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BAUXITE

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GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

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4 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 diaspore and boehmite, $Al_2O_3.H_2O$ (Al_2O_3-85%; Al-45%); gibbsite or hydrargillite, $Al_2O_3.3H_2O$ (Al_2O_3-65.4%; Al-34.6%), and bauxite (containing colloidal alumina hydrogel), $Al_2O_3.2H_2O$ (Al_2O_3-73.9%; Al-39.1%). The iron oxide in bauxite ore is present as hematite or goethite, silica as clay and free quartz, and titania as leucoxene 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 1.4.2010, as per UNFC system are placed at 3,480 million tonnes. These resources include 593 million tonnes reserves and 2,887 million tonnes remaining resources. By grades, about 84% resources are of metallurgical grade. The resources of refractory and chemical grades are limited and together account for about 4%. By States, Odisha alone accounts for 52% of country's resources of bauxite followed by Andhra Pradesh (18%), Gujarat (7%), Chhattisgarh and Maharashtra (5% each) and Madhya Pradesh and Jharkhand (4% each). 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 GSI, State Directorates of Geology & Mining, Government of Chhattisgarh and CMDC during 2011-12 are given in Table - 2.

PRODUCTION, STOCKS & PRICES

The production of bauxite at 12,877 thousand tonnes in 2011-12 increased marginally as compared to the previous year.

There were 155 reporting mines in 2011-12 as against 193 in the previous year. Besides, production of bauxite was reported as associate mineral by 6 mines during the current year. In all, 71 producers reported production of bauxite in 2011-12. Ten principal producers having 38 mines contributed 89% of the total production. 38 major mines, each producing more than 50 thousand tonnes per annum, together accounted for 92% of the total production.

The contribution of the Panchpatmali bauxite mine of NALCO was 39% of the total production. The share of public sector mines was about 44% of the total production in 2011-12 and the same was 45 per cent in the previous year.

About 56 % of the total production of bauxite was of grade 40-45%, 26 % was of grade below 45-50% Al_2O_3 grade, 9% was of below 40% Al_2O_3 grade, 3% was of Cement grade, 2% was of 50-55% Al_2O_3 grade and one percent in Abrasive, Refractory & Others grades. Nominal production of less than one percent was reported in 55 % to below 60% Al_2O_3 and Chemical grade during the year under review.

Odisha emerged as the leading producing state accounting for about 39% of the total production. Next in the order of production were Chhattisgarh (18%), Maharashtra (15 %), Jharkhand (14 %), Gujarat (7%), Madhya Pradesh (5%) and remaining 2 % was produced by Goa , Karnataka and Tamil Nadu (Tables - 3 to 6).

Mine-head stocks at the end of 2011-12 were 7,988 thousand tonnes as compared to 9,404 thousand tonnes at the beginning of the year. About 92% of total stock was held in Gujarat at the end of the year (Tables - 7(A) & 7(B)).

The average daily employment of labour in bauxite mines was 7028 in 2011-12 as against 7851 in the previous year.

