	961			
Maharashtra 14		-	-	19000	793658	789922	-	300055	-	-	-	150877	-	2053512	625275			
Kolhapur	6	-	-	19000	459678	783422	-	300055	-	-	-	-	-	1562155	395805			
Raigad	5	-	-	-	-	6500	-	-	-	-	-	150877	-	157377	22364			
Ratnagiri	3	-	-	-	333980	-	-	-	-	-	-	-	-	333980	207106			
Odisha 4		-	-	-	284	10110	4724027	-	-	-	-	-	-	4734421	1591786			
Koraput	2	-	-	-	284	9500	4724027	-	-	-	-	-	-	4733811	1591633			
Sundergarh	2	-	-	-	-	610	-	-	-	-	-	-	-	610	153			
Tamil Nadu 3		-	-	-	-	-	269766	-	-	-	-	-	-	269766	42690			
Namakkal	2	-	-	-	-	-	168348	-	-	-	-	-	-	168348	25043			
Salem	1	-	-	-	-	-	101418	-	-	-	-	-	-	101418	17647			

Figures in parentheses indicate number of associated mines.

Table –5 (B) : Grade wise Production of Bauxite, 2009-10 (P)
(By Sectors, States and Districts)

(Qty in tonnes; value in Rs.'000)

State/District	No. of mines	Production by Grades : Al ₂ O ₃ content										For use other than Alumina & Aluminium extraction					Total	
		For use in Alumina & Aluminium extraction					Below 40%	Cement	Abrasive	Refractory	Chemical	Others	Quantity	Value				
		60% & above	55% - 60%	50% - 55%	45% - 50%	40% - 45%												
India	200(3)0	-	132577	404941	1574231	6520960	2792019	891593	96341	198905	3892	1336543	13952002	4563581				
Public sector	19	-	48545	271704	31975	3766262	2172100	-	-	-	-	-	6290586	2291550				
Private sector	181(3)	-	84032	133237	1542256	2754698	619919	891593	96341	198905	3892	1336543	7661416	2272031				
Chhattisgarh	15	-	-	-	911765	774462	213	-	-	109	-	-	1686549	551126				
Kanker	3	-	-	-	-	44	213	-	-	109	-	-	366	121				
Kawardha	2	-	-	-	223084	288226	-	-	-	-	-	-	511310	106366				
Surguja	10	-	-	-	688681	486192	-	-	-	-	-	-	1174873	444639				
Goa	1	-	-	-	-	-	-	31050	-	-	-	-	31050	1865				
South Goa	1	-	-	-	-	-	-	31050	-	-	-	-	31050	1865				
Gujarat	106	-	132577	375574	-	23995	4250	630928	96341	198796	-	1165358	2627819	623648				
Amreli	1	-	-	-	-	-	-	45084	-	-	-	-	45084	8115				
Jamnagar	90	-	48569	-	-	23995	-	479585	94787	198796	-	1130162	1975894	444585				
Junagarh	1	-	-	-	-	-	-	48733	-	-	-	-	48733	4873				
Kachhh	9	-	84008	375574	-	-	-	-	1554	-	-	13546	474682	150236				
Porbandar	4	-	-	-	-	-	-	57526	-	-	-	21650	79176	15329				
Sabarkantha	1	-	-	-	-	-	4250	-	-	-	-	-	4250	510				
Jharkhand	36	-	-	-	28966	1225799	415195	-	-	-	-	-	1669960	634249				
Gumla	21	-	-	-	24000	951610	-	-	-	-	-	-	975610	364266				
Latehar	2	-	-	-	-	23994	-	-	-	-	-	-	23994	10173				
Lohardaga	13	-	-	-	4966	250195	415195	-	-	-	-	-	670356	259810				

(Contd.)

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Table - 5 (B) (Concl.d.)

