Indian Minerals Yearbook 2019

(Part- III : MINERAL REVIEWS)

58th 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).

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review of "Exploration & Development" under "General Reviews".

PRODUCTION & STOCKS

The production of bauxite at 23,688 thousand tonnes in 2018-19 increased by 4% as compared to the previous year.

There were 154 reporting mines in 2018-19 as against 163 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 2018-19. Out of these ten principal producers having 39 mines contributed 88% of the total production.

The contribution of the Panchpatmali bauxite mines of NALCO was 31% in the total production. The share of Public Sector mines was about 46 % of the total production in 2018-19, as against 36 per cent in the previous year.

About 81 % of the total production of bauxite was of 40-45% Al_2O_3 grade, 11% was of Cement grade, and the remaining production was reported in other grades except two grades (55% -60% and 60% & above grade), during the year under review.

Odisha emerged as the leading producing state accounting for about 65% of the total production during 2018-19 (Tables -2 to 5).

Mine-head closing stocks of bauxite in 2018-19 were 19,658 thousand tonnes as compared to 18,072 thousand tonnes in the previous year. About 85% of the total stock was held in Gujarat at the end of the year (Tables- 6 'A' & 6 'B').

The average daily employment of labour in bauxite mines was 5,829 in 2018-19 as against 6,632 in the previous year.

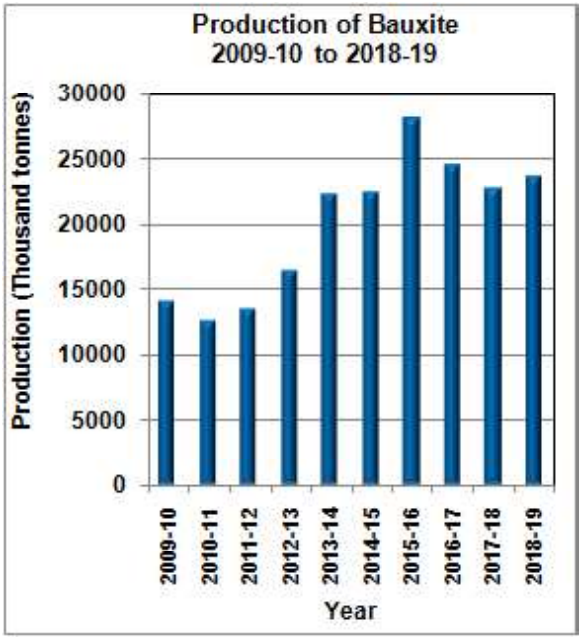

Table – 1 : Reserves/Resources of Bauxite as on 1.4.2015
(By Grades/States)

(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, 2018-19

Name & address of producer	Location of mine	
	State	District
National Aluminium Co. Ltd, NALCO Bhawan, P/1, Nayapali Bhubaneswar-751 061, Odisha.	Odisha	Koraput
Utkal Alumina International Ltd, J-6, Jayadev-Vihar, Bhubaneswar-751 013, Odisha.	Odisha	Rayagada
Hindalco Industries Ltd, Ahura Centre, I[st] Floor, B-Wing, Mahakali Caves road, Andheri (East), Mumbai-400 093, Maharashtra	Chhattisgarh Jharkhand Maharashtra	Surguja Gumla Latehar Lohardaga Kolhapur
Odisha Mining Corporation Ltd. OMC House, Unit-V, Post Box No. 34, Bhubaneswar- 751 001 Odisha .	Odisha	Koraput
Bharat Aluminium Co. Ltd, Aluminium Sadan, Core-6, Sope Office Complex, 7 Lodhi Road, New Delhi- 110 003.	Chhattisgarh	Kabirdham Surguja
Minerals & Minerals Ltd, Court Road, Lohardaga-835 302, Jharkhand.	Jharkhand	Lohardaga Gumla
Panditrao Mines & Minerals, Pvt. Ltd. A/P-Minche Budruk, Tal-Bhudargad, Kolhapur- 416 223, Maharashtra.	Maharashtra	Kolhapur
Gujarat Mineral Development Corpn Ltd, Khanij Bhawan, 132 Feet Ring Road, Near University Ground, Vastrapur-380 052, Ahmedabad, Gujarat.	Gujarat	Devbhoomi Dwarka Kachchh
Naresh P. Makhecha Plot No. 299, Corporation Ltd. GIDC Industiral Area, Porbandar- 360 577, Gujarat.	Gujarat	Devbhoomi Dwarka Porbandar
Ashapura Minechem Ltd, Jeevan Udyog Building, 3[rd] floor, 278, D.N. Road, Fort Mumbai- 400 001, Maharashtra.	Maharashtra	Ratnagiri