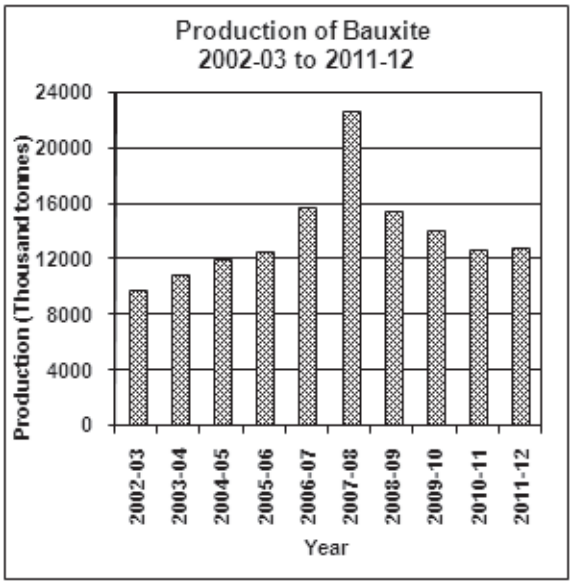

Table – 1 : Reserves/Resources of Bauxite as on 1.4.2010
(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining resources								Total resources (A+B)
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	
		STD121	STD122			STD221	STD222						
All India : Total	**321258**	**89223**	**182457**	**592938**	**105894**	**245091**	**274165**	**655673**	**431006**	**1155570**	**19283**	**2886682**	**3479620**
By Grades													
Chemical	2314	-	-	2314	-	3986	411	2493	182	4947	-	12019	14333
Refractory	26480	44837	951	72268	753	5590	402	5201	208	9326	-	21480	93748
Chemical/Refractory mixed with others	3416	-	39	3455	202	1924	344	1919	216	9038	-	13643	17098
Metallurgical-1	184786	38129	155095	378010	65568	187321	215300	446004	293097	630731	14843	1852864	2230874
Metallurgical-2	28669	961	12265	41895	13956	9938	29189	104223	67309	309123	4440	538178	580073
Metallurgical mixed	11435	338	5019	16792	3919	1135	2518	53898	-	28611	-	90081	106873
Low Grade	32145	4452	5133	41730	21054	6334	18614	22189	54837	108521	-	231549	273279
Mixed Grade excluding chemical/ refractory	21283	268	1312	22863	177	6960	6766	3800	4244	13373	-	35320	58183
Abrasive	113	20	40	173	-	634	123	92	56	961	-	1866	2039
Others	8640	103	2544	11287	92	-	472	2489	5136	9135	-	17324	28611
Unclassified	1088	115	59	1262	171	21257	26	13360	5720	11039	-	51573	52835
Not-known	889	-	-	889	-	12	-	5	-	20765	-	20782	21671
By States													
Andhra Pradesh	-	-	-	-	-	-	-	188971	138120	288176	-	615267	615267
Bihar	-	-	-	-	-	-	-	-	-	4114	-	4114	4114
Chhattisgarh	21246	48435	4818	74499	3992	4069	875	33764	11792	23241	18747	96480	170979
Goa	15169	-	1207	16376	14941	1097	10121	6820	-	8646	-	41625	58001
Gujarat	98794	4560	10407	113761	3359	20295	2586	26593	22107	48019	-	122959	236720
Jammu & Kashmir	-	-	-	-	-	-	-	1323	182	520	-	2025	2025
Jharkhand	16023	7290	12863	36176	5135	11341	5531	15760	17397	54447	536	110147	146323
Karnataka	5399	542	-	5941	1735	394	10	-	2220	45405	-	49764	55705
Kerala	-	-	-	-	29	-	24	2037	9284	2722	-	14096	14096
Madhya Pradesh	17144	1068	1590	19802	3151	11733	1199	6640	53715	50551	-	126989	146791
Maharashtra	14461	4473	7219	26153	16886	6704	12531	52191	10524	49896	-	148732	174885
Odisha	132314	22855	144354	299523	56667	188316	237723	310224	155081	562924	-	1510935	1810458
Rajasthan	-	-	-	-	-	-	-	-	-	528	-	528	528
Tamil Nadu	708	-	-	708	-	1141	3564	960	10084	8363	-	24112	24820
Uttar Pradesh	-	-	-	-	-	-	-	10390	500	8018	-	18908	18908

Figures rounded off.

Table – 2 : Details of Exploration Activities for Bauxite, 2011-12

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage drilled		
Geological Survey of India							
Gujarat	Ukheda,	-	-	-	-	-	In this belt, kaolinisation,
Kachchh	Daban						laterisation and bauxitisation
	Wamoti						were observed together.Bauxite is
	Naniand						pisolitic and its size varies from
	Khanpur						2 cm to1 m in diameter. The
							width ranges from 1 m to 3.5 m.
							Al_2O_3 & TiO_2 content in XRF
							analysis varies from 16.09% to
							64.45% and 1.34% to 5.14%
							respectively in Wamoti Nani and
							Wamoti Moti.
Madhya Pradesh	Tantar &	-	-	-	-	-	Investigation was carried out in
Dindori	Tainchi						collaboration with DGM, MP.
	Blocks						Identified 05 pockets of bauxite over
							an area of 3.9 sq km. The pisolitic
							bauxite is richer in alumina than
							massive bauxite. The average
							thickness is about 2.2 m. The
							analytical results of bauxite/
							aluminous laterite show an average
							value of Al_2O_3 48.3%, SiO_2 3.07%,
							Fe_2O_3 12.18% and P_2O_5 0.16%.
							The Al_2O_3 content is more than
							50% in Pisolitic bauxite in the
							Silpiri Tiklukheru area and can be
							categorised under 'Metallurgical
							Grade-II'.
Maharashtra							
Ratnagiri &	N/v Hathivale,	-	-	-	-	-	Sampling work carried out to locate
Sindhudurg	Arekarwadi						bauxite rich zone within the
							laterite in NE of the Hathivale
							to Sagve and Vijaydurg in the SW.
							Profile sampling in Hathivale &
							Arekarwadi areas shows bauxite
							enrichment at greater depth. Area
							SE of Hathivale & areas around
							Nanarwadi show bauxitic nature at
							shallow level. Analytical results of
							samples are awaited.
Directorate of Geology							
Odisha							
Kalahandi	Lingapadar	1:25,000	51	-	-	406	Bauxite occurs in association with
							khondalite. The area comprised
							of khondalite, pyroxene granulite,

(Contd.)

