Scope for Bauxite based Projects in Gujarat State

By

J.V. Bhatt

Sr. Development Officer (Minerals)

INDEXTb

INDUSTRIAL EXTENSION BUREAU

(A Govt. of Gujarat Organization)

Nanalal Chambers, Ashram Road

Ahmedabad-380 009

PREFACE

Gujarat Bauxite is well-known for its superior quality and occurs in Kachchh, Jamnagar, Junagadh, Sabarkantha, Kaira, Ahmedabad and Valsad districts in the Stat's mineral policy, thrust has been given to utilise lowgrade minerals, solid waste, gangue minerals tailings for the industrial application by new technology and process developed by R & D laboratories. Low grade Bauxite dumps lying at bauxite mines in state needs attention for its utilisation. Jawaharlal Nehru Aluminium Research Development & Design Center, Nagpur has been assigned the project of low grade bauxite benefication for refractory and abrasive appalication by iNDEXTb with cooperation of GMDC.

New Industrial Policy of 1995-2000 AD has also given special incentives for employment oriented projects and given stress for development of Mineral based industries. Bauxite based projects captive mines may able to generate large employment in rural areas of Kalayanpur, Lakhpat, Mandvi, Kapadwanj talukas of Jamnagar, Sabarkantha, Kaira, Kachchh Districts. Exploitation of Bauxite in these talukas thus will be able to ease the unemployment in rural areas.

Industrial Extension Bureau has given stress on the development of value added mineral projects. A special drive to boost up mineral Industry & Processing minerals with latest technology has been initiated by the Bureau by signing MOU with IBM, Nagpur and within a short span it has been geared to publish study reports on Granite, Limestone, China clay, Bentonite, State Mineral Resources which attracted entrepreneurs for mineral industry projects. iNDEXTb undertook revision of its first edition on "**Scope of Bauxite based Projects in Gujarat State**" with the developments of bauxite products technology by R&D organisation.

The study includes resources, leasing system, specification for industrial applications, status of bauxite based industry, scope for bauxite based projects including manufacture of value added bauxite based items and export potentiality of raw Bauxite. The report also identifies eighteen Bauxite based projects which could be set up in SSI or medium scale sector and goes further to suggest the locations of potential captive mine area and project sites.

The revised second edition compiled by Shri J.V Bhatt, Sr. Development Officer (Mineral) and Shri MM Parmar, Senior Officer (Minerals) under the guidance of Shri AK Ojha, General Manager (Technical) is placed before you which gives insight on the exploitation of Bauxite reserves of the State on commercial scale.

The first edition was appreciated by refractory, Abrasive, Aluminachemicals units in the state. The demand from refractory manufacturers, mineral engineers and entrepreneurs has compelled to update and release second edition for the attracting investments in the bauxite projects in Saurashtra and Kachchh region. I hope the revised edition will be useful to interested entrepreneurs, bauxite lease holders, refractory manufacturers, and bauxite consumers industries.

L. Mansingh, IAS
Industries Commissioner &
Chairman, iNDEXTb

Gandhinagar
September 1996

INDEX

SUMMARY

- Gujarat provides 14.63% share in Bauxite production in the country. Jamnagar contributes 86.74%, Kachchh 5.81%, Sabarkantha 1.67%, Kheda 2.98% share in Bauxite production in the State.
- Kachchh Bauxite was reserved in 1963 for Gujarat Minderal Dev. Corpn. Ltd. G.M.D.C has established 50,000 tonnes per annum capacity calcination plant at Ghadhsisa in Mandvi taluka. GMDC and GACL has jointly signed M.O.U for putting 600,000 tonne per year Alumina plant with Raython engineers and constructors Inc. USA. Initial viability study for the project is under scrutinity of the Govt.
- Carborandum Universal Ltd has started brown Abrasive grain. Unit at Varwala in Dwarka taluka, in addition to its calcination plant at Okha. "Gujarat Bauxite Ltd" and "Saurashtra Calcine bauxite and Allied Industries Ltd" are implementing 17,000 MT and 36,000 T calcined bauxite plants at Sanand in Ahmedabad District and Bhatia in Jamnagar District. "Cut Fast" is running Abrasive Unit at Dhoraji in Jamnagar district.
- Jamnagar Bauxite was dereserved for the exploitation by Private Sector. Value added Bauxite based products like abrasive, high alumina refractory, technical alumina and alumina chemical compounds projects are identified.
- To encourage Bauxite based values added projects, Bureau has taken in-depth study for scope for Bauxite based industries. Products which have export potentialities are catagorised as a thrust area. Aluminium Chemicals project profiles which may be undertaken in SSI Sector are considered priority product for the expansion of the existing alum units. Project profiles based on Bauxite are covered in the report which includes:
    - Abrasive Grains
    - Activated Alumina
    - Alumina Powder
    - Aluminium Chloride
    - Aluminium Hydroxide GEL
    - Aluminium Stearate
    - Aluminium Sulphate
    - Calcined Bauxite
    - Calcined & Tabular Alumina
    - Coated Abrasive
    - Emery Grains
    - High Alumina Refractory Bricks
    - High Alumina Cement
- In addition to above, items like absorbent grade activated alumina, dessciant alumina, alumina catalysts, catalysts support, microfined hydrate, sandyalumina, tabular alumina, aluminium phosphate are identified for the new projects.
- Projects on above items, potential locations for acquisition of mining leases, lease system list of prospecting reports, mining centers, Glossary of alumina, export potentiality, price realisation, status of existing industries are incorporated as the part of report.

1.0 INTRODUCTION

1.1 Bauxite deposits of Gujarat have been known since more than decade. The well-known deposits of Jamnagar district in Saurashtra are famous for its superior quality in international trade and commerce. Jamnagar and Kachchh bauxite are at present being used within the country by many agencies in alumina production, chemicals, refractories and abrasives. Some part of the production is being exported to Iran and Iraq.

The occurrences of bauxite in several districts of the State was known since long. The first systematic appraisal of the deposit, extent geological setting and quality was done by Shri Y.S. Sahasrabudde of Geological Survey of India. The above work focused the attention of the State Government and detailed assessment programme by the State Department of Geology & Mining was started since 1963 which is being continued even today.

As a result of the above prospecting work, the position of the bauxite deposits in the different districts of the State is tabulated in Table 1.1.

Table-1.1 *Districtwise Bauxite Reserves in Gujarat State*

District	Grade	Percentage of Al_2O_3	Reserves (in Mln.Tons)
Kachchh	Refractory & Metallurgical	45% to 51%	42.25
Jamnagar	-do-	-do-	22.00
Jungadah	-do-	-do-	16.00
Bhavnagar	Metallurgical	45% to 50%	0.146
Amreli	-do-	Below 45%	0.016
Sabarkantha	Low Grade	-do-	23.43
Kheda	-do-	-do-	0.86
Valsad	-do-	-do-	0.38
Total			**105.00**

1.2 Saurashtra and Kachchh bauxite deposits occur in the laterite belt stretching up to 22.40 kms. closely following the trend of the coast line. All the bauxite deposits of the State are distributed in the three separate areas.

1. The coastal track of Jamnagar and Bhavnagar districts.
2. The south and southern track of Kachchh district.
3. Ahmedabad region, comprising Kaira, Bharuch and Surat district.

Gujarat Mineral Development Corporation has acquired bauxite mining leases in Jamnagar and Kachchh districts. Bauxite pockets of Kachchh district are reserved for the Corporation. Some of the pockets of Mevasa, Mahadevia and Ran villages are also reserved for G.M.D.C. in Jamnagar district. There are 62 private bauxite leases

covering 4377.58 hectares of land under mining leases in the State and annually an average 5 lakh tonnes of bauxite is exploited.

In addition to above GMDC is also running its Bhatia and Naradi bauxite projects and mined 75,363 tonnes of bauxite during 1994-95.

To augment bauxite reserves, State department is engaged in the concealed bauxite prospecting in Kachchh district.

Reservation of Kachchh bauxite was done with a view that GMDC may put up an alumina plant based on bauxite of Kachchh. GMDC has established 50,000 tonnes per annum Bauxite Calcination plant at Ghadsisa in Mandvi Taluka of Kachchh district involving 8 crores and 25 lakh investment.

1.3 The geological characteristic of the bauxite pockets of the State is such that it will not justify today mechanize mining on a large scale. Considering above constraint and of technology and peculiarity of the deposits, pressure is mounting on the Government to reconsider its decision of reservation of bauxite of Kachchh for the development of bauxite based industries in the State in the private sector.

1.4 Low grade grade bauxite of Kaira, Sabarkantha districts and non plant grade bauxite dumps lying idle needs an attention as it incurs loss of revenue, and solid waste at minesite. iNDEXTb in collaboration of G.M.D.C has sponsered project work on evolution of refractory & abrasive grade bauxite from low grade bauxite of Gujarat" to the Jawaharlal Nehru Aluminium Research Development & Design centre, Nagpur.

1.5 Mineral benefication MOU signed by iNDEXTb with Indian Bureau of Mines, Nagpur also includes feasibility study for the lowgrade bauxite upgradation. The iNDEXTb will publish the commercial report on sale to the desirous lease holders and entrepreneurs.

2.0 BAUXITE RESOURCES

2.1 World Distribution and Ranking

Largest bauxite resources are distributed in countries like America, Africa, Asia, Australia and Europe. Guinea followed by Australia have the largest reserves of bauxite in the world (9100 million metric tonnes (MT) and 8080 million MT respectively). They are closely followed by Brazil (4000 MT), Vietnam (3300 MT), India (3035 MT), Jamaica (2000 MT), Indonesia (1760 MT), Venezuela (1150 MT) and Cameroon (1030 MT). Accordingly to these estimation, 88% of the world bauxite resources belong to lateritic type, 11.5% are Karstic bauxites and only 0.5% belong to Tikhvin type deposits.

The estimates for sub-economic and hypothetical resources could change considerably with further exploration and technological advancement. Majority of these speculative resources of lateritic bauxite are discovered in tropical forests while buried tertiary, mesozoic and paleozoic karstic bauxite deposits may occur in the orogenic mountain system of central, east and south east Asia.

So far as the Indian bauxite reserves are concerned, the estimates of Bardossy and Aleve place these at 2420 million metric tonnes. But the currently estimated insitu reserves of bauxite in India are placed over 3037 million tonnes. This is based on the provisional inventory prepared by the Indian Bureau of Mines as on 1.4.90 in concurrence with the Geological Survey of India and other exploration agencies. Table 2.1.1 gives the estimated world bauxite reserves and resources of unbeneficiated crude ore.

Table 2.1.1 *Estimated World Bauxite Reserves and Resources of Crude (Unbeneficiated) Ore*

(in million metric tonnes)

Continents/ Countries	Type of Deposits K, L, T	Reserves Proved/ Probable	Reserves Possible	Sub-econo-economic & hypo-thetical resources	Total
(1)	(2)	(3)	(4)	(5)	(6)
Europe					
Albania	K	-	-	1	1
Austria	K	-	-	2	2
Czechoslovakia	K	-	-	5	5
Fed.Rep.of Germany	L	-	2	-	2
France	K>L	30	200	5	235
Greece	K	300	200	200	700
Hungary	K	160	00	90	350
Italy	K	40	60	40	140
Poland	L>T	-	5	10	15
Romania	K	30	20	10	60
Spain	K	-	-	50	50

(1)	(2)	(3)	(4)	(5)	(6)
United Kingdom (Northern Ireland)	L	-	4	2	6
USSR (European part)	L>T>K	200	100	100	400
Yugoslavia	K	150	200	150	500
Sub-Total		**910**	**891**	**665**	**2466**
Asia					
Afganisthan	K		-	5	5
Indonesia	L	760	,000	300	2,060
Iran	K	10	60	30	100
Malaysia	L	20	80	80	180
Pakisthan	K>L	150	25(	600	1,000
Peoples Rep.of China(Taiwan)	L	-	-	60	60
Philippines	L>K	-	20	180	200
Saudi Arabia	L	30	120	-	150
Turkey	K>L	30	200	30	260
USSR (Asian part)	K>L>T	50	200	50	300
Vietnam	L>K	300	3,000	1,400	4,700
Sub-Total		**3,510**	**5,260**	**3,085**	**11,855**
Africa					
Angola	L	-	-	10	10
BurkinaFaso	L	-	-	20	20
Cameroon	L	680	350	300	1,330
Chad	L	-	-	10	10
Ghana	L	180	300	100	580
Guinea	L	2,600	6,500	1,000	10,100
Guinea-Bissau	L	30	130	-	160
Ivory Coast	L	-	120	180	300
Malagashi Rep.	L	-	550	50	600
Malawi	L	-	20	40	60
Mali	L	160	400	100	660
Mozambique	L	-	2	8	10
Sierra Leone	L	40	200	-	240
South African Rep.	L	-	20	30	50
Togo	L	-	-	5	5
Zaire	L	-	-	100	100
Zimbabwe	L	-	5	5	10
Sub-Total		**3,690**	**8,597**	**1,958**	**14,245**

(1)	(2)	(3)	(4)	(5)	(6)
America					
Brazil	L	500	3,500	500	4,500
Colombia	L	-	50	50	100
Costa Rica	L	40	40	120	200
Cuba	L>K	-	10	10	200
Dominican Rep.	K	30	20	-	50
French Guiana	L	40	100	30	170
Guyana	L	400	400	2,000	2,800
Haiti	K	10	40	-	50
Honduras	L	-	-	10	10
Jamaica	K	1,500	500	-	2,000
Mexico	L	-	-	50	50
Panama	L	-	-	70	70
Suriname	L	570	230	-	800
USA	L>K	30	10	280	320
Venezuela	L	350	800	5,000	6,150
Sub-Total		**3,470**	**5,700**	**8,120**	**17,290**
Australia Oceania					
Australia	L	3,530	4,550	-	8,080
Fiji	L	-	5	10	15
Manus Island	L	-	-	1	1
New Zealand	L	-	-	20	20
Polau Island	L	-	10	40	50
Solomon Island	K	50	10	-	60
Sub-Total		**3,580**	**4,575**	**71**	**8,226**
Grand Total (Rounded)		15,200	25,000	13,800	54,000

Note: According to Provisional National Mineral Inventory prepared by IBM as on 1.4.90, the total insitu reserves in India work out to be 3,035 million tonnes.

Abbreviations:
L = Lateritic bauxite; K = Karst bauxite; T = Tikhvin type bauxite

Source: Mineral Facts & Problems No-14 - Monograph on Bauxite. (Revised Edition - Nov. 1992).

2.2 The total resources of the country are estimated at around 2333 million tonnes. The total recoverable reserves are estimated at 2330 million tonnes. Out of 2333 million tonnes, recoverable reserves about 83% is of metallurgical grade. The reserves of the refractory and chemical grade constitutes 18.17% and free holder reserve constitutes 18.2%. Statewise and districtwise recoverable reserve of bauxite is shown in the Table 2.2.1.

Table 2.2.1 *Statewise Districtwise & Categorywise Recoverable Reserves of Bauxite in Leasehold & Freehold Areas*

(in '000 Tonnes)

State/District	a-Leasehold b-Freehold c-Leasehold & Freehold	Proved	Probable	Possible	Total	Simplified Grade
ORISSA						
Total :		310,462.0 (21.5%)	266,689.0 (18.5%)	865,124.6 (60.0%)	1,444,275.6 (100%)	
		-	-	13.6	13.6 (0.010%)	Refractory
		277,356.0	264,144.0	807,462.0	1,348,962.0 (93.53%)	Metallurgical
		33,106.0	-	10,842.0	43,948.0 (1.3%)	Mixed & Low grade
		-	2,545.0	46,807.0	4,93,502.0 (3.4%)	Unspecified grade
Phulbani	b	-	-	16,200.0	16,200.0	Metallurgical
Bolangir	a	33,099.0	-	7,183.0	40,282.0	Metallurgical
	b	-	98,808.0	18,056.0	116,864.0	
	c	21,257.0	-	3,633.0	24,890.0	
Kalahandi	b	-	-	3.6	3.6	Refractory
	b	33,106.0	65,607.0	226,656.0	292,263.0	Metallurgical
	b	-	-	44,321.0	77,427.0	Mixed & low grade
Total :	b	33,106.0	65,607.0	270,980.6	369,693.6	
Keonjhar	b	-	2,585.0	2,455.0	5,000.0	Unspecified

Koraput	a	96,037.0	23,778.0	194,472.0	314,287.0	Metallurgical
	b	126,963.0	75,951.0	341,208.0	544,122.0	
	b	-	-	10,800.0	10,800.0	Mixed & low grade
	b	-	-	58.0	58.0	Unspecified grade
Total :	a	96,037.0	23,778.0	194,472.0	314,287.0	
	b	126,963.0	75,951.0	352,066.0	554,980.0	
Sundergarh	a	-	-	10.0	10.0	Refractory
	a	-	-	15.0	15.0	Mixed & low grade
	a	-	-	54.0	54.0	Metallurgical
Total :	a	-	-	79.0	79.0	
ANDHRA PRADESH						
Total :		169,848.0 (27.2%)	161,199.0 (44.1%)	260,954.2 (100%)	592,001.2	Metallurgical
Godavari East	b	-	-	37,962.2	37,962.2	Metallaurgical
Vishakhapatnam	b	169,848.0	161,199.0	222,992.0	554,039.0	Metallurgical
MADHYA PRADESH						
Total :		62,836.5 (44.6%)	40,360.4 (28.7%)	37,594.1 (26.7%)	140,791.0 (100%)	
		3,816.0	160.0	2,125.4	6,101 (4.33%)	Refractory
		53,227.4	36,238.6	15,807.9	105,273.9 (74.7%)	Mewtallurgical
		5,310.7	2,754.0	12,943.4	21,008.1 (14.92%)	Mixed & low grade
		256.7	1,132.0	6,285.3	7,673.0 (5.43%)	Unspecified grade
Balaghat	b	-	-	211.0	211.0	Chemical
	b	-	-	577.0	577.0	Refractory
	b	365.0	2,946.0	2,104.0	5,443.0	Metalalurgical
	b	180.0	-	2,215.0	2,395.0	Mixed & low grades
Total :	b	545.0	2,946.0	5,107.0	8,598.0	

Bastar	a	3,600.0	-	-	3,600.0	Refractory
	b	200.0	-	-	200.0	Chemical
	b	392.0	-	-	392.0	Mixed & low grade
Total :	a	3,600.0	-	-	3,600.0	
	b	592.0	-	-	592.0	
Bilaspur	a	134.0	200.0	-	334.0	Metallurgical
	b	1,440.0	309.5	110.7	1,860.2	
	b	-	-	10.5	10.5	Chemical
	b	-	-	13.5	13.5	Refractory
	b	940.0	-	40.0	980.0	Mixed & low grade
Total :	a	134.0	200.0	0	334.0	
	b	2,380.0	309.5	174.7	2,864.2	
Guna	b	-	-	8.0	8.0	Refractory
	b	-	-	5.5	5.5	Unspecified grade
	b	-	-	11.5	11.5	Mixed & low grade
Total :	b	-	-	25.0	25.0	
Jabalpur	a	-	-	2.4	2.4	Chemical
	a	15.4	160.0	478.1	789.5	Refractory
	b	64.6	-	-	64.5	
	a	90.8	74.0	215.2	380.0	Mixed & low grade
	b	3.5	-	21.0	24.5	
	a	466.1	113.6	351.4	931.1	Metallurgical
	b	-	-	133.6	133.6	
	a	244.4	973.9	3,283.5	4,501.8	Unspecified grade
	b	-	-	120.0	120.0	
Total :	a	952.7	1,321.5	4,330.5	6,604.7	
	b	68.1	-	274.6	342.7	
Mandla	a	422.5	-	-	422.5	Metallurgical
	b	3,695.0	5,995.0	1,948.0	11,638.0	
	b	-	-	162.5	162.5	Refractory
	b	-	-	20.0	20.0	Mixed & low grade

Total :	a	422.5	-	-	422.5	
	b	3,695.0	5,995.0	2,130.5	11,820.5	
Raigarh	b	-	-	34.0	34.0	Chemical
	b	-	-	205.0	205.0	Refractory
	b	-	-	196.5	196.5	Metallurgical
	b	126.0	-	4,359.5	4,485.5	Mixed & low grade
Total :	b	126.0	-	4,795.0	4,921.0	
Rajnandgaon	b	-	-	11.0	11.0	Chemical
	b	-	-	461.0	461.0	Metallurgical
	b	-	-	2,815.0	2,815.0	Mixed & low grade
Total :	b	-	-	3,287.0	3,287.0	
Rewa	a	-	-	13.8	13.8	Metallurgical
	b	-	12,945.0	5,580.0	18,535.0	
	b	-	-	2,525.0	2,525.0	Mixed & low grade
	a	-	-	2,429.0	2,429.0	Unspecified
	b	-	2,525.0	-	2,525.0	
Total :	a	-	-	2,442.8	2,442.8	
	b	-	15,470.0	8,115.0	23,585.0	
Satna	a	26.7	75.1	108.9	210.6	Chemical
	b	-	-	14.2	14.2	
	a	-	-	378.2	378.2	Refractory
	a	-	164.6	3,436.4	3,601.0	Metallurgical
	b	3,330.0	-	427.0	3,377.0	
	a	147.1	145.7	652.7	945.5	Mixed & low grade
	b	-	10.0	6.8	16.8	
	a	11.3	124.1	26.5	161.9	Unspecified
	b	-	34.0	40.8	74.8	
Total :	a	185.1	509.5	4,602.3	5,296.8	
	b	3,350.0	44.0	88.8	3,482.8	

