Indian Minerals Yearbook 2018

(Part- III : Mineral Reviews)

57th Edition

BAUXITE

(ADVANCE 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 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 haematite or goethite; silica as clay; and free quartz & titania as leucoxene 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).

Exploraton & Development

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

PRODUCTION & STOCKS

The production of bauxite at 22,313 thousand tonnes in 2017-18 decreased by 10% as compared to the previous year.

There were 152 reporting mines in 2017-18 as against 165 in the previous year. Besides, production of bauxite was reported as an associated mineral by 6 mines during the year. In all, 64 producers reported production of bauxite in 2017-18. Out of these ten principal producers having 44 mines contributed 86% of the total production.

The contribution of the Panchpatmali bauxite mines of NALCO was 32% in the total production. The share of Public Sector mines was about 37 % of the total production in 2017-18, as against 31 percent in the previous year.

About 71 % of the total production of bauxite was of 40-45% Al_2O_3 grade, 16% was of Cement grade, and the remaining 13% of production was of other grades during the year under review.

Odisha emerged as the leading producing State accounting for about 51% of the total production during 2017-18 (Tables -2 to 5).

Mine-head closing stocks of bauxite in 2017-18 were 17,836 thousand tonnes as compared to 16,301 thousand tonnes in the previous year. About 90% 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 6,031 in 2017-18 as against 6,491 in the previous year.

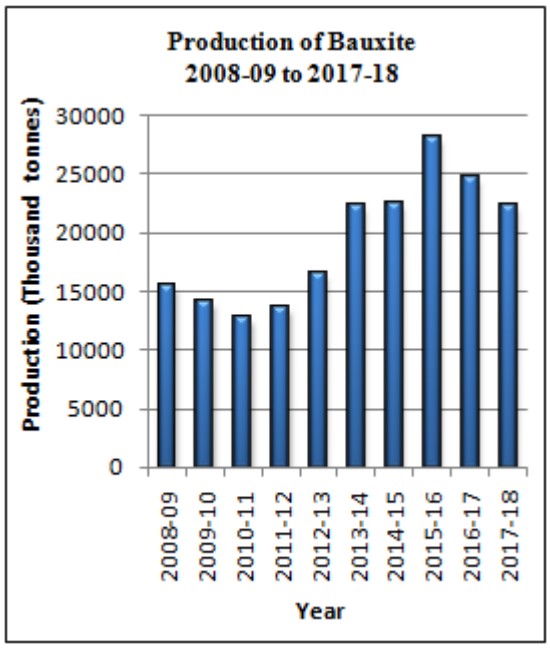

Table – 1 : Reserves/Resources of Bauxite as on 1.4.2015
(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	
		STD121	STD122			STD221	STD222						
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 Mixed with others	3546	139	742	4426	1184	2218	205	2970	216	8484	-	15278	19704
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	-	28799	17340	111518	126598
Low Grade	19779	11167	9870	40816	11769	4803	19569	23447	54837	119307	48190	281922	322738
Beneficiable	-	-	-	-	-	-	-	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.

Table – 2 : Principal Producers of Bauxite, 2017-18

Name & address of producer	Location of mine	
	State	District
National Aluminium Co. Ltd, NALCO Bhawan, P/1, Nayapali Bhubaneshwar-751 061, Odisha.	Odisha	Koraput
Utkal Alumina International Ltd, J-6, Jayadev-Vihar, Bhubaneshwar-751 013, Odisha.	Odisha	Rayagada
Hindalco Industries Ltd, Century Bhawan, 3rd Floor, Dr. Annie Beasant Road, Worli, Mumbai-400 030, Maharashtra.	Chhattisgarh Jharkhand Maharashtra	Surguja Gumla Latehar Lohardaga Kolhapur
Bombay Minerals Ltd, Okha-Jamnagar 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
Minerals & Minerals Corpn, 8/9, Ankur Apartment, Near Motor Park Colony, Jamnagar - 361 001 Gujarat.	Gujarat	Devbhoomi Dwarka

(Contd.)