Table - 2 (Concld.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage drilled		
							charnockite, granite gneiss, porphyritic granite gneiss, pegmatite, laterite & bauxite. The length & width of the deposit vary from 0.6 km-1.5 km and 0.5 km-0.6 km respectively. Thickness of the mineralised zone varies from 3-11 m. Resources will be estimated after the receipt of analysis report.
Kalahandi	Telangi mine	1:10,000	0.005	-	-	170	Resources were not estimated. Six blanket type bauxite bearing plateau have been located having average length and width of 0.5 km - 1 km and 0.20 km-0.40 km respectively. The thickness of aluminious laterite/ bauxite is about 3 m.
	Around	1:25,000	70	-	-	410	
	Gopalpur	1:2,000	1.25				
- do - Koraput	Around Maligan, Dongari & Janigurha	1:25,000.	54	-	-	98	Resources will be estimated after receipt of analysis report. The area comprised of litho units like khondalite, quartzite, pyroxene granulite, charnokite, granite gneiss, etc. Four bauxite bearing plateau have been delineated with length varying from 250-1000 m and width from 150-300 m. Thickness of bauxite zone was found about 4 m. One red ochre occurrence has been noticed also n/v Maligan with dimension of 30 m x 10 m approximately.
Directorate of Geology & Mining, Chhattisgarh							
Kabirdham	Darai	1:50,000	104	85	812.7	633	About 3.25 lakh tonnes resources of bauxite were estimated.
	Area	1:4,000	2.408				
Surguja	Dandkeshra block, Mainpat	1:50,000	215	112	1142.35	592	About 4 lakh tonnes resources of metal grade of bauxite were estimated.
		1:4,000	2.72				
Chhattisgarh Mineral Development Corporation, Chhattisgarh							
Surguja	Barima (Mainpat)	-	16 (Hect.)	88	1135.20	210	Geophysical mapping of 16 ha was completed. Resources were not estimated.

Table – 3 : Principal Producers of Bauxite, 2011-12

Name & address of producer	Location of mine	
	State	District
National Aluminium Co. Ltd, NALCO Bhawan,P/1, Nayapali, Bhubaneshwar – 751 013, Odisha.	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	Kawardha
Ashapura Minechem Ltd, Jeevan Udyog Building, 278, D.N.Road, Fort, Mumbai – 400 001.	Maharashtra	Ratnagiri
Gujarat Mineral Dev. Corp. Ltd, Khanij Bhavan, 132 Ft, Ring Road, Vastrapur, Ahmedabad.	Gujarat	Jamnagar
M. P. State Mining Corporation Ltd, Paryawas Bhawan, Block No. 1(A), Second Floor, Jail Road, Arera Hill, Bhopal - 462 011, Madhya Pradesh.	Madhya Pradesh	Rewa Satna

(Contd.)

Table - 3 (Concld.)

Name & address of producer	Location of mine	
	State	District
Bharatesh Construction Company, 34, Corporation Complex, Goaves, Hindwadi, Belgaum -590 011.	Maharashtra	Kolhapur
Alatage Stone Crushing Ind. House No. 148, Near Madrasa, At. Arathi, Post & Tal-Shriwardhan, Dist. Raigad -402 110, Maharashtra.	Maharashtra	Raigarh
Ram Awatar Agrawal, Post- Jaitwara, Satna, Madhya Pradesh.	Madhya Pradesh	Satna
Panditrao Mines & Minerals Pvt. Ltd, At. Post- Minche Budruk, Tah. Bhudargad, Dist. Kolhapur - 416 223, Maharashtra.	Maharashtra	Kolhapur

Table – 4 : Production of Bauxite, 2009-10 to 2011-12
(By States)

(Qty in tonnes; value in ₹ '000)

States	2009-10		2010-11		2011-12(P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**14124093**	**4887897**	**12722820**	**5122151**	**12877394**	**5520032**
Chhattisgarh	1687069	607911	2109949	777273	2365304	1268221
Goa	31050	3105	100900	10090	84700	8470
Gujarat	2687306	667424	938574	570664	843497	430400
Jharkhand	1670577	673016	1855993	627327	1830850	692085
Karnataka	123316	32748	64643	11348	83019	20157
Madhya Pradesh	1056847	365097	616319	262437	617146	205571
Maharashtra	1985006	628556	2133736	549201	1937898	505268
Odisha	4879580	1909188	4856808	2305022	5045888	2372555
Tamil Nadu	3342	852	45898	8789	69092	17305

Table – 5 (A) : Gradewise Production of Bauxite, 2010-11
(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹ '000)