(Contd)

Table- 2 (Concld)

Table – 3 : Production of Bauxite, 2016-17 to 2018-19
(By States)

(Qty in tonnes; Value in ₹'000)

States	2016-17		2017-18		2018-19 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**24745487**	**14865504**	**22786106**	**15784174**	**23687721**	**17168410**
Chhattisgarh	1954234	1365345	2558701	2199036	1532600	1573656
Goa	-	-	4378	876	518	104
Gujarat	5881257	3127056	3559241	2129517	2181064	1293201
Jharkhand	2289825	1642791	2593647	2275062	2412484	2198169
Karnataka	386	171	-	-	-	-
Madhya Pradesh	676478	543776	593633	442907	722549	577694
Maharashtra	1946032	942724	2028765	955340	1424864	721898
Odisha	11990006	7238829	11447741	7781436	15413642	10803688
Tamil Nadu	7269	4812	-	-	-	-

Table –4 (A) : Gradewise Production of Bauxite, 2017-18
(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	**163(6)**	**-**	**16680**	**688945**	**15877091**	**1387022**	**4085730**	**47666**	**463513**	**219459**	**22786106**	**15784174**
Public Sector	21	-	-	167127	7812702	-	11864	-	18813	211989	8222495	5405102
Private Sector	142(6)	-	16680	521818	8064389	1387022	4073866	47666	444700	7470	14563611	10379072
Chhattisgarh	**13**	**-**	**-**	**269362**	**2289339**	**-**	**-**	**-**	**-**	**-**	**2558701**	**2199036**
Kabirdham	3	-	-	269362	395800	-	-	-	-	-	665162	666176
Surguja	10	-	-	-	1893539	-	-	-	-	-	1893539	1532860
Goa	**1**	**-**	**-**	**-**	**-**	**-**	**4378**	**-**	**-**	**-**	**4378**	**876**
South Goa	1	-	-	-	-	-	4378	-	-	-	4378	876
Gujarat	**81**	**-**	**16680**	**125595**	**96954**	**-**	**2644117**	**47666**	**415972**	**212257**	**3559241**	**2129517**
Amreli	1	-	-	-	-	-	15000	-	-	-	15000	10110
Devbhoomi Dwarka	60	-	16680	45033	96954	-	1899124	47658	398044	-	2503493	1366501
Kheda	3	-	-	-	-	-	336724	-	-	-	336724	279112
Kachchh	9	-	-	80562	-	-	8702	8	17928	211989	319189	261099
Porbandar	4	-	-	-	-	-	216345	-	-	-	216345	147905
Sabarkantha	4	-	-	-	-	-	168222	-	-	268	168490	64790
Jharkhand	**25**	**-**	**-**	**55990**	**1628447**	**875227**	**-**	**-**	**33893**	**-**	**2593647**	**2275062**
Gumla	15	-	-	55990	1487872	-	-	-	33893	-	1577845	1343233
Latehar	2	-	-	-	96750	-	-	-	-	-	96750	89266
Lohardaga	8	-	-	-	43825	875227	-	-	-	-	919052	842563
Karnataka	**2***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Belagavi	1	-	-	-	-	-	-	-	-	-	-	-
Dakshina Kannada	1	-	-	-	-	-	-	-	-	-	-	-
Madhya Pradesh	**19(6)**			**-**	**148301**	**12580**	**411992**	**-**	**13558**	**7202**	**593633**	**442907**
Anuppur	1	-	-	-	19518	-	-	-	-	-	19518	20338
Jabalpur	2	-	-	-	-	-	45220	-	-	-	45220	34844
Katni	8(3)	-	-	-	-	12580	299472	-	10558	1216	323826	238269
Rewa	1	-	-	-	-	-	586	-	-	290	876	1033
Satna	2(3)		-	-	-	-	43260	-	-	5696	48956	32963
Shahdol	2	-	-	-	128783	-	7936	-	-	-	136719	102182
Sidhi	3	-	-	-	-	-	15518	-	3000	-	18518	13278
Maharashtra	**14**	**-**	**-**	**237998**	**620087**	**145437**	**1025243**	**-**	**-**	**-**	**2028765**	**955340**
Kolhapur	7	-	-	237998	497369	145437	544118	-	-	-	1424922	731292
Raigarh	4	-	-	-	-	-	18720	-	-	-	18720	10165
Ratnagiri	3	-	-	-	122718	-	462405	-	-	-	585123	213883
Odisha	**5**	**-**	**-**	**-**	**11093963**	**353778**	**-**	**-**	**-**	**-**	**11447741**	**7781436**
Koraput	3	-	-	-	7136750	-	-	-	-	-	7136750	4768054
Rayagada	1	-	-	-	3957213	353778	-	-	-	-	4310991	3013382
Sundargarh	1	-	-	-	-	-	-	-	-	-	-	-
Tamil Nadu	**3***	**-**	**-**	**-**	**-**	**-**	**-**	**-**		**-**	**-**	**-**
Namakkal	2	-	-	-	-	-	-	-	-	-	-	-
Salem	1	-	-	-	-	-	-	-	-	-	-	-