Table- 2 (Concld.)

Name & address of producer	Location of mine	
	State	District
Panditrao Mines & Minerals, Pvt. Ltd. Anant Building C, B1 Nale Colony, Devkar Paland Corner, Karveer, Kolhapur- 416 007, Maharashtra.	Maharashtra	Kolhapur
Gujarat Mineral Development Corpn Ltd, Devbhoomi Khanij Bhawan, 132 Feet Ring Road, Near University Ground, Vastrapur-380 002, Ahmedabad, Gujarat.	Gujarat	Dwarka Kachchh
Chhatisgarh Mineral Development Corporation Ltd. Sonakhan Bhawan, Ring Road No-1, Village-Purena, Raipur- 492 006, Chhatisgarh.	Chhatisgarh	Kabirdhan Surguja
Ashapura Minechem Ltd, Jeevan Udyog Building, 3rd floor, 278, D.N. Road, Fort Mumbai- 400 001, Maharashtra.	Maharashtra	Ratnagiri

Table – 3 : Production of Bauxite, 2015-16 to 2017-18 (By States)

(Qty in tonnes; Value in ₹'000)

States	2015-16		2016-17		2017-18 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**28123789**	**15437694**	**24745487**	**14865504**	**22312681**	**15020673**
Chhattisgarh	1991455	1314345	1954234	1365345	2558453	2053953
Goa	163950	40960	-	-	4378	876
Gujarat	10387092	4857172	5881257	3127056	3101577	1598056
Jharkhand	2111227	1399189	2289825	1642791	2590720	2142293
Karnataka	12050	5423	386	171	-	-
Madhya Pradesh	684288	479401	676478	543776	581391	454848
Maharashtra	1907543	1043950	1946032	942724	2028422	970673
Odisha	10839038	6278252	11990006	7238829	11447740	7799974
Tamil Nadu	27146	19002	7269	4812	-	-

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

(Qty in tonnes; Value in ₹'000)

