

BAUXITE



Indian Minerals Yearbook 2017

(Part- III Mineral Reviews)

56th Edition

BAUXITE

(FINAL RELEASE)

**GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES**

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3 Bauxite

Bauxite is basically an aluminous rock that contains hydrated aluminium oxide as main constituent and iron oxide, silica & titania as minor constituents present in varying proportions. Hydrated aluminium oxides present in the bauxite ore are diasporite and boehmite, $Al_2O_3 \cdot H_2O$ (Al_2O_3 -85%; Al-45%); gibbsite or hydrargillite, $Al_2O_3 \cdot 3H_2O$ (Al_2O_3 -65.4%; Al-34.6%), and bauxite (containing colloidal alumina hydrogel), $Al_2O_3 \cdot 2H_2O$ (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 & titania as leucosene or rutile. Bauxite is the principal 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 3,896 million tonnes of resources of bauxite which is sufficient to meet both domestic and export demands.

RESERVES/RESOURCES

Reserves/Resources of bauxite in the country as on 1.4.2015, as per NMI database, based on UNFC system have been placed at 3,896 million tonnes. These resources include 656 million tonnes Reserves and 3,240 million tonnes Remaining Resources. By grades, about 77% 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 51% of country's resources of bauxite followed by Andhra Pradesh (16%), Gujarat (9%), Jharkhand (6%), Maharashtra (5%) and Madhya Pradesh & Chhattisgarh (4% each). Major bauxite resources are concentrated in the East Coast bauxite deposits in Odisha and Andhra Pradesh (Table-1).

Exploration & Development

The exploration & development details are given in the review of "Exploration & Development" in "General Reviews".

PRODUCTION & STOCKS

The production of bauxite at 24,665 thousand tonnes in 2016-17 decreased by 12% as compared to the previous year.

There were 157 reporting mines in 2016-17 as against 190 in the previous year. Besides, 7 mines have reported production of bauxite as associated mineral during the year. In all, 70 producers reported production of bauxite in 2016-17. Ten principal producers having 50 mines contributed 86% of the total production. Fifty Six (56) major mines, including one associated mine each producing more than 50 thousand tonnes

per annum, together accounted for 96% of the total production.

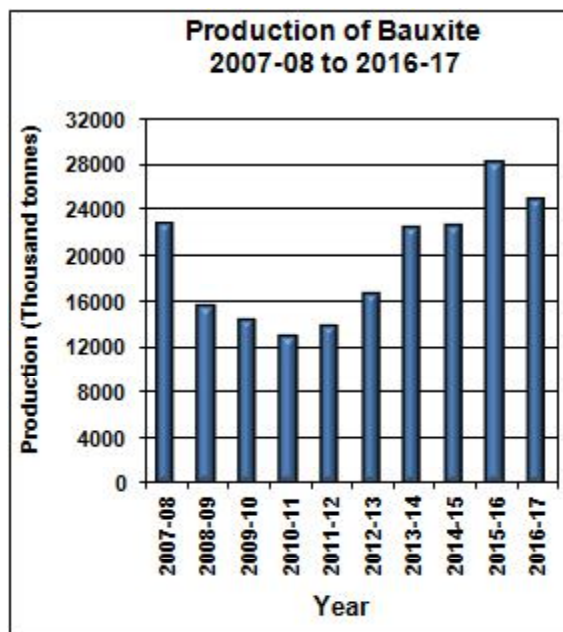
The share of Public Sector mines was about 31 % of the total production in 2016-17, as against 24 per cent in the previous year.

About 61 % of the total production of bauxite was of 40-45% Al_2O_3 grade, 25% was of Cement grade, 7% was of 45-50% Al_2O_3 grade, 4% was of below 40% Al_2O_3 and the remaining 3% of production was of grades that included 50-55% Al_2O_3 , Abrasive, Refractory and Chemical during the year under review.

Odisha emerged as the leading producing State accounting for about 49% of the total production followed by Gujarat (24%), Jharkhand (9%), Chhattisgarh and Maharashtra (8% each). The remaining was produced by Madhya Pradesh, Goa, Karnataka and Tamil Nadu (Tables-2 to 5).

Mine-head closing stocks of bauxite in 2016-17 were 16,262 thousand tonnes as compared to 14,093 thousand tonnes in the previous year. About 89% of total stock was held in Gujarat at the end of the year (Tables- 6 'A' & 'B').

The average daily employment of labour in bauxite mines was 6,029 in 2016-17 as against 8,652 in the previous year.