Figures in parentheses indicate number of associated mines

** Only labour reported*

Table – 4 (B) : Gradewise Production of Bauxite, 2018-19 (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	**154(6)**	**20125**	**879744**	**19109076**	**412588**	**2687167**	**8851**	**216458**	**353712**	**23687721**	**17168410**
Public Sector	18	-	545998	9973795	30180	13375	-	35878	339062	10938288	7546335
Private Sector	136(6)	20125	333746	9135281	382408	2673792	8851	180580	14650	12749433	9622075
Chhattisgarh	**13**	**-**	**55532**	**1429096**	47972	**-**	**-**	**-**	**-**	**1532600**	**1573656**
Kabirdham	2	-	49737	365360	47000	-	-	-	-	462097	593155
Kondagaon	2	-	-	-	-	-	-	-	-	-	-
Surguja	9	-	5795	1063736	972	-	-	-	-	1070503	980501
Goa	**1**	**-**	**-**	**-**	**-**	**518**	**-**	**-**	**-**	**518**	**104**
South Goa	1	-	-	-	-	518	-	-	-	518	104
Gujarat	**75**	**20125**	**36184**	**99897**	**29233**	**1466283**	**8851**	**181268**	**339223**	**2181064**	**1293201**
Amreli	-	-	-	-	-	-	-	-	-	-	-
Devbhoomi Dwarka	50	20125	12737	99897	25	741082	8851	140317	-	1023034	591288
Kheda	9		-	-	-	211846	-	-	-	211846	177287
Kachchh	7	-	23447	-	29208	6655	-	30751	339062	429123	267635
Porbandar	5	-	-	-	-	264397	-	10200	-	274597	166905
Sabarkantha	4	-	-	-	-	242303	-	-	161	242464	90086
Jharkhand	**24**	**-**	**41874**	**2336198**	**14232**	**-**	**-**	**20180**	**-**	**2412484**	**2198169**
Gumla	15	-	41874	1416418	-	-	-	20180	-	1478472	1339828
Latehar	2	-	-	3440	-	-	-	-	-	3440	3777
Lohardaga	7	-	-	916340	14232	-	-	-	-	930572	854564
Karnataka	**1***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Belagavi	-	-	-	-	-	-	-	-	-	-	-
Dakshin Kannada	1	-	-	-	-	-	-	-	-	-	-
Madhya Pradesh	**20(6)**	**-**	**-**	**125130**	**16926**	**550994**	**-**	**15010**	**14489**	**722549**	**577696**
Anuppur	1	-	-	-	-	13595	-	-	-	13595	11053
Jabalpur	2	-	-	-	-	47337	-	4000	-	51337	41486
Katni	8(3)	-	-	-	16926	313018	-	2804	-	332748	241024
Rewa	1	-	-	-	-	11680	-	-	-	11680	9461
Satna	3(3)	-	-	-	-	56150	-	5206	14489	75845	66486
Shahdol	2	-	-	125130	-	49799	-	-	-	174929	156395
Sidhi	3	-	-	-	-	59415	-	3000	-	62415	51789
Maharashtra	**12**		**236481**	**502205**	**16806**	**669372**	-	-	-	**1424864**	**721898**
Kolhapur	6	-	236481	242664	16806	411621	-	-	-	907572	475505
Raigarh	3	-	-	-	-	-	-	-	-	-	-
Ratnagiri	3	-	-	259541	-	257751	-	-	-	517292	246393
Odisha	**5**	**-**	**509673**	**14616550**	**287419**	**-**	**-**	**-**	**-**	**15413642**	**10803688**
Koraput	3	-	509673	9604427	-	-	-	-	-	10114100	6990618
Rayagada	1	-	-	5012123	287419	-	-	-	-	5299542	3813070
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, 2017-18 and 2018-19 (By Frequency Groups)