State/District	For use in Alumina & Aluminium extraction : Al_2O_3 content						For use in other than Alumina & Aluminum extraction				Total	
	No. of Mines	55-60%	50-55%	45-50%	40-45%	Below 40%	Cement	Abrasive	Refractory	Chemical	Quantity	Value
India	**165(7)**	**-**	**16450**	**1655318**	**15019459**	**1095384**	**6175031**	**93984**	**285912**	**403949**	**24745487**	**14865504**
Public Sector	20	-	-	205808	6949950	-	-	-	34756	386173	7576687	4633550
Private Sector	145(7)	-	16450	1449510	8069509	1095384	6175031	93984	251156	17776	17168800	10231954
Chhattisgarh	**13**	**-**	**-**	**11197083**	**751738**	**2897**	**-**	**-**	**1255**	**1261**	**1954234**	**1365345**
Kabirdham	3	-	-	11141158	8100	2897	-	-	-	-	1152155	797852
Kondagaon	2	-	-	-	-	-	-	-	1255	1261	2516	2709
Surguja	8	-	-	55925	743638	-	-	-	-	-	799563	564784
Goa	**1***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
South Goa	1*	-	-	-	-	-	-	-	-	-	-	-
Gujarat	**92**	**-**	**16450**	**130650**	**66576**	**35**	**4778306**	**93984**	**239083**	**386173**	**5881257**	**3127056**
Amreli	1	-	-	-	-	-	50904	-	-	-	50904	32731
Devbhoomi Dwarka	67	-	16450	-	66576	35	4640196	93984	207864	-	5025105	2506450
Kheda	7	-	-	-	-	-	1504	-	-	-	1504	676
Kachchh	11	-	-	130650	-	-	-	-	31219	386173	548042	399365
Porbandar	5	-	-	-	-	-	188129	-	-	-	188129	140533
Sabarkantha	1	-	-	-	-	-	67573	-	-	-	67573	47301
Jharkhand	**18**	**-**	**-**	**1530**	**1420661**	**862099**	**-**	**-**	**5535**	**-**	**2289825**	**1642791**
Gumla	12	-	-	1530	1333091	-	-	-	5535	-	1340156	941161
Latehar	1	-	-	-	87570	-	-	-	-	-	87570	60949
Lohardaga	5	-	-	-	-	862099	-	-	-	-	862099	640681
Karnataka	**2**	**-**	**-**	**-**	**-**	**-**	**386**	**-**	**-**	**-**	**386**	**171**
Belagavi	1	-	-	-	-	-	386	-	-	-	386	171
Dakshina Kannada	1*	-	-	-	-	-	-	-	-	-	-	-
Madhya Pradesh	**20(7)**			**3045**	**215565**	**33096**	**369218**	**-**	**40039**	**16515**	**676478**	**543776**
Anuppur	1	-	-	-	38475	-	-	-	-	-	38475	32896
Jabalpur	2(1)	-	-	3045	-	-	54047	-	7840	-	64932	59168
Katni	8(3)	-	-	-	50	32096	287532	-	27299	605	347582	265189
Rewa	2	-	-	-	2140	-	-	-	-	-	2140	1070
Satna	2(3)		-	-	-	-	3839	-	3900	15910	23649	23894
Shahdol	2	-	-	-	174900	-	-	-	-	-	174900	136618
Sidhi	3	-	-	-	-	-	23800	-	1000	-	24800	24941
Maharashtra	**13**	**-**	**-**	**323010**	**711978**	**61192**	**849852**	**-**	**-**	**-**	**1946032**	**942724**
Kolhapur	7	-	-	323010	525174	61192	232988	-	-	-	1142364	656403
Raigarh	3	-	-	-	-	-	221880	-	-	-	221880	62126
Ratnagiri	3	-	-	-	186804	-	394984	-	-	-	581788	224195
Odisha	**3**	**-**	**-**	**-**	**11852941**	**137065**	**-**	**-**	**-**	**-**	**11990006**	**7238829**
Koraput	1	-	-	-	6825000	-	-	-	-	-	6825000	4088175
Rayagada	1	-	-	-	5027941	137065	-	-	-	-	5165006	3150654
Sundargarh	1	-	-	-	-	-	-	-	-	-	-	-
Tamil Nadu	**3**	**-**	**-**	**-**	**-**	**-**	**7269**	**-**		**-**	**7269**	**4812**
Namakkal	2*	-	-	-	-	-	-	-	-	-	-	-
Salem	1	-	-	-	-	-	7269	-	-	-	7269	4812

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

Table – 4 (B) : Gradewise Production of Bauxite, 2017-18 (P)
(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