Shanhdol	a	2151.3	-	-	2,151.3	Mixed & low grade
	b	-	-	-	1,280.0	
	b	-	-	25.0	25.0	Chemical
	b	-	-	199.0	199.0	Refractory
	b	1,140.0	-	35.0	1,175.5	Metallurgical
Total :	a	2,151.3	-	-	2,151.3	
	b	2,420.0	-	259.0	2,679.5	
`hivpur	b	-	-	15.0	15.0	Chemical
	b	-	-	15.0	15.0	Unspecified grade
Total :	b	-	-	30.0	30.0	
;idhi	a	-	-	104.2	104.2	Refractory
	a	-	-	61.8	61.8	Mixed & low grade
Total :	a	-	-	166.0	166.0	
Surguia	a	-	13,565.0	-	13,565.0	Metallurgical
	b	42,214.9	-	1,400.0	43,614.9	
	b	-	-	360.0	360.0	Unspecified grade
Total :	a	-	13,565.0	-	13,565.0	
	b	42,214.9	-	1,760.0	43,974.9	
Vidisha	b	-	-	5.0		Unspecified
GUJARAT						
Total :		36,422.7	18,967.2	52,353.9	1,07,743.8	
		(33.8)	(17.6)	(48.6)	(100)	
		4,362.5	137.0	494.3	4,993.8	Chemical
		5,813.1	16.0	10,398.3	16,227.4	Refractory
		800.9	-	388.3	1,189.9	Abrasive
		7,457.3	1,239.4	14,629.0	23,325.8	Metalalurgical
		12,138.7	2,286.8	4,617.3	19,042.8	Mixed & low grade
		5,850.2	15,288.0	21,826.8	42,965.0	Unspecified grade

Amreli	a	7.0	-	-	7.0	Metallurgical
	b	-	1.0	-	1.0	
Total :	a	7.0	-	-	7.0	
	b	-	1.0	-	1.0	
Bhavnagar	a	-	-	410.0	410.0	
	b	100.0	-	-	100.0	Metallurgical
Total :	a	-	-	410.0	410.0	
	b	100.0	-	-	100.0	
Jamnagar	a	274.0	-	487.3	761.3	Chemical
	b	3,142.7	137.0	7.0	3,286.5	
	a	-	16.0	8,312.8	8,328.7	Refractory
	b	1,511.2	-	-	1,511.2	
	a	704.0	15.0	8,434.1	9,153.2	Metallurgical
	b	5,303.4	319.0	38.5	5,660.9	
	a	-	-	25.0	25.0	Abrasive
	b	60.3	-	38.5	98.8	
	a	-	125.0	1,171.4	1,296.4	Mixed & low grade
	b	2,969.2	2,161.8	59.0	5,190.0	
	a	-	-	4,374.1	4,374.1	Unspecified grade
	b	-	-	314.0	314.0	
Total :	a	978.0	156.0	22,804.6	23,938.6	
	b	12,865.0	2,617.8	457.0	16,061.3	
Junagadh	a	-	-	880.7	880.7	Unspecified grade
	b	-	-	13,493.0	13,493.0	
	b	-	-	1,288.0	1,288.0	Metallurgical
Total :	a	-	-	880.7	880.7	
	b	-	-	14,781.0	14,781.0	
Kheda	a	-	-	103.5	103.5	Refractory
	b	162.5	-	-	162.5	
	a	-	-	29.2	29.2	Metallurgical
	b	306.5	-	-	306.5	
	a	-	-	118.5	118.5	Mixed & low grade

	b	-	-	-	-	
	a	-	-	328.2	328.2	Unspecified grade
	b	-	-	35.0	35.0	
Total :	a	-	-	579.3	579.3	
	b	468.5	-	35.0	35.0	
Kutch	a	16.0	-	-	16.0	Chemical
	b	930.0	-	-	930.0	
	a	189.0	-	-	189.0	Refractory
	b	3951.0	-	1,777.2	3,728.2	
	b	442.6	-	324.8	767.4	Abrasive
	a	2,327.3	-	-	2,327.3	Mixed & low grade
	b	6,842.2	-	3,074.0	9,916.2	
	a	589.0	-	-	589.0	Unspecified grade
	b	5,257.2	32.0	2,154.4	7,443.6	
Total :	a	3,374.3	-	-	3,374.3	
	b	18,459.4	66.4	11,759.6	30,285.4	
Sabarkantha	a	-	-	204.8	204.8	Refractory
	a	-	-	247.4	247.4	Unspecified grade
	b	-	504.0	-	504.0	
	b	-	608.0	-	608.0	Metallurgical
	a	-	-	194.5	194.5	Mixed & low grade
	b	-	14,752.0	-	14,752.0	
Total :	a	-	-	646.7	646.7	
	b	-	15,864.0	-	15,864.0	
Valsad	b	-	262.0	-	262.0	Metallurgical
	b	45.0	-	-	45.0	
Total :	b	45.0	262.0	-	307.0	
MAHARASHTRA ***Total :***		58,098.6 (66.6%)	11,761.9 (13.5%)	17,389.4 (19.9%)	87,249.9 (100%)	

		1,161.0	73.1	3,780.0	5,014.1 (5.74%)	Chemical
		-	48.0	-	48.0	Refractory
		56,797.6	4,936.8	7,067.0	68,801.4 (78.8%)	Metallurgical
		140.0	6,704.0	4,293.0	11,137.0 (12.76%)	Mixed & low grade
		-	-	2,249.0	2,249.0 (2.57%)	Unspecified grade
Raigad	a	-	73.1	-	73.1	Chemical
	b	-	-	128.0	128.0	
	a	309.3	263.3	52.4	624.9	Metallurgical
	b	9,659.0	135.0	279.0	10,073.0	
	b	-	48.0	-	48.0	Refractory
Total :	a	309.3	336.4	52.4	698.1	
	b	9,659.0	135.0	279.0	10,073.0	
Kolhapur	a	39,574.0	4,010.0	1,070.0	44,591.0	Metallurgical
	b	5,256.0	-	4,023.0	9,279.0	
	b	1,161.0	-	2,556.0	3,717.0	Chemical
	a	140.0	0	0	140.0	Mixed & low grade
	b	-	-	1,629.0	1,629.0	
Total :	a	39,714.0	4,010.0	1,007.0	44,731.00	
	b	6,417.0	-	8,208.0	14,625.0	
Ratnagiri	a	-	57.0	124.0	181.0	Metallurgical
	b	568.0	98.5	524.0	1,190.5	
	b	-	-	776.0	776.0	Chemical
	b	-	-	2,264.0	2,264.0	Mixed & low grade
	b	-	-	1,098.0	1,098.0	Unspecified grade
Total :	a	-	57.0	124.0	181.0	
	b	568.0	98.5	4,662.0	5,328.5	

Satra	b	-	290.0	-	290.0	Metallurgical
	b	-	6,704.0	-	6,704.0	Mixed & low grade
Total :	b	-	6,994.0	-	6,994.0	
Thana	b	-	-	320.0	320.0	Chemical
	b	-	-	400.0	400.0	Mixed & low grade
Total :	b	-	-	720.0	720.0	
Sindhudurg	a	1,084.0	-	-	1,084.0	Metallurgical
BIHAR						
Total :		11,892.7 (19.5%)	13,498.1 (22.1%)	35,713.4 (58,4%)	61,104.1 (100%)	
		-	-	5.0	5.0 (0.008%)	Chemical
		26.5	23.5	387.8	437.8 (0.71%)	Refractory
		7,993.2	5,964.6	18,824.5	32,782.3 (53.6%)	Metallurgical
		3,177.0	7,264.0	11,637.8	22,078.8 (36.1%)	Mixed & low grade
Monghyr	b	-	-	805.5	80-5.5	Mixed & low grade
	b	-	-	7.5	7.5	Unspecified grade
Total :	b	-	-	813.0	813.0	
Palamau	a	-	-	1,400.0	1,400.00	Metallurgical
	b	-	-	733.6	733.6	
	b	-	-	1,189.6	1,189.6	Mixed & Low grade
Total :	a	-	-	1,400.0	1,400.0	
	b	-	-	1,923.2	1,923.2	

Rohtas	b	-	-	1,250.0	1,250.0	Mixed & low grade
	b	-	-	50.0	50.0	Unspecified grade
Total :	b	-	-	1,300.0	1,300.0	
Gumla	a	-	-	262.8	262.8	Refractory
	b	-	-	102.0	102.0	
	a	2,528.7	3,370.1	1,579.5	7,478.3	Metallurgical
	b	1,028.0	-	13,359.1	14,387.1	
	a	261.0	109.0	28.0	398.0	Mixed & low grade
	b	36.0	7,401.0	3,628.0	11,065.0	
	b	-	-	5.0	5.0	Chemical
	b	660.0	-	2,774.3	3,434.3	Unspecified grade
Total :	a	2,789.7	3,479.1	1,870.3	8,139.1	
	b	1,724.0	7,401.0	19,868.4	28,993.4	
Lohardaga	a	26.5	23.5	23.0	73.0	Refractory
	a	3,161.5	2,432.5	1,671.3	7,265.3	Metallurgical
	b	1,275.0	162.0	81.0	1,518.0	
	a	1,500.0	-	-	1,500.0	Mixed & low grade
	b	1,416.0	-	364.4	1,762.4	
	a	-	-	1.8	1.8	Unspecified grade
Total :	a	4,688.0	2,456.0	1,694.3	8,838.3	
	b	2,691.0	162.0	428.2	3,282.2	
Dumka	b	-	-	6,415.0	6,415.0	Mixed & low grade
GOA						
Total :		8,426.0 (30.0%)	9,885.0 (35.2%)	9,778.0 (34.8%)	28,089.0 (100%)	
		-	-	1,504.0	1,504.0 (5.35%)	Refractory
		5,456.0	914.0	2,671.0	9,041.0 (32.18%)	Metallurgical

		2,970.0	8,971.8	2,765.0	14,706.0 (52.3%)	Mixed & low grade
		-	-	2,838.0	2,838.0 (10.1%)	
North Goa	b	-	210.0	782.0	992.0	Mixed & low grade
South Goa	a	-	914.0	-	914.0	Metallaurgical
	a	2,970.0	8,761.0	1,983.0	13,714.0	Mixed & low grade
	a	-	-	2,838.0	2,838.0	Unspecified grade
Total :	a	2,970.0	9,675.0	4,821.0	17,466.0	
Unknown District	b	-	-	1,504.0	1,504.0	Refractory
	b	5,456.0	-	2,671.0	8,127.0	Metallurgical
Total :	b	5,456.0	-	4,175.0	9,631.0	
KARNATAKA						
Total :		1,743.3 (6.4%)	6,001.4 (21.9%)	19,671.5 (71.8%)	27,416.1 (100%)	
		296.3	93.5	102.0	491.7 (1.79%)	Refractory
		1,407.4	4,593.9	8,558.6	14,559.9 (53.1%)	Metallurgical
		39.6	1,314.0	7,729.3	9,082.9 (33.12%)	Mixed & low grade
		-	-	2,501.6	2,501.6 (0.09%)	Unspecified grade
Belgaum	a	202.0	-	-	202.0	Metallurgical
	b	-	420.0	263.0	683.0	
	a	39.6	162.0	-	201.6	Mixed & low grade
Total :	a	241.6	162.0	-	403.6	
	b	-	420.0	263.0	683.0	

Chikamagalur	b	-	-	120.0	120.0	Metallurgical
North Kanara	b	-	-	102.0	102.0	Refractory
	b	-	300.0	4,477.0	4,477.0	Metallurgical
	b	-	720.0	6,675.5	7,395.5	Mixed & low grade
	b	-	-	48.0	48.0	Unspecified grade
Total :	b	-	1,020.0	11,302.5	12,322.5	
South Kanara	a	296.3	93.5	-	389.8	Refractory
	a	1,185.4	373.9	2,965.1	4,524.4	Metallurgical
	b	20.0	3,500.0	733.5	4,253.5	
	b	-	432.0	1,833.8	2,265.8	Mixed & low grade
	b	-	-	2,453.6	2,453.6	Unspecified grade
Total :	a	1,481.7	467.4	2,965.1	4,914.2	
	b	20.0	3,932.0	5,020.3	8,972.9	
TAMIL NADU						
Total :		1,359.0 (7.4%)	15,064.0 (83.2%)	1,904.0 (10.4%)	18,327.0 (100)	
		-	28.0	-	28.0 (0.15%)	Refractory
		1,359.0	4,748.0	66.0	6,173.0 (33.6%)	(Metallaurgical
		-	10,288.0	498.0	10,786.0 (58.8%)	Mixed & low grade
		-	-	1,340.0	1,340.0 (7.31%)	Unspecified grade
Madurai	b	-	-	16.0	16.0	Unspecified
Nilgiris	a	-	-	66.0	66.0	Metallurgical
	b	-	800.0	-	800.0	

	a	-	1,135.0	50.0	1,185.0	Mixed & low grade
	b	-	4,072.0	448.0	4,520.0	
	b	-	28.0	-	28.0	Refractory
	b	-	-	1,324.0	1,324.0	Unspecified grade
Total :	a	-	1,135.0	1116.0	1,251.0	
	b	-	4,900.0	1,772.0	6,672.0	
Salem	a	597.0	228.0	-	825.0	Metallaurgical
	b	762.0	3,720.0	-	4,482.0	
	a	-	3,480.0	-	3,480.0	Mixed & low grade
	c	-	236.0	-	236.0	
Total :	a	597.0	3,708.0	-	4,305.0	
	b	762.0	3,220.0	-	4,482.0	
	c	-	236.0	-	236.0	
Dindigul-Quid-e-Muleth	a	-	1,365.0	-	1,365.0	Mixed & low grade
UTTAR PRADESH						
Total :		5,193.0 (55.1%)	250.0 (2.7%)	3,977.0 (42.2%)	9,420.0 (100%)	
		810.0	-	-	810.0 (8.59%)	Refractory
		1,978.0	-	-	1,978.0 (20.99%)	Metallurgical
		2,405.0	250.0	3,977.0	6,632.0 (70.40%)	Mixed & low grade
Banda	a	-	-	127.0	127.0	Mixed & low grade
	b	2,405.0	-	1,850.0	4,255.0	
	b	810.0	-	-	810.0	Refractory
	b	1,978.0	-	-	1,978.0	Metallurgical

Total :	a	-	-	127.0	127.0	
	b	6,193.0	-	1,850.0	7,043.0	
Lalitpur	b	-	-	2,000.0	2,000.0	Mixed & low grade
Varanasi	b	-	250.0	-	250.0	Mixed & low grade
KERALA						
Total :		1,220.0 (15.4%)	5,068.0 (64.0%)	1,633.2 (20.6%)	7,923.2 (100%)	
		56.0	-	-	56.0 (0.70%)	Refractory
		79.0	-	-	79.0 (0.99%)	Metallurgical
		1,087.0	5,068.0	1,633.2	7,788.2 (98.2%)	Mixed & low grade
Kannur	b	331.0	4,241.0	424.2	4,996.2	Mixed & low grade
Kollam	b	462.0	-	1,209.0	1,671.0	Mixed & low grade
Thiruvananthapuram	b	294.0	264.0	-	558.0	Mixed & low grade
Kasargod	b	56.0	-	-	56.0	Refractory
	b	79.0	-	-	79.0	Metallurgical
	b	-	563.0	-	563.0	Mixed & low grade
Total :	b	135.0	563.0	-	698.0	

JAMMU & KASHMIR						
Total :		537.0 (30.1%)	830.0 (46.6%)	416.0 (23.2%)	1,783.0 (100%)	
		-	-	416.0	416.0 (23.2%)	Chemical
		387.0	665.0	-	1,052.0 (59.0%)	Mixed & low grade
		150.0	165.0	-	315.0 (17.6%)	Unspecified grade
Udhampur	a	-	-	416.0	416.0	Chemical
	a	387.0	665.0	-	1,052.0	Mixed & low grade
	a	150.0	165.0	-	315.0	Unspecified grade
Total :	a	537.0	830.0	416.0	1,783.0	
MEGHALAYA						
Total :		-	896.0 (100%)	-	896.0 (100%)	Metallurgical grade
Khasi Hills East	b	-	896.0	-	896.0	Metallurgical grade
RAJASTHAN						
Total :		-	-	318.5 (100%)	318.5 (100%)	Mixed & low grade
Kota	b	-	-	318.5	318.5	Mixed & low grade

2.3 Indian Resources

Important bauxite deposits in the country lies in Andhra Pradesh, Madhya Pradesh, Bihar, Gujarat, Maharashtra, Goa, Jammu & Kashmir, Karnataka, Kerala, Tamil Nadu and Uttar Pradesh. Production from 1984 to 1987 with value is mentioned in Table 2.3.1. Statewise bauxite reserves are given in Table 2.3.2.

Table 2.3.2 *Recoverable Reserves of Bauxite (As on 1.4.1990)*

Name of State	Reserves in million tonnes		
	Leasehold	Freehold	Total
Orissa	354.648	1062.738	*1442.276
Andhra Pradesh	-	592.001	592.001
Madhya Pradesh	34.583	106.208	140.791
Maharashtra	46.694	40.556	87.250
Gujarat	29.837	77.907	107.744
Bihar	18.377	42.727	61.104
Uttar Pradesh	0.127	9.293	9.421
Meghalaya	-	0.896	0.896
Rajasthan	-	0.318	0.318
Tamil Nadu	6.921	11.170	#18.327
Goa	17.466	10.623	28.089
Jammu Kashmir	1.783	-	1.783
Karnataka	5.318	22.098	27.416
Kerala	-	7.923	7.923
All India Total	515.754	1984.458	2525.320

Note: * It includes 24.890 million tonnes of Freehold & Leasehold common deposits
This includes 0.236 million tonnes of freehold & leasehold common deposits.

2.4 Alumina production in India

There are seven alumina production plants in india, the details of which are given in Table 2.4.1 alongwith their installed capacity.

Only two companies, BALCO and HINDALCO, are producing alumina at the rate of about 80-90% of their installed capacity. Aluimina production from other companies are erratic and very less due to power shortage. NALCO is yet to start full-fledged production. 4.25 lakh tonnes of alumina produced by NALCO will be utilised for producing 2.18 lakh tonnes of alumina metal per year and the remaining 3.75 lakh tonnes will be available to export.

Table 2.4.1 *List of Plants Producing Alumina in India*

Sl. No.	Name of Company	Location	Installed Capacity(TPY)
1.	Bharat Aluminium Co (BALCO)	Korba MP	100,000
2.	Hindustan Aluminium Co (HINDALCO)	Renukoot UP	250,000
3.	National Aluminium Co (NALCO)	Dhamanjodi	800,000
4.	Madras Aluminium Co (MALCO)	Metturdam Tamil Nadu	250,000
5.	Indian Aluminium Co (INDALCO)	Hirakud Orissa	24,000
6.	Indian Aluminium Co (INDALCO)	Belgaum Karnataka	75,000
7.	Indian Aluminium Co (INDALCO)	Alwaye Kerala	20,000

The country has 2525 million tonnes reserves of bauxite ore. It produces about 27.79 million tonnes of bauxite ore annually and was ranked 5th amongst the world producer. The production only comes from ten States (Table 2.3.2). Most of the Indian deposits are associated with lateritic cappings occuring as blanket on the plateahole ranges of peninsualr India. Major deposits of the country are occuring in five groups.

Though USBM has shown India's total reserve base as 2333 million tonnes considering only 8 major deposits, the overall in-situ resources of bauxite in India at present are placed at 2525 million tonnes.

2.4.1 The above computation is based on varying cut-off values of alumina and silica without taking into full consideration the developments in alumina technology. For Eastern Ghat deposits, explored in recent past, a cut-off value of +40% Al_2O_3 and -5% SiO_2 was considered whereas for other deposits, mainly explored in the past, only aluina was taken as guiding factor demarcating the ore-zone.

The recoverable reserves as estimated by Indian Bureau of Mines (IBM) in the National Mineral Inventory, 1992 are 2525 million tonnes, of which 135 MT is based on empirical thumb rules. There are several factors which influence the bauxite recovery during mining such as geometry of the deposits, methodology of mining, infrastructure, characteristics of bauxite, consumer specifications and available technology. Thus, the recoverable reserve of particular deposit may be significantly different from other and no uniform factor can be applied especially for deposits of different geological nature.

2.5 A computer base study was carried out by BALCO on Gandhamardan deposit of Eastern Ghat to find out the effect of changing cut-off values of SiO2 on grade and ore reserves. The salient results are given in Table 2.5.1.