(Qty in tonnes)

Production group	No. of mines		Production for the group		Percentage to total production		Cumulative percentage	
	2017-18	2018-19 (P)	2017-18	2018-19 (P)	2017-18	2018-19 (P)	2017-18	2018-19 (P)
Total	**163(6)**	**154(6)**	**22786106**	**23687721**	**100.00**	**100.00**	**-**	**-**
Up to 1000	46(3)	59	2839	3579	0.01	0.01	0.01	0.02
1001 - 3000	6	10(1)	11291	22181	0.05	0.09	0.06	0.11
3001 - 5000	5	4	20150	16953	0.09	0.07	0.15	0.18
5001 - 10000	9(1)	5(1)	72980	44804	0.32	0.19	0.47	0.37
10001 - 25000	20	16(1)	296143	271288	1.30	1.15	1.77	1.52
25001 - 50000	19(1)	9(2)	747655	419767	3.28	1.77	4.05	3.29
50001 and above	58(1)	51(1)	21635048	22909149	94.95	96.71	100.00	100.00

Figures in parentheses indicate number of associated mines

Table – 6 (A) : Mine-head Closing Stocks of Bauxite, 2017-18 (P) (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	**-**	**-**	**2946**	**637445**	**1319673**	**605207**	**14422798**	**424063**	**492130**	**167443**	**18071705**
Chhattisgarh	-	-	-	1630	32034	-	-	95	1255	1261	36275
Goa	-	-	-	-	4020	-	18402	-	-	-	22422
Gujarat	-	-	-	539340	862004	335	13833245	420648	451254	149313	16256139
Jharkhand	-	-	-	336	75745	56958	102	-	134	-	133275
Karnataka	-	-	-	-	19296	-	9000	-	-	-	28296
Madhya Pradesh	-	-	-	4420	4546	397697	115637	-	39487	15833	577620
Maharashtra	-	-	2946	78530	189561	128586	431429	-	-	-	831052
Odisha	-	-	-	13189	132467	10174	-	-	-	1036	156866
Tamil Nadu	-	-	-	-	-	11457	14983	3320	-	-	29760

Table – 6 (B) : Mine-head Closing Stocks of Bauxite at the end of the Year 2018-19 (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	**-**	**373**	**635243**	**2088305**	**533435**	**15016755**	**499268**	**499045**	**385956**	**19658380**
Chhattisgarh	-	-	1630	54446	183	-	95	1255	1261	58870
Goa	-	-	-	4020	-	18402	-	-	-	22422
Gujarat	-	373	565648	496710	29719	14256020	499173	456196	376820	16680659
Jharkhand	-	-	4468	110860	37156	-	-	-	-	152484
Karnataka	-	-	-	19296	-	9000	-	-	-	28296
Madhya Pradesh	-	-	3999	2407	332046	242010	-	41594	7875	629931
Maharashtra	-	-	46309	180724	111702	486345	-	-	-	825080
Odisha	-	-	13189	1219842	11172	-	-	-	-	1244203
Tamil Nadu	-	-	-	-	11457	4978	-	-	-	16435

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 10,000 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 causes 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 Govt of Odisha has extended mining lease period of Panchpatmali (North-Central Block) mine up to 16.11.2032 from 31.03.2020 and Panchpatmali (South Block) up to 19.07.2029 from 31.03.2020. The Panchpatmali (North- Central Block) has achieved 100% capacity utilisation with transportation (production) of 6.825 million tonnes for third successive year and transportation from South block was 0.4 million tonne during the year. The bauxite excavation from mines of NALCO during the year 2018-19 was about 7.41 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. The Govt of Odisha has issued terms and condition for grant of Pottangi lease over the reduced area of 697.979 ha.