State/District	For use in Alumina & Aluminium extraction : Al_2O_3 content				For use other than Alumina & Aluminum extraction				Total	
	No. of Mines	50-55%	45-50%	40-45%	Below 40%	Cement	Abrasive	Refractory	Chemical	Quantity	Value
India	**152(6)**	**4100**	**691814**	**15870507**	**1387020**	**3636311**	**46044**	**467427**	**209458**	**22312681**	**15020673**
Public Sector	20	-	167126	7812454	-	11862	-	18396	201988	8211826	5288375
Private Sector	132(6)	4100	524688	8058053	1387020	3624449	46044	449031	7470	14100855	9732298
Chhattisgarh	**13**	**-**	**272231**	**2286222**	-	**-**	**-**	**-**	**-**	**2558453**	**2053953**
Kabirdham	3	-	272231	392930	-	-	-	-	-	665161	626033
Surguja	10	-	-	1893292	-	-	-	-	-	1893292	1427920
Goa	**1**	**-**	**-**	**-**	**-**	**4378**	**-**	**-**	**-**	**4378**	**876**
South Goa	1	-	-	-	-	4378	-	-	-	4378	876
Gujarat	**74**	**4100**	**125595**	**96953**	**-**	**2211074**	**46044**	**415555**	**202256**	**3101577**	**1598056**
Amreli	1	-	-	-	-	15000	-	-	-	1500	10105
Devbhoomi Dwarka	57	4100	45033	-	-	1899140	46036	397627	-	2488889	1205746
Kheda	2		-	-	-	13274	-	-	-	13274	8380
Kachchh	8	-	80562	-	-	8701	8	17928	201988	309187	217816
Porbandar	4	-	-	-	-	220345	-	-	-	220345	124177
Sabarkantha	2	-	-	-	-	54614	-	-	268	54882	31832
Jharkhand	**25**	**-**	**55990**	**1625447**	**875227**	**-**	-	**34056**	-	**2590720**	**2142293**
Gumla	15	-	55990	1484872	-	-	-	34056	-	1574918	1245525
Latehar	2	-	-	96750	-	-	-	-	-	96750	85165
Lohardaga	8	-	-	43825	875227	-	**-**	**-**	**-**	919052	811603
Karnataka	**2***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Belagavi	1	-	-	-	-	-	-	-	-	-	-
Dakshin Kannada	1	-	-	-	-	-	-	-	-	-	-
Madhya Pradesh	**18(6)**	**-**	**-**	**137674**	**12580**	**406119**	-	**17816**	**7202**	**581391**	**454848**
Anuppur	1	-	-	8841	-	-	-	-	-	8841	7672
Jabalpur	2	-	-	-	-	45220	-	-	-	45220	34849
Katni	7(3)	-	-	-	12580	293650	-	14816	1216	322262	256491
Rewa	1	-	-	50	-	536	-	-	290	876	959
Satna	2(3)	-	-	-	-	43260	**-**	-	5696	48956	33772
Shahdol	2	-	-	128783	-	7936	**-**	**-**	**-**	136719	99638
Sidhi	3	-	-	-	-	15517	**-**	3000	**-**	18517	21467
Maharashtra	**11**		**237998**	**630247**	**145437**	**1014740**	-	-	-	**2028422**	**970673**
Kolhapur	7	-	237998	497367	145437	543777	-	-	-	1424579	727635
Raigarh	1	-	-	-	-	18720	-	-	-	18720	10202
Ratnagiri	3	-	-	132880	-	45543	-	-	-	585123	232836
Odisha	**5**	**-**	**-**	**11093964**	**353776**	**-**	-	-	-	**11447740**	**7799974**
Koraput	3	-	-	7136750	-	-	-	-	-	7136750	4691411
Rayagada	1	-	-	3957214	353776	-	-	-	-	4310990	3108563
Sundargarh	1*	-		-	-	-	-	-	-	-	-
Tamil Nadu	**3***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Namakkal	2	-	-	-	-	-	**-**	**-**	**-**	-	-
Salem	1	-	-	-	-	-	-	-			

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

Table – 5 : Production of Bauxite, 2016-17 and 2017-18(P) (By Frequency Groups)

(Qty in tonnes)

Production group	No. of mines		Production for the group		Percentage to total production		Cumulative percentage	
	2016-17	2017-18 (P)	2016-17	2017-18 (P)	2016-17	2017-18 (P)	2016-17	2017-18 (P)
Total	**165(7)**	**152(6)**	**24745487**	**22312681**	**100.00**	**100.00**	**-**	**-**
Up to 1000	43(1)	39(3)	4908	2835	0.02	0.01	0.02	0.01
1001 - 3000	10(1)	6	21475	12527	0.09	0.06	0.11	0.07
3001 - 5000	7	5	27931	20149	0.11	0.09	0.22	0.16
5001 - 10000	14	10(1)	104149	82020	0.42	0.37	0.64	0.53
10001 - 25000	22(3)	17	381854	247409	1.54	1.11	2.18	1.64
25001 - 50000	13(1)	19(1)	551844	751527	2.23	3.36	4.41	5.00
50001 and above	56(1)	56(1)	23653326	21196214	95.59	95.00	100.00	100.00

Figures in parentheses indicate number of associated mines.