State	No. of Mines	For use in Alumina & Aluminium extraction :Al_2O_3 content						For use other than Alumina & Aluminum extraction					Total	
		60%-65%	55%-60%	50%-55%	45% -50%	40% -45%	Below 40%	Cement	Abrasive	Refractory	Chemical	Other	Quantity	Value
India	**193(4)**		**95740**	**261897**	**1986758**	**9283749**	**118391**	**506552**	**52389**	**39057**	**62825**	**315462**	**12722820**	**5122151**
Public Sector	19		52395	167405	390697	5066523	26238	-	-	-	-	23506	5726764	2778635
Private Sector	174(4)		43345	94492	1596061	4217226	92153	506552	52389	39057	62825	291956	6996056	2343516
Chhattisgarh	**13**		**-**	**-**	**1453549**	**656400**	**-**	**-**	**-**	**-**	**-**	**-**	**2109949**	**777273**
Kanker *	1		-	-	-	-	-	-	-	-	-	-	-	-
Kawardha	2		-	-	509150	190202	-	-	-	-	-	-	699352	171168
Surguja	10		-	-	944399	466198	-	-	-	-	-	-	1410597	606105
Goa	**1**		**-**	**-**	**-**	**-**	**-**	**100900**	**-**	**-**	**-**	**-**	**100900**	**10090**
South Goa	1		-	-	-	-	-	100900	-	-	-	-	100900	10090
Gujarat	**100**		**76726**	**261774**	**182164**	**60610**	**44892**	**106869**	**51151**	**39057**	**61477**	**53854**	**938574**	**570664**
Amreli	1		-	-	-	-	-	8380	-	-	-	-	8380	3193
Jamnagar	86		708	6702	-	60610	1215	71431	49866	39057	61477	30348	321414	199124
Kachchh	9		76018	255072	182164	-	43677	10282	1285	-	-	23506	592004	367285
Porbandar	3		-	-	-	-	-	16776	-	-	-	-	16776	1062
Sabarkantha *	1		-	-	-	-	-	-	-	-	-	-	-	-
Jharkhand	**36**		**-**	**-**	**74694**	**1780079**	**1220**	**-**	**-**	**-**	**-**	**-**	**1855993**	**627327**
Gumla	23		-	-	44839	998536	-	-	-	-	-	-	1043375	382399
Latehar	1		-	-	-	19867	-	-	-	-	-	-	19867	9099
Lohardaga	12		-	-	29855	761676	1220	-	-	-	-	-	792751	235829
Karnataka	**2**		**-**	**-**	**-**	**38300**	**26343**	**-**	**-**	**-**	**-**	**-**	**64643**	**11348**
Belgaum	1		-	-	-	-	26343	-	-	-	-	-	26343	3688
Dakshin Kannada	1		-	-	-	38300	-	-	-	-	-	-	38300	7660
Madhya Pradesh	**19(4)**		**19014**	**123**	**114221**	**433016**	**44736**	**3861**	**-**	**-**	**1348**	**-**	**616319**	**262437**
Anuppur	1		-	-	-	90540	-	-	-	-	-	-	90540	52966
Jabalpur*	1		-	-	-	-	-	-	-	-	-	-	-	-
Katni	2		-	-	99762	-	38480	-	-	-	-	-	138242	28981
Rewa	1		-	-	-	64840	-	-	-	-	-	-	64840	29697
Satna	9 (4)		19014	-	12564	20386	6256	3861	-	-	1348	-	63429	16935
Shahdol	2		-	-	-	257250	-	-	-	-	-	-	257250	133345
Sidhi	3		-	123	1895	-	-	-	-	-	-	-	2018	513
Maharashtra	**15**		**-**	**-**	**162130**	**1459736**	**-**	**219914**	**-**	**-**	**-**	**291956**	**2133736**	**549201**
Kolhapur	5		-	-	162130	791176	-	214914	-	-	-	-	1168220	323348
Raigad	6		-	-	-	45500	-	-	-	-	-	291956	337456	55317
Ratanagiri	4		-	-	-	623060	-	5000	-	-	-	-	628060	170536
Odisha	**4**		**-**	**-**	**-**	**4855608**	**1200**	**-**	**-**	**-**	**-**	**-**	**4856808**	**2305022**
Koraput	2		-	-	-	4855608	1200	-	-	-	-	-	4856808	2305022
Sundergarh *	2		-	-	-	-	-	-	-	-	-	-	-	-
Tamil Nadu	**3**		**-**	**-**	**-**	**-**	**-**	**44660**	**1238**	**-**	**-**	**-**	**45898**	**8789**
Namakkal *	2		-	-	-	-	-	-	-	-	-	-	-	-
Salem	1		-	-	-	-	-	44660	1238	-	-	-	45898	8789

*Figures in parentheses indicate number of associated mines. * Only labour reported.*

Table – 5 (B) : Gradewise Production of Bauxite, 2011-12(P)
(By Sectors, States and Districts)

(Qty in tonnes; Value in ₹ '000)