CONSUMPTION

In 2018-19, the consumption of bauxite estimated at 22.19 million tonnes increased marginally by 8% as compared to 20.63 million tonnes in the previous year. Alumina/Aluminium Industry was the principal consumer of bauxite and accounted for 89% consumption in 2018-19 followed by Cement (9%) 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 2016-17 to 2018-19 (By Industries)

(In tonnes)

Industry	2016-17	2017-18 (R)	2018-19 (P)
All Industries	**20936700**	**20630600**	**22188800**
Abrasives	71400	65700	35900
Alumina	18892600	18385500	19714000
Calcination	282800	283800	283800
Cement	1553900	1806200	2075100
Ferroalloys	17800	15900	13500
Pulverising	7300	7300	-
Refractory[1/]	110200	65500	65600
Others (ceramic, chemical, iron & steel, etc)	700	700	900

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. in Jharkhand. Udgiri, Gudeghar, Kolhapur distt., Maharashtra and Bhoomi Resourc -es Pvt Ltd, Maharashtra.
Utkal Alumina	Odisha	Baphlimali bauxite mine (Odisha)
Vedanta Aluminium	Lanjigarh (Odisha)	Supplier from Gujarat, BALCO, Bagmar Bauxite Indus- tries 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 (4%) and China (3%). Countrywise reserves of bauxite are furnished in Table-9.

The world production of bauxite increased marginally by 4% to 326 million tonnes in 2018 as compared to 314.4 million tonnes in preceding year. Australia continued to be the major producer and accounted for about 29% share in the total production, followed by China (19%), Guinea (18%), Brazil (10%) 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
Canada	-
China	1000000
Guinea	7400000
India*	660000
Indonesia	1200000
Jamaica	2000000
Malaysia	110000
Russia	500000
Saudi Arabia	200000
USA	20000
Vietnam	3700000
Other countries	5000000

Source: *USGS, Mineral Commodity Summaries, 2020.*
(a) For Australia, joint Ore Reserve Committee compliant reserve were about 2.3 billion tonnes.
** Reserve /resources of bauxite in the country as on 01.04.2015 as per NMI database based on UNFC system has been placed at 3,896 million tonnes.*

To provide generalised view of the development in various countries the country wise description sourced from latest available publication of USGS, Mineral Year Book, 2017 is detailed below:

Australia

Bauxite production increased by 5% at 4.38 million tonnes but alumina production decreased slightly to1,95,000 tpy as compared with that in 2016. Rio Tinto increased bauxite production of the Gove Mine in the Northern Territory by 23% to 2.11 million tonnes as compared with production in 2016. The completion of a project to upgrade the conveyor system and export facilities in the fourth quarter of 2016 was cited for increased production at the Gove Mine. The project increased the mine capacity to approximately 13 million tonnes per year from 8.2 million tonnes per year. Bauxite production from the Weipa Mine increased by 5% to 1.47 million tonnes as compared with that of 2016, citing maintenance work on the calciner.

Rio Tinto continued 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 of infrastructure, including loading facilities at the nearby port. Mining was scheduled to start in mid-2018. Metro completed the acquisition of Gulf Alumina Ltd in early 2017. Gulf Alumina was developing the Skardon River project adjacent to the Bauxite Hills project, and Metro consolidated the projects into a single operation after completing the acquisition. The combined bauxite deposit reserves were reported to be 92.2 million tonnes.

Brazil

Bauxite production decreased slightly to 7,44,000 tonnes but alumina production was essentially unchanged compared with the revised amounts in 2016. Decreased bauxite production was attributed to an 11% decrease to 1.74 million tonnes in production at the MRN Mine in Para State, which was negatively impacted by drought conditions in the Porto Trombetas region. Bauxite deliveries to export markets were affected by decreased output from the MRN Mine owing to lack of water for the tailings system, but bauxite deliveries to the Alunorte alumina refinery in Barcarena, Para State were not affected. Production from the Paragominas Mine in Para State increased slightly 3,00,000 tonnes, partially offsetting the decreased production from the MRN Mine.