Table – 6 (A) : Mine-head Closing Stocks of Bauxite, 2016-17 (By States & Grades)

(Qty in tonnes)

State	For use in Alumina & Aluminium metal Extraction Al_2O_3 Content						For use other than Alumina & Aluminium metal extraction				
	60% & above	55-60%	50-55%	45-50%	40-45%	Below 40%	Cement	Abrasive	Refractory	Chemical	Total
India	**-**	**-**	**553**	**602790**	**1259251**	**574931**	**12975259**	**424414**	**222304**	**241540**	**16301042**
Chhattisgarh	-	-	-	4397	6423	-	-	95	1255	1261	13431
Goa	-	-	-	-	4020	-	18170	-	-	-	22190
Gujarat	-	-	553	473516	800667	335	12398893	420999	186967	218073	14500003
Jharkhand	-	-	-	236	40168	59634	-	-	440	-	100478
Karnataka	-	-	-	-	19296	-	9000	-	-	-	28296
Madhya Pradesh	-	-	-	4420	43319	388310	175642	-	33642	22206	667539
Maharashtra	-	-	-	107032	323443	103985	358571	-	-	-	893031
Odisha	-	-	-	13189	21916	11210	-	-	-	-	46314
Tamil Nadu	-	-	-	-	-	11457	14983	3320	-	-	29760

Table – 6 (B) : Mine-head Closing Stocks of Bauxite at the end of the Year 2017-18 (P)
(By States & Grades)

(In tonnes)

State	For use in alumina & aluminium metal extraction Al_2O_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	**-**	**3319**	**637378**	**1323406**	**597625**	**14193841**	**425237**	**488385**	**166408**	**17835600**
Chhattisgarh	-	-	1630	32035	-	-	95	1255	1261	36276
Goa	-	-	-	4020	-	18402	-	-	-	22422
Gujarat	-	373	539341	847826	335	13609289	421822	452566	149314	16020866
Jharkhand	-	-	268	75846	56957	-	-	134	-	133205
Karnataka	-	-	-	19296	-	9000	-	-	-	28296
Madhya Pradesh	-	-	4420	22354	389080	111078	-	34430	15833	577195
Maharashtra	-	2946	78530	189562	128586	431089	-	-	-	830713
Odisha	-	-	13189	132467	11210	-	-	-	-	156866
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.

In Odisha, NALCO has adopted the mechanised 'Trench method' of opencast mining at Panchpatmali (North- Central Block) 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 operation of new mines i.e South Block of Panchpatmali mine started in May-2017. The Panchpatmali (North- Central Block) mine has achieved 100% capacity utilisation with transportation of 6.825 million tonnes during the year 2017-18. Total bauxite excavation from mines of NALCO during the year 2017-18 was about 7.08 million tonnes. The higher capacity mobile equipment like dumpers, wheel loaders, ripper dozers and faster drills have been introduced.

Pottangi Bauxite Mine (75 million tonnes) in the Koraput district of Odisha has been reserved by Govt. of India in favour of M/s NALCO.

CONSUMPTION

In 2017-18, the consumption of bauxite was estimated at 20.34 million tonnes as compared to 20.93 million tonnes in the previous year. Alumina/ Aluminium Industry was the principal consumer of bauxite and accounted for 90% consumption in 2017-18 followed by Cement (8%) 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).

Table-7: Consumption* of Bauxite 2015-16 to 2017-18 (By Industries)

(In tonnes)

Industry	2015-16	2016-17 (R)	2017-18 (P)
All Industries	**19622500**	**20936700**	**20339400**
Abrasives	92700	71400	92100
Alumina	17438200	18892600	18324600
Calcination	374600	282800	283800
Cement	1405800	1553900	1551700
Ferro-alloys	15100	17800	16000
Pulverising	-	7300	7300
Refractory[1/]	287900	110200	63900
Others (ceramic, chemical, iron & steel, etc)	8200	700	++

Figures rounded off

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

1/ Includes consumption of calcined bauxite.

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)	Supplier from Gujarat, BALCO, Bagmar Bauxite Industries Pvt Ltd, Chhattisgarh; LDR, M.P.