Table 2.5.1 *Mean Grade & Reserve for varying Cut-off Value of SiO_2 for Gandhidham Bauxite Deposit*

Cut-off Value	Corresponding Length % of Ore Zone	Mean Grade% Al_2O_3	SiO_2	% Change in Ore Reserve
- 5.0	57.52	46.47	2.32	Base
- 6.0	60.24	46.40	2.50	+ 5.94
- 7.0	64.17	46.31	2.70	+11.55
- 8.0	66.68	46.24	2.88	+15.92
- 9.0	68.77	46.15	3.05	+19.56
-10.0	70.60	46.07	3.22	+22.74

It may be observed from Table 2.5.1 that, with increasing silica cut-off values, the ore reserves increases appreciably, whereas the mean grade still remains under control, to be acceptable by the present alumina technology for dominantly gibbsitic bauxite of Eastern Ghats. Thus, it becomes clear that this ultimately should result in increase of reserves in Gandhamardan by more than 20%. The result of this study may be checked in NALCO's working mine at Panchpatali and , accordingly, the bauxite deposits of Eastern Ghats can be reassessed to get a realistic picture of the bauxite resources of the country. For want of such exercise at this stage, we may, however, assume 2911 million tonnes given by USBM.

2.6 The Indian Bauxite deposits may be grouped under five major groups typified by (i) Eastern Ghats, (ii) Western Ghats, (iii) Inland High level Plateaux, (iv) Inland Lowlying Hillocks and (v) Coastal plains. All these deposits are of lateritic type (in- situ and transported) with varying mode of occurence, chemical, mineralogical and physio-mechanical properties depending upon the parent rock composition, mode of origin, geomorphological disposition and age of bauxite formation.

These can be used in alumina extraction by Bayer's process with varying economics of production. Their generalised chemico-minological characteristics are presented in Table 2.6.1.

Table 2.6.1 *Generalised Chemico-Mineralogical Characteristics of Indian Bauxite*

Chemical	Mineralogical
Al_2O_3 : 38-65% (Av.range 42-50%)	Al_2O_3 in gibbsite ($Al_2O_3.3H_2O$) 25-60% Al_2O_3 in boehmite ($Al_2O_3.H_2O$) Traces-30% Al_2O_3 in diaspore ($Al_2O_3.H_2O$) Traces-8% Al_2O_3 in kaolinite ($Al_2O_3.2SiO_2$) 0.15-6% Al_2O_3 alumogoethite (Fel-xAlxO(OH)Traces-1.2% Al_2O_3 alumohematitite(Fel-xAlx)203 Traces-0.4% Al_2O_3 silimnite($Al_2O_3.SiO_2$)0-0.10% Al_2O_3 amorphous(Al-Si and/or Al-Fe gel)Not defined

Chemical	Mineralogical
SiO_2 : 0.3-8% (Av.range 1.5-4.5%)	SiO_2 in kaolinaite ($Al_2O_3.2SiO_2.2H_2O$) 0.2-7.0% SiO_2 quartz (SiO_2) 0.03-1.0% SiO_2 silimnite ($Al_2O_3.SiO_2$)0.0-05% SiO_2 chamosite (Hydrous silicate of Al and Fe) Not defined)
Fe_2O_3 (Av.range 7-25%)	Fe_2O_3 in geothite ($Fe_2O_3.H_2O$) 0.5-20% Fe_2O_3 hematite (Fe_2O_3) 0.8-23% Fe_2O_3 maghemite (Y Fe_2O_3) magnetite (Fe_3O_4) chamosite and siderite ($FeCO_3$) Not defined
TiO_2 0.5-12% (Av.range 2-8%)	TiO_2 in anatase (TiO_2) 0.5-11% TiO_2 rutile (TiO_2) Traces-4% Ilmenite ($FeO.TiO_2$) and sphere ($CaTiSiO_4$) Not defined
$CaCO_3$ 0-11%	$CaCO_3$ in calcite ($CaCO_3$) 0-11%
Loss-on-ignition 12-34% (LOI) Av.range18-26%	In gibbsite, boehmite, diaspore, kaolinite goethite, corg, inorganic Co_2
Trace elements	Mn, P, V, Cr, Ni, Ga, Mg, Mo, CO 3-1300 ppm Sr.Zr, Cu, Pt, Zn, Sc, Ba
Organic matters	0-06%

2.6.1 Eastern Ghats

The major bauxite deposits of Orissa and Andhra Pradesh and Tamil Nadu fell under this unique bauxite province which is 70 to 80 kms. from the coastline and accounts for 75% of India's total reserves. The deposits occur as medium to large sized plateau cappings at an elevation of 950-1400 m above M.S.L. The large thickness of ore zone (10-16 meters) with little over burden makes it ideal for cost effective exploitation. The bauxite is, in general, characterised by medium alumina (42-48%), fairly low silica (1.5-3.5%), low titania (1-3%) and high iron (8-28%; Fe_2O_3) and less than 1% P_2O_5, V_2O_5, MnO, MgO, CaO, Ga_2O_3, Na_2O_3 and K_2O together. Here the main aluminous mineral is gibbsite (more than 95%) and boehmite is insignificant (less than 2%). The silica is mainly in the form of kaolinite with only 20-30% SiO_2 as free quartz. Anatase is the major titanium mineral followed by rutile and ilmenite. goethite and hematite occur in variable proportions from equal amount to high content of geothite.

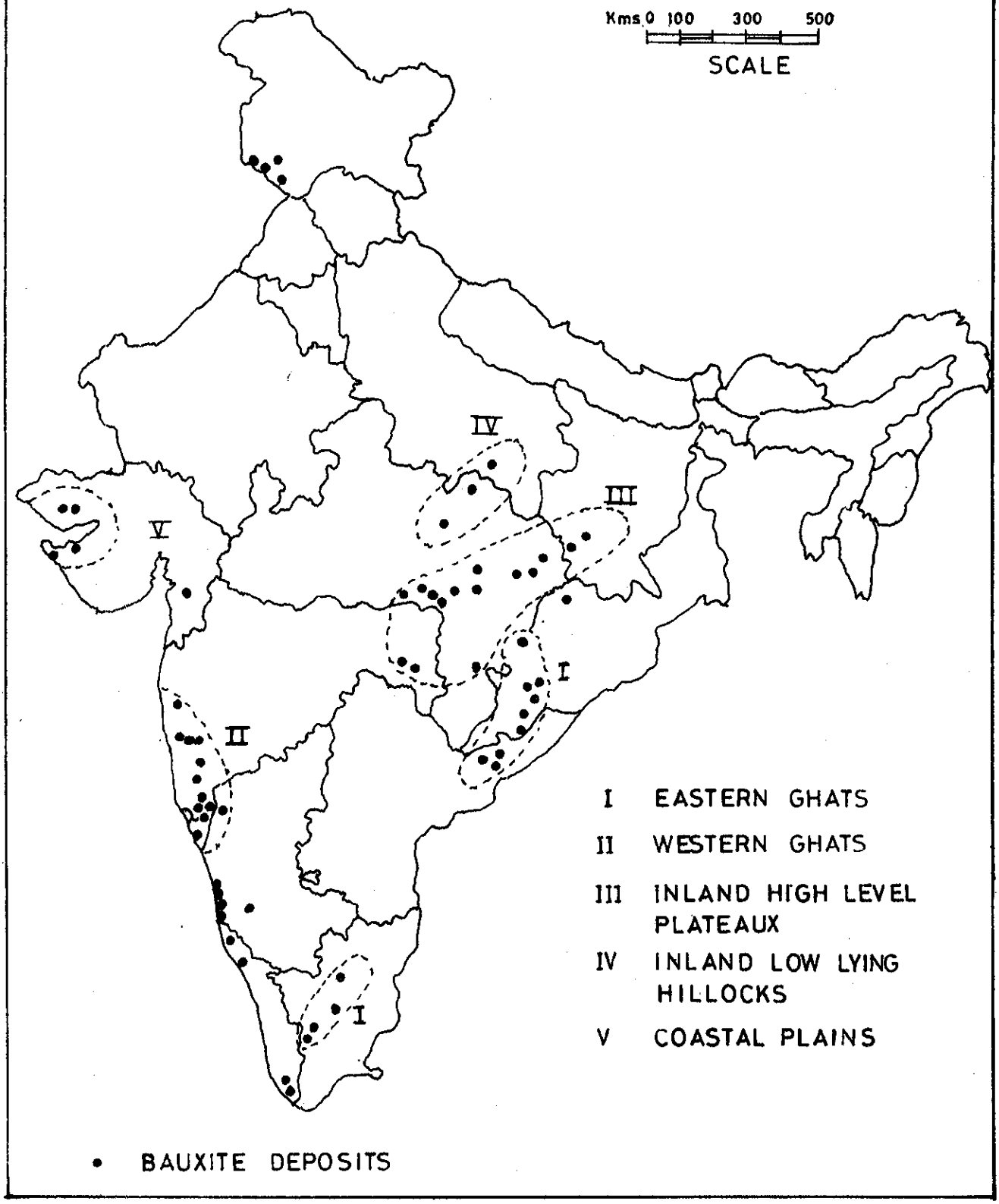
2.6.2 Western Ghats

The Dhangarwadi and Udgiri deposits of Maharashtra mainly represent this group. The average Al_2O_3 content is 51%, whereas SiO_2, Fe_2O_3, TiO_2 and LOI are 3.5%, 13%, 4.8% and 27% respectively. The major aluminous mineral is gibbsite followed by boehmmite and traces of diaspore. About 20 to 25% alumina is in the form of boehmite. More than 90% silica is locked up in kaoliite (6%).

2.6.3 Inland High Level Plateaux

A large number of scattered bauxite deposits of Central India are classified under this group and these had formed the main stay for alumina production till Eastern Ghat bauxites were discovered. In physico chemical character and mineralogy the bauxite is similar to Western Ghat deposits and is originated from similar type of basaltic rocks

GEOMORPHOLOGICAL GROUPS OF BAUXITE DEPOSITS OF INDIA



(Deccan Traps). The only exception is higher content of titaniu and noticeable quantity of diaspore in some deposits under this group.

2.6.4 **Inland Low Level Hillocks**

The deposits of this group occur in small low lying hillocks and have distinct genetic and geomorphological setting. The bauxite deposits are mostly located in central India and are less significant both in reserve and extent. Some of the bauxite of this group viz. Katni deposits ar characterised by fairly low iron and silica content and, thus, is used for refractory purpose. Mineralogically, this bauxite is similar in general to group (ii) and (iii) deposits.

2.6.5 **Coastal Plains**

The bauxite deposits of Kachchh and Saurashtra in Gujarat uniquely occurs at very low altitude. These are known for their superior quality, being most suitable for use in the refractory and chemical industries. Two types of bauxite formations, for example, hard massive and bouldery type, are notices in this group, which are characterised by very high alumina (more than 55% Al_2O_3), low to medium silica (1.5-5%) and low iron (less than 10% Fe_2O_3) (6%). the dominant aluminous mineral is gibbsite followed by boehmite and traces diaspore. The silica is mostly bound in kaolinite and quartz is present only in small quantity.

Districtwise reserves and grades for the producing States are mentioned in Table 2.2.1.

2.7 State of Gujarat, which is known for its superior quality bauxite, has initiated prospecting programme since 1964. Bauxite deposits of Gujarat can be divided into 2 groups on the basis of their mode of occurences.

Bauxite deposits of Gujarat can be divided broadly into two groups on the basis of their mode of occurence: (i) bouldery/nodular, and (ii) massive blanket types. In the former type, bauxite occurs as hard, compact, greyish or pinkish boulders and nodules which are embedded in a clayey matrix. The size and concentration of boulders are variable. the massive blanket type deposits are generally more ferruginous than the bouldery type; they are hard compact and massive overlying a clay zone. The massive type shows red, brown and pink colours and has a mottled appreance.

The bauxite deposits of Gujarat can be further grouped into two categories on the basis of origin, viz. insitu deposits and transported deposits. the insitu deposits show a gradual increase in alumina from Deccan Traps towards the overlying bauxite horizon with a corresponding decrease of silica content. These features are absent in the transported variety. Both types of deposits occur scattered over a large area in Saurashtra and Kachchh regions.

On the basis of their rock association, the deposits can be further divided into three groups:

i) those associated with insitu weathering of the pyroclasts of Deccan Traps

ii) transported reqorked material of residual deposits, and

iii) those associated with Supra-trappean limestone. (High percentage of lime in bauxite of Ahmedabad region may be due to this limestone).

2.7.1 *Kutch District*

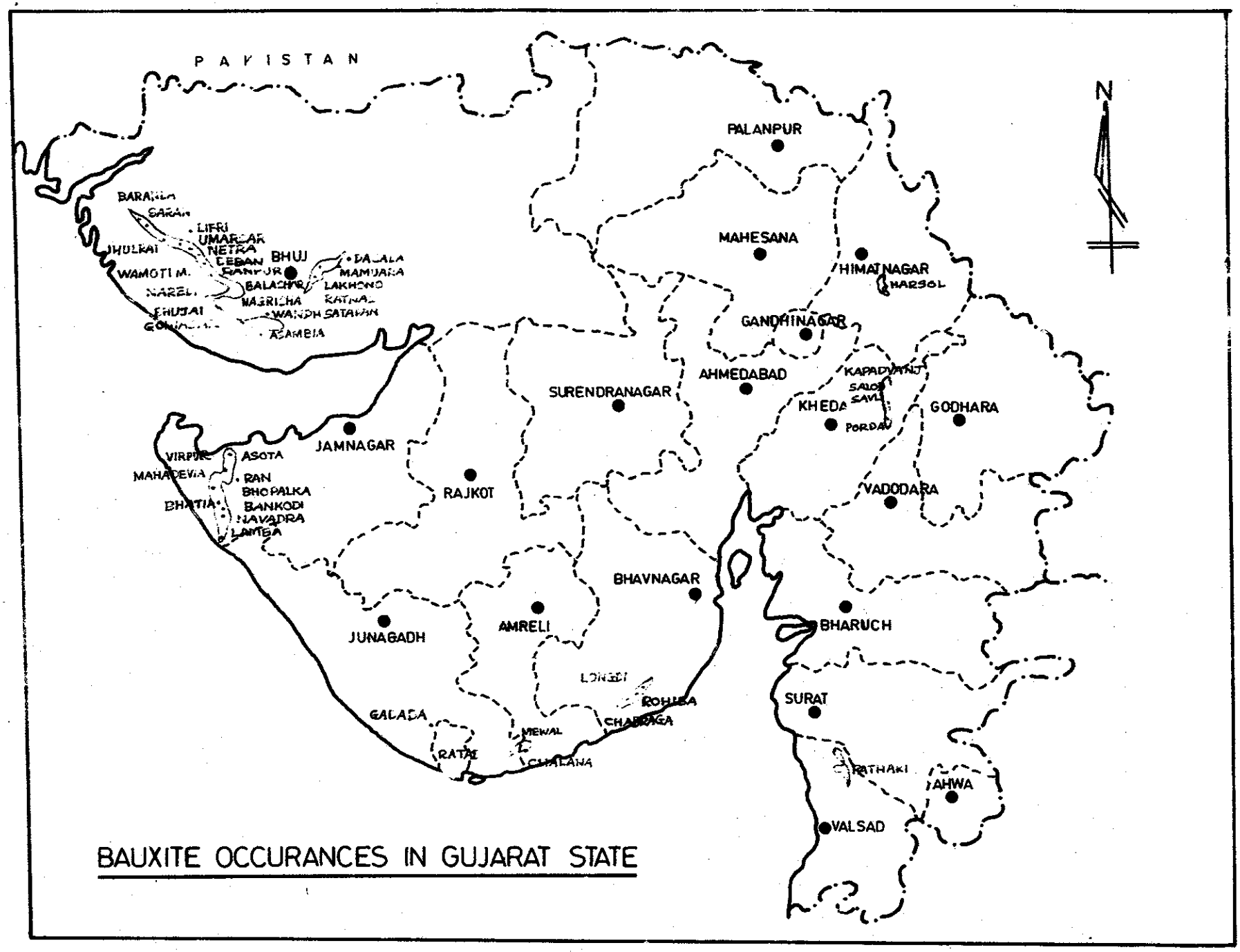
Sahasrubuddhe, has suggested the following geological sequence which is a slight modification of Wynne's sequence:

Alluvium, blown sand and sub-recent deposits	Recent
Upper Tertiary (unconformity)	Pleistocene to Miocene
Argillaceous group (fossiliferous) Arenaceous group Nummulitic group Gypseous shales Lateritic pyroclastics and volcaanoclastic sediments (sub-nummulitic) Stratified traps and associated intertrappen beds, etc. Infra-trappean grits Unconformity	Eocene
Oolitic beds	Upper Jurassic group Lower Jurassic group

The Deccan Traps and the Tertiaries are separated by a persistent horizon of sub-Nummulitic group of rocks with which bauxite- bearing laterites are associated. The Deccan Traps occur consistently over a distance of 160 Kms. and rest unconformably on either infra-trappean grits or the Bhuj series of upper Jurassic age. At places, they occur as outliers. But in the northern and eastern portions of Kachchh, traps are absent, though sub-Nummulitic laterite and Tertiaries are notices. the Deccan Traps are generally horizontal, with dip rarely exceeding 10 degrees. the sub-Numulitic group consists of about six identifiable rock types. This group of rocks rests conformably on Deccan Traps and occurs as a narrow belt. Towards east, they fringe round Bhuj rocks with no exposures of Deccan Traps as already mentioned. The diverse association of rock types in sub- nummulitic group has given rise to contrasting opinions of its age. The leterite associated with this group of rocks is porous, pitted, clayey and is red, yellow, brown, grey and mottled in colour often appearing pseudo-brecciated or concretionary and conglommeratic. the laterite is 3 to 4 m thick and it passes on to clayey zones which are 2 to 10 m in thickness. The lighomorge exhibits "leissagung lines" similar to current bedding.

The kinds of bauxite deposits have been recognised in Kachchh area : (a) deposits formed insitu due to alteration of the pyroclastic facies of Deccan lava flows wherein the original textures of volcanic agglomerate, breccias and tuffs have been retained, and (b) transported and reworked insitu material. Even the laterite profile varies for these two types. The insitu deposits show four zones, viz. (i0 nodular or pisolitic zone, (ii) massive earthy zone, (iii) granular zone, and (iv) clay zone. In the nodular zone, irregular rounded mamsses of hard bauxite are set in a loose earthy matrix. In the upper portions of the zone, a dense dull to light grey coloured, amorphous material, perhaps cliachite, is present which contains blebs of gibbsite. The nodules exhibit poor concentric structure. The massive zone is made up of hard earthy bauxite which is divided by numerous horizontal partings imparting a pseudo-stratification granuler bauxite, occuring at the bottom of bauxite profile consists of gritting particles of bauxite held loosely in an earthy-white matrix. The clay zone seems to be made up of a misture of kaolinised rock and grains of "waxy gibbsite".

The deposits of the transported group which have not been transported far from the source also show three zones, viz. (a) nodular bauxite with pseudo-brecciated appreance, (b) mixed zone of pisolitic and massive earthy bauxite, and (c) zone of lithoargic clays, whereas, those that have been transported over considerable distances show only two zones, viz. (a) zone of well rounded small pebbles of bauxite material held in a ferruginous matrix, and (b) a zone of grit consisting assorted grains of quartz, zasper, etc. (indicating shallow water conditions) set in an aluminous matrix.


PAKISTAN
N
PALANPUR
MAHESANA
HIMATNAGAR
HARSOL
GANDHINAGAR
AHMEDABAD
KAPADVANJ
SALOD
SAVLI
KHEDA
PORDAN
GODHARA
SURENDRANAGAR
JAMNAGAR
VIRPUR
ASOTA
MAHADEVIA
RAN
BHOPALKA
BHATIA
BANKODI
NAVADRA
LAMBA
RAJKOT
VADODARA
BHAVNAGAR
BHARUCH
JUNAGADH
AMRELI
SURAT
GALADA
RATAI
MEWAL
CHAMANA
ROHISA
CHARDARA
RATHAKI
AHWA
VALSAD
BHUJ
LAKHONO
RATNAL
SATAPAR
ASAMBIA
BAUXITE OCCURANCES IN GUJARAT STATE

Mineralogically, the bauxite of Kutch area coprises 73 percent of gibbsite, 14 percent kaolinite, and 12 percent impurities, the latter including limonitic material, anatase, brookite, calcite, etc.