Production capacity at the Juruti Mine was being expanded to 6.5 million tonnes from 5.7 million tonnes . The expansion project that was started in 2016 would be completed in 2018. Production increased by 4,00,000 tonnes compared with that in 2016. Production was negatively affected by heavy rainfall in the first half of the year. In the second half of the year, lack of water during drought conditions resulted in decreased quality of bauxite shipped to the Alumar refinery, but alumina production was not significantly affected.

Canada

Orbite Technologies Inc. started trial production of high-purity alumina in January. Orbite used high-alumina clay as the raw material

for its 3 metric tonnes per day refinery at Cap-Chat, Quebec. However, trial production was stopped in March owing to equipment issues. Inspection of the plant's calciner identified issues with the heating system, which would require about 8 months to repair, pending the availability of financing. As a result of the shutdown and equipment issues, Orbite filed for protection under the Bankruptcy and Insolvency Act in April. The supplier of the calcination equipment identified the cause of its failure and was working to correct the problem. Restart of the plant was not expected until the end of the first quarter of 2018, pending available financing. In addition to high-purity alumina, Orbite's plant was designed to produce gallium, iron oxide, rare-earth elements, and high-purity silica.

China

Bauxite production was estimated to be 70 million tonnes, 8% more than that in 2016. Bauxite imports were at 68.6 million tonnes, 32% more than the 51.8 million tonnes imported in 2016. The leading sources of bauxite imports, in descending order, were Guinea (40%), Australia (37%), Malaysia (7%), and Brazil (5%). Imports from Guinea, Australia, and the Solomon Islands increased by 15.7 million tonnes (132%), 4.17 million tonnes (20%), and 1.26 million tonnes (531%), respectively, compared with those in 2016, accounting for the increased imports. These increases were partially offset by decreased imports from Brazil by 1.1 million tonnes , India by 2.4 million tonnes and Malaysia by 2.67 million tonnes. Malaysia remained the third-ranked supplier in 2017 but imports from Malaysia decreased by 36% to 4.78 million tonnes from 7.45 million tonnes in 2016. Malaysia had been the leading supplier of bauxite imports to China in 2015, supplying 24 million tonnes by (43%), until Malaysia's Government temporarily banned bauxite mining starting January 2016, but continued to allow exports of stockpiled bauxite.

Fiji

Bauxite production was more than double that in 2016 but was 68% less than the revised production in 2014. Aurum Exploration Fiji Ltd. had difficulty selling its bauxite in 2016 in part because of concerns about the impurity levels in the bauxite. Exports to customers in China resumed in August 2016 after a washing plant was installed to remove impurities from the bauxite but the mine was still ramping up to the prior production rate.

Guinea

Bauxite production increased by 47% to 14.7 million tonnes as compared with that in 2016 and by 183% to 29.9 million tonnes compared with that in 2015. Increased production was partially attributed to the completion and ramp-up of a 5 million tonnes mine in the Boke region owned by SMB Winning Consortium Ltd (a joint venture among Hongqiao Group Ltd, Shandong Yantai Port Corp., United Mining Supply plc, and Winning International Group Ltd.), which began shipments in September 2015.

Increased bauxite production was partially offset by a 4% to 6,14,000 tonnes decrease in production from the Sangaredi Mine, attributed to maintenance issues in the first quarter of the year. Capacity of the mine, a joint venture among Alcoa (23%), Rio Tinto (23%), Dadco Group (5%) and the Government of Guinea (49%), was being expanded to 18.5 Mt/yr from 14.5 million tonnes. The project would be completed by yearend 2018. United Company RUSAL Plc (Russia) continued construction of the Dian-Dian Mine, which would have a capacity of 3 million tonnes per year. Bauxite production was expected to begin in early 2018, and it would be shipped by rail to a port for export. Further expansion to 9 million tonnes per year was planned for completion in 2021. RUSALwas also planning to restart production from the 650,000 tonnes per year Friguia alumina refinery and the adjacent 2.1 million tonnes per year bauxite mine in April 2018. The refinery and mine were shut down in April 2012 owing to low alumina prices. In January Alufer Mining Ltd [Guernsey (United Kingdom)] started construction of the 5.5 million tonnes per year Bel Air Mine. Production was scheduled to start in the third quarter of 2018.