USES & SPECIFICATIONS

Bauxite is primarily used to produce alumina through the Bayer process. Aluminium industry normally uses bauxite containing minimum 40% 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 BIS has specified IS:5953-1985(Reaffirmed 2008 & 2014) specifications for metallurgical grade bauxite. Details of the industries are provided in a separate review named 'Aluminium and Alumina'.

In Steel Industry, bauxite is used as a slag corrector in place of fluorite and generally bauxite, containing 45 to 54% Al_2O_3 and 5% SiO_2 (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 specifications of bauxite 'IS : 10817-1984 (Reaffirmed 2008 & 2014) for Refractory Industry.

The IS specifications of bauxite for consumption in Chemical and Petroleum industries are given in 'IS : 3605-1984 (Reaffirmed 2010).

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.

As per Ministry of Mines Notification dated 25th April 2018 the threshold value of Bauxite mineral has been classified in following two categories:-

(i) For Aluminous laterite: Al_2O_3- 20% (Min.)

(ii) For Bauxite: Al_2O_3- 30% (Min.) and SiO_2 (Total) -7% (Max.)

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 and China (3% each). Countrywise reserves of bauxite are furnished in Table- 9.

The world production of bauxite was estimated at 304 million tonnes in 2017. Australia continued to be the major producer and accounted for about 29% share in total production, followed by China (21%), Guinea (15%), Brazil (13%) and India (7%) (Table-10).

Table – 9 : World Reserves of Bauxite (By Principal Countries)

(In '000 tonnes)

Country	Reserves
World: Total (rounded off)	**30000000**
Australia [a]	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, 2019.*

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

(a) For Australia, joint Ore Reserve Committee compliant reserve were about 2.3 billion tonnes.

To give generalised view of the development in various countries the country-wise description is sourced from latest available publication of Mineral Year Book 'USGS' 2016 as detailed below:-

Australia

Bauxite production increased slightly by about 1.09 million tonnes, but alumina production increased at 796,000 tpy by about 4% compared to that in 2015. Increased alumina production was partially attributed to an 11% to 312,000 tpy increase from Rio Tinto plc's (United Kingdom) 3.4 million tpy Yarwun refinery in Queensland, which completed rampup in 2015. Bauxite production from the Weipa Mine increased at 1.76 million tonnes by 6% compared with that in 2015 as Rio Tinto increased alumina production at the Yarwun refinery. Rio Tinto increased bauxite production at 8 million tonnes Gove Mine in the Northern Territory at 1.59 million tonnes by 21% compared with production in 2015. Bauxite from the Gove Mine was sold to third-party customers because the 3.8-Mt/yr Gove alumina refinery was temporarily shut down in May 2014.

Australian Bauxite Ltd was ramping up production at the Bald Hill Mine in Tasmania that started bauxite production in December 2015. Production at the 1.5 million tonnes mine was less than planned and experienced temporary delays owing to difficulties in obtaining customers. Most of the bauxite produced was sold for use in cement and as a fertilizer additive instead of for metallurgical uses.

Rio Tinto started construction of a 22.8 million tonnes bauxite mine in Queensland. Bauxite produced at the Amrun Mine would be shipped through the port of Cape York. Completion of the project was expected in the first half of 2019.

Metro Mining Ltd was developing the Bauxite Hills project in Queensland with construction scheduled to start in mid-2017. The bauxite deposit reserves were reported to be 48.2 million tonnes. Metro was also in the process of acquiring Gulf Alumina Ltd and expected to complete the transaction in early 2017. Gulf Alumina was developing the Skardon River project adjacent to the Bauxite Hills project. Metro planned to consolidate the projects into a single operation after acquiring Gulf Alumina. Bauxite mining was scheduled to start in 2018 at an initial rate of 2 million tonnes, and increasing production to 4 million tonnes was being considered.

Brazil

The Juruti Mine capacity was being expanded to 5.7 million tonnes from 4.7 million tonnes. The expansion project would be completed in 2017. Some of the new capacity was ramped up, and

production increased to 5.2 million tonnes compared to 4.7 million tonnes in 2015. The mine was a joint venture of Alcoa Corp. (60%) and Alumina Ltd. (40%).