The important deposits of Kutch district are in the talukas Abdasa, Lakhpat, Nakhtrana and Mandvi. Anjar and Bhuj talukas contain some deposits of lesser importance. the laterites occupying certain areas in Bachau and Rapar talukas are devoid of bauxite. The deposits are listed talukawise.

i) *Abdasa Taluka:*

Balachor (Nani), roha-Raidhanjar area, Deban deposit, Naredi deposit and Wamoti(moti) deposit.

ii) *Anjar Taluka:*

Lakhond deposit, Kumka deposit and Mamuare-Dagara deposit.

iii) *Lakhpat Taluka:*

Baranda deposit, Fulra deposit, Thutrai deposit, Matanomadh (Madh) deposit, Panadra deposit, Rawalesar deposit, Samjiaara- Morchbani deposit and Saran deposit.

iv) *Mandvi Taluka:*

Asambia (Nana) deposit, Faradi-Punadi-Tumbdi deposits, Goniasar-Wandh deposits, Hamla deposit, Nangrecha deposit, Rataria (Nana) deposit.

v) *Nakhatrana Taluka:*

Bhojal deposit, Khanpur deposit, kotda-Jarjrok deposits, Lifri deposit, Nandra deposit, Netra deposit and Rasatia deposit.

Bhavnagar, Amreli and Junagadh Districts

The laterite outcrops occuring in Bhavnagar, Amreli and Junagadh districts lie between Bhavnagar and Veraval and can be grouped into (i) bauzite occurence betwen Bhavnagar and Talaja, and (ii) bauxite north of Mahuva.

2.7.2 i) *Bauxite occurance between Bhavnagar and Talaja:*

In this area, laterite forms low hups in a narrow zone of about 35 kms. length. It is found between Deccan Traps and Gaj beds. Such humps rarely exceed three metres above the black soil covered plains. The soft, clayey laterite forms thin crusts of oxidized limonitic material unlike those of Kutch and jamnagar districts. Soft, fine, white clays are found extensively below the laterite.

ii) *Bauxite North of Madhuvan:*

Light brown to grey coloured generally soft laterite contains fairly thick horizone of bauxite near Loingdi and Talgajarda. The laterite and Loingdi forms an extensive patch found in association with rhyolites, the volcanic facies of Deccan basalts. However, black cotton soil overlies the laterite, exposing it only at a few places. The thickness of bauxite horizons is around 1.5 .

The Talagjarda deposits are on a group of three low-lying small mounds less than 7 m from the ground level. They consist of buff to grey laterite with conspicuous presence of quartz grains. The thickness of bauxite is around 2.5 m. This bauxite also contains quartz grains. But the presence of calcite developed along fine cracks and fissures may render the ore uneconomic.

The laterites near Dongar, Kagvadar, Nageori-Una and Una-Sanwa are generally highly ferruginous and generally thickly spread at places. But the bauxite contained in them is either of insignificant quantity or of uneconomic quality with inclusions of quartz grains.

2.7.3 *Sabarkantha, Kaira, Bhroach and Surat Districts:*

The laterite belt occuring in these districts runs for about 150 kms. in a north-south direction comprising of several isolated narrow exposures between Sabarkantha district in the north and Surat district in the south. Of these, the laterites near Harsol and Ambaliyara in Sabarkantha districts are bauxite-bearing. Other deposits are at Taibpur, Dhanakapur, Kapadvanj, Sauli, Sikindera, paira, Sait and Dakor in Kaira district and Gandevi and Tarkesar in Surat district, there being no deposit of any consequence in Bharuch district.

Sahastrabudhe and Kulkarni have suggested the following geological sequence for this region:

Alluvium	-	Recent and Sub-recent
Laterite	-	Pleistocene
Argillaceous and calcareous sand-stones, limestones, clays, etc.	-	Early Eocene
Deccan Trap	-	Cretaceous

The laterites are found along the western margin of Deccan Traps, resting apparently on the limestones. The laterite belt is discountinuous and humpy at places. The laterite is porous, pitted, clayey with red, yellow, brown, fawn, fawn grey and mottled colours suggesting variable composition. It is also pseudo-brecciated and concretionary, but siliceous laterite is harder and brittle, breaking with a sub-conchoidal fracture. The laterite is 3 to 4 m thick and passes downwards into clayey zones. In a few sectors near Taibpur and Kapadvanj, limestones are seen to have been lateritised, where fawn grey calcareous material retaining the trend of the original rock.

In an ideal bauxite section, three zones are seen, which from top to bottomm are i) nodular, ii) massive, and iii) clayey. The nodular zone also contains some pisolites besides irregular rounded masses of hard bauxite set in a loose earthy matrix. The massive zone exhibits pseudo stratification since it is divided by horizontal partings. The clayey zone consists of fine grey plastic clays with reddish earthy aterial similar to "Terr-rosa". A notable feature of this region is that the elongated funnel shaped or irregular pockets of bauxite rest on an irregular surface of limestones.

Two distinctly discernible varieties of bauxite are observed in this region: first, a fawn grey coloured, earthy, massive variety which under microscope shows clayey patches, often with limonitic coatings. The second variety shows, also under microscope, diffused outlines of various shades of brown indication the colloidal nature of bauxite minerals. In addition, calcite blebs are seen surrounded by bauxite material perhaps indicating replacement of calcite by bauxite. A few grains of limonite apparently pseudomorphs of sphere are also seen.

Theoretically, gibbsite contributes about 75 percent, kaolinite 15 percent and ipurities about 7 percent of the total mineral constituents of bauxite of this region; the impurities are limonitic material, anatasa, brookite, calcite, etc. A few analyses of bauxite samples have shown that the Al_2O_3 content is around 51 percent and silica 7 percent. In general, it can be called "moderate alumina low titania type". The titania content is around 6 percent.

2.7.4 *Jamnagar District:*

The deposits occuring in the Kalyanpur taluka of jamnagar and Junagadh districts are also referred to as Saurashtra bauxites. The bauxite mines lie within 0.5 to 8 kms. from the coast. The quality of bauxite in Saurashtra competes with the best bauxites of the world, and Japan has found that this bauxite surpasses those from Indonesia, Malaysia and Australia. However, in view of transport problems, the Saurashtra bauxites are yet to attract Japanese buyers.

The geological succession of the area is as shown below:

Recent	Soil and alluvium
Gaj series (Lower Miocene)	Shell limemstone Calcareous clay Concretionary limestone Calcareous clay Greenish bentonitic clay Calcereous grit Gonglomerate
	Unconformity
Plaeocent to Lower Miocene	Laterite with or without segregations of bauxite
Supra Trappean (Palaeocene)	Ochreous and bentonitic clays (dominantly purple to brown coloured and spotted)
Deccan Trap (cretaoeous)	Brown clay (altered pyroclastics and trap) Basalts of Deccan Trap (Amygdular at places)
	Base not exposed

The important occurance, though not widespread, is of the conglomerates consisting of rounded pebbles of laterite, high grade bauxite and fragments of altered trap, all set in the calcerous matric of Gaj fossil shells. This indicates that the Gaj beds are of post-lateritization period, themselves not affected by lateritisation.

In this region, two kinds of laterites are identified: i) hard, deep, brown and clay-free, ferruginous laterite forming a thin crust on the surface, and ii) soft mottled clay-rich, aluminous thicker zone, also exhibiting pseudo-stratification. the latter variety contains the known pockets of bauxite. The mottled appearance is imparted to the rock by greyish white kaolinite patches and brownish-red ferruginous material consisting of haematite, goethite and limonite. the laterite forms ellipsoidal bodies parallel to the pseudo-stratification and it passes downwards into a zone of ochereous and richy coloured bentonitic clays, often mixed with kaolinitic clay. The clays exhibit very thin impersistant laminations at places and also differ in colour from purple to yellow.

The generalized bauxite section shows the following zones:

Concretionary motled zone

Nodular zone

Compact massive zone (high grade)

Earthy zone (clay-rich bauxite, grading down to lithomerge).

Generally all these zones are characterised by oolitic, pisolitic and colloform structures. Bauxite also occurs as nodular segregations in mottled laterite, and segregated patches in association with kaolinitic clay. The scrap sections have exposed insignificant patches and nodules of bauxite. The workable deposits, mostly in the form of small pockets are

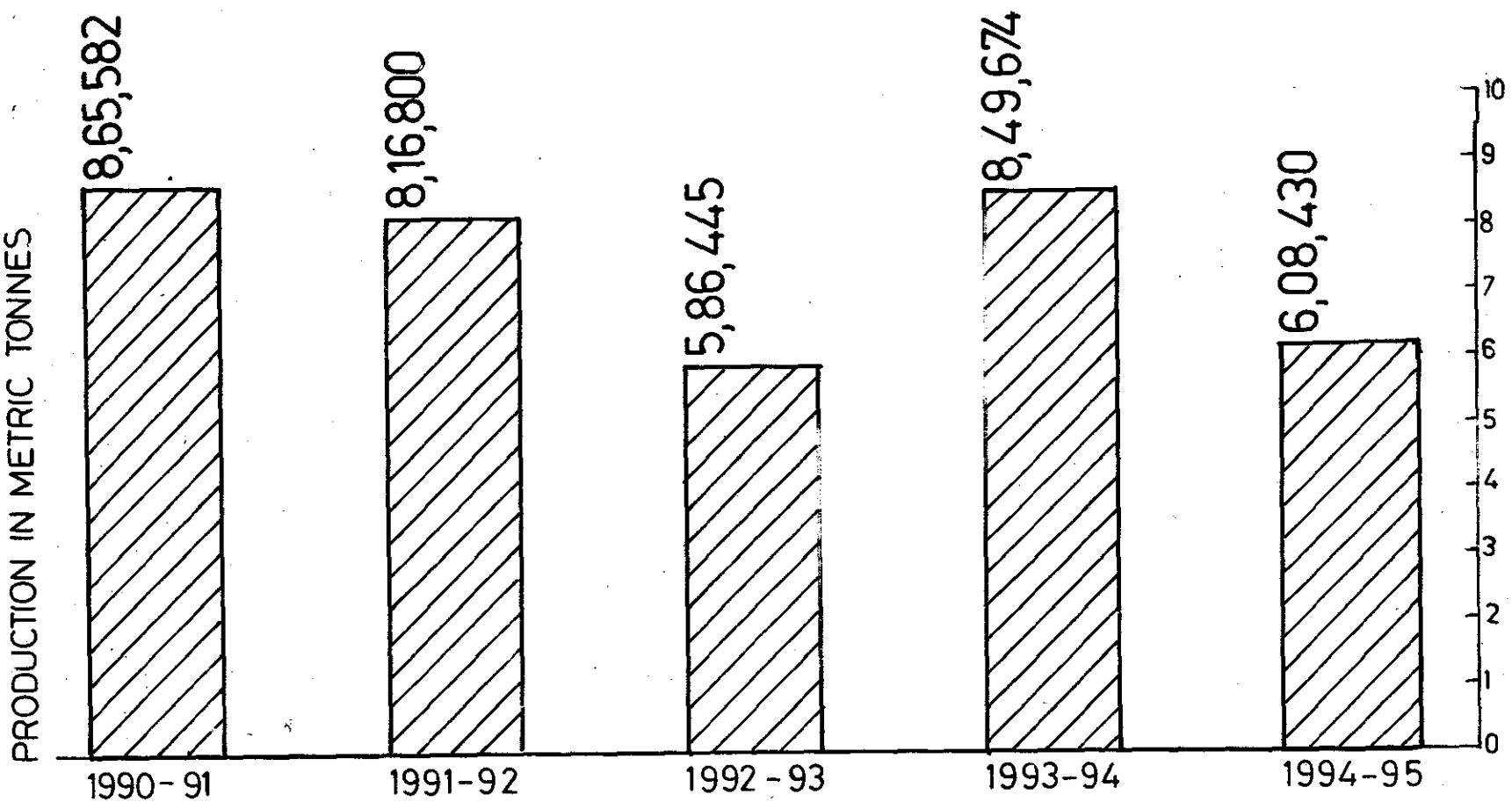
on gentle slopes. At places, the bauxite is exposed on the surface without the laterite or limestone covering.

The bauxite deposits are lensoid or bun-shaped with a convex upper surface. The laterite-bauxite horizon is bouldery with ellispsoidal and irregular blocks which form as aggregates of smaller nodules. The thickness of this zone is about 4 m. Though there is laternal repetition of lenses, connected with "thin necks", vertical repetition is not seen. The material in these lenses is highly heterogeneous and varies in composition very sharply from low grade iron rich-bauxite to high grade, alumina- rich ore.

In Jamnagar district, workable deposits occur in 14 villages, viz. Bankodi, Bhatia, Bhopalka, Habardi, kennedy, Khakhard, Lol, Mahadevia, Mewasa, Mota-Asota, Nandana, Purdhara, Ran and Virpur. The deposits in Mewasa and Virpur not only contain about 67 percent of the total reserves estimated for the lease-hold areas but contain material of good grade as well. The Mahadevia deposit is next to importance.

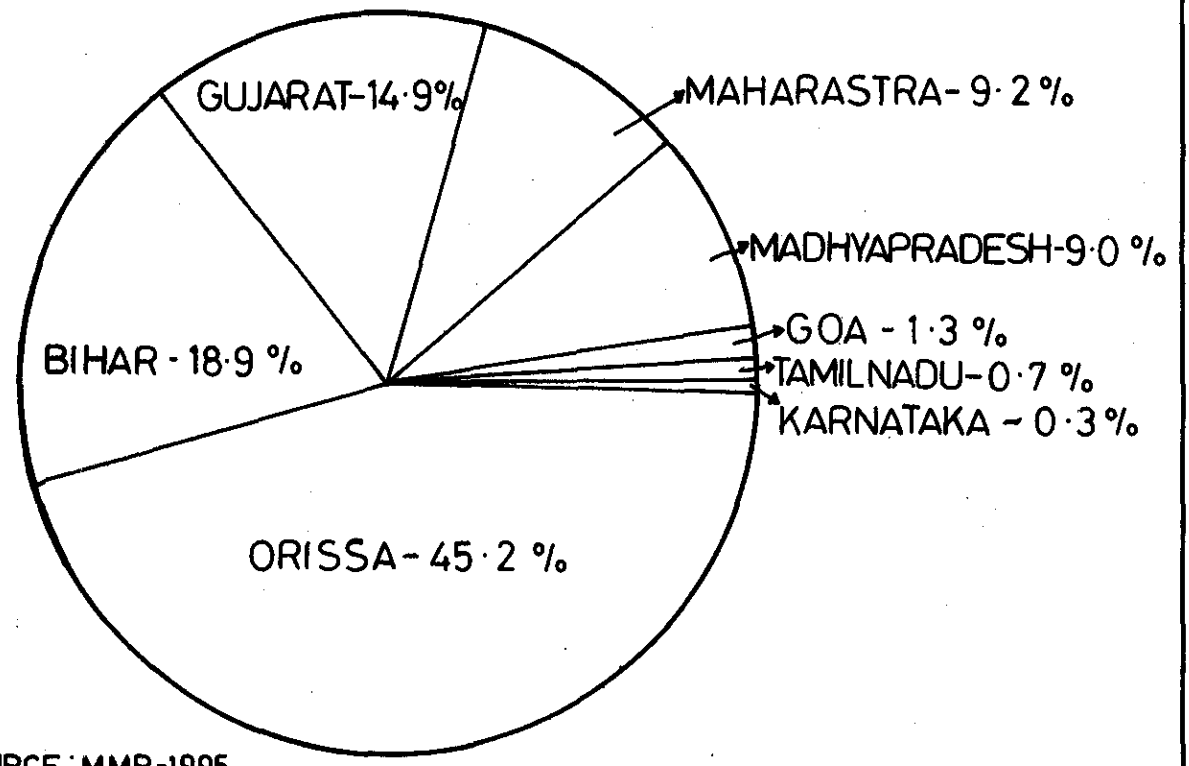
BAUXITE PRODUCTION TREND IN GUJARAT STATE

SCALE :- 1 CM = 1 LAKH M.T.



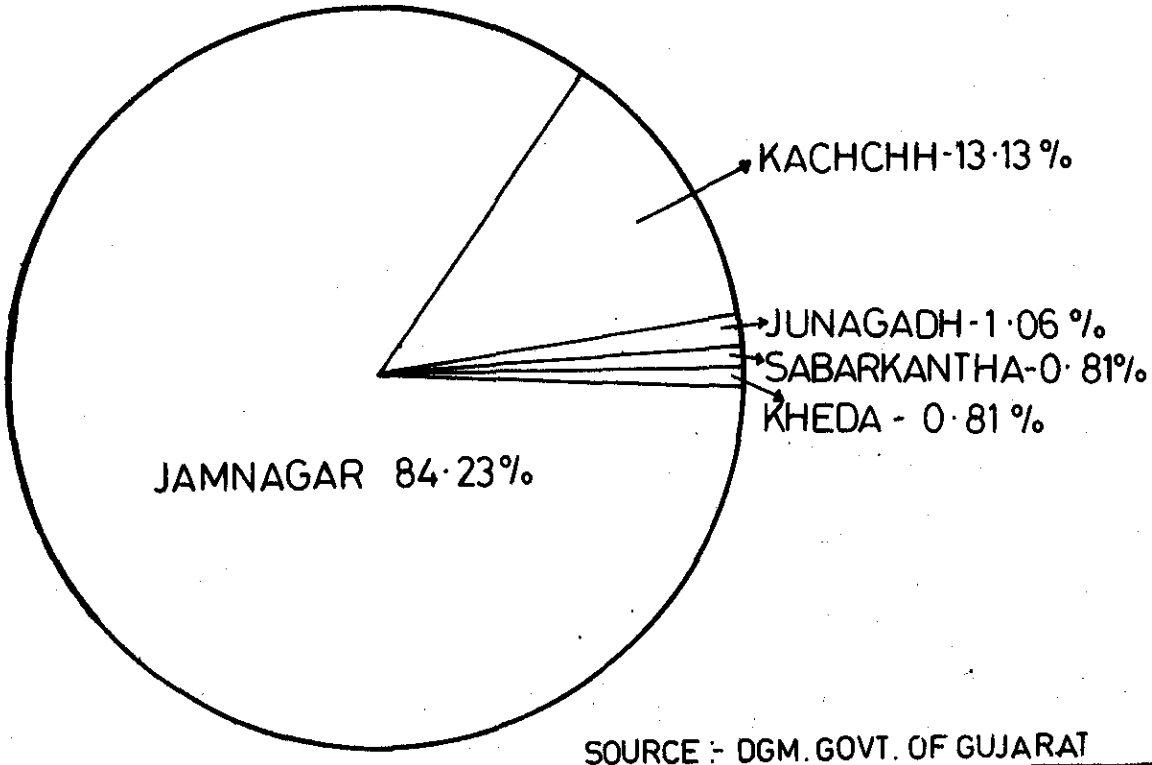
SOURCE :- DGM. GOVT. OF GUJARAT.

STATE WISE PRODUCTION OF BAUXITE IN THE COUNTRY



SOURCE : MMR-1995

DISTRICT WISE PRODUCTION OF BAUXITE IN GUJARAT STATE



SOURCE :- DGM. GOVT. OF GUJARAT

3.0 SPECIFICATION & PRICE REALISATION

3.1 Bauxite can be used in different industries. To manufacture desired end product it is essential to utilise specified raw bauxite. If any deviation in the quality of ore fed to plant vis- a-vis the specification required, then technical and economic problems crop up in plant operation. For the quality product, it is advisable to adhere necessary specifications.

The alumina content alongwith other deterious constituents of bauxite determines its intrinsic value for obtaining the aluminium metal since they affect the possible recovery of alumina in the bayer's process and the cost of production.

The U.S National Stockpile specifications for metal grade bauxite for alumina production are given in Table 3.1.1 for both trihydrate ore as well a mixture of monohydrate and trihydrate ore.

Table 3.1.1 *Specifications of Bauxite for the Production of Aluminium (USA)*

Constituent		Percentage by weight (dry basis)	
		Trihydrate Ore	Mixed monohydrate & trihydrate Ore
Alumina (Al_2O_3)	Min.	55.0	47.0
Silica (SiO_2)	Max.	5.0	4.0
Total alkalies(as oxide)	Max.	1.0	1.0
Ferrous Oxide (FeO)	Max.	3.0	3.0
Phosphorus Oxide(P_2O_5)	Max.	1.0	1.0
Manganese, Chromium & Vanadium Oxides ($MnO_2 + Cr_2O_3 + V_2O_5$)	Max.	2.0	2.0
Loss on ignition	Min.	50% of actual Al_2O_3	40% of actual Al_2O_3

It may be observed that the modules (alumina: silica) in the case of trihydrate ore is 11 whereas it is 11.75 for a mixture of trihydrate and monohydrate ores. Since the specifications given in the Table 3.1.1 are on dry basis, analysis should be made after heating the samples to 105 ^{o}C that only free water is removed while the chemically combined one is still retained. Depending upon the alumina and total silica content, the Indian Standards Institution has specified 3 grades of bauxite for use in alumina production which are given in Table 3.1.2 Test samples are taken according to IS 199: 1962, and the chemical composition is determined, in accordance with IS: 2000 - 1962 after drying at 105 + 2 ^{o}C.