State/District	No. of mines	Production by Grades : Al ₂ O ₃ content										For use other than Alumina & Aluminium extraction					Total	
		For use in Alumina & Aluminium extraction					Below 40%	Cement	Abrasive	Refractory	Chemical	Others	Quantity	Value				
		60% & above	55% - 60%	50% - 55%	45% - 50%	40% - 45%												
Karnataka	2	-	-	-	-	120016	3300	-	-	-	-	-	-	-	123316	34122		
Belgaum	1	-	-	-	-	-	3300	-	-	-	-	-	-	-	3300	413		
Dakshin Kannad	1	-	-	-	-	120016	-	-	-	-	-	-	-	-	120016	33709		
Madhya Pradesh	20(3)	-	-	-	76586	131925	791583	22430	-	-	3892	-	-	1026416	248063			
Katni	3	-	-	-	43181	78920	33448	12469	-	-	-	-	-	168018	34703			
Rewa	2	-	-	-	31975	13450	-	-	-	-	-	-	-	45425	14309			
Satna	10 (3)	-	-	-	1430	16555	44556	9961	-	-	3892	-	-	76394	13845			
Shahdol	2	-	-	-	-	23000	709500	-	-	-	-	-	-	732500	184696			
Sidhi	3	-	-	-	-	-	4079	-	-	-	-	-	-	4079	510			
Maharashtra	15	-	-	29367	556914	824820	114527	207185	-	-	-	-	171185	1903998	575457			
Kolhapur	6	-	-	29367	466114	572505	114527	207185	-	-	-	-	-	1389698	401599			
Raigarh	6	-	-	-	-	5700	-	-	-	-	-	-	171185	176885	24019			
Ratnagiri	3	-	-	-	90800	246615	-	-	-	-	-	-	-	337415	149839			
Odisha	4	-	-	-	-	3416601	1462951	-	-	-	-	-	-	4879552	1894698			
Koraput	2	-	-	-	-	3416288	1462600	-	-	-	-	-	-	4878888	1894515			
Sundergarh	2	-	-	-	-	313	351	-	-	-	-	-	-	664	183			
Tamil Nadu	1	-	-	-	-	3342	-	-	-	-	-	-	-	3342	353			
Salem	1	-	-	-	-	3342	-	-	-	-	-	-	-	3342	353			

Figures in parenthesis indicate number of associated mines.

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Table – 6 : Production of Bauxite, 2008-09 and 2009-10 (P)
(By Frequency Groups)

(Quantity in tonnes)

Production Group	No. of Mines		Production		Percentage to total production		Cumulative Percentage	
	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10
Total	198(5)	200(3)	15460202	13952002	100	100	–	–
Upto 1000	47 (2)	58	8920	8166	0.06	0.06	0.06	0.06
1001 - 3000	18(2)	12(1)	36278	22185	0.23	0.16	0.29	0.22
3001 - 5000	10 (1)	14(1)	44913	57065	0.29	0.41	0.58	0.63
5001 - 10000	16	14	120812	105537	0.78	0.76	1.36	1.39
10001 - 25000	35	35(1)	566921	579654	3.67	4.15	5.03	5.54
25001 - 50000	26	23	937605	827417	6.07	5.93	11.10	11.47
50001 and above	46	44	13744753	12351978	88.90	88.53	100.00	100.00

Figures in parenthesis indicate number of associated mines.

Table – 7 (A) : Mine-head Stocks of Bauxite at the beginning of the year, 2009-10
(By States & Grades)

(In tonnes)

State	Stocks by Grades : AL ₂ O ₃ Content For use Alumina & Aluminium metal extraction					For use other than Alumina & Aluminium metal extraction					Total
	60% & above 55%- 60%	50%- 55%	45%- 50%	40%- 45%	Below 40%	Cement	Abrasive	Refra-ctory	Chemical	Others	
India	62623	695903	421571	807935	67704	2008882	126794	124626	1310	4241930	8559278
Chhattisgarh	–	–	10762	7025	36	–	–	–	–	–	17823
Goa	–	–	–	–	–	519934	–	–	–	–	519934
Gujarat	60864	693897	346529	377127	7573	1435916	126794	122499	–	4240354	7411553
Jharkhand	–	–	2099	327612	77	–	–	–	–	–	329788
Karnataka	–	–	–	705	6009	–	–	–	–	–	6714
Madhya Pradesh	1759	1640	2731	17012	8284	1762	–	2127	1310	–	36625
Maharashtra	–	366	48152	65422	–	51270	–	–	–	1576	166786
Odisha	–	–	11298	5247	23464	–	–	–	–	–	40009
Tamil Nadu	–	–	–	7785	22261	–	–	–	–	–	30046

Table – 7 (B) : Mine-head Stocks of Bauxite at the end of the year, 2009-10(P)
(By States & Grades)

(In tonnes)