China

Bauxite production was estimated to be 60.8 million tonnes, 6% less than that in 2015. Bauxite imports were 51.8 million tonnes, 7% less than the 55.9 million tonnes imported in 2015. The leading sources of bauxite imports, in descending order, were Australia (41%), Guinea (23%), and Malaysia (14%). Although Malaysia supplied 43% of bauxite imports to China in 2015, it dropped from the leading supplier to the third-ranked supplier after Malaysia's Government temporarily banned bauxite mining starting in January. Increased imports from Australia, Brazil, and Guinea partially offset the decreased imports from Malaysia.

Guinea

United Company RUSAL Plc (Russia) continued construction of the Dian-Dian Mine, which would have a capacity of 3 million tonnes. The bauxite mine would be completed in 2017, and bauxite would be shipped by rail to a port for export. Further expansion to 9 million tonnes was planned for completion in 2021. Alufer Mining Ltd continued preparation work to construct the 5.5 million tonnes Bel Air Mine. Construction was scheduled to start in January 2017, and production would start in the third quarter of 2018.

Guinea Alumina Corp., a subsidiary of Emirates Global Aluminum PJSC (United Arab Emirates), was developing a 12 million tonnes bauxite mine in the Boke region that would be completed in 2018. A rail spur was constructed to link the mine with an existing rail line. A 55,000 tonnes sample was shipped to China in December for testing. Construction of support facilities at the port in Kamsar was completed in August, and shipments started in September. The upgraded port was able to ship 30 million tonnes of bauxite.

Indonesia

Bauxite production was 1.4 million tonnes compared with 472,000 tonnes in 2015, 2.56 million tonnes in 2014, and 57 million tonnes in 2013, as mines that supplied two alumina refineries ramped up production. 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. The Government proposed to change the bauxite export ban by establishing a system to issue 5-year bauxite export permits to companies building alumina refineries in Indonesia.

Jamaica

The Government of Jamaica approved a plan for Noranda to transfer bauxite to ships with cargo capacities of 170,000 tonnes from smaller ships in a location along the south coast of Jamaica. This plan would enable Noranda to export bauxite produced at the 5.4 million tonnes St. Ann Mine to China and other locations more efficiently. Previously, exports were only sent to refineries in the United States, but Noranda was seeking markets elsewhere since the shutdown of the Sherwin refinery in Texas.

Malaysia

Bauxite production decreased to 1 million tonnes in 2016 from 35 million tonnes in 2015 and 3.67 million tonnes in 2014. In January, the Government temporarily banned bauxite mining in response to illegal mining and pollution at ports from bauxite stockpiles. The initial mining ban was for 3 months but was extended until at least March 2017. Exportation of bauxite was still allowed in order to remove uncovered stockpiles at ports. When mines increased production in 2015, storage facilities and other infrastructure were inadequate for handling and storing bauxite, leading to water pollution. Production in Malaysia increased in 2015 to supply alumina refineries in China after Indonesia implemented a ban on exporting bauxite and other mineral ores in 2014.

Table – 10 : World Mine Production of Bauxite 2015 to 2017

(By Principal Countries)

(In '000 tonnes)

Country	2015	2016	2017
World: Total (rounded off)	**292900**	**281300**	**303800**
Australia	80910	83517	89421
Brazil[e]	37064	37700	38123
China	60788	66158	65000[e]
Ghana	1015	1144	1477
Greece	1831	1880	1927
Guinea (b)	20692	26917	47009
Guyana	1526	1479	1459
India (f)	28124	24745	22313
Indonesia	611	1485	3700
Jamaica	9629	8540	8245
Kazakhstan	4683	4801	4843
Malaysia	27700	6670	810
Russia	5398	5432	5523
Saudi Arabia	2174	3843	3708
Suriname	1865	-	-
Turkey	1050	989	1001
Vietnam	1123	1523	2672
Other countries	6717	4477	6569

Source: *World Mineral Production, 2013-2017, BGS. b: No adjustment has been made for moisture content,* f*: Year ended 31st March following that stated.*

FOREIGN TRADE

Exports

Exports of bauxite decreased drastically by 45% to 1,529 thousand tonnes in 2017-18 from 2,791 thousand tonnes in 2016-17. Exports were mainly to China (83%), Kuwait (7%), Nepal (3%) and Hong Kong & Mozambique (2% each) (Tables-11 to 13).