Guinea Alumina Corp., a subsidiary of Emirates Global Aluminum PJSC (United Arab Emirates), continued development of a 12 million tonnes per year bauxite mine in the Boke region which is scheduled for completion in 2018. Construction of support facilities at the Port of Kamsar were completed in 2016. A railroad spur line was under construction to connect the mine to an existing railroad line to Kamsar. Alliance Minière Responsable Ltd and SMB Winning Consortium signed an agreement to develop a bauxite deposit in the Boke

Table – 10 : World Mine Production of Bauxite 2016 to 2018
(By Principal Countries)

(In '000 tonnes)

Country	2016	2017	2018
World: Total (rounded off)	**289200**	**314400**	**326000**
Australia	83517	89421	95947
Brazil[c]	39244	38072	32007
China	66158	69000*	62000*
Guinea[(n)]	32424	51701	59574
India**[(f)]	24745	22313	23840*
Indonesia*	1485	4200	10300
Jamaica	8540	8245	9963
Kazakhstan	4801	4846	6104
Russia	5432	5523	5651
Saudi Arabia	4768	4117	4323
Vietnam	1400*	2700*	3570
Sierra Leone	1369	1788	1938
Guyana	1479	1459	1925
Other countries	13881	11017	8857

Source: *BGS World Mineral Production, 2014-2018.*

*(c) Including beneficiated and direct shipping ore. * Estimated*

(f) Years ended 31 March following that stated. (n) No adjustment has been made for moisture content

***India's production of bauxite during 2016-17, 2017-18 and 2018-19 was 24.75 million tonnes, 22.31 million tonnes and 23.84 million tonnes, respectively.*

region. Initial mine capacity would be 5 million tonnes per year, and expansion to 10 million tonnes per year was planned. The first phase of the mine would be completed and production would commence by January 2019.

Indonesia

Bauxite production was 2.9 million tonnes in 2017 as compared with 1.4 million tonnes in 2016, 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 and some mines were permitted to export bauxite. 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. Exports of bauxite resumed in July for the first time since the ban started in 2014. The Government issued export licences to companies building alumina refineries in Indonesia so that they could use proceeds of bauxite sales to finance construction.

Malaysia

Bauxite production decreased to 2 million tonnes in 2017 from 3 million tonnes in 2016 and 35 million tonnes in 2015. The Government extended the temporary ban on bauxite mining for the entire year in response to illegal mining and pollution at ports from bauxite stockpiles. The ban was initially imposed in January 2016. Export 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. Although mining bauxite was prohibited, illegal mining was reported after the ban was imposed. Government officials estimated that 3.6 million tonnes of bauxite were stockpiled at ports in April and industry observers stated that the stockpiles were not diminishing even though exports were reported, evidence that mining was continuing.

Vietnam

Bauxite and alumina production increased by 69% and 50%, respectively, as Vietnam National Coal and Mineral Industries Group (Vinacomin) continued

to ramp up production at the 6,50,000 tonnes per year Nhan Co alumina refinery in Dak Nong Province that started production in December 2016. Production at full capacity was not expected until 2018.

FOREIGN TRADE

Exports

Exports of bauxite decreased slightly by 1% to 1,510 thousand tonnes in 2018-19 from 1,529 thousand tonnes in the preceding year. Exports were mainly to China (74%), Kuwait (14%), Nepal (7%), Qatar (3%) and Slovenia (1%). Export of bauxite (aluminium & concentrate) were at 1,503 thousand tonnes in 2018-19 which increased by 10% from 1,369 thousand tonnes in the preceding year. Exports were mainly to China (74%), Kuwait (14%) and Nepal (6%). Export of bauxite (other aluminium & concentrate) decreased sharply by 96% to 6,823 tonnes from 1,59,979, tonnes in the preceding year. Export were mainly to Nepal (97%) (Tables-11 to 13).