Table 3.1.2 *Classification of Bauxite according to Indian Standard Specifications*

Constituent		Percentage by weight		
		Grade I	GradeII	Grade III
Total alumina	min.	51	48	44
Total silica	max.	3.5	5	5
P_2O_5	max.	0.20	0.20	0.20
V_2O_5	max.	0.20	0.20	0.20
$Fe_2O_3 + TiO_2$	max.	30	30	30
Loss on ignition at 1100 $_oC$	min.	20	20	20

3.2 Chemical Uses

As per the U.S Stockpile specifications, alumina should be as high as possible in bauxite used in chemical manufacture. The trihydrate variety is preferred to monohydrate since the latter consumes more of acids in which they are partially soluble.

The acid soluble iron oxide should be as low as possible. Iron causes settling difficulties. It is also difficult to remove once it is in solution. Dry bauxite used for making aluminium sulphate should not have Fe_2O_3 more than 2.25 percent. In practice, however, the major manufactures use ore containing one percent of Fe_2O_3, in the USA.

Insoluble silica exceeding 10 percent cannot be tolerated because it causes settling difficulties. Its presence also results in poor filtering and retards chemical reactions. The resultant residue creates handling problems and also reduces the effective plant capacity.

The Indian Standard Specifications for bauxite in chemical and petroleum industries are given in Table 3.2.1.

Table 3.2.1 *Specifications for Bauxite for use in Chemical and Petroleum Industries (IS:3605-1966)*

Constituent		Percentage by weight
Loss on ignition	max.	32.0
Silica	max.	3.0
Alumina	min.	58.0
Iron oxide (Fe_2O_3)	max.	2.0
Titania (TiO_2)	max.	4.0
Phosphorus pentoxide	max.	0.3
Manganese Oxide	max.	0.1
Calcium and Magnesium as Oxides	max.	2.0

From Table 3.2.1 it may be seen that the alumina requirement of the ore is as high as 58 percent, the other constituents such as SiO_2, Fe_2O_3 and TiO_2 being small. In fact, the U.S Stockpile specifications also recommend a high alumina trihydrate for use as an absorbent in petroleum refining. The reason for using only trihydrate is that its absorptive capacity is 3 to 4 times more than that of monohydrates. For practical reasons, hard, gravelly and pisolitic ore is selected since it does not disintegrate and pack in the absorbing towers.

3.3 Refractory Use

The specifications for bauxite as stipulated for the National Stockpile for use in the refractory industry are given in Table 3.3.1. Apart from the details of the constituents and their proportions by weight given in Table 3.3.1, magnesia, lime, potash and soda content, together should not exceed one percent. Their quantities in excess of this lower the fusion temperature of the refractory products. All impurities except silica present in excess cause deformation and warping in the refractory products. Uniform shrinkage also results during burning.

Table 3.3.1 *Specifications for Bauxite for Refractory Industry*

Constituent		Percentage by weight (Calcined basis)
Alumina (Al_2O_3)	min.	85.00
Silica (SiO_2)	max.	7.00
Irorn oxides (Fe_2O_3)	max.	3.75
Titania (Tio_2)	max.	3.75
Loss on ignition	max.	0.50

Specifications for bauxite for the manufacture of firebricks are given in Table 3.3.2 on dry as well as calcined basis. Here, the iron content is most important since excessive iron warps the bricks produced. If the total of lime, alkalies and magnesia exceeds one percent, fusion results in a much lower temperature of 1650 ^{o}C. This is extremely injurious to the quality of bricks produced.

Specifications for fused refractory products on clacined basis are shown in Table 3.3.3. Excess of silica lowers the fluidity of the liquid during production. It also causes cracks during the casting of products. Excess of iron compounds is also known to result in similar defects in addition to the change of colour of the products. Similarly, the titania content in excess results in variation of colour and may cause blisters on the product. Too much of titania may even cause breakage of the items produced. The specifications for bauxite for use in refractory industry as laid down by the Indian Refractory Manufacturers Association are slightly different from those of the U.S. Stockpile. According to the former specifications, a minimum of 58 percent of alumina is required.

The maximum permissible percentage of Fe_2O_3 and TiO_2 is 3.0 and 3.5 percent by weight respectively. Lumps of 75 mm size are preferable.

Table 3.3.2 *Specifications for Bauxite for Firebricks Manufacture*

Constituent	Percentage by weight	
	Calcined basis	Dry basis
Alumina (Al_2O_3)	87.00(min.)	59.4 to 61
Silica (SiO_2)	6.00(max.)	1.5 to 5.5
Irorn oxides (Fe_2O_3)	2.75(max.)	0.5 to 2.00
Titania (Tio_2)	3.75(max.)	1.7 to 2.6
Loss on ignition	0.75(max.)	31 to 32
Bulk density	3.1	-

Table 3.3.3 *Specifications for Bauxite for Fused Refractory*

Constituent		Percentage by weight (Calcined basis)
Alumina (Al_2O_3)	min.	80.0
Silica (SiO_2)	-	5.0 to 8.0
Irorn oxides (Fe_2O_3)	max.	2.0
Titania (Tio_2)	max.	5.0
Loss on ignition	max.	1.0

3.4 Abrasive Industry

Bauxite of both monohydrate and trihydrate varieties is used for abrasive making. The U.S Stockpile specifications are shown in Table 3.4.1. Silica is regarded as the most important impurity since its presence in excess affects the overall efficiency of the abrasive making operation. It is the chief power and carbon consuming constituent and also causes erratic furnace operations and poor control of the chemical reactions involved. Silica also forms ferrosilicon alloy with iron, which is non-magnetic and cannot be separated magnetically from the product.

Iron in bauxite is the least undesired impurity since it reduces to a metallic state from the oxides during the process and can be magnetically separated from the finished products. Its upper limit of 7 percent has been stipulated mainly to minimise power consumption.

Titania is a desirable constituent in the bauxite meant for abrasive making. Its presence helps in imparting toughness to the product and helps in getting sharp points in the crystalline products produced. The presence of excess of lime and magnesia results in a

reduction of the crystal sizes of the abrasives. Organic material has no significant consequence on the process or the product.

Calcined bauxite of hard variety should be granular and pass through 60 mesh and 3 percent through 100 mesh. The desired bulk density varies from 1.260 to 1.560 gm/cc.

Table 3.4.1 *Specifications for Bauxite for Abrasive*

Constituent		Percentage by weight (Calcined basis)
Al_2O_3	min.	80.00
SiO_2	max.	7.00
Cao	max.	0.4
MgO	max.	0.4
Total alkalies(as oxides)	max.	0.7
Fe_2O_3	max.	8.0
P_2O_5	max.	0.5
$MnO_2 + Cr_2O_3 + V_2O_5$	max.	1.0
Tio_2	min.	3.5

3.5 Use in Cement Making

Bauxite of very widely ranging quality over a very wide range can be used in the cement making industry. This is evident from Table 3.5.1. Thus, as such, there are no specifications for the use of this ore in the cement making industry. Excess of silica results in cement of doubtful quality since it affects the settling property by forming a coating on the clinker.

Table 3.5.1 *Quality of Bauxite for use in Cement Making Industry*

Constituent	Percentage by weight
Alumina	30 to 70
Lime	25 to 45
Iron Oxide	5 to 20
Titania	2
Silica	6

Cement produced with more than 70 percent of alumina and less than one percent of silica and iron oxide has a higher melting point as compared to other cements. When this cement is mixed with the refractory grade bauxite, the cement produced possesses properties of quick hardening. It can also withstand a temperature upto 1800 ^{0}C.

3.6 Price Realisation

3.6.1 Raw bauxite price depends on the presence of alumina content and impurities. Silica and Iron Oxide are deciding factor for the impurities, while alumina percentage existance will grade the ore for the industrial utility. The price of the raw bauxite depends on the source of supply availability and quantity purchased. State bauxite mining centers prices with Al_2O_3 percentage in the Jamnagar, Kachchh, Sabarkantha, Kaira districts are settled between the supplier and customer. The details are given in Table 3.6.1. The price of Calcined bauxite is much more than that of crude bauxite. The prices of calcined bauxite from Jamnagar and Ahmedabad is summarized and given in Table 3.6.2.

Table 3.6.1 *Price tariff of Raw Baixite in Gujarat* (as on 1/8/96)

Company	High Grade	Medium Grade	Low Grade
G.M.D.C. Ahmedabad	Al_2O_3 58-60% Fe_2O_3 Max.2-4% CaO 1-2% -Rs.225+taxes/MT	Al_2O_3 53% & above -Rs.130+taxes/MT	Al_2O_3 50-52% -Rs.100/MT
	High Grade Spl. Al_2O_3 58-60% Fe_2O_3 Max.2-4% CaO 1-2% -Rs.350+taxes/MT		
	Screended dust at Gadhsisha Calcination Plant -Rs.150+taxes/MT		
	Unscreended dust at Gadhsisha Calcination Plant -Rs.75+taxes/MT		
Bombay Minerals Limited Jamnagar	Al_2O_3 57-60% -Rs.375 to 400/MT	-	Al_2O_3 46-50% -Rs.100/MT
Saurashtra Calcined Bauxite & Allied Inds. Ltd Porbandar	Al_2O_3 58-60% -Rs.450 to 475/MT	Al_2O_3 58-60% -Rs.325 to 350/MT	Al_2O_3 50-54% - Rs.95 to 105/MT
Prabhudas Vithaldas Porbandar	Al_2O_3 58-60% Fe_2O_3 3-4% CaO 2-3% -Rs.350+taxes/MT	Al_2O_3 58-60% Fe_2O_3 4-6% CaO 2-3% Rs.150+taxes/MT	Al_2O_3 58-60% Fe_2O_3 8-12% CaO 2-3% Rs.110+taxes/MT

Source: GMDC, Bombay Minerals, Saurashtra Calcined Bauxite & Allied Inds. Ltd., Prabhudas Vithaldas.

Table 3.6.2 *Calcined Baixite Average Price in Gujarat*

Sr. No.	Mining Centers	Price (In Rs.)	District
1.	GIDC, Porbandar	1200/- (Drawn draft product)	Junagadh
2.	Bhatia +	1800/- (Rotary kiln product)	Jamnagar
3.	Okha *	1800/- (-do-)	Jamnagar
4.	Jamkhambhaliya #	1800/- (-do-)	Jamnagar

Source: + Saurashtra Calcine Bauxite & Allied Industries Ltd
Galaxy, Ground Floor, PB No.55, Porbandar-360 575
Tel. No.23223, Fax: 41370

* Carborundum Universal Ltd, PO Box No.2
Port Okha-361 350

Bombay Mineral Supply Co, Vazir Falia, Jamnagar

3.6.2 Calcined bauxite is manufactured by two ways either by downdraft or rotary kiln. Product of the rotary kiln is better as contamination will be less. Rotary products are more preferred.

3.6.3 Low grade bauxite lying at captive mines of Carborandum, Orient, Natraj. Bombay Minerals Pvt Ltd., Saurashtra Calcine & Allied Industries Ltd. needs attention for utilization. Refractory & Abrasive factories located in the state need calcined bauxite. Refractory grade bauxite is depleted so it is advisable to adopt the process technology for upgradation of lowgrade bauxite for refractory industry. iNDEXTb with financial support of G.M.D.C has sponsered project of "Evolution of low grade bauxite refractory & Abrasive application" to Jawarharlal Nehru Aluminium Research Development Design centre Nagpur. The project aim is to evoluate viable benefication process for the upgradation.

4.0 BAUXITE LEASING AND STATE POLICY

4.1 The mines and minerals (Regulation & Development) Amended upto 25 Jan 1994 has declared bauxite as a first schedule specified mineral, with a royalty rate @ Rs. 34 per tonne. No prospecting or mining lease shall be granted without previous approval of Central Govt.

4.2 For acquisition of a mining lease, applicant has to first obtain a prospecting licence. If the area is prospected by any Government agencies, then he has to enclose a certificate for the area prospected from the Head of the Organization, with the mining lease application of the area applied, and mining plan duly approved by the central Govt for the development of mineral deposits in the area concerned.

4.3 For filing lease application, applicant has to enclose following documents alongwith the application:

a) Application Form (E) in triplicate.

b) Challan of Rs. 500/- fee which is to be deposited in Government treasury Head in 128, Mines & Mineral concession fees and Royalty receipt under .C.R. 1960.

c) Three copies of current year income-tax clearance certificate.

d) The map indicating the area applied with reference to fix point in triplicate.

e) Affidavit regarding no mining lease or prospecting licence in the state or true copy of No Mining Dues Certificate if applicant is a mining lease holder in the State.

f) Deposit of Rs. 1000/- challan three copies in the Head of 843, Civil Deposit Revenue Deposit.

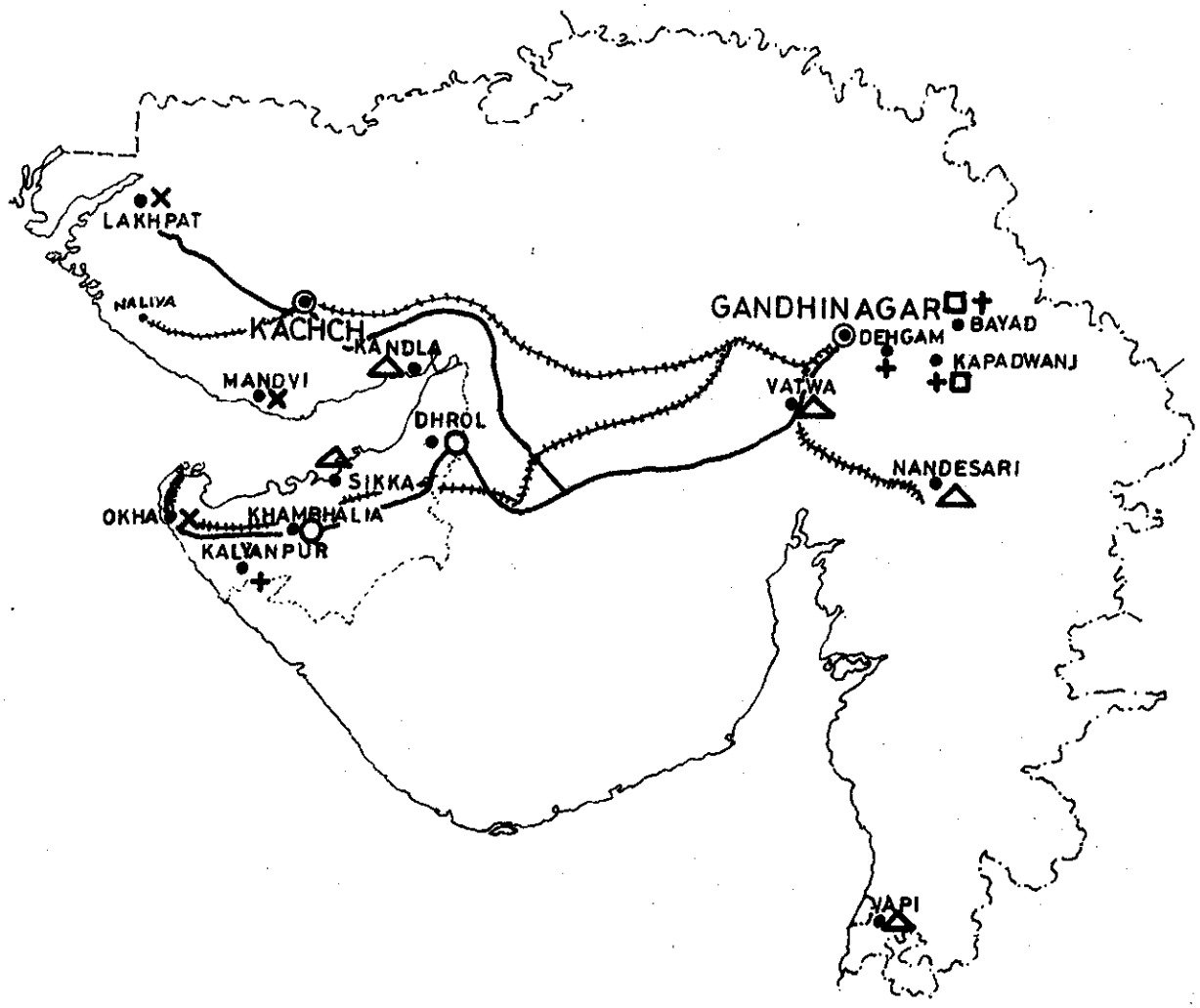
4.4 **Mining Lease Policy**

Government of Gujarat as per recommendation of G.S.I., Government of India, reserved whole district of Kutch and nine villages of Kalyanpur taluka in Jamnagar district for exploitation of bauxite in public sector, by Government notification of health and Industries Department No. MNL-1760/75600-GII dated 31-12-1963. The nine villages are: Ran, Habardi, Mewasa, Nandana, Mahadevia, Lamba, Bankodi, Bhatia, Mota Asota.

Subsequently, by another notification of Health and Industries Department No. MNL-1760/3788 G.V. dated 26-12-1964, Government of Gujarat reserved all areas of Jamnagar and Junagadh districts for exploitation of bauxite in the public sector.

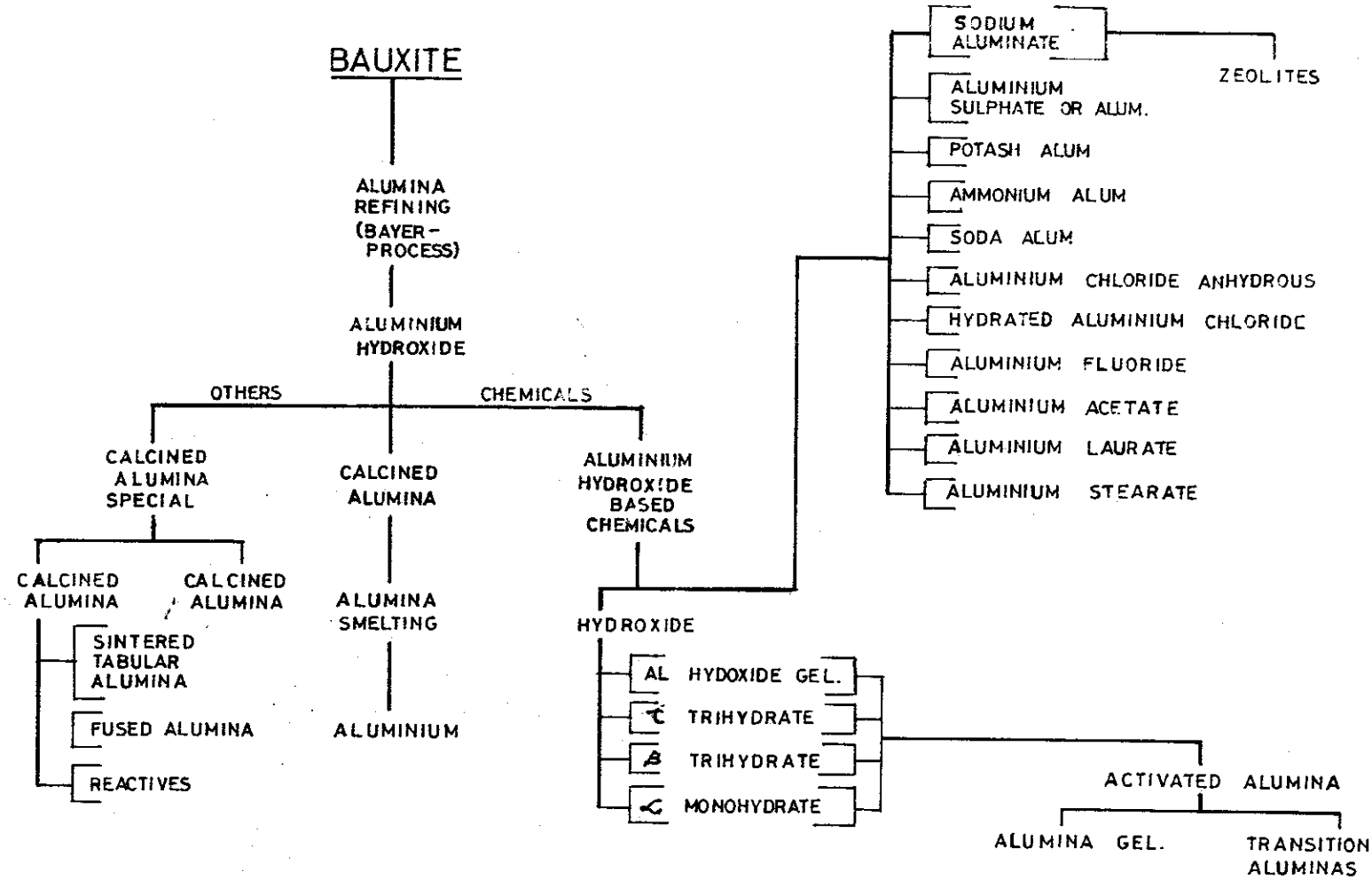
4.5 Industries, Mines & Energy Department vide their Notification No. GU/78-90-MCR-2177(119-1029 (i) Chh dated 2-8-1978 dereserved the bauxite deposits of Junagadh district completely and whole Jamnagar district except the villages of Ran, habardi, Mewasa, Nandana, Mahadevia, Lamba, bankodi, Bhatia, Mota Asota, Later on with the concurrence of Government of India the above mentioned nine villages of Kalyanpur taluka of Jamnagar district are dereserved by IMED Notification No. GU/80/12/MOR-2177 (119)-GOI Chh dated 5-2-1980 for public, subject to condition that leases have to establish bauxite based value added industries such as refractories, abrasive. Captive mining leases for calcination or for setting up of emery grain industry are not being sanctioned. Many leases have set up such industries, but their grievances are that not all the bauxite mined by them are of suitable quality for use in their industry. They claimed that hardly 25 percent of useful grade of bauxite mined can be utilised in their plant while 75 percent of bauxite mined are not useful and are dumped at the site.