State	Stocks by Grades : AL ₂ O ₃ Content For use Alumina & Aluminium metal extraction					For use other than Alumina & Aluminium metal extraction					Total
	60% & above 55%- 60%	50%- 55%	45%- 50%	40%- 45%	Below 40%	Cement	Abrasive	Refra-ctory	Chemical	Others	
India	55934	827123	58571	257391	72890	1411167	7751	17127	2638	6486044	9196636
Chhattisgarh	–	–	37339	532	289	–	304	4202	–	–	42666
Goa	–	–	–	–	–	500	–	–	–	–	500
Gujarat	55934	826444	–	79897	11823	1387938	7447	12925	–	6460053	8842461
Jharkhand	–	–	410	21345	23	–	–	–	–	–	21778
Karnataka	–	–	–	14245	4141	–	–	–	–	–	18386
Madhya Pradesh	–	–	2718	10630	38199	700	–	–	2638	–	54885
Maharashtra	–	679	14535	106523	–	22029	–	–	–	25991	169757
Odisha	–	–	3569	10930	18415	–	–	–	–	–	32914
Tamil Nadu	–	–	–	13289	–	–	–	–	–	–	13289

BAUXITE

MINING & TRANSPORT

The mining of bauxite is carried out by opencast method. The mines are classified in the following three categories depending upon the level of mechanisation.

- (i) Manually-operated mines;
- (ii) Semi-mechanised mines;
- (iii) Mechanised mines.

Manually-operated Mines

Many bauxite mines are small, producing less than 25,000 tpy. The entire work of overburden removal, extraction of bauxite and loading of bauxite in trucks is carried out manually and the bauxite is transported to respective railway siding or plants by road.

Semi-mechanised Mines

In semi-mechanised mines, mining operations are carried out by Jack hammer drilling and normally ANFO mixture is used as an explosive for blasting in mineralised zone as well as in overburden, if required. Loading of mineral to trucks or dumpers is done by payloaders or manually. Since bauxite occurs as small lenses or pockets of boulders or as segregations in murrum and laterite, it is difficult to mechanise the mining operations.

Mechanised Mines

Mechanised mining operations are carried out in a few captive mines of the alumina/aluminium plants. In these mines, use of compressed-air drills for drilling blastholes is made. Sometimes, compressed-air jack hammer drills are also used for drilling blastholes for secondary blasting of boulders and also in toe drilling in irregular bauxite faces which result due to improper fragmentation of bauxite. The blasted overburden/ore materials are handled and transported separately by using shovels or excavators and trucks/dumpers. Separate benches are maintained for the overburden and ores. The height of benches in ore varies from 1.5 to 7.5 m. Hindalco has done away with drilling and blasting at its Durgmanwadi mines in Maharashtra by using state-of-the-art ripper dozer which is regarded as "Miner's Plough". A ripper dozer silently ploughs the mine surface to extract the mineral. It has totally eliminated the ground vibrations and air pollution normally caused by dust, gases and noise.

In Bagru Hill mines of Hindalco in Jharkhand, the blasted bauxite is transported with the help of dumpers to the crusher. The 4-inch crushed bauxite is then transported to Lohardaga railway station by a monocable aerial ropeway.

BALCO also has monocable ropeway for transporting bauxite from its captive mines to the alumina plant at Korba in Chhattisgarh.

Computerised mine planning, use of mobile crusher, simultaneous land reclamation, restricting operations to small portions of mining area at a time, etc. have greatly helped in conserving energy and faster land rehabilitation.

In Odisha, NALCO has adopted the mechanised 'Trench method' of opencast mining at Panchpatmali mine. In this method, a pilot trench is driven through the mid deposit and several other trenches are opened on both the sides in a staggered pattern exposing and creating more number of working fronts. The fertile top soil is preserved by dozing aside and hard laterite of 3 m thickness is drilled and blasted. The overburden is removed using higher capacity mobile equipment like dumpers and wheel loaders to expose the bauxite bed.

The top slice of bauxite having 8-10 m thickness is loosened by drilling and blasting and the bauxite of 3-4 m thickness at the bottom contact is removed selectively using backhoe shovels. The mine has achieved overall capacity of 4.8 million tonnes bauxite after expansion. Accordingly, higher capacity mobile equipment like dumpers, wheel loaders, ripper dozers and faster drills have been introduced. NALCO is planning to further increase bauxite mining capacity to 6.3 million tonnes under Second phase expansion.