BAUXITE

**Table – 1 : Reserves/Resources of Bauxite as on 1.4.2015
(By Grades/States)**

(In '000 tonnes)

Grade/State	Reserves			Remaining Resources							Total Resources (A+B)		
	Proved STD111	Probable		Feasibility STD211	Pre-feasibility STD221	Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)			
		STD121	STD122									Total (A)	
All India : Total	434043	18599	203780	656422	254378	132633	382369	710878	430890	1209706	119588	3240442	3896864
By Grades													
Chemical	6844	-	52	6896	276	4584	411	3018	182	4922	-	13393	20289
Refractory	58239	-	8919	67158	637	12439	45808	7267	734	10496	489	77870	145027
Chemical/Refractory	3546	139	742	4426	1184	2218	205	2970	216	8484	-	15278	19704
Mixed with others													
Metallurgical-1	266825	6241	166026	439093	186793	54042	270125	450564	292022	669230	19573	1942349	2381442
Metallurgical-2	44140	501	655	45296	28908	20698	35585	105661	67906	310738	22520	592016	637312
Metallurgical mixed	9897	26	5157	15080	5051	3841	2518	53969	17340	28799	17340	111518	126598
Low Grade	19779	11167	9870	40816	11769	4803	19569	23447	54837	119307	48190	281922	322738
Beneficial	-	-	-	-	-	-	-	55096	-	-	-	55096	55096
Mixed grade Excluding Chem./Refrac.	16993	232	2000	19225	5285	7507	6824	6839	4370	13266	-	44092	63317
Abrasive	651	-	70	721	28	805	123	92	56	961	840	2906	3627
Others	3347	97	8241	11685	3856	143	1097	1949	4848	10997	1545	24435	36120
Unclassified	3545	196	2048	5789	10183	21540	105	-	5720	11039	8954	57540	63329
Not-Known	236	-	-	236	407	12	-	5	-	21465	138	22027	22263
By States													
Andhra Pradesh	-	-	-	-	-	-	-	188971	138120	288176	-	615267	615267
Bihar	-	-	-	-	-	-	-	-	-	4114	-	4114	4114
Chhattisgarh	12537	218	2313	15068	15341	4570	46389	37264	12892	23483	18747	158687	173755
Goa	12357	-	1207	13564	14919	1097	10121	6820	-	8646	-	41603	55168
Gujarat	154911	2094	28229	185234	17324	35470	3925	28953	22107	56857	710	165347	350581
Jammu & Kashmir	-	-	-	-	-	-	-	1323	182	1220	-	2725	2725
Jharkhand	54471	219	8049	62740	9734	6154	15117	17883	17397	54106	55930	176321	239061
Karnataka	126	1123	3140	4389	2468	864	10	82	2220	35603	-	41246	45635
Kerala	-	-	-	-	29	-	24	2037	9284	2722	-	14096	14096
Madhya Pradesh	11979	3313	8299	23591	12566	15084	6013	11061	54484	50590	-	149797	173388
Maharashtra	11281	11221	3686	26188	15449	2064	16809	39197	8367	76501	-	158386	184574
Odisha	176002	441	148856	325269	166547	66189	280396	365938	155253	590780	44202	1669305	1994574
Rajasthan	-	-	-	-	-	-	-	-	-	528	-	528	528
Tamil Nadu	379	-	-	379	-	1141	3564	960	10084	8363	-	24112	24491
Uttar Pradesh	-	-	-	-	-	-	-	10390	500	8018	-	18908	18908

Figures rounded off.

BAUXITE

Table – 2 : Principal Producers of Bauxite, 2016-17

Name & address of producer	Location of mine	
	State	District
National Aluminium Co. Ltd, NALCO Bhawan, P/1, Nayapali Bhubaneswar-751 013, Odisha.	Odisha	Koraput
Utkal Alumina International Ltd, J-6, Jayadev-Vihar, Bhubaneswar-751 013, Odisha.	Odisha	Rayagada
Hindalco Industries Ltd, Century Bhawan, 3rd Floor, Dr. Annie Beasant Road, Worli, Mumbai-400 030, Maharashtra.	Chhattisgarh Jharkhand	Surguja Gumla Latehar Lohardaga Kolhapur
Bombay Minerals Ltd, Jamnagar-Dwarka Highway Jam-Khambalia-361 305, Distt. Devbhoomi Dwarka, Gujarat.	Gujarat	Devbhoomi Dwarka
Bharat Aluminium Co. Ltd, Aluminium Sadan, Core-6, SCOPE Office Complex, 7 Lodhi Road, New Delhi- 110 003.	Chhattisgarh	Kabirdham Surguja

(Contd.)

Table- 2 (Concltd.)