PROBABLE LOCATIONS FOR BAUXITE BASED PROJECTS



- × HIGH ALUMINABRICK PROJECTS
- ⊙ ABRASIVE PROJECTS
- ◉ DISTRICT POINT
- \+ CALCINATION PROJECTS
- RAILWAY LINE
- △ ALUMINA CHEMICALS
- NATIONAL HIGHWAY
- □ EMERY GRAIN

INDUSTRIAL APPLICATIONS OF BAUXITE



Apart from increasing their cost of production, this is also against the conservation of mineral resources and if this bauxite is not utilised either by export or for other internal industries, it will continue to lie there without any economic return to the party or social benefit to the nation, apart from revenue loss to the State Government (Royalty + M.R.T). Government has considered their representation, in 1984, and permitted sale of 10 percent of bauxite mined to any other lease- holder in Gujarat in exchange of his bauxite, which could be useful to any other industry in the State. However, even then they have continued to make representations that this 10 percent is too less as low grade bauxite mined is in high ratio than high grade bauxite. Hence, Government took a liberal one-time decision on 4-12-1985 that 40 percent of total bauxite mined from inception of the plant till 4-12-1985 will be permitted to be exported. This decision was further extended upto 1988 in view of liberal export policy of Government of India for the years 1985-1988 permitting export of all grades of bauxite.

In December 1988, Government again took a decision to permit all the stock of non-plant grade bauxite as on 31-3-1988 to be exported by 30--6-1989. This has eased the situation. The liberal export policy of Government of India is extended upto 31-3-1991. In the recent export policy, low grade bauxite of western coast is allowed to be exported and it is decanalised. Few private parties e.g. Gujarat Bauxite Pvt Ltd, Saurashtra Calcine & Allied Industries exported low grade bauxite to south asian countries in the year 1992-93 amounting Rs. 5 crore.

4.6 As far as quality of bauxite is concerned, Kutch and Jamnagar are the two districts where high grade bauxite is available.

Presently in Jamnagar district no patch of high grade bauxite is available either in Government waste land or in private land. The reserves of high grade bauxite available has depleted very fast and hardly 1.5 million tonnes of bauxite is remaining in the leased area already leased out. Good grade bauxite exists in agricultural fields adjoining to laterite mounds. Applicants of bauxite mines are compelled to purchase private agricultural fields in the Jamnagar District. Farmers after knowing the value, demands premium for the land sale.

As far as Kutch district is concerned, the total reserves of all grade of bauxite are 42 million tonnes. Out of this, high grade reserves are of the order of 6 to 3 million tonnes. Kutch is reserved for public sector undertaking with few exceptions. Reservation was done with a view that Gujarat Mineral Development Corporation may put up an alumina plant based on bauxite of Kutch. After scrutinity of techno feasibility study reports from reputed consultants for its viability, G.M.D.C & G.A.C.L has now signed MOU with M/s. Rayathon Engineers, USA for establishment of 60,000 per annum alumina project involving Rs. 1500 crore investment. Pre-feasibility report is under scrutinity of experts for its viability.

5.0 STATUS OF BAUXITE BASED INDUSTRIES IN GUJARAT

5.1 Bauxite mining in Jamnagar has attracted Emery manufacturers to establish their units in Hapa in Jamnagar area. Alum units are also flourished in Nadiad, Anand towns of the Kheda district. At present there is a decline in the Emergy and Alum market.

Organized sector has entered in the abrasive and refractory industries and they have put calcination and refractory plants at Okha, Porbandar, Jamnagar, Khambhalaya, Kadi, Sanand, etc. places. Organized sector industries are tabulated in Table 5.1.1.

Table 5.1.1 *Organised Sector Bauxite based Units in Gujarat*

Sr. No.	Name of the Unit	Location	Product	Plant & Capacity
1.	Carborandum Universal Ltd	Okha Jamnagar	Calcined bauxite	75 tonnes/day
2.	Natraj Ceramic & Chem. PO Jamkhabhaliya Dist. Jamnagar	Khambalaya Jamnagar	High alumina refractory & monoliths	3000 tonnes/day
3.	Orient Abrasives Ltd GIDC, Porbandar	Porbandar Junagadh	Calcined bauxite & abrasive grains	7006 tonnes/day
4.	Interkilan Ceramic P.Ltd	Kadi Ahmedabad	High alumina refractory	2000 tonnes/day
5.	Gujarat Refractory Shilp Bldg; 8th Floor Ahmedabad-380 009	Sanand Ahmedabad	High alumina refractory	1500 tonnes/day
6.	Saurashtra Calcined Bauxite Ltd	GIDC Porbandar & Bhatia Jamnagar	Calcined bauxite -do-	100 tonnes/day
7.	Bombay Mineral P.Ltd Vazir Falia Jamnagar	1. Hapa Jamnagar 2. Jamkham-bhaliya	Calcined Bauxite	200 tonnes/day
8.	Special Refractory GIDC, Vatva Ahmedabad	Vatva Ahmedabad	High alumina refractory	2000 tonnes/day
9.	VRW Refractories GIDC, Kerala, Dholka Dist. Ahmedabad-382 220	GIDC Kerala	High alumina refractory	3000 tonnes/day
10.	Madhu Refractories Ltd NH-8A, Morbi	Dhuva Morbi	High alumina refractories	500 TPM
11.	Cut Fast Abrasive Tools Ltd Dhrol, Jamnagar	Dhrol Jamnagar	Brown & white abrasive grains	

In addition to above, few private sector parties are operating calcination unit in the SSI sector.

Gujarat Mineral Development Corporation has established for 50,000 tonnes per annum calcination plant at Ghadhsisa in Mandvi taluka Kachchh district with an investment of Rs. 8 crore and 25 lakhs. Gujarat Bauxite Pvt Ltd is also planning calcination of 60 tonnes with an investment of Rs. 4 crores at Sanand. Bombay Mineral Supply Co. has established calcination plant near Jamkhambhalaya with 200 tonnes per day capacity plant. Saurashtra calcine & Allied Industries Ltd, Porbandar is also establishing rotary kiln at Bhatia for 36,000 + PA calcination purpose. The production of bauxite during last 3 years in Gujarat is given in Table 5.1.2.

Table 5.1.2 *Production of Bauxite in Gujarat*

Year	Production (in tonnes)
1992-93	1,14,568
1993-94	1,13,081
1994-95	75,363

In abrasive sector, Carborandum Universal Ltd has established an abrasive grain unit at Varwala in Dwarka taluka of Jammnagar district. "Cut Fast" is also operating white and brown abrasive grain factory at Dhrol in Jamnagar district.

Emery units are also in operation at GIDC Mehsana and Vijapur in Mehsana district. One SSI unit is also in pipe-line for emery at Kapadwanj in Kheda district.

Kachchh bauxite reservation is coming in the way of speedy establishment of bauxite based industries.

Government intends to reconsider its decision and desires to liberalise its policy so that bauxite based industries can come up in the backward district of Kachchh and Jamnagar. Non metallurgical route small scale value added aluminium chemicals units are encouraged in the Wagara, Jhagadia, in Bharuch District & Pipar in Dholka taluka of Ahmedabad District.

6.0 EXPORT POTENTIALITY

6.1 New Export Policy has allowed western coast low grade bauxite export. Considering the present Indian fiscal constraints, it is more viable to export low grade raw bauxite initial stage, as huge unutilized low grade bauxite are lying at Saurashtra and Kachchh mines. Non-plant grade bauxite lying at captive mines pits of Carborandum Universal Ltd, Orient Abrasive Ltd. Nataraj Ceramic Chemical Industry Ltd. needs attention for utility.

Mineral & Metal Trading Corporation has offered to invest Rs. 6 crore in the development of extra berth at Porbandar Port for the export of bauxite to the Middle East which is major buyer. It has agreed to invest only if the Government allows canalised exports of bauxite for four or five years. it is learnt that if the mineral gets decanalised before the investment is recovered, the port will have to sell out the money from the profits it would earn out of the export of this mineral. MMTC exports about 400,000 tonnes of bauxite mainly to the Middle East.

6.2 Export markets have been found for the low grade bauxite which has been stockpiled as waste at various mines in Gujarat. MMTC says it has created markets in the Midle East and Scandinavian countries. The Jamnagar lease-holders have already made three shipments. The export of the entire low grade bauxite of about 500,000 tonnes from Kutch and Jamnagar is expected to take a couple of years because of the lack of a developed port along the Saurashtra coast for berthing more than one ship at a time. The Portwise Export of Bauxite from Gujarat is given in Table 6.2.1.

Table 6.2.1 *Export of Bauxite from Gujarat(Portwise)*

(Figures in '000 tonnes)

Year	Okha Port	Porbandar	Total
1991-92	07	178	185
1992-93	36	179	215
1993-94	38	143	181
1994-95	90	66	156
1995-96	126	119	245*

(*upto January 1996)

Source: Gujarat Maritime Board, O-6, New Mental Hospital Compound Meghaninagar, Ahmedabad-380 016

6.3 National Aluminium Company has set itself an ambitious export target of 400,000 tonnes of calcined alumina valued at over Rs. 400 crores. While Pechinery Trading would life 1.75 lakh tonnes of enriched calcined alumina, the USSR would take two lots of 47,250 tonnes and 80,000 tonnes. As for Neeco AG, it would buy 40,000 tonnes during the current year and another 20,000 tonnes. A spot sale of 7,100 tonnes of North Korea is presently under negotiation. A significant achievement for Nalco has been that in its first year of commercial production in 1987-88, the company earned foreign exchange worth Rs. 235 crores by exporting alumina to the USA, USSR, Braxil, Norway, China and

North Korea. In the first six months, Nalco has shipped 260,000 tonnes of alumina netting about Rs. 200 crore.

6.4 In order to achieve self-sufficiency in mineral based metal requirements, it is inferred that increase in export of metals like copper and lead through foreign exchange. The resources being a constraint for massive expansion of the production capacity of mineral based metals in the country. It is advisable that Government should go in for two or three massive aluminium plants on product sharing basis like Kudremukh iron ore project with foreign collaborators.

6.5 In the public sector NALCO has reported alumina exports of 77,000 tonnes in 1987-88 which increased to 384,000 tonnes in 1988-89, to 449,000 tonnes in 1989-90, while aluminium metal exports increased from 15,000 tonnes in 1989 to 27,000 tonnes in 1989-90. In the private sector, INDAL has reported alumina exports of 74,000 tonnes in 1987-88 which increased 77,000 tonnes in 1988-89 but 1989-90 results show a fall of 61,000 tonnes. MALCO has reported alumina export of 9,000 tonnes in 1989-90.

6.6 MMTC envisaged to increase bauxite export in the coming 5 years. 10 fold increase in the export is projected in the Table 6.6.1.

MMTC has drawn a corporate plan for the export possibility of raw bauxite.

Table 6.6.1 *Projected Exports of Bauxite (canalised item)*

Year	Export (Rs.in crore)
1991-92	11
1992-93	14
1993-94	57
1994-95	93

6.7 NALCO earned foreign exchange worth Rs, 235 crore through export of alumina and aluminium metal after its commercial production.

6.8 The Industrial Promotion and Investment Corporation of Orissa Ltd is reported to have commissioned a pre-feasibility study by MECON for setting up a 5 lakh capacity alumina refinery in Korapur district. nalco has already commissioned its 2.4 million tonnes bauxite mine and 8 lakh tonnes refinery. While Nalco's deposits are on the Panchpatmali Hills near Damnajodi, the proposed 100% export-oriented project is likely to be based on the deposits of Kodingamale (91.4 million tonnes reserve), and/or Bafalimali (195 MT) and Sasbahumali (80 MT). Kodingamali has been chosen because the Kerput-Rayagada rail link. Preliminary discussions have also been held with international firms like Pechinery of France and VAW of West Germany on the possibility of technical know-how and finance linked with buy-back arrangements for the proposed complex expected to cost Rs. 400/500 crore.

6.9 Nalco flagged-off a ship of 25,000 tonnes of alumina from Vizag port on October 1990. It, thus, completed export of 260,000 tonnes of alumina in the first six months. With an annual export capacity of 375,000 tonnes of alumina, Nalco had exported 384,000 tonnes of alumina during the last financial year. The company has ambitious plans to improve

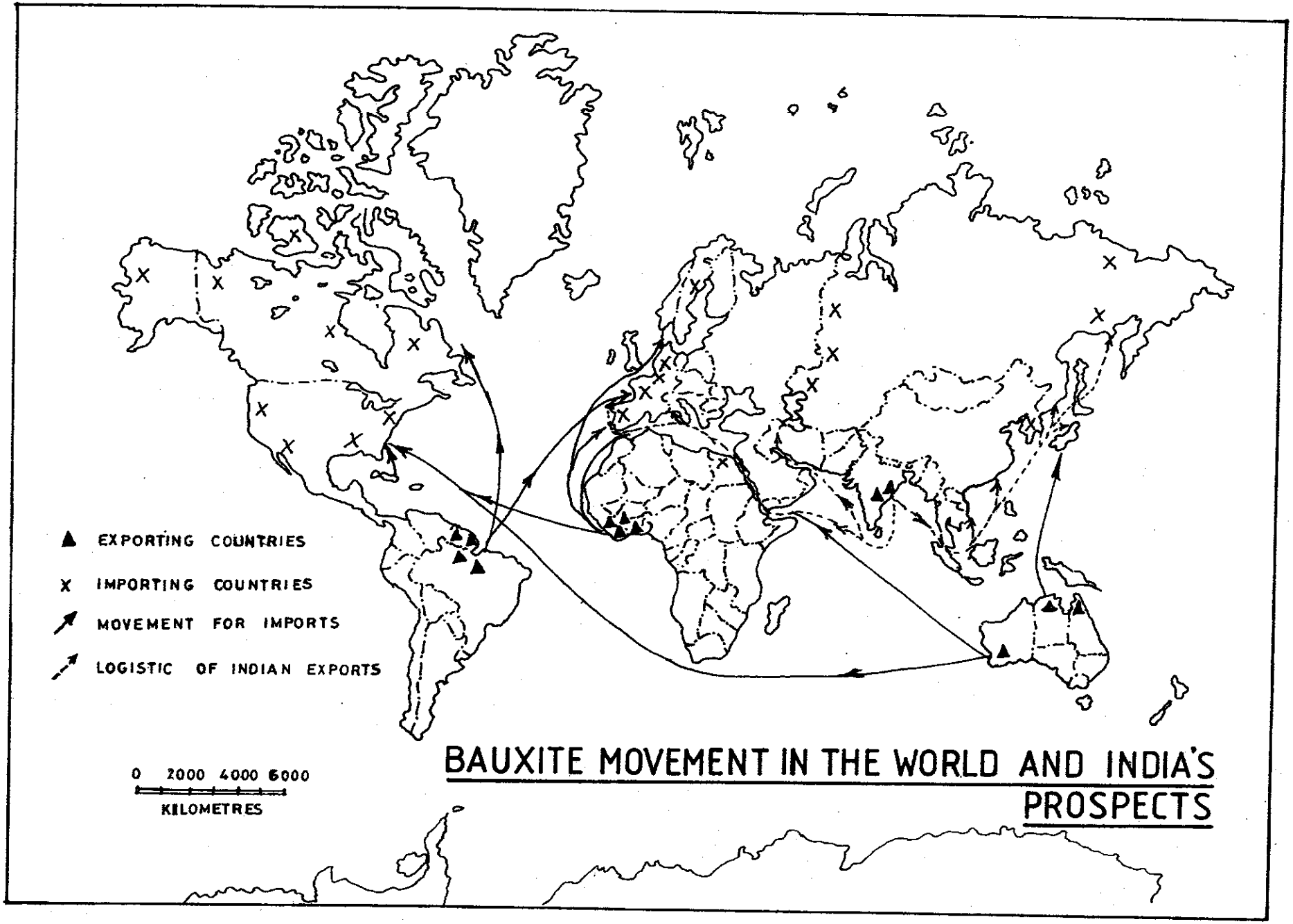
upon its earlier performance in the current financial year and export over 400,000 tonnes of alumina. Inspite of relatively depressed aluminium prices in the international market, Nalco has also been able to export 9,700 tonnes of high quality aluminium metal.

The foreign exchange earnings of the company in the first half of the current financial year has already crossed Rs. 200 crore, the release said. It also expects to double the export of aluminium metal to 30,000 tonnes in the current financial year as compared to 15,000 tonnes last year. With its current targets, Nalco expects to earn more than Rs. 350 crore in exports this year as compared to Rs. 235 crore last year.

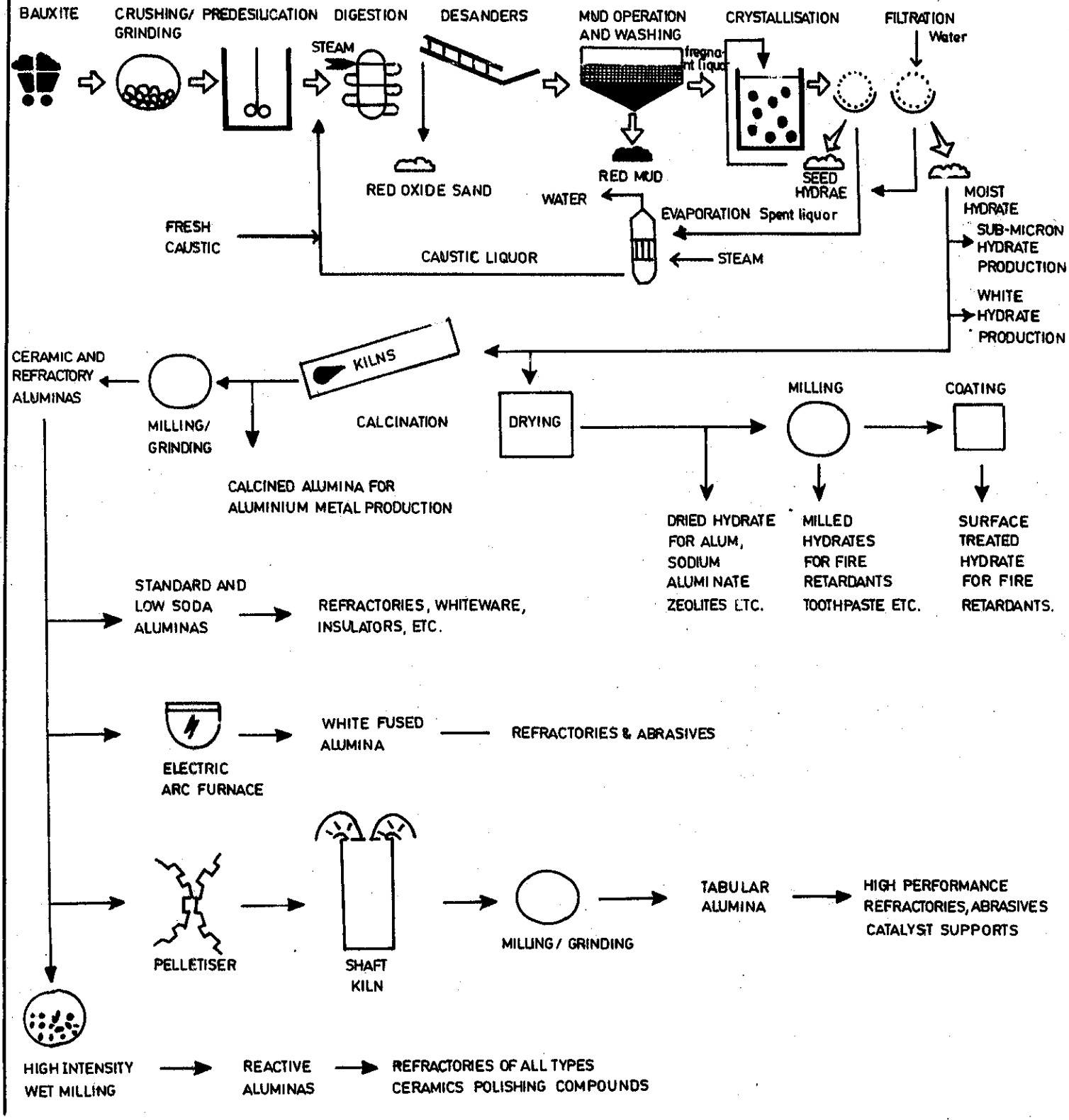
6.10 Export of alumina have shown substantial increase both in terms of quantity and value in the financial year 1990-91. There was a rise of 115% in value and 24% in quantity over April- September 1988. In April-September 1989, 2.20 lakh tonnes of alumina were shipped valued at Rs. 139 crore. In the same month last year, 104,000 tonnes were exported, the value being around Rs. 65 crore. The substantial increase in exports of alumina was mainly due to its higher prices in the international market. In 1989-90, the export earnings from alumina are projected at Rs. 300 crore compared to Rs. 200 crore in 1988-89. The quantity exported in current year may, however, be around last year's level of 440,000 tonnes.