CONSUMPTION

In 2009-10, reported consumption of bauxite was 9.89 million tonnes as compared to 9.93 million tonnes in the previous year. Alumina/aluminium industry was the principal consumer of bauxite, accounting for 86.5% consumption in 2009-10 followed by cement (9.2%) and refractory (3.9%) (Table-8). Consumption of ferro-aluminium is furnished in Table-9.

Gujarat was the main supplier of abrasive and refractory grade bauxite. Alumina plants draw supplies mostly from their captive mines. Hindalco sources bauxite from other suppliers also (Table - 10).

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Table – 8 : Reported Consumption of Bauxite*
2007-08 to 2009-10
(By Industries)

Industry	(In tonnes)		
	2007-08	2008-09 (R)	2009-10(P)
All Industries	10599900	9931000	9885900
Abrasives	4200(5)	4200(5)	4200(5)
Alumina ^{1/}	9652500(4)	8443200(4)	8549600(4)
Cement	614900(24)	1144400(28)	911500(28)
Ceramic	100(3)	100(3)	100(2)
Chemical	6500(3)	5900(3)	5900(3)
Ferro-alloys	13600(4)	8900(5)	12500(5)
Fertilizer	18200(2)	18200(2)	18200(2)
Iron & steel	1200(7)	1200(7)	1200(7)
Refractory ^{2/}	288700(59)	304900(62)	382700(64)

Figures rounded off. Data collected on non-statutory basis. Figures in parentheses denote the number of units in organised sector reporting* consumption. (*Includes actual reported consumption and/or estimates made wherever required).

^{1/} Excludes industrial end-use consumption of laterite which was 2.231 million tonnes, 3.012 million tonnes and 3.099 million tonnes during 2007-08, 2008-09 and 2009-10, respectively.

^{2/} Includes about 5.369 million tonnes, 5.785 million tonnes and 6.411 million tonnes bauxite equivalent of alumina estimated to have been consumed in the production of aluminium metal in 2007-08, 2008-09 and 2009-10, respectively.

^{3/} Includes consumption of calcined bauxite.

Table – 9 : Reported Consumption of Ferro-aluminium, 2007-08 to 2009-10
(By Industries)

Industry	(In tonnes)		
	2007-08	2008-09(R)	2009-10 (P)
All Industries	221	56	60
Alloy steel	52 (1)	52 (1)	52 (1)
Iron & steel	169 (1)	4 (1)	8 (1)

Data collected on non-statutory basis. Figures in parentheses denote the number of units in organised sector reporting* consumption.

(*Includes actual reported consumption and/or estimates made wherever required).

Table – 10 : Domestic Sources of Supplies of Bauxite to Alumina Plants

Producer	Plant	Source of supply
NALCO	Damanjodi, Koraput (Odisha)	Captive mines at Panchpatmali Hills, Koraput dist., Odisha.
BALCO	Korba (Chhattisgarh)	Captive mines in Surguja & Bodai-Daldali in Kawardha (Kabirdham) dist. Chhattisgarh.
Hindalco	Renukoot (Uttar Pradesh)	Captive mines in Shahdol dist., Madhya Pradesh; Gumla and Lohardaga dist., Jharkhand and Surguja dist. in Chhattisgarh & other suppliers in Orissa, Madhya Pradesh and Jharkhand; Katni Bauxite Pvt. Ltd, Satna, Laxmidasji Ramji, Katni and Minerals & Minerals Corp., Gujarat.
	Belgaum (Karnataka) Muri, Ranchi (Jharkhand)	Captive mines in Chandgad and Durgmanwadi, Kolhapur dist. Maharashtra and Lohardaga dist., Jharkhand.
MALCO	Mettur (Tamil Nadu)	Captive mines at Yercaud and Kolli, Salem dist. Tamil Nadu.

USES & SPECIFICATIONS

Bauxite is primarily used to produce alumina through the Bayer process. Aluminium industry normally uses bauxite containing minimum 58% Al₂O₃. However, slightly inferior grades with a suitable blend are also used, depending upon other characteristics, such as solubility in caustic soda and absence of silica. The IS : 5953-1985 (Reaffirmed 2003) specifications for metallurgical grade bauxite are given in Table-11. Details of the 'Aluminium and Alumina' industries are provided in a separate review.