Imports

In 2018-19, imports of bauxite increased drastically by 54% to 2,254 thousand tonnes from 1,461 thousand tonnes in the previous year. Imports were mostly from Guinea (37%), Brazil (32%), Trinidad (12%), Pakistan & Ghana (8% each) and China (3%). Import of bauxite (other aluminium & concentrate) decreased considerably by 18% to 179 thousand tonnes from 219 thousand tonnes in the preceding year. Almost the entire imports were made from Pakistan (99%). On the other hand imports of bauxite (aluminium & concentrate) increased by 67% to 2,075 thousand tonnes from 1,243 thousnad tonnes in the previous year. Imports were mainly from Guinea (40%), Brazil (35%) and Trinidad (13%) (Tables - 14 to 16).

Table – 11 : Exports of Bauxite (By Countries)

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1529308**	**2705041**	**1509737**	**3045300**
China	1273189	1877226	1113661	1710739
Kuwait	106270	183754	206992	376268
Nepal	45634	100843	103494	252175
Slovenia	6180	69042	9428	128031
Italy	633	13155	4625	102615
UK	901	20136	3400	93220
Qatar	1203	26590	52050	65303
Germany	139	3016	2450	47724
France	2797	39101	2908	39472
Japan	522	12002	1020	27177
Other countries	91840	360178	9709	202575

Figures rounded off

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

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**159979**	**250261**	**6823**	**17662**
Nepal	470	2672	6592	13400
Thailand	150	3152	75	1901
Ethiopia	10	137	124	1718
Kuwait	++	2	22	370
Vietnam	18	362	7	188
UAE	13	106	2	46
Bangladesh	54	406	2	38
Kenya	-	-	++	2
France	-	-	++	++
China	159199	242639	-	-
Other countries	66	784	-	-

Figures rounded off

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

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1369328**	**2454780**	**1502915**	**3027637**
China	1113990	1634587	1113661	1710739
Kuwait	106270	183752	206970	375898
Nepal	45164	98171	96902	238775
Slovenia	6180	69042	9428	128031
Italy	633	13155	4625	102615
UK	901	20136	3400	93220
Qatar	1203	26590	52050	65303
Germany	137	3014	2450	47724
France	2797	39101	2908	39472
Japan	522	12002	1020	27177
Other countries	91531	355232	9500	198682

Figures rounded off

Table – 14 : Imports of Bauxite (By Countries)

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1461495**	**7727096**	**2254595**	**13364137**
Brazil	111590	452683	732163	4184366
Guinea	585157	2400599	832933	4043917
China	93611	1758343	57634	1483909
Trinidad	135424	471900	261562	1476896
Pakistan	219417	1303999	180401	1147782
Ghana	185295	782057	178912	756560
Hong Kong	-	-	4440	122321
Singapore	-	-	4250	69166
Guyana	429	11683	1366	43454
Saudi Arabia	-	-	456	19167
Other countries	130572	545832	478	16599

Figures rounded off

FUTURE OUTLOOK

The total resources of bauxite that comprise various grades, as found to occur in the country as on 1.4.2015, are estimated at 3,896 million tonnes.

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

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**218917**	**1300717**	**179491**	**1142853**
Pakistan	218917	1300717	179387	1141280
Ukraine	-	-	80	1161
China	-	-	24	409
Guinea	-	-	++	3

Figures rounded off

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

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1242578**	**6426379**	**2075104**	**12221284**
Brazil	111590	452683	732163	4184366
Guinea	585157	2400599	832933	4043913
China	93611	1758343	57610	1483501
Trinidad	135424	471900	261562	1476896
Ghana	185295	782057	178912	756560
Hong Kong	429	-	4440	122321
Singapore	-	-	4250	69166
Guyana	429	11683	1366	43454
Saudi Arabia	-	-	456	19167
Netherlands	171	6416	398	15137
Other countries	130901	542698	1014	6803

Figures rounded off

The resources of Metallurgical grade bauxite are adequate while those of the Chemical and Refractory grade bauxite are relatively limited considering the future requirements. India's strength in aluminium is production due to its rich reserve of bauxite, a core resources used in production of aluminium. As per provision made in Mineral (Auction) Rule 2015, a total of 7 bauxite blocks were auctioned till June,2020 in the State of Maharashtra (6 blocks) & Madhya Pradesh (1block).

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.