6.11 Export for High alumina refractory & monoliths in South Asian countries through Kandla port is bright.

6.12 To increase the export of low grade bauxite to South Asian countries, it is advisable to increase the handling and berthing facilities to accommodate the ships. Gujarat Maritime Board may involve private participation in building the jetty and handling cranes for mineral bulk loading.


EXPORTING COUNTRIES
IMPORTING COUNTRIES
MOVEMENT FOR IMPORTS
LOGISTIC OF INDIAN EXPORTS
0 2000 4000 6000
KILOMETRES
BAUXITE MOVEMENT IN THE WORLD AND INDIA'S PROSPECTS

PRODUCTION FLOWSHEET FOR NON-METALLURGY ALUMINAS



7.0 TECHNOLOGY

7.1 Bauxitization is followed by the laterization of the parent rock. In case of Gujarat bauxite of Saurashtra and Kachchh parent rock is Bassalt. In case of bauxite mining heterogenous ore is generated. Selective mining is supplemented by hand sorting whereby ferruginous, silicioues impurities like laterite, quartz, are separeted from bauxite with the help of megascopic characteristics like colour, texture, sp. gravity, etc.

7.2 High and medium grade bauxite are hand sorted. Low grade below 45% Al_2O_3, 15% Fe_2O_3, 10-15% silica, 4.5% TiO_2, 4% CaO are dumped as low grade. Low grade bauxite lying as a huge heaps in Bhatia, Mewasa, Mahadevia. Bauxite mining centre needs attention for the utilisation.

7.3 iNDEXTb intends to identify the process-technology for the upgradation of low grade bauxite for refractory and ceramic application. Benefication study by IBM ore-dressing laboratory was carried out for Jamnagar district samples. The results are given in Table 7.3.1.

7.4 The benefication techniques that are employed in the country are not effective in beneficiating marginal or submarginal grade ores in which iron, kaolinitic clay and titanium minerals are finely dispersed in the crystal lattice of bauxite minerals. RRL Bhubaneshwar, the JNRDC, Nagpur, The IBM, Nagpur are engaged in the process-development. RRL, Bhubaneshwar has evolved lab-scale process for the upgradation. iNDEXTb with the help of G.M.D.C has given sponsership project of evolution of process ofr upgradation of low grade bauxite for refractory & Abrasive application to Jawaharlal Nehru Alumina Research & Development Center, Nagpur.

7.5 Know-how for alumina based chemicals are generally in-house developments though certain research laboratories and consultants may be available for specific items. In general technology tie-up with foreign companies would be necessary for manufacturing internationally acceptable quality products. Availing of foreign technology would also help exporting the products which would be necessary for setting up large size units. Certain units have know-how available. Know-how from these organisation is generally available through National Research Development Corp. (NRDC) New Delhi on a non-exclusive basis for lump sum premium and royalty.

Sources are:

1) National Chemical Laboratory, Pune, for Zeolite catalysts.
2) Indian ceramic society, Hyderabad for special grades of alumina used in spark plugs, electronics ceramics and other special applications.
3) National Metallergical laboratory Jamshedpur for Vanadium pentoxide, calcined alumina.
4) Bharat Heavy Electrical Ltd. for special grades of alumina.
5) Central Glass & Ceramics Research Institute, Calcutta, for synthetic high alumina aggregates, high alumina cements, high alumina ceramics.
6) Defence Research Laboratory, Kanpur for red mud based building bricks and sintered flyash aggregates.
7) Central Building Research Institute, Roorke for red mud based building bricks and sintered flyash aggregates.
8) Regional Research Laboratory, Bhubaneshwar for Flyash refractory products.

7.6 Technology evolved by JNRDC, Nagpur for benefication of low grade bauxite involving minimum stages will be made available to bauxite lease holders after receipt of the results from Nagpur.

Table 7.3.1 *Results of Laboratory Investigations carried out by IBM for bauxite benefication in Jamnagar District*

IBM/RI No.	Sample No. & Title of Investigation	Original Assay %	Mineralogy	Wt. (%)	Concentrate Assay %	Recovery% Al_2O_3	Process Adopted
217	Benefication of bauxite ore sample from Hadmatia village, Jamnagar dist.	Al_2O_3 - 55.16 Fe_2O_3 - 2.24 SiO_2 - 7.04 TiO_2 - 2.50 CaO - 0.70 LOI - 30.78 Al_2O_3/ SiO_3 - 8.0	Valuable minerals: gibbsite and cliachite. Gangue: clay, quartz & iron oxides.	94.61	Al_2O_3 - 58.16 Fe_2O_3 - 2.47 SiO_2 - 5.80 Al_2O_3/ SiO_2 - 10.00	95.30	Tumbling
225	Benefication of calcareous bauxite sample from Mewas area Jamnagar dist.	Al_2O_3 - 56.86 Fe_2O_3 - 2.84 SiO_2 (T) - 4.42 TiO_2 - 2.35 CaO / 3.50 LOI - 29.00 Al_2O_3 SiO_3 - 12.90	Valuable minerals: gibbsite. Gangue: calcite	-	Al2O3 - 63.28 CaO - Less than 0.2	Almost 100.00	Acid leaching.

8.0 SCOPE FOR BAUXITE BASED PROJECTS

8.1 The superior grade bauxite of the State is blended with the lower grade for metallurgical, refractory and chemical purposes. No refractory grade bauxite is available in the country except in Gujarat. Refractory units situated in the eastern sector haul raw bauxite from the State of Gujarat. Abrasive unit operated at Madras, Calcutta, Bombay also purchase calcined bauxite from Jamnagar and Porbandar.

State Department of Geology and Mining, Govt. of Gujarat has carried out detailed prospecting and proved 110 million tonnes reserve in the state. On the basis of sizeable reserves there exist a good scope for bauxite based projects in Jamnagar and Kachchh districts.

8.2 Recently, Gujarat Mineral Development Corporation has established calcination plant in Mandvi taluka of Kachchh district for the 50,000 tonnes per annum. Gujarat Bauxite Pvt Ltd is also erecting 60 tonnes per day calcination plant at Sanand involving Rs. 3 crore investment. Saurashtra calcined bauxite and Allied Industries Ltd is also implementing calcined bauxite project of 36,000 MT per annum at Bhatia in Jamnagar district. Bauxite has good demand in the refractory, abrasive sectors. At present 60,000 tonnes calcined bauxite is produced annually in the State. With the increasing demand there exists a scope for the production of calcined bauxite.

Carborandum Universal Ltd has also put up an abrasive unit at Varwala village in Dwarka taluka of Jamnagar district, involving an investment of about Rs 5 crore. In new industrial policy of 1995-200 AD. Power intensive industry is allowed. Employment oriented integrated mineral industry projects are given special incentives. The supply of chemical grade bauxite is mainly fro Saurashtra region. Considering above fact it is beneficial to establish aluminium chemical compounds like Aluminium chloride, Aluminiu hydroxide, Aluminium sulphare, Aluminium fluoride units in the Kalyanpur taluka of Jamnagar district. State has earmarked Jhagadia, Wagara, and Pipar chemical estate. Small Scale aluminium compounds unit can be established in above estates.

8.3 The consumption of bauxite is mostly in aluminium while in cement, refractory, abrasive, chemical, ceramic, ferro-alloy, foundry and oil refinery, it is in a descending order. The consumptions pattern for above industries for the years 1984-1986 is given in the table 8.3.1. Chemical and abrasive units located outside the State consumers considerable quantity of chemical grade bauxite from Gujarat. Alumina compounds units in the state utilising chemical grade bauxite are possible to establish in Jamnagar district. Present alum manufacturing units with little investment can manufacture aluminium chloride, aluminium stearate, aluminium phosphate chemicals.

8.4 Prospecting work in the Sabarkantha, Kaira district has revealed low to medium grade bauxite and 15.43 million tonnes reserve is proved in Sabarkantha district. It is profitable to erect emery and alumina chemicals units in the Dehgam, Bayad and Kapadwanj taluka of Ahmedabad, Sabarkantha and Kheda districts respectively.

Table 8.3.1 *Consumption of Bauxite by Industries*

(in tonnes)

Name of Industry	1987	1988	1989-90
All Industries	**2,132,200**	**3,951,300**	**4,487,000**
Alluminium [1,2]	1,622,007	2,271,100	2,532,400
Alumina (export)	21,100	1,201,100	1,465,700
Refractory	173,833	180,700	188,800
Cement [3]	188,300	174,400	182,100
Abrasives	78,100	71,800	65,600
Chemicals	35,200	34,800	33,800
Iron & Steel	11,084	11,200	12,300
Alloy Steel	100	100	100
Ceramics	1,500	1,800	1,800
Charge Chrome/Ferro Alloys	878	4,200	4,200
Others	200	200	200

1. Consumption of BALCO is for the financial year. 2. Consumption excludes the Bauxite consumed in alumina which is exported. 3. Excludes consumption of laterite which was 392,700, 475,700 and 466,000 tonnes during 1987, 1988 and 1989-90 respectively.

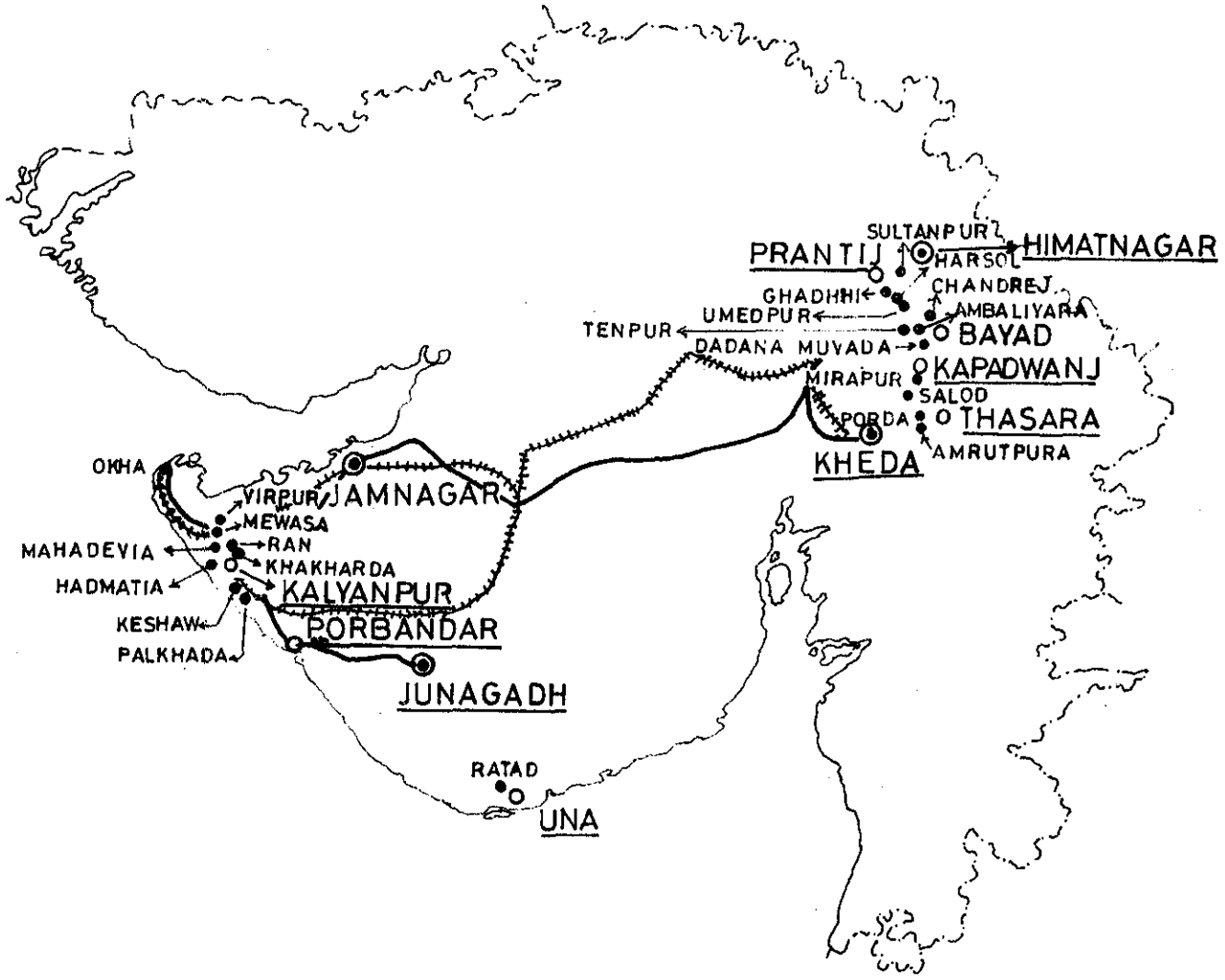
Source: ME Division, IEM, Nagpur.

8.5 Project Profiles

Project profiles on bauxite value added products have been included in the report (as a separate section) for the benefit of prospective entrepreneurs. The important bauxite based items identified include: Absorbant grade activated alumina, Dessicent alumina, Alumina catalysts & catalysts support, Abrasive, refractory & ceramic grade alumina manufacture, Micro fined hydrate, Sandy alumina, Tabular alumina, Activated alumina, Calcined alumina, Alumina chemicals, etc. Project profiles have been included indicating among other things, the technology suppliers and sources of know-how.

With the announcement of new industrial policy of bauxite, potential talukas are covered in the Category I & II where subsidy upto Rs 30 lakhs for the project is available. With the above package of incentives, it is suggested to locate bauxite based units in Kalyanpur, Dwarka talukas of Janagar district. Proposed "Alumina" plant of GMDC & GACL in Kachchh will be able to attract high tech alumina based items in ceramic sector. "Grinding media"; & Alumina linners are the identified items, for the downstream processing of alumina project process technology & know-how sources are generally with independent consultants, and Regional Research Laboratories at Bhubaneshwar, CGCRI Calcutta, National Chemical Laboratory Pune. Indian Ceramic Society, Hyderabad and NML, Jamshedpur.

POTENTIAL AREAS FOR ACQUISATION OF BAUXITE MINES IN THE GUJARAT STATE



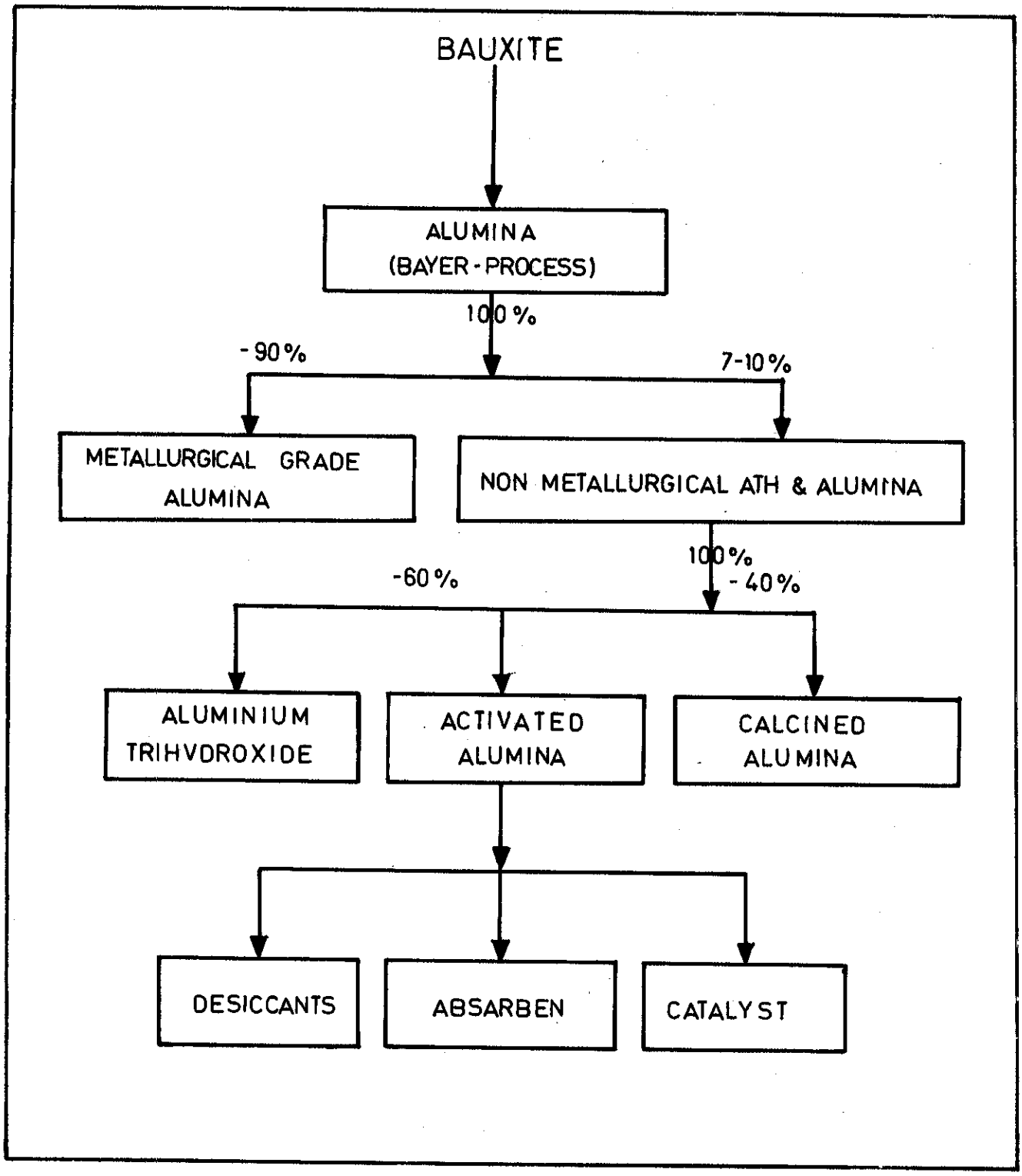
DISTRICT POINT

TALUKA POINT

VILLAGE POINT

NATIONAL HIGHWAY

RAILWAY LINE



PRODUCTREE OF ALUMINA ORIGIMATD BAYER-PROCERS

PROJECT PROFILES

INDEX

ABRASIVE GRAINS (ALUMINIUM OXIDE)

INTRODUCTION

Today industrial importance of abrasive has gained such an importance that without abrasive civilization could well revert back to primitive stage. The grading or dividing of the crush into various sizes through a series of screen is the main process in case of abrasive grain manufacture. The use of abrasive grain is closely tied to the development and use of grinding wheels. Abrasive industry is key industry catering to the needs of all engineering industries for precision grinding, tool grinding etc.

The development of grinding machines is closely allied to the wheel development and both are dependent upon the advancement of manufactured grain. It can be classified into basic two heads (a) Based on Silicon carbide (b) Based on aluinium oxide. Credit for the discovery of manmade abrasives goes to Frank B Newton founder of the ubiquitous abrasive company Norton Co. of Worcester, assachussets, USA. Back in 1885, he manufactured the first virtrified manmade grinding wheel from emery grit and clay firing it in his potter's kiln. Prior to this emery was the only commercially available abrasive. The development of the fusing technology which resulted fro the potter's kiln led to furnaces such as the Higgins, and Acheson furnace. Such furnaces required plentiful and cheap supplies of electricity and hence plants were constructed close to hydro-electric power sources. The cost of energy can account for as much as 40% of the cost of final abrasive product. Well established abrasive materials are silicon carbide, the aluminum oxides, and diamond. The former two products have remained the two primary synthetic material for much of this century.

Abrasive grains based on aluminium oxide can again be classified into more heads, depending upon the colour of grains although basic raw material remains the same (a) white (b) pink (c) brown.

Particulars	White fused alumina		
	Abrasive	Refractory	
		A	B
Chemical composition			
Al_2O_3%	99.7	99.7	99.3
Fe_2O_3%	0.035	0.035	0.07
SiO_2 %	0.025	0.025	0.07
TiO_2 %	0.007	0.007	0.008
CaO %	0.025	0.025	0.08
Na_2O %	0.15	0.15	0.4
Mineralogical composition			
α-Al_2O_3%	96	96	94
β-Al_2O_3 %	3	3	5
Physical Properties			
R.U.L (C)	1900	1900	1900
Porosity %	3	3	4
Knoop Hardness (MPa)	2050	-	-
Bulk Density (g/cc0)	3.87	3.87	3.76

MARKET POTENTIAL

The world market for abrasives is estimated to be around Rs. 6000 crore while India's export amounted Rs. 2 to 3 crore a year. Even one per cent of global market is tapped the country can earn Rs. 60 crore. In the eight plan 6000 tonnes capacity is to be added to the existing 15,000 tonnes. Of the extra capacity nearly 3500 tonnes will have to be exclusively created to meet the export markets.