Name & address of producer	Location of mine	
	State	District
Minerals & Minerals Corpn, 8/9, Ankur Apartment, Near Motor Park Colony, Jamnagar - 361 001 Gujarat.	Gujarat	Devbhoomi Dwarka
Orient Abrasive Ltd, GIDC Industrial Area, Porbandar-360 577, Gujarat.	Gujarat	Devbhoomi Dwarka Kachchh
Gujarat Mineral Development Corp Ltd, Khanij Bhawan, 132 Feet Ring Road, Near University Ground, Vastrapur-380 002, Ahmedabad, Gujarat.	Gujarat	Devbhoomi Dwarka Kachchh
Smt Nirmalaben S. Mehta, Jamnagar-Dwarka Highway, Opp. Ashok petrol pump, Jam-Khambalia - 361 305 Distt. Devbhoomi Dwarka, Gujarat.	Gujarat	Jamnagar
Ashapura Minechem Ltd, Jeevan Udyog Building, 3rd floor, 278, D.N. Road, Fort Mumbai- 400 001, Maharashtra.	Maharashtra	Ratnagiri

**Table – 3 : Production of Bauxite, 2014-15 to 2016-17
(By States)**

(Qty in tonnes; Value in `'000)

States	2014-15		2015-16		2016-17 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	22493671	11922367	28123789	15437694	24664632	14170420
Chhattisgarh	1560784	1164426	1991455	1314345	1954233	1336544
Goa	268500	44235	163950	40960	-	-
Gujarat	5825628	2381970	10387092	4857172	5818467	2857981
Jharkhand	2040519	1330002	2111227	1399189	2289825	1318549
Karnataka	127500	31875	12050	5423	386	171
Madhya Pradesh	831899	526735	684288	479401	658375	501600
Maharashtra	2669408	1274425	1907543	1043950	1946042	934677
Odisha	9091061	5124105	10839038	6278252	11990035	7216087
Tamil Nadu	78372	44594	27146	19002	7269	4811

BAUXITE

Table -4 (A) : Gradewise Production of Bauxite, 2016-17(P)
(By Sectors/States/Districts)

(Qty in tonnes; Value in ` '000)

State/District	No. of Mines	For use in Alumina & Aluminium extraction : Al ₂ O ₃ content					For use in other than Alumina & Aluminum extraction					Total
		55-60%	50-55%	45-50%	40-45%	Below 40%	Cement	Abrasive	Refractory	Chemical	Quantity	
India	157(7)	-	16450	1632332	15049042	1096992	6111560	84033	278358	395865	24664632	14170420
Public Sector	17	-	-	182549	6985580	-	-	-	34757	377535	7580421	4586268
Private Sector	140(7)	-	16450	1449783	8063462	1096992	6111560	84033	243601	18330	17084211	9584152
Chhattisgarh	13	-	-	1174096	774724	2897	-	-	1255	1261	1954233	1336544
Kabirdham	3	-	-	1117898	31359	2897	-	-	-	-	1152154	792392
Kondagaon	2	-	-	-	-	-	-	-	1255	1261	2516	2260
Surguja	8	-	-	56198	743365	-	-	-	-	-	799563	541892
Goa	1*	-	-	-	-	-	-	-	-	-	0	0
South Goa	1*	-	-	-	-	-	-	-	-	-	0	0
Gujarat	86	-	16450	130651	73141	35	4896435	84033	239028	378694	5818467	2857981
Amreli	1	-	-	-	-	-	50904	-	-	-	50904	32735
Devbhoomi Dwarka	64	-	16450	-	60770	35	4600914	84033	207700	-	4969902	2298690
Kheda	7	-	-	-	-	-	1504	-	-	-	1504	676
Kachchh	9	-	-	130651	12371	-	-	-	31219	377535	551776	391169
Porbandar	4	-	-	-	-	-	176808	-	-	-	176808	92698
Sabarkantha	1	-	-	-	-	-	66305	-	109	1159	67573	42013
Jharkhand	18	-	-	1530	1420661	862099	-	-	5535	-	2289825	1318549
Gumla	12	-	-	1530	1333091	-	-	-	5535	-	1340156	747357
Latehar	1	-	-	-	87570	-	-	-	-	-	87570	47194
Lohardaga	5	-	-	-	-	862099	-	-	-	-	862099	523998
Karnataka	2	-	-	-	-	-	386	-	-	-	386	171
Belagavi	1	-	-	-	-	-	386	-	-	-	386	171
Dakshina Kannada	1*	-	-	-	-	-	-	-	-	-	0	0
Madhya Pradesh	18(7)	-	-	3045	215565	33696	357619	-	32540	15910	658375	501600
Anuppur	1	-	-	-	38475	-	-	-	-	-	38475	31112
Jabalpur	2(1)	-	-	3045	-	-	54047	-	7840	-	64932	50028
Katni	7(3)	-	-	-	50	32096	277533	-	19800	-	329479	241345
Rewa	1	-	-	-	2140	-	-	-	-	-	2140	2939
Satna	2(3)	-	-	-	-	1600	2239	-	3900	15910	23649	23804
Shahdol	2	-	-	-	174900	-	-	-	-	-	174900	127472
Sidhi	3	-	-	-	-	-	23800	-	1000	-	24900	24900
Maharashtra	13	-	-	323010	711981	61200	849851	-	-	-	1946042	934677
Kolhapur	7	-	-	323010	525177	61200	232987	-	-	-	1142374	640323
Raigarh	3	-	-	-	-	-	221880	-	-	-	221880	56536
Ratnagiri	3	-	-	-	186804	-	394984	-	-	-	581788	237818
Odisha	3	-	-	-	11852970	137065	-	-	-	-	11990035	7216087
Koraput	1	-	-	-	6825000	-	-	-	-	-	6825000	4058890
Rayagada	1*	-	-	-	5027970	137065	-	-	-	-	5165035	3157197
Sundargarh	1	-	-	-	-	-	-	-	-	-	0	0
Tamil Nadu	3	-	-	-	-	-	7269	-	-	-	7269	4811
Namakkal *	2*	-	-	-	-	-	-	-	-	-	0	0
Salem	1	-	-	-	-	-	7269	-	-	-	7269	4811