Imports

In 2017-18, imports of bauxite decreased considerably by 23% to 1,461 thousand tonnes from 1,895 thousand tonnes in the previous year. Imports were mostly from Guinea (40%), Pakistan (15%), Ghana (13%), Trinidad (9%), Brazil (8%), China (6%) and Sierra Leone, Jamaica & Solomon (3% each) (Tables - 14 to 16).

Table – 11 : Exports of Bauxite (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2790675**	**5105333**	**1529308**	**2705040**
China	2355161	3970254	1273189	1877226
Kuwait	307610	534462	106270	183754
Nepal	41832	100039	45634	100843
Slovenia	5779	74444	6180	69042
Mozambique	-	-	33000	42523
France	1945	32964	2797	39101
USA	3724	101427	1396	36563
Hong Kong	398	3323	25000	36337
Oman	21206	50318	20098	30353
Malaysia	-	-	1918	28911
Other countries	53020	238102	13826	260387

Table – 12: Exports of Bauxite: Other Aluminium Ores & Concentrates (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**288290**	**480727**	**159980**	**250260**
China	287577	472408	159199	242639
Thailand	246	5274	150	3152
Nepal	353	1497	470	2672
Sudan	21	296	54	626
Bangladesh	54	461	54	406
Vietnam	13	333	18	362
Djibouti	-	-	10	156
Ethiopia	21	277	10	137
UAE	-	-	13	106
Kuwait	-	-	-	2
Other countries	5	181	2	2

Table – 13: Exports of Bauxite: Aluminium & Concentrates (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2502385**	**4624606**	**1369328**	**2454780**
China	2067584	3497846	1113990	1634587
Kuwait	307610	534462	106270	183752
Nepal	41479	98542	45164	98171
Slovenia	5779	74444	6180	69042
Mozambique	-	-	33000	42523
France	1945	32964	2797	39101
USA	3724	101348	1396	36563
Hong Kong	398	3323	25000	36337
Oman	21206	50318	20098	30353
Malaysia	-	-	1918	28911
Other countries	52660	231359	13515	255440

Table – 14 : Imports of Bauxite (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1894927**	**7785093**	**1461495**	**7727096**
Guinea	1258114	3773467	585157	2400599
China	98215	1673188	93611	1758343
Pakistan	179833	1108207	219417	1303999
Ghana	-	-	185295	782057
Trinidad	-	-	135424	471900
Brazil	201956	796871	111590	452683
Sierra Leone	-	-	47401	237050
Jamaica	-	-	40326	157921
Solomon Is	-	-	42673	144418
Guyana	26	683	429	11683
Other countries	156783	432677	172	6443

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

Country	2016-17		2017-18	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**179265**	**1104608**	**218917**	**1300717**
Pakistan	179239	1104076	218917	1300717
China	26	532	-	-

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

Country	2016-17		2017-18	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1715662**	**6680485**	**1242578**	**6426379**
Guinea	1258114	3773467	585157	2400599
China	98189	1672656	93611	1758343
Ghana	-	-	185295	782057
Trinidad	-	-	135424	471900
Brazil	201956	796871	111590	452683
Sierra Leone	-	-	47401	237050
Jamaica	-	-	40326	157921
Solomon Is	-	-	42673	144418
Guyana	26	683	429	11683
Netherlands	177	7311	171	6416
Other countries	157200	429497	501	3309

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 FITCH Report, the production of bauxite has been estimated to grow from 30.9 million tonnes in 2018 to 50.7 million tonnes by 2027.