State/District	No. of Mines	Production by grades : Al_2O_3 content For use in alumina & aluminium extraction						For use other than alumina & aluminium extraction					Total	
		60% & above	55%-60%	50%-55%	45%-50%	40%-45%	Below 40%	Cement	Abrasive	Refractory	Chemical	Others	Quantity	Value
India	**155(6)**	**-**	**27507**	**302357**	**3342611**	**7163856**	**1196435**	**382905**	**129608**	**144188**	**2033**	**185894**	**12877394**	**5520032**
Public Sector	18	-	18879	177173	1323718	3892878	125600	-	64128	62218	-	5554	5670148	2676253
Private Sector	137(6)	-	8628	125184	2018893	3270978	1070835	382905	65480	81970	2033	180340	7207246	2843779
Chhattisgarh	**12**	**-**	**-**	**-**	**1694188**	**670886**	**-**	**-**	**230**	**-**	**-**	**-**	**2365304**	**1268221**
Kawardha	2	-	-	-	964365	-	-	-	230	-	-	-	964595	581495
Surguja	10	-	-	-	729823	670886	-	-	-	-	-	-	1400709	686726
Goa	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**84700**	**-**	**-**	**-**	**-**	**84700**	**8470**
South Goa	1	-	-	-	-	-	-	84700	-	-	-	-	84700	8470
Gujarat	**77**	**-**	**27507**	**302345**	**70491**	**85523**	**28573**	**98791**	**128250**	**93790**	**2033**	**6194**	**843497**	**430400**
Amreli	1	-	-	-	-	-	250	-	-	-	-	-	250	121
Jamnagar	61	-	-	5973	-	65023	235	39496	54023	26432	1513	640	193335	68759
Junagarh	1	-	-	-	-	-	-	9061	-	-	-	-	9061	970
Kachchh	9	-	27507	296372	70491	20500	28088	1130	64227	67358	520	5554	581747	348377
Porbandar	5	-	-	-	-	-	-	49104	10000	-	-	-	59104	12173
Jharkhand	**28**	-	-	**-**	**129288**	**1431945**	**269617**	**-**	-	-	-	-	**1830850**	**692085**
Gumla	18	-	-	-	85455	1226316	-	-	-	-	-	-	1311771	493993
Latehar	1	-	-	-	-	13706	-	-	-	-	-	-	13706	4618
Lohardaga	9	-	-	-	43833	191923	269617	-	-	-	-	-	505373	193474
Karnataka	**1**	**-**	**-**	**-**	**-**	**-**	**83019**	**-**	**-**	**-**	**-**	**-**	**83019**	**20157**
Belgaum	1	-	-	-	-	-	83019	-	-	-	-	-	83019	20157
Madhya Pradesh	**18(5)**	-	-	**-**	**105008**	**237330**	**210810**	**13600**	-	**50398**	**-**	-	**617146**	**205571**
Anuppur	1	-	-	-	-	7890	41660	-	-	-	-	-	49550	6939
Katni	3(1)	-	-	-	97862	-	40988	13600	-	1822	-	-	154272	63669
Rewa	1	-	-	-	-	53055	-	-	-	-	-	-	53055	18402
Satna	8(4)	-	-	-	5430	13400	3567	-	-	38921	-	-	61318	43003
Shahdol	2	-	-	-	-	162985	124595	-	-	-	-	-	287580	61089
Sidhi	3	-	-	-	1716	-	-	-	-	9655	-	-	11371	12469
Maharashtra	**13**	-	-	**12**	**48586**	**987334**	**604416**	**117850**	-	-	-	**179700**	**1937898**	**505268**
Kolhapur	6	-	-	12	48586	473180	478416	113850	-	-	-	-	1114044	306568
Raigarh	4	-	-	-	-	57000	118000	-	-	-	-	179700	354700	70176
Ratnagiri	3	-	-	-	-	457154	8000	4000	-	-	-	-	469154	128524
Odisha	**3(1)**	-	-	**-**	**1295050**	**3750838**	**-**	**-**	-	-	-	-	**5045888**	**2372555**
Koraput	2	-	-	-	1253227	3750838	-	-	-	-	-	-	5004065	2343964
Sundergarh	1(1)	-	-	-	41823	-	-	-	-	-	-	-	41823	28591
Tamil Nadu	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**67964**	**1128**	**-**	**-**	**-**	**69092**	**17305**
Namakkal *	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Salem	1	-	-	-	-	-	-	67964	1128	-	-	-	69092	17305

Table – 6 : Production of Bauxite, 2010-11 and 2011-12(P) (By Frequency Groups)

(Qty. in tonnes)