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

BAUXITE

Table – 4 (B) : Gradewise Production of Bauxite, 2015-16
(By Sectors/States/Districts)

(Qty in tonnes; Value in ` '000)

State/District	For use in Alumina & Aluminium extraction : Al ₂ O ₃ content					For use other than Alumina & Aluminium extraction					Total	
	No. of Mines	50-55%	45-50%	40-45%	Below 40%	Cement	Abrasive	Refractory	Chemical	Quantity	Value	
India	190(5)	16150	3034157	13760447	859016	9864340	259287	278548	51844	28123789	15437694	
Public Sector	18	-	1726276	4873890	-	-	-	2393	17775	6620334	3802432	
Private Sector	172(5)	16150	1307881	8886557	859016	9864340	259287	276155	34069	21503455	11035262	
Chhattisgarh	11	-	1044684	946771	-	-	-	-	-	191455	1314345	
Kabirdham	3	-	994857	89700	-	-	-	-	-	1084557	730630	
Surguja	8	-	49827	857071	-	-	-	-	-	906898	583715	
Goa	1	-	-	163750	-	200	-	-	-	163950	40960	
South Goa	1	-	-	163750	-	200	-	-	-	163950	40960	
Gujarat	115	16150	75500	620204	15	9156188	259287	215649	44099	10387092	4857172	
Anreli	1	-	-	-	-	4757	-	-	-	4757	3592	
Devbhoomi Dwarka	91	16150	75500	620204	15	8756338	259287	215649	26324	9969467	4590219	
Kheda	7	-	-	-	-	20793	-	-	-	20793	8489	
Kachechh	9	-	-	-	-	105050	-	-	17775	122825	45485	
Porbandar	6	-	-	-	-	236585	-	-	-	236585	182471	
Sabarkantha	1	-	-	-	-	32665	-	-	-	32665	26916	
Jharkhand	19	-	-	1414039	654023	-	-	43165	-	2111227	1399189	
Gumla	12	-	-	1319749	-	-	-	43165	-	1362914	871400	
Latehar	1	-	-	94290	-	-	-	-	-	94290	67323	
Lohardaga	6	-	-	-	654023	-	-	-	-	654023	460466	
Karnataka	2	-	-	-	-	12050	-	-	-	12050	5423	
Belagavi	1	-	-	-	-	12050	-	-	-	12050	5423	
Dakshin Kannada *	1*	-	-	-	-	-	-	-	-	0	0	
Madhya Pradesh	22(5)	-	14854	239148	143402	259405	-	19734	7745	684288	479401	
Anuppur	1	-	-	46150	-	-	-	-	-	46150	37151	
Jabalpur	1(1)	-	-	-	-	23400	-	2700	-	26100	17156	
Katni	7(3)	-	14854	12783	132550	218775	-	3984	-	382964	240497	
Rewa	4	-	-	5350	63	-	-	-	-	5413	4939	
Satna	4(1)	-	-	-	10789	17230	-	-	7745	35764	21046	
Shahdol	2	-	-	174865	-	-	-	-	-	174865	128192	
Sidhi	3	-	-	-	-	-	-	13050	-	13050	30420	
Maharashtra	13	-	224100	1243155	30937	409351	-	-	-	1907543	1043950	
Kolhapur	7	-	224100	687601	-	147485	-	-	-	1059186	606438	
Raigarh	3	-	-	-	-	227000	-	-	-	227000	63560	
Ramagiri	3	-	-	555554	30937	34866	-	-	-	621357	373952	
Odisha	4	-	1675019	9133380	30639	-	-	-	-	10839038	6278252	
Koraput	2	-	1675019	4665123	-	-	-	-	-	6340142	3632901	
Rayagada	1	-	-	4468257	30639	-	-	-	-	4498896	2645351	
Sundargarh*	1*	-	-	-	-	-	-	-	-	0	-	
Tamil Nadu	3	-	-	-	-	27146	-	-	-	27146	19002	
Namakkal *	2*	-	-	-	-	-	-	-	-	0	0	
Salem	1	-	-	-	-	27146	-	-	-	27146	19002	

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

BAUXITE

**Table – 5 : Production of Bauxite, 2015-16 and 2016-17
(By Frequency Groups)**

(Qty in tonnes)