Table – 11 : Specifications for Metallurgical Grade Bauxite
(IS : 5953-1985; Reaffirmed 2003)

Constituent	(In % by weight)	
	Gr. I (essentially gibbsite or trihydrate)	Gr. II * (mixture of gibbsite, boehmite and diaspor or trihydrate & monohydrate)
Total Al ₂ O ₃ , min	40	47
Total available alumina, min	36	43
Total SiO ₂ , max	4	4
Module Al ₂ O ₃ /SiO ₂ , min	12	12
Fe ₂ O ₃ / TiO ₂ , max	30	30
P ₂ O ₅ , max	0.20	0.20
V ₂ O ₅ , max	0.20	0.20
Loss on ignition at 1100°C	20	20

* Normally, 1 to 20% diaspor and 5 to 7% boehmite.

In steel industry, bauxite is used as a slag corrector in place of fluorspar. Steel industry consumes bauxite, containing 45 to 54% Al₂O₃ and 5% SiO₂ (max). Size preference is 25 to 125 mm with a tolerance of 5% (max) for -25 mm and +100 mm fractions.

The BIS has prescribed the following specifications for bauxite in refractory industry (Table-12).

Table – 12 : IS Specifications of Bauxite for Refractory Industry
(IS : 10817-1984; Reaffirmed 2000)

Constituent	Percent
Al ₂ O ₃	58 min
Fe ₂ O ₃	3 max
TiO ₂	3 max
CaO	0.5 to 0.6
LOI	27 to 30

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The refractory manufacturers use bauxite of the following specifications:

Specifications of Bauxite used by Refractory Industry

Constituent	Percent
Al ₂ O ₃	55-60
Fe ₂ O ₃	4-6
TiO ₂	5-8
SiO ₂	2
Others	25-40
PCE	33-36 (Ortan)

The IS specifications of bauxite for consumption in chemical and petroleum industries are given in Table - 13.

Table – 13 : IS Specifications of Bauxite for Chemical and Petroleum Industries (IS : 3605-1984; Reaffirmed 2003)

Constituent	Requirement
Alumina (as Al ₂ O ₃), % by mass, min	58.0
Silica (as SiO ₂), % by mass, max	3.0
Iron oxide (as Fe ₂ O ₃), % by mass, max	2.0
Titania (as TiO ₂), % by mass, max	4.0
Phosphorus pentoxide (as P ₂ O ₅), % by mass, max	0.3
Manganese dioxide (as MnO), % by mass, max	0.1
Calcium and magnesium (as CaO), % by mass, max	2.0
Loss on ignition, % by mass, max	32.0

Apart from the chemical specifications, the physical requirements are that the material passing through 90-micron IS sieve but retained on 212-micron IS sieve should be 90% max, that passing through 300-micron IS sieve shall be 1% by mass max and that passing through 212- micron IS sieve but retained on 300-micron IS sieve should be 10% maximum.

SUBSTITUTION

There is no substitute of bauxite for aluminium metal extraction on a large scale. However, calcined clay can be substituted for refractory bauxite but only with reduction in length of time and stock resistance. Sillimanite, alumina, silicon carbide, magnesite-chromite and carbon-magnesite refractories are the alternatives for high-alumina material but at higher cost. Silicon carbide and diamonds can substitute for fused aluminium oxide in abrasive use but again at higher cost. Synthetic mullite substitutes for bauxite-

based refractories. Silicon carbide and alumina-zirconia are costlier substitutes for bauxite-based abrasives.

TRADE POLICY

As per the Foreign Trade Policy for 2009-2014 and policy on export and import, imports of aluminium ores and concentrates including natural bauxite, whether calcined or not, and others are permitted freely. There are no policy restrictions on the export of bauxite.

WORLD REVIEW

The bauxite reserves are estimated at 27 billion tonnes, located mainly in Guinea (27%), Australia (23%), Vietnam (8%), Brazil and Jamaica (7% each), China and India (3% each). Countrywise reserves of bauxite are given in Table - 14.

The world production of bauxite was estimated at 199 million tonnes in 2009. Australia continued to be the major producer accounting for 33% share in total production, followed by China (15%), Brazil (13%), Guinea and India (7% each) (Table -15).

Table – 14 : World Reserves of Bauxite (By Principal Countries)

Country	Reserves
(In '000 tonnes)	
World : Total (rounded)	27000000
Australia	6200000
Brazil	1900000
China	750000
Greece	600000
Guinea	7400000
Guyana	700000
India*	770000
Jamaica	2000000
Kazakhstan	360000
Russia	200000
Suriname	580000
USA	20000
Venezuela	320000
Vietnam	2100000
Other countries	3200000

Source: Mineral Commodity Summaries, 2010.