Production group	No. of mines		Production for the group		Percentage to total production		Cumulative percentage	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
Total	**193(4)**	**155(6)**	**12722820**	**12877394**	**100.00**	**100.00**	**-**	**-**
Up to 1000	72(1)	51(1)	4048	8420	0.03	0.07	0.03	0.07
1001 - 3000	14(1)	15(1)	27060	25351	0.21	0.20	0.24	0.27
3001 - 5000	14(2)	8(1)	65528	34992	0.52	0.27	0.76	0.54
5001 - 10000	13	13	97445	93291	0.77	0.72	1.53	1.26
10001 - 25000	20	17(2)	305770	317009	2.40	2.46	3.93	3.72
25001 - 50000	19	13(1)	686277	569157	5.39	4.42	9.32	8.14
50001 and above	41	38	11536692	11829174	90.68	91.86	100.00	100.00

Figures in parentheses indicate number of associated mines.

Table – 7 (A) : Mine-head Stocks of Bauxite at the begining of the year, 2011-12 (By States & Grades)

(Qty. in tonnes)

State	Stocks by Grades : Al_2O_3 Content for use in alumina & aluminium metal extraction					For use other than alumina & aluminium metal extraction					
	55%-60%	50%-55%	45%-50%	40%-45%	Below 40%	Cement	Abrasive	Refractory	Chemical	Others	Total
India	**4045**	**483948**	**367863**	**1119455**	**284238**	**6470476**	**12917**	**18834**	**354343**	**287622**	**9403741**
Chhattisgarh	-	-	52109	5371	-	-	80	4275	-	-	61835
Goa	-	-	-	-	-	30928	-	-	-	-	30928
Gujarat	2961	482449	284530	866855	191704	6408980	11085	13309	351013	270987	8883873
Jharkhand	-	-	980	33987	116	-	-	-	-	-	35083
Karnataka	-	-	-	19296	4822	-	-	-	-	-	24118
Madhya Pradesh	1084	1499	6711	11612	50506	294	-	1250	3330	-	76286
Maharashtra	-	-	21374	163621	-	18702	-	-	-	16635	220332
Odisha	-	-	2159	18713	20655	-	-	-	-	-	41527
Tamil Nadu	-	-	-	-	16435	11572	1752	-	-	-	29759

Table – 7 (B) : Mine-head Stocks of Bauxite at the end of the year, 2011-12(P)
(By States & Grades)

(In tonnes)

State	Stocks by Grades : Al_2O_3 Content for use in alumina & aluminium metal extraction				For use other than alumina & aluminium metal extraction					
	50%-55%	45%-50%	40%-45%	Below 40%	Cement	Abrasive	Refractory	Chemical	Others	Total
India	**926**	**39115**	**1109739**	**263267**	**6022334**	**21771**	**31996**	**356686**	**142205**	**7988039**
Chhattisgarh	-	8980	5916	-	-	95	4275	-	-	19266
Goa	-	-	-	-	11503	-	-	-	-	11503
Gujarat	926	-	850606	4391	5971314	19924	19611	353158	142205	7362135
Jharkhand	-	2919	12144	1681	-	-	-	-	-	16744
Karnataka	-	-	19296	9072	-	-	-	-	-	28368
Madhya Pradesh	-	835	11078	63935	9663	-	8110	3528	-	97149
Maharashtra	-	14377	186314	156967	18281	-	-	-	-	375939
Odisha	-	12004	24385	10786	-	-	-	-	-	47175
Tamil Nadu	-	-	-	16435	11573	1752	-	-	-	29760

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 midddle of the 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 2011-12, reported consumption of bauxite was 11.88 million tonnes as compared to 10.62 million tonnes in the previous year. Alumina/aluminium industry was the principal consumer of bauxite, accounting for 89% consumption in 2011-12 followed by cement (9%) and refractory (1%) (Table-8).

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 too (Table - 9).

USES & SPECIFICATIONS

Bauxite is primarily used to produce alumina through the Bayer process. Aluminium industry normally uses bauxite containing minimum 38% Al_2O_3. 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 2008) specifications for metallurgical grade bauxite are given in Table-10. Details of the 'Aluminium and Alumina' industries are provided in a separate review.

Table – 8 : Reported Consumption of Bauxite* 2009-10 to 2011-12 (By Industries)

(In tonnes)

Industry	2009-10	2010-11(R)	2011-12(P)
All Industries	**12226200**	**10622600**	**11888100**
Abrasives	4200(5)	3200(3)	3400(3)
Alumina[1/]	11026500(4)	9391900(4)	10634600(4)
Cement	1042800(27)	1082000(32)	1103600(32)
Ceramic	100(3)	1300(3)	1200(3)
Chemical	5900(3)	5900(3)	5900(3)
Ferro-alloys	12900(5)	10200(7)	11300(7)
Fertilizer	18200(2)	18200(2)	18200(2)
Iron & steel	1200(7)	1200(6)	1200(6)
Refractory[2/]	114400(53)	108700(53)	108700(49)