Production group	No. of mines		Production for the group		Percentage to total production		Cumulative percentage	
	2015-16	2016-17 (P)	2015-16	2016-17 (P)	2015-16	2016-17 (P)	2015-16	2016-17 (P)
Total	190(5)	157(7)	28123789	24664632	100.00	100.00	-	-
Up to 1000	65	39(1)	2190	4909	0.01	0.02	0.01	0.02
1001 - 3000	6	10(1)	12843	21475	0.05	0.09	0.06	0.11
3001 - 5000	7	7	28188	27933	0.10	0.11	0.16	0.22
5001 - 10000	17(1)	14	139443	103512	0.50	0.42	0.66	0.64
10001 - 25000	19(2)	19(3)	320788	341870	1.14	1.38	1.80	2.02
25001 - 50000	16	12(1)	656337	507477	2.33	2.06	4.13	4.08
50001 and above	60(2)	56(1)	26964000	23657456	95.87	95.92	100.00	100.00

Figures in parentheses indicate number of associated mines.

**Table – 6 (A) : Mine-head Closing Stocks of Bauxite, 2015-16
(By States & Grades)**

(Qty in tonnes)

State	For use in Alumina & Aluminium metal Extraction Al ₂ O ₃ Content						For use other than Alumina & Aluminium metal extraction				Total
	60% & above	55-60%	50-55%	45-50%	40-45%	Below 40%	Cement	Abrasive	Refractory	Chemical	
India	-	-	4625	855693	1150864	657292	10747503	423596	155828	97570	14092971
Chhattisgarh	-	-	-	5182	1611	337	-	95	-	-	7225
Goa	-	-	-	-	4020	-	18170	-	-	-	22190
Gujarat	-	-	1679	696931	856814	20973	10380996	420181	142149	74868	12594591
Jharkhand	-	-	-	486	41544	98886	-	-	426	-	141342
Karnataka	-	-	-	-	19296	-	8614	-	-	-	27910
Madhya Pradesh	-	-	-	13296	58704	377772	145427	-	13253	22702	631154
Maharashtra	-	-	2946	126609	146959	136657	179313	-	-	-	592484
Odisha	-	-	-	13189	21916	11210	-	-	-	-	46315
Tamil Nadu	-	-	-	-	-	11457	14983	3320	-	-	29760

BAUXITE

Table – 6 (B) : Mine-head Closing Stocks of Bauxite at the end of the Year 2016-17 (P)
(By States & Grades)

(In tonnes)

State	For use in alumina & aluminium metal extraction Al ₂ O ₃ Content					For use other than alumina & aluminium metal extraction				
	60% & above	50-55%	45-50%	40-45%	Below 40%	Cement	Abrasive	Refractory	Chemical	Total
India	-	3499	579941	1275927	573880	12949152	424410	214804	240740	16262353
Chhattisgarh	-	-	4397	6423	-	-	95	1255	1261	13431
Goa	-	-	-	4020	-	18170	-	-	-	22190
Gujarat	-	553	473516	800507	335	12382788	420995	186966	218073	14483733
Jharkhand	-	-	63	40167	59631	-	-	440	-	100301
Karnataka	-	-	-	19296	-	9000	-	-	-	28296
Madhya Pradesh	-	-	4420	37479	387262	165640	-	26143	21406	642350
Maharashtra	-	2946	84356	346120	103985	358571	-	-	-	895978
Odisha	-	-	13189	21915	11210	-	-	-	-	46314
Tamil Nadu	-	-	-	-	11457	14983	3320	-	-	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 and produce less than 25,000 tpy. The entire work of overburden removal, extraction of bauxite and loading of bauxite on to 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 on to trucks or dumpers is done by payloaders or manually. Since bauxite occurs as small lenses or pockets or 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. These mines use compressed-air drills for drilling blastholes. Sometimes, compressed-air jack hammer drills are also used for drilling blastholes for secondary blasting of boulders and also for toe drilling in irregular bauxite faces caused 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 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 and instead has adopted the state-of-the-art ripper dozer which is regarded as "Miner's Plough". The ripper dozer silently ploughs the mine surface to extract the mineral. It eliminates 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.

BAUXITE

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 middle of the deposit and several other trenches are opened on both sides in a staggered pattern exposing and creating more number of working faces. Transportation of ore to alumina refinery at Damanjodi has been done through a 14.6 km long single-flight, multi curve cable belt conveyor of 1800 TPH capacity. The mining operations involve dozing aside the top fertile soil which is usually preserved 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 6.825 million tonnes per year bauxite after expansion from 6.3 million tonnes. Accordingly, higher capacity mobile equipment like dumpers, wheel loaders, ripper dozers and faster drills have been introduced.