* India's total resources of bauxite as per UNFC system are placed at 3.29 billion tonnes as on 1.4.2005.

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**Table – 15 : World Production of Bauxite, 2007 to 2009
(By Principal Countries)**

(In '000 tonnes)			
Country	2007	2008	2009
World: Total	212000	214000	199000
Australia	62428	64038	65843
Brazil	25461	28097	26074
China	20446	25177	30000
Greece	2126	2174	1935
Guinea	18519	17682	14774
Guyana	2243	2092	1485
India*	22625	15554	14048
Jamaica	14568	14636	7817
Kazakhstan	4963	5160	5131
Russia	6054	5675	5775
Suriname	5273	5333	3388
Venezuela	5323	4192	4267*
Other countries	21971	24190	18463

Source: World Mineral Production, 2005-2009.

* India's production of bauxite during 2007-08, 2008-09 and 2009-10 was 22,625 thousand tonnes, 15,460 thousand tonnes and 13,952 thousand tonnes, respectively.

Australia

Since over three decades, Australia continued to be the leader in the production of bauxite with 65.8 million tonnes production. The Government of Queensland chose Aluminium Corporation of China Ltd (Chinaalco) to develop 650 million tonnes Aurukun bauxite deposit on Cape York Peninsula. The production from this deposit is expected in 2011. Bauxite Resources Ltd (BRL) started production at its bauxite mine near Bindoon, W. Australia in August, 2009. The mine has a capacity to produce bauxite at 3 million tpy.

Brazil

Brazil, the third largest producer of bauxite, recorded production at about 26 million tonnes in 2009 with a share of 13% in world total. Alcoa World Alumina & Chemicals (a joint venture between Alcoa and Alumina Ltd), commissioned the Juruti bauxite mine with 2.6 million tpy capacity in September 2009.

China

China was the world's second largest producer in 2009. Almost all production of bauxite came from mines owned and operated by

Aluminium Corp. of China (Chinaalco). The majority of bauxite deposits are diasporic in nature with high silica to alumina ratios. Chinese refineries predominantly use a combined Bayer-Sinter process. Guizhou Guanglu Aluminum Co. started construction of a 1.6 million tpy bauxite mine to feed its new 800,000 tpy alumina refinery in Quinzhen in Guizhou Province. The project was to be completed by 2012. A new 80 million tonne bauxite deposit was also discovered in the said Province near Zunyi. A new 800,000 tpy refinery was to start there by 2010-end.

FOREIGN TRADE

Exports

Exports of bauxite decreased substantially to 476 thousand tonnes in 2009-10 from 1.71 million tonnes in 2008-09. Exports were mainly to Kuwait (38%) and UAE and China (25% each) (Table - 16).

Imports

In 2009-10, imports of bauxite increased to 54,345 tonnes from 45,612 tonnes in the previous year. Imports were mostly from China (Table - 17).

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**Table – 16 : Exports of Bauxite
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	1708349	3708188	475692	732096
Kuwait	81688	107264	182244	227560
UAE	228023	412064	120850	167000
China	524500	1001347	120900	104270
Japan	83314	194672	2780	56210
Slovenia	5592	57523	4861	42858
Saudi Arabia	260884	305898	2747	26472
France	7750	137346	40	978
Chinese Taipei/ Taiwan	239331	833315	–	–
Georgia	170566	494028	–	–
Unspecified	64000	71269	40	848
Other countries	42701	93462	41230	105900

**Table – 17 : Imports of Bauxite
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	45612	988232	54345	1141378
China	43798	950830	53574	1109414
UAE	100	14340	500	21542
Netherlands	162	4782	162	6360
USA	45	599	103	3608
Austria	–	–	3	296
Nepal	–	–	3	158
Guyana	321	7304	–	–
Malaysia	342	1093	–	–
Vietnam	205	5883	–	–
Pakistan	639	3399	–	–
Other countries	++	2	–	–

FUTURE OUTLOOK

The country has large resources of bauxite, occupying the sixth place in the world total resources. The resources of metallurgical grade bauxite are quite adequate while those of the chemical and refractory grade bauxite are

relatively limited considering the future requirements. With the abundance of bauxite resources, Eastern Ghat regions of Odisha and Andhra Pradesh are likely to be the hubs for bauxite mining activities in future. The refractory and chemical grade bauxite can be preserved for future use.