Figures rounded off.
Figures in parentheses denote the number of units in organised sector reporting consumption.*
*(*Includes actual reported consumption and/or estimates made wherever required). Excludes industrial end-use consumption of laterite which was 3,614,500 tonnes, 3,735,300 tonnes and 3,830,300 tonnes during 2009-10, 2010-11 and 2011-12, respectively.*
1/ Includes about 9096 thousand tonnes, 9726 thousand tonnes and 10780 thousand tonnes bauxite equivalent of alumina estimated to have been consumed in the production of aluminium metal in 2009-10, 2010-11 and 2011-12, respectively.
2/ Includes consumption of calcined bauxite.

Table – 9 : 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 Industries	Renukoot (Uttar Pradesh)	Captive mines in Shahdol dist., Madhya Pradesh; Gumla and Lohardaga dist., Jharkhand and Surguja dist. in Chhattisgarh & other suppliers in Odisha, 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.
Vedanta Aluminium	Lanjigarh (Odisha)	GMDC, Gujarat, Ashapura Minechem, Maharashtra, BALCO, Chhattisgarh.

Table – 10 : Specifications for Metallurgical Grade Bauxite (IS : 5953-1985; Reaffirmed 2008)

(In % by weight)

Constituent	Gr. I (essentially gibbsite or trihydrate)	Gr. II * (mixture of gibbsite, boehmite and diaspore or trihydrate & monohydrate)
Total Al_2O_3 min	40	47
Total available alumina, min	36	43
Total SiO_2, max	4	4
Module Al_2O_3/SiO_2, min	12	12
Fe_2O_3/TiO_2, max	30	30
P_2O_5, max	0.20	0.20
V_2O_5, max	0.20	0.20
Loss on ignition at 1100 °C	20	20

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

In steel industry, bauxite is used as a slag corrector in place of fluorite. Steel industry consumes bauxite, containing 45 to 54% Al_2O_3 and 5% SiO_2 (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-11):

Table – 11 : IS Specifications of Bauxite for Refractory Industry (IS : 10817-1984: Reaffirmed 2008)

Constituent	Percent
Al_2O_3	58 min
Fe_2O_3	3 max
TiO_2	3 max
CaO	0.5 to 0.6
LOI	27 to 30

The refractory manufacturers use bauxite of the following specifications:

Specifications of Bauxite used by Refractory Industry

Constituent	Percent
Al_2O_3	55-60
Fe_2O_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-12.

Table – 12 : IS Specifications of Bauxite for Chemical and Petroleum Industries (IS : 3605-1984; Reaffirmed 2010)

Constituent	Requirement
Alumina (as Al_2O_3), % by mass, min	58.0
Silica (as SiO_2), % by mass, max	3.0
Iron oxide (as Fe_2O_3), % by mass, max	2.0
Titania (as TiO_2), % by mass, max	4.0
Phosphorus pentoxide (as P_2O_5), % by mass, max	0.3
Manganese dioxide (as MnO_2), % 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% maximum, that passing through 300-micron IS sieve shall be 1% by mass maximum and that passing through 212- micron IS sieve but retained on 300-micron IS sieve should be 10% maximum.

The other specifications laid down by BIS are IS:8228-1976 (Reaffirmed 2008) for bauxite sand and IS:8988-1978 (Reaffirmed 2008) for bauxite powder for foundry washes.

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. The raw material like alunite, anorthosite, coal wastes and oil shales are other potential sources of alumina. The extraction would require new plants with different technology. These non-bauxitic materials could satisfy the demand for primary metal, refactories, aluminium chemicals and 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 28 billion tonnes, located mainly in Guinea (26%), Australia (21%), Brazil (9%), Vietnam(8%), Jamaica (7%) and Guyana & China (3% each). Countrywise reserves of bauxite are given in Table - 13.

The world production of bauxite was estimated at 248 million tonnes in 2011. Australia continued to be the major producer accounting for 28% share in total production, followed by Indonesia (17%), China (15%), Brazil (14%), Guinea (7%) and India (5%) (Table -14).

Table – 13 : World Reserves of Bauxite (By Principal Countries)

(In '000 tonnes)

Country	Reserves
World : Total (rounded)	**28,000,000**
Australia	6,000,000
Brazil	2,600,000
China	830,000
Greece	600,000
Guinea	7,400,000
Guyana	850,000
India*	900,000
Indonesia	1,000,000
Jamaica	2,000,000
Kazakhstan	160,000
Russia	200,000
Sierra Leone	180,000
Suriname	580,000
USA	20,000
Venezuela	320,000
Vietnam	2,100,000
Other countries	2,100,000

Source: *Mineral Commodity Summaries, 2013.*
** India's total resources of bauxite as per UNFC system are placed at 3.48 billion tonnes as on 1.4.2010.*

China

China Power Investment Corporation (CPIC) started construction of a mine with 1 million tonnes per annum capacity in Wanchangping, Guizhan Province which will supply bauxite to a refinery being constructed in Wuchuan, Guizhou Province. CPIC is also developing 1 million tonnes per annum bauxite mine at Dazhuyuan in the same Province. Shanxi Hauxing Aluminium Co. Ltd started construction of 900,000 tonnes per annum bauxite mine in Xing county, Shanxi Province to supply bauxite to a alumina refinery being built by the Company.