CONSUMPTION

In 2016-17, the consumption of bauxite was estimated at 20.84 million tonnes as compared to 19.62 million tonnes in the previous year. Alumina/Aluminium Industry was the principal consumer of bauxite and accounted for 91% consumption in 2016-17 followed by Cement (7%) and Calcination (1%) (Table-7).

Gujarat was the main supplier of abrasive and refractory grade bauxite. Besides, Madhya Pradesh also produces refractory grade bauxite. Alumina plants draw supplies mostly from their captive mines. Hindalco sources bauxite from other suppliers too (Table- 8).

USES & SPECIFICATIONS

Bauxite is primarily used to produce alumina through the Bayer process. Aluminium industry normally uses bauxite containing minimum 40% 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 2008 & 2014) specifications for metallurgical grade bauxite are listed in Table-9. Details of the industries are provided in a separate review named 'Aluminium and Alumina'.

**Table-7: Consumption* of Bauxite
2014-15 to 2016-17
(By Industries)**

Industry	(In tonnes)		
	2014-15	2015-16 (R)	2016-17 (P)
All Industries	13572400	19622500	20846700
Abrasives	71800	92700	71400
Alumina	12017500	17438200	18892600
Calcination	140500	374600	282800
Cement	1039400	1405800	1470800
Ferro-alloys	8000	15100	17800
Refractory ^{1/}	286500	287900	110600
Others (ceramic, chemical, iron & steel, etc)	8700	8200	700

Figures rounded off

** Includes actual reported consumption and/or estimates made wherever required and paucity of data, hence coverage may not be complete.*

^{1/} Includes consumption of calcined bauxite. Whereas the apparent consumption of Bauxite was 24403691 tonnes for the year 2016-17.

**Table – 8 : Domestic Sources of Supplies of
Bauxite to Alumina Plants**

Producer	Plant	Source of supply
NALCO	Damanjodi, Koraput (Odisha)	Captive mines at Panchpatmali Hills, Koraput distt. Odisha.
BALCO	Korba (Chhattisgarh)	Captive mines in Surguja & Bodai-Daldali in Kabirdham (Kawardha) distt. Chhattisgarh.
Hindalco Industries	Renukoot (Uttar Pradesh)	Captive mines in Shahdol distt. Madhya Pradesh; Gumla & Lohardaga distts. Jharkhand and Surguja distt. in Chhattisgarh. Also other suppliers include suppliers from Odisha, Madhya Pradesh and Jharkhand; Katni Bauxite Pvt. Ltd, Satna, Laxmidasji Ramji, Katni; and Minerals & Minerals Corp., Gujarat.
	Belagavi (Karnataka), Muri, Ranchi (Jharkhand)	Captive mines in Chandgad & Durgmanwadi, Kolhapur distt. Maharashtra and Lohardaga distt. Jharkhand. Udgiri, Gudeghar, Kolhapur distt. Bhoomi Resources Pvt Ltd Maharashtra.
Utkal Alumina	Odisha	Baphlimali bauxite mine (Odisha)
Vedanta Aluminium	Lanjigarh (Odisha)	GMDC, Gujarat, Ashapura Minechem, Maharashtra, BALCO, Bagmar Resources Pvt Ltd, Chhattisgarh; LDR, M.P.

BAUXITE

Table – 9 : Specifications for Metallurgical Grade Bauxite (IS : 5953-1985; Reaffirmed 2008 & 2014)

(In % by weight)

Constituent	Gr. I	Gr. II *
	(essentially gibbsite or trihydrate)	(mixture of gibbsite, boehmite and diaspore or trihydrate & monohydrate)
Total Al ₂ O ₃ (min.)	40.00	47.00
Total available alumina (min.)	36.00	43.00
Total SiO ₂ (max.)	4.00	4.00
Module Al ₂ O ₃ /SiO ₂ (min.)	12.00	12.00
Fe ₂ O ₃ /TiO ₂ (max.)	30.00	30.00
P ₂ O ₅ (max.)	0.20	0.20
V ₂ O ₅ (max.)	0.20	0.20
Loss on ignition at 1100° C	20.00	20.00

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

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

BIS has prescribed the following specifications of bauxite for Refractory Industry (Table-10).

Table – 10 : IS Specifications of Bauxite for Refractory Industry (IS : 10817-1984; Reaffirmed 2008 & 2014)

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

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-11.

Table – 11 : IS Specifications of Bauxite for Chemical and Petroleum Industries (IS : 3605-1984; Reaffirmed 2010)

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 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 for bauxite as source for aluminium metal extraction carried out on a large scale. However, calcined clay can be substituted for refractory bauxite but only with reduction in time and stock resistance. Sillimanite, alumina, silicon carbide, magnesite-chromite and carbon-magnesite refractories are the other alternatives for high-alumina material but these would entail higher cost. Silicon carbide and diamonds can substitute for fused aluminium oxide in abrasive use but these would entail again at higher cost. Synthetic mullite is a probable substitute 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, however, would require new plants with different technology. These non-bauxitic materials could satisfy the demand for primary metal, refractories, aluminium chemicals and abrasives.

TRADE POLICY

As per the Foreign Trade Policy 2015-2020 and policy on export and import, imports of aluminium ores and concentrates including natural bauxite, calcined and activated bauxite and others are permitted free. There are no policy restrictions on the export of bauxite.

WORLD REVIEW

The world bauxite reserves are estimated at 30 billion tonnes and are located mainly in Guinea (25%), Australia (20%), Vietnam (12%), Brazil (9%), Jamaica (7%), Indonesia & Guyana (3% each) and China (3%). Countrywise reserves of bauxite are furnished in Table- 12.

The world production of bauxite was estimated at 289 million tonnes in 2016. Australia continued to be the major producer and accounted for about 29% share in total production, followed by China (24%), Brazil (14%), Guinea (11%) and India (9%) (Table-13).

**Table – 12 : World Reserves of Bauxite
(By Principal Countries)**

(In '000 tonnes)	
Country	Reserves
World: Total (rounded off)	30000000
Australia	6000000
Brazil	2600000
China	1000000
Greece	250000
Guinea	7400000
Guyana	850000
India*	830000
Indonesia	1000000
Jamaica	2000000
Kazakhstan	160000
Malaysia	110000
Russia	500000
Saudi Arabia	210000
USA	20000
Vietnam	3700000
Other countries	3200000

Source: Mineral Commodity Summaries, 2018.

* India's total resources of bauxite as per UNFC system are placed at 3.89 billion tonnes as on 1.4.2015.

Australia

Bauxite production at 2.28 million tonnes increased by about 3% and alumina production decreased slightly to 3,78,000 tpy from that in 2014. Rio Tinto expanded bauxite capacity of the Gove mine in the Northern Territory to 8 million tpy from 6 million tpy, and production increased by 15% to 9,69,000 tpy as compared to the production in 2014. Bauxite production from the Weipa mine increased by 5% to 1.4 million tonnes from that in 2014. Australian Bauxite Ltd. completed construction of the Bald Hill mine in Tasmania and started bauxite production in December. The mine is expected to ramp up to 1.5 million tpy by mid-2017. Rio Tinto has plans to construct a 22.8 million tonnes bauxite mine in Queensland. Bauxite produced at the Amrun mine would be shipped through the port of Cape York. The project is scheduled for completion in 2019.

China

Bauxite production was estimated to be 65 million tpy, 10% more than the revised amount in 2014. Bauxite imports were 55.9 million tpy, 54% more than the 36.3 million tpy imported in 2014. The leading sources of bauxite imports, in descending order, were Malaysia (43%), Australia (35%) and India (14%). Results of exploration projects completed in 2014 were announced, including the discovery of 210 million tonnes of bauxite reserves. Two of the deposits discovered were in Guizhou Province. The Hongguangbe deposit contained 21 million tonnes, and the Dazhuyuan deposit contained 33 million tonnes.

Guizhou Province

Chinalco, Aluminium Corp. of China, which completed the 1.2 million tpy Maochang mine at the year end of 2015 has plans to commence production in early 2016 to supply feed to Qingzhen refinery. China Power Investment Corp. continued construction of an 8,00,000 tpy alumina refinery in Wuchuan County. The refinery would be supplied with bauxite from 1 million tpy Dazhuyuan mine and 1 million tpy Wachangping mine, which were completed during the year.

Guinea

United Company RUSAL Plc continued construction of the Dian-Dian mine, which would have a capacity of 3 million tpy. The bauxite mine was scheduled for completion in 2016 for bauxite to be shipped by rail to a port for export. Hongqiao Group Ltd completed its 5 million tpy bauxite mine in the Boke region and began shipments to its refinery in China in September.

BAUXITE

Indonesia

Bauxite production in Indonesia fell to 2,02,000 tonnes in 2015 as compared to 2.56 million tonnes in 2014 and 57 million tonnes in 2013, as mines that had exported bauxite was closed after a ban on exporting bauxite and other unprocessed mineral ores took effect on January 12, 2014. The export ban was part of the 2009 mining law and was intended to increase economic development in the country through investment in mineral processing facilities. Tayan refinery of PT Indonesia Chemical Alumina is on trial runs of 3 lakh tpa and it will draw bauxite from nearby deposits from West Kalimantan.

Malaysia

Bauxite production in Malaysia increased to 35 million tonnes in 2015 from 3.67 million tonnes in 2014 as mines increased production to supply bauxite feeds to alumina refineries in China. The surge in demand from China was due to the export ban on unprocessed mineral ores, including bauxite that got implemented in Indonesia in 2014.

Russia

Production started at the Cheryomukhovskaya - Glubokaya section of the North Urals mine. Further expansion that was scheduled for completion in 2016, and a third expansion proposed for completion in 2017, would increase the capacity of the mine to 4.6 million tonnes per year from the current 3.4 million tonnes per year.