The Chinese Government promoting research on recovering alumina from coal ash as domestic bauxite is limited and low grade. Two such refineries namely Datang International Power Generation Co. Ltd in Qingshuihe, Inner Mongolia Autonomous Province and China Coal Corp. in Pingsu, Shanxi Province were under construction. The later, having capacity of one lakh tonnes per annum slated to be completed by second half of 2012. Besides, Shenhua Group Corp. Ltd also started construction of alumina refinery capacity of about one million tonnes per annum in Jungar Banner, Inner Mongolia Autonomous Region. Elsewhere in Tuokduo, Inner Mongolia Autonomous Region, the Datang Inner Mongolia Recycling Resources Co. Ltd started production of alumina from coal ash during 2011.

Jamaica

Rusal started production from Russell Place bauxite mine. The Government of Jamaica permitted Noranda Aluminium Holding Corp. to increase bauxite exports of 5.4 million tonnes per annum from its St. Ann Mine for two years.

India

NALCO's captive mine capacity increased to 6.83 million tonnes per annum from 6.3 million tonnes per annum. Bauxite from Jerrela deposit will be supplied to Anrak Aluminium Ltd alumina refinery at Rachapalle, Andhra Pradesh.

FOREIGN TRADE

Exports

Exports of bauxite increased substantially to 401 thousand tonnes in 2011-12 from 116 thousand tonnes in 2010-11. Exports were mainly to China (71%), Kuwait (11%), Oman (8%) and Nepal (4%) (Table - 15).

Imports

In 2011-12, imports of bauxite increased marginally to 78,980 tonnes from 63,584 tonnes in the previous year. Imports were mostly from China (Table - 16).

Table – 14 : World Production of Bauxite, 2009 to 2011 (By Principal Countries)

(In '000 tonnes)

Country	2009	2010	2011
World: Total	**198000**	**226000**	**248000**
Australia	66168	68535	69977
Brazil	26074	32028	33695
China	29213	36837	37000[e]
Greece	1935	1902	2324
Guinea	14774	16427	17593
Guyana	1485	1083	1818
India*	14124	12641	12992
Indonesia	15000	27000	41000
Jamaica	8104	8540	10189
Kazakhstan	5131	5310	5495
Russia	5300	5035	5380
Suriname	3388	3097	3236
Venezuela	3611	3126	2455
Other countries	3693	4439	4846

Source: *World Mineral Production, 2007-2011.*
**India's production of bauxite during 2009-10, 2010-11 and 2011-12 was 14,124 thousand tonnes, 12,723 thousand tonnes and 12,877 thousand tonnes, respectively.*

Table – 15 : Exports of Bauxite (By Countries)

Country	2010-11		2011-12	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All countries	**116066**	**295202**	**401027**	**922326**
China	150	1672	285140	480925
Kuwait	49801	59077	43879	122252
Slovenia	7200	65825	9472	95273
Oman	16170	25974	32340	55502
Saudi Arabia	3155	22264	5255	48548
Italy	976	9510	1654	17839
Nepal	10710	7131	17714	16031
Japan	1500	34638	675	14507
USA	1903	8492	546	11336
Iran	2000	4158	500	10685
Other countries	22501	56461	3852	49428

Table – 16 : Imports of Bauxite (By Countries)

Country	2010-11		2011-12	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**63584**	**1201033**	**78980**	**1603329**
China	62735	1176872	77207	1568839
USA	222	5904	395	8914
Netherlands	360	12981	205	7499
Guyana	-	-	264	5733
Pakistan	50	307	700	5115
Rep. of Korea	7	1523	12	2473
Hong Kong	-	-	100	1909
Malaysia	-	-	36	1372
Switzerland	-	-	25	525
Germany	200	2009	20	477
Other countries	10	1437	16	473

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. As per the Report of the Working Group for 12th Five Year Plan, the abundance of bauxite resources in Eastern Ghat regions of Odisha and Andhra Pradesh are likely to be the hubs for bauxite mining activities in future. The Working Group has recommended that the large deposits of these areas can be reserved for the greenfield alumina refineries. Additional bauxite resources are required for the brownfield expansion of the existing alumina refineries.