FOREIGN TRADE

Exports

Exports of bauxite decreased drastically to 2,791 thousand tonnes in 2016-17 from 8,915 thousand tonnes in 2015-16. Exports were mainly to China (84%), Kuwait (11%) and Nepal & Estonia (1% each) (Tables-14 to 16).

Imports

In 2016-17, imports of bauxite increased to 1,895 thousand tonnes from 1,116 thousand tonnes in the previous year. Imports were mostly from Guinea (66%), Brazil (11%), Pakistan (9%) and Guinea Bisu (6%) (Tables - 17 to 19).

**Table – 13 : World Mine Production of Bauxite
2014 to 2016
(By Principal Countries)**

Country	2014	2015	2016
World: Total (rounded off)	260000	291000	289000
Australia	78632	80910	83517
Brazil	36313	37064	39244
China	59212	60788	68000 ^e
Greece	1876	1831	1880
Guinea	19182	19470	30800
Guyana	1564	1526	1479
India	22494	28124	24665
Jamaica	9677	9629	8540
Kazakhstan	4516	4683	4802
Malaysia ^e	3500	27700	6670
Russia	5589	5398	5432
Saudi Arabia	2076	2174	3843
Suriname	2708	1865	-
Other countries	12713	10190	10400

Source: World Mineral Production, 2012-2016, BGS.

BAUXITE

**Table – 14 : Exports of Bauxite
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	8914624	19527404	2790675	5105333
China	8528536	18613085	2355161	3970254
Kuwait	104422	200228	307610	534462
USA	463	11834	3724	101427
Nepal	25526	52759	41832	100039
Slovenia	5759	74965	5779	74444
Estonia	16400	36759	30800	54828
Oman	856	3631	21206	50318
Turkey	513	7868	2394	37440
France	355	4641	1945	32964
Japan	500	13093	1000	23963
Other countries	231294	508541	19224	125194

**Table – 15: Exports of Bauxite: Other Aluminium Ores & Concentrates
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	158494	390431	288290	480727
China	127049	325300	287577	472408
Thailand	150	3177	246	5274
Nepal	1107	1706	353	1497
Bangladesh	54	455	54	461
Vietnam	9	221	13	333
Sudan	-	-	21	296
Ethiopia	22	283	21	277
Sri Lanka	-	-	5	93
USA	-	-	++	79
Germany	-	-	++	9
Other countries	30103	59289	-	-

BAUXITE

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

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	8756130	19136973	2502385	4624606
China	8401487	18287785	2067584	3497846
Kuwait	104400	199905	307610	534462
USA	463	11834	3724	101348
Nepal	24419	51053	41479	98542
Slovenia	5759	74965	5779	74444
Estonia	16400	36759	30800	54828
Oman	856	3631	21206	50318
Turkey	513	7868	2394	37440
France	355	4641	1945	32964
Japan	500	13093	1000	23963
Other countries	200978	445439	18864	118451

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

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	1116010	5982901	1894927	7785093
Guinea	613570	2431430	1258114	3773467
China	68814	1408488	98215	1673188
Pakistan	124187	808714	179833	1108207
Brazil	263534	1178393	201956	796871
Guinea Bisu	-	-	112416	347252
Chinese Taipei/Taiwan	-	-	24459	41931
Estonia	-	-	19655	34950
Netherlands	310	13121	177	7311
Cayman Is	-	-	75	1172
Guyana	-	-	26	683
Other countries	45595	142755	1	61

BAUXITE

**Table – 18: Imports of Bauxite: Other Aluminium Ores & Concentrates
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	124164	837477	179265	1104608
Pakistan	123612	804820	179239	1104076
China	201	11522	26	532
Brazil	351	21135	-	-

**Table – 19 : Imports of Bauxite: Aluminium & Concentrates
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	991846	5145424	1715662	6680485
Guinea	613570	2431430	1258114	3773467
China	68613	1396966	98189	1672656
Brazil	263183	1157258	201956	796871
Guinea Bisu	-	-	112416	347252
Chinese Taipei/Taiwan	-	-	24459	41931
Estonia	-	-	19655	34950
Netherlands	310	13121	177	7311
Pakistan	575	3894	594	4131
Cayman Is	-	-	75	1172
Guyana	-	-	26	683
Other countries	45595	142755	1	61

FUTURE OUTLOOK

The total resources of bauxite that comprise of various grades, as found to occur in the country as on 1.4.2015, are estimated as 3,896 million tonnes. The resources of Metallurgical grade bauxite are adequate while those of the Chemical and Refractory grade bauxite are relatively limited considering the future requirements. As per

provision made in Mineral (Auction) Rule 2015, bauxite block was auctioned in 2017 in the State of Maharashtra.

As per the Report of the Working Group for the 12th Five Year Plan, the abundance of bauxite resources in Eastern Ghat regions of Odisha and Andhra Pradesh is likely to metamorphose the region into a hub for bauxite mining activities in future.