The combined annual turnover of eight medium and large scale and 12 fro small scale sectors comes to Rs. 150 crore.

Product is recognised as one of the thrust areas for export.

Technological improvement have reduced demand for abrasives. The foundry industry has lessened its demand for grinding wheels, due partly to lower output also to the higher standards of finishing. This loss of demand from heavy industry has been partly offset by a growth in the precision end of the market. In the UK, this is seen for example, in the consumer boom for domestic DIY equipment such as sandpapers. Blasting is an important market for abrasive materials, particularly brown aluminas garnet and olivine. Before health and environmental considerations, surfaced concerning free silica, silica sand was the primary material used for blasting. However its usage has been usurped by other materials which contains no free silica. Brown regular alumina is an efficient blasting agent utilising its strong, yet blocky shape to dig into and remove surface contamination, instead of merely denting and moving it from one place to another. In the blasting operation grains are fired at the surface using either compressed air or water, with suitable rust inhibitors. The latter method is known as wet or vapour blasting. Both wet and dry methods are required high degrees of operator skill, manipulating grit size, nozzle size, blasting pressure blasting angle, and distance between nozzle and work surface to achieve maximum benefit. Important markets for this process include cleaning of components such as turbine and impeller blades of gas turbine aero-engines, and etching glass. Other markets for abrasives include lapping and polishing through to non-slip surface such as flooring, boat decks and airport runways. One unusual application is found in the mass catering industry. In this instance potatoes are rapidly peeled by holding them against a rotating disc impregnated with an epoxy resin and brown fused alumina.

The demand for brown fused alumina for the abrasives market is slowly declining although this abrasive material is still the major consumption in the manufacture of bonded and coated abrasives. The demand for brown fused alumina in the industrial market is slowly increasing particularly in the blasting field due to environmental considerations involved with the use of silica sand. Abrasives produced from Bayer process alumina are seeing an increase in demand as more and more specialisation is practised by grinding wheel and coated abrasive manufacturers. The increase in demand for refractory raw materials is growing rapidly because of constant innovations and improvements being made by the manufacturers of refractories.

MANUFACTURING PROCESS/TECHNOLOGY

For brown aluminium oxide abrasive grains, bauxite is calcined at 1150 ^{o}C to remove chemically combined water. It is fused in electric arc furnace with coke and iron borings for proper reduction of impurities. Fusion temperature is of the order of 2100 ^{o}C to 2200 ^{o}C. White and pink aluminium oxide grains are obtained from fusing calcined alumina powder with adding Cr_2O_3 during fusion. After fusion, the product is slowly cooled which results in the crustallisation of alumina. The product is then subjected to crushing and grinding and the crystallised alumina is separated from the ferrosilicon alloy by magnetic separation and hand picking.

PLANT AND MACHINERY

1. Electric Arc Furnace : (Single phase 600 KVA, 90-120 VAC-9" diameter electrodes)
2. Jaw-Crusher: One tonne per hour

3. Double Roller Crusher complete with 15 HP motor.
4. Vibrating screens with 2HP Motor
5. Rotary kiln.

RAW MATERIALS

a) Bauxite in which TiO_2 and CaO should be as less as possible. TiO_2 should not be more than 4% and CaO should be practically nil. Results can be obtained blending different ore.

b) Coke can be purchased from open market.

c) Iron boring.

PROJECT SIZE

The project envisages to manufacture 2000 tonnes abrasive grains with Rs. 200 lakh investment.

		Rs. Lakhs
1.	Land & Building	30.00
2.	Plant & Machinery	120.00
3.	Capital investent	50.00
		200.00

UTILITY

1.	Power	2000 KVA
2.	Water	10,000 Litres
3.	Manpower	15 Supervisory + 30 Non Supervisory.

SUGGESTED LOCATIONS

Plant can be located in Bhatia, Jamkhambhalia, Kapadwanj. At Bhatia premium price of land is Rs. 90.. per sq.m. in the industrial estate. At Kapadwanj the price is Rs. 25.00 per sq.m. and at Jakhambhaliya it is Rs. 5.25 per sq..

GOVERNMENT POLICY/KEY ELEMENTS

- Bauxite deposits of Kachchh are reserved for GMDC. In Janagar, Mewasa, Mahadevia, Bhatia pockets are also reserved for the corporation.
- In the rest of other districts like Kheda, Sabarkantha, Valsad, bauxite leases can be acquired. An applicant get priority over the trader.

LIST OF PLANT & MACHINERY SUPPLIERS

Furnaces

1. Stock & Co. Ltd.
   8, Gargacha Road, Calcutta.
2. GEC of India Ltd.
   Chittaranjan Avenue, Calcutta.
3. Hindustan Brown Bovery Ltd.
   Brown Bovery House, 264/265 Dr. A.B Road
   Bombay 430 025

Crusher & Screens

1. Lokmanya Engg. Works
   26, Bharat Khand Cotton Mills Compound
   Naroda, Ahmedabad 380 016
2. Kusum Engg. Co. Ltd.
   25, Swallow Lane, Calcutta - 56
3. Maycee Engg.
   Sentinee House No.2, 2nd floor,
   Arthur Bundar Road, Colaba
   Bombay-5

LIST OF RAW MATERIAL SUPPLIERS

1. Gokaldas Janadas
   Lamba Bandar, Dist. Janagar
2. The Bombay Mineral Supply Co. Ltd.
   Vazirfali, Jamnagar 361 001
3. Prabhudas Kakheja
   1st floor, Kedareshwar Road
   Porbandar.

LIST OF SOME OF THE EXISTING UNITS

1. Carborandu Universal Ltd.
   28, Rajaji Road, TIAM House
   Madras 600 001
   - Carborandum Universal Ltd.
   PO Veraval T: Okhamandal
   Dist. Jamnagar
2. Catfast Abrasive Tools Ltd
   Pallikkaranai, Madras 600 073
   - Catfast Abrasive Tools Ltd (Electro Min. Div.)
   Dhrol - 361 210 Dist. Jamnagar.
3. Flexo Plast Abrasive
   K.L Thirani & Co.
   1 & 3 Brabourne Road
   Calcutta 700 001
4. Grind Well Norton Ltd.
   Army & Navy Bldg., MG Road
   Bombay 400 023
5. John Oakey & Mohan Ltd.
   Mohannagar
   Uttar Pradesh 201 007
6. Orient Abrasive Ltd.
   1212, Chiranjiv Tower,
   43, Nehru Place
   New Delhi 110 019
   - Orient Abrasive Ltd.
   G.I.D.C Industrial Area,
   Porbandar - 360 577 Dist. Junagadh
7. Snam Abrasive P. Ltd
   142, Sipcot Indl. Complex
   Hosur 635 126
8. Sterling Abrasives P. Ltd
   Plot No. 45 & 46, GIDC Odav
   Ahmedabad 382 415

ACTIVATED ALUMINA

INTRODUCTION

The product is used as catalyst and drying of gases and liquids. It is highly porous and granular form of aluminiumm oxide having preferential absorptive capacity for moisture from gases, vapours and some liquids. It is insoluble in water, slightly soluble in acid and alkali. It is used for removing oil vapours from commercial gases like oxygen, nitrogen etc.

MARKET POTENTIAL

The combined production of the five units engaged in the manufacture is around 50 tonnes. To meet the indigenous need the product is still imported. During 19th-26th March, 1991. Asian Peroxides Ltd., imported 15240 kg. from Switzerland of Rs. 4,5431 value. During 8th-10th August, 1990, Reliance Inudstries Ltd. imported 43,545 kg. product value of Rs. 10,79,175 from USA. During 1989 WIDIA India Ltd. has also imported 1088 kg. product of Rs. 86,640 from USA from Madras Port. Delton Chemicals Ltd. has imported the product from Calcutta Port during 1989. The product can contain the import requirements of the units. Due to its diversified uses it has good prospect.

MANUFACTURING PROCESS

Alum is dissolved in water in a concrete or lead linked tank to get a concentrated solution. A 50% solution of caustic soda is introduced into it and the mixture is warmed with agitation. The process of precipitation is slow and will take 50 to 80 hrs. to achieve the desired degree. The filtered aluminium hydroxide is suspended in considerable amount of water in an iron tank and further redissolved in sodium hydroxide by heating the solution. Carbon dioxide is passed to this solution adjusting the pH between 7 and 10. Alumina is precipitated in gel form. The precipitated gel is filtered and washed on rotary filters. The washed filtered alumina is activated in a rotary kiln by heating in a current of Air or Nitrogen or other inert gases to prevent it from exposed for long time to the steam formed during dehydration. The gel is dried between 400-800^{o}C. By varying the activation, activated alumina of different characteristics can be prepared.

The product from kiln is cooled and pulverised. It may be sold as powder or mixed with binder and made into round particles or pressed in the form of pellets. The finished product is packed in air tight polythene packs.

PLANT AND MAHCINERY

1. Reactor (Lead lined or concrete)
2. Rotary filter
3. Precipitation tank
4. Caustic dissolving tank
5. Rotary kiln
6. Air cooler
7. Pulverisor
8. Bag filling & sealing machine
9. Boiler
10. Water treatment plant

RAW MATERIALS

Alum can be manufactured or it can be purchased from open market "Kensun Enterprise", Bombay who is major manufacturer. Caustic soda can be purchased from Gujarat Heavy Chemicals or Gujarat Alkalies.

For the manufacture of 1 tonne product - alum (Hydrated aluminium sulphate) 6.4 tonnes Sodium hydroxide 3.8 tonnes Carbon dioxide 400 kgs.

PROJECT SIZE

The product envisaged to manufacture one tonne per day with a investment of Rs. 25 laksh.

Land & Building	5.00 lakhs
Plant & Machinery	15.00 lakhs
Working capital	5.00 lakhs
Total:	25.00 lakhs

UTILITY

Water	-	100 KL
Power	-	500 KWH
Manpower	-	4 skilled + 5 unskilled

SUGGESTED LOCATION

Unit manufacturing alum can think of producing the product with an additional investment. The plant can be located at Bayad,Jhamkhambhaliya, Kalyanpur, Calur, as where bauxite is available.

GOVT. POLICY/KEY ELEMENTS

- No objection certificate for effluent disposal from Gujarat Pollution Control Board is necessary.
- S.S.I registration from D.I.C of the concerned districts.

LIST OF RAW MATERIAL SUPPLIER

1. Key-Sun Enterprise
   A/6, Gautamdham Apt., Bajaj Road
   Vile Parle (W)
   Bombay - 400 056
2. Kanoria Chemicals & Industries Ltd.
   3407, GIDC Estate
   Ankleshwar - 393 002.

LIST OF PLANT & MACHINERY SUPPLIER

1. Chemsphere Engineers & Contractors Pvt. Ltd.
   Jai Hind Bldg., 1 Bhuleshwar
   Bombay 400 002.
2. Chem Tex Engineering Enterprises
   Plot No. 277, GIDC, Opp.: L- 1 Shed
   Bhd. IBP Petrol Pumps,
   Odhav, Ahmmedabad 382 415.

EXISTING UNITS

1. Chemicals (India) Co.
   33, Brabourne Road
   Calcutta - 700 001.
2. Ganga Chemicals
   124/127 Nainiappa, Naicken Street
   Madras - 600 003.

ALUMINA POWDER

INTRODUCTION

Aluminium metal is produced generally by Bayer process. Before alumina is used for electrolytic production of metal, this refined alumina can be used as a starting material of alumina powder.

It is required for the manufacture of spark plugs ceramics. High purity powder of different grades are also utilised for ceramic in clinical care. The Central glass and Ceramic Research Institute has developed an alumina based spherical head for the hip joint. If hip joints takes off as an application area, product requirement will be created.

MARKET POTENTIAL

Alumina powder is a high-tech product obtained from alumina and is used in the manufacture in spark plug and in electronic industry. Some of them are Kaiser Chemicals, Union Carbide Corpn., Corning Glass Company. In India there are three units, The Indian Aluminiumm Co. -makes at least two grades of alumina powder - SRM-30 (particle size betwen 3 & 5 microns) and C-Grade (particle size-43 microns). National Aluminium Company has recently announced production of alumina for spark plug, electronics etc. Mechanical seal valves, welding nozzles, and fixtures are other specialized products requiring alumina powder. Nalco target for alumina production is 780,000 for 1990-91.

MANUFACTURING PROCESS

A varieties of processes have been developed for producing different grades and qualities of alumina powder. A solution precipitation process for making ultra fine powders involves mixing a metal alkoxide with dry alcohol and reacting this with an alcohol-water solution to produce a suspension of fine oxide particles. The oxides can be centrifuged and separated, the alcohol recycled and the final product used as a slurry or dried as a powder. This process gives a particle size between 0.3 & 0.6 microns. This can be sintered at much lower temperatture and can reach 99% of the density. The process know-how can be obtained from USA or Japanese companies engaged in the manufacture of the product. Various technology choices exist for producing different grade of alumina powder of various parties. Normal grade and electronic grade prices vary with Al_2O_3 content.

PLANT & MACHINERY

1. Reaction vessel (1 no.)
2. Centrifugal (1 no.)
3. Steam Drier (1 no.)
4. Disc filter (1 no.)
5. Slurry pump (horizontal) (1 no.)
6. Process tank agitators (pendular) (1 no.)
7. Alumina handling system (1 no.)

RAW MATERIALS

Alumina is being presently manufactured by two units viz. who may be able to offer the raw material. Alternatively the item may be imported. Indian market price is Rs. 1 kg. The alumina price is Rs. 10/- per kg., while import price is Rs. 50/- per kg.

PLANT SIZE

The project envisaged to manufacture 10 kg./tpd. with an investment of Rs. 75 lakhs.

1.	Land & Building (2000 sq.mt.)	15.00 lakhs
2.	Plant & Machinery	40.00 lakhs
3.	Working capital	20.00 lakhs
	Total cost	75.00 lakhs

UTILITY

Power	:	1500 KWH
Water	:	100 KL
Steamm	:	8 tonne

SUGGESTED LOCATION

Project of this nature, location like backward area of Kutch, Surendranagar and Jamnagar District could be considered.

GOVERNMENT POLICY/KEY ELEMENTS

- Technology may be required to be tied up for manufacture abroad. (Product has a good market in High-tech areas).
- Ties up with INDAL or NALCO for the procurement of intermediate refined alumina is essential.

LIST OF RAW MATERIAL SUPPLIER

1. Indian Aluminium Co. Ltd.
   'Jeevandeep', Middleton Street
   Calcutta - 700 001.
   T.No. 402 210, 403 819
2. National Aluminium Co.
   IPICOL House
   10th floor, IDCO Tower, Janpath,
   Bhubaneshwar - 751 007
   Orissa.
   T.No. 54328, 5552.

LIST OF PLANT & MACHINERY SUPPLIER

1. Arunoday Engineering Works
   Nr. Sompath Temple
   Bilimora, Gujarat. (Chemical Filter)
2. Bharat Heavy Plate & Vessels Ltd.
   B.H.P., V. Post, Visakhapatnam
   Andhra Pradesh.

LIST OF EXISTING UNITS

1. Indian Aluminium Co.
   1, Middleton Street, Calcutta 700 001
2. National Aluminium Company
3. Chiba Ceramic Mfg. Co.
   10-14-Inage Higashi 2-Chome Chiba-281 (Japan)
4. Sumitome Chemical America
   345, Park Avenue, New York, NY - 10054
   Phone - 212-207-0603

ALUMINIUMM CHLORIDE ($AlCl_3$)

INTRODUCTION

The product has good market in pharmaceuticals dyestuffs. Aluminium chloride can be manufactured from bauxite in which Al_2O_3% is more than 58%. In Gujarat calcined bauxite is manufaactured by few units in Jamnagar and Junagadh. Intermediate raw product can be easily available unit can be established in a small scale sector in chemical estates of the State.

MARKET POTENTIAL

Aluminium chloride there are fourteen units anufacturing aluminium chloride of 33833 capacity. Out of these, seven units are located in Gujarat in Nandesari, Vapi, Vatva chemical estate. Total production of aluminium chloride is found to be around 7193 tonnes in the State. Still there exist a demand supply gap. It is advisable to create a new unit in a small scale sector.

MANUFACTURING PROCESS/TECHNOLOGY

Bauxite is first of all dehydrated by calcining in a rotary kiln. The calcined bauxite is mixed with one half to one third of its weight of coal or coke and powdered in a pulveriser. Powder mixture is treated with sufficient amount of asphalt and briquetted in a briquetting machine. The briquettes formed are further heated in a rotary kiln to remove the valatile mamtter present in the coal and to produce a calcined product of about 18% carbon. The calcined briquetes are charged into a vertical shaft kiln ade of iron and lined with fire brick. A layer of bauxite is provided between the iron shell of the kiln and the fire brick in order to protect the iron shell from chlorine. Hot air is blasted to the bottom and half way up of the kiln and the mass is heated to a temperature of 1600 ^{o}F in about minutes. After this air blast is stopped and chlorine is blown into the top of the furnace until the alumina is converted to aluminium chloride. The chlorination will take 8 to 10 hours for completion. The aluminium chloride vapours leaving the furnace bottom is cooled in a cooler and further sublimed in a consider from where it is removed periodically.

PLANT AND MACHINERY

- Pulveriser(1 No.)	- Mixer (1 No.)	- Briquetting Machine (1 Bc)
- Rotary Kiln	- Shaft kiln	- Cooler
- Condensor (iron)	- Dryer	- Scrubber (Refractory lined)

RAW MATERIAL

Calcined bauxite can be purchased from the open market at @ Rs. 1500/- per tonne. Coke & Asphalt also can be purchased from the dealer's in the State.

Raw material requirement for the tonne aluminium Chloride.

Bauxite (58% Al_2O_3)	:	663 kg
Coke	:	138 kg
Asphalt	:	40 kg
Chlorine	:	800 kg
Air	:	Requirement

PROJECT SIZE

For the manufacture of 500 tonnes per annum, it is envisaged to invest Rs. 45.00 lakh.

1.	Land & Building	:	10.00 lakhs
2.	Plant & Machinery	:	20.00 lakhs
3.	Capital investment	:	15.00 lakhs
	Total	:	45.00 lakhs

UTILITY

Power	:	50 HP
Water	:	10,000 litrs. (per month)
Manpower	:	10
L.D.O.	:	20,000 (per month)
Coke	:	8,000 kg (per month)

SUGGESTED LOCATIONS

The product market is in dyestuffs and Pharaceuticals and raw material calcined bauxite is easily available from Saurashtra, so plant can be located in Saurashtra in Bhatia, Jamnagar, Bayad, Dehga where incentive packages are available.

GOVERNMENT POLICY/KEY ELEMENT

- SSI registration from the District Industry Centre.
- Clearance certificate from the Gujarat Pollution control Board, Gandhinagar.
- Coal quota can be procured from the Gujarat Small Inds. Corp., Ashram Road, Ahmedabad.

LIST OF PLANT & MACHINERY SUPPLIERS

1. Mukind Iron & Steel Works Ltd.
   LBS Marg, Kurla, Bombay - 70 *(Cooler)*
2. Air Control & Chemical Engg. Co. Ltd.
   Accel House, New Patel Society, Opp. Kadwa Patidar Boarding, Panchvati
   Ahmedabad 380 006 *(Condensor, Mixer)*
3. Dalfeb Engineers
   284, GIDC Indl. Estate , Makarpura, Baroda *(Condensor, Mixer)*

LIST OF RAW MATERIAL SUPPLIERS

1. Carborand Universal Ltd.
   PO Okha, Ta. Dwarka, Dist. Jamnagar *(Calcined Bauxite)*
2. Orient Abrasive Ltd.
   GIDC Indl. Area, Porbandar 360 577 *(Calcined Bauxite)*
3. Dhrangadhra Cheical Works
   PO Dhrangadhra, Dist. Surendranagar *(Chlorine)*
4. Bobay Gas Co. Ltd.
   214, Dada Navroji Road, Bombay 400 001 *(Coke)*

LIST OF EXISTING UNITS

1. Base Metal Chlorinations (P) Ltd
   2, Anand Nagar Society, Jetalpur Road, Baroda 390 005
   Factory : Nandesari GIDC
2. United Dyes & Polymers
   Harisadan, Khadia Char Rasta, Ahmedabad 380 001
   Factory: GIDC Vatva
3. Mittolia Chemicals
   503/504 Sheffield Tower, Lokhandwala Complex
   Andheri (W), Bombay 400 058
   Factory: GIDC Ankleshwar

ALUMINIUM HYDROXIDE GEL

INTRODUCTION

Aluminium is always trivalent in its compounds and most of aluminium salts are hydrolysed by water. Aluminium hydroxide is a white, viscous suspension translucent in thin layers from which small amounts of water may separate on standing. It is a white solid which is amorphous in character and on drying it assumes a glossy appearance. On heating it loses water at dull red heat and is changed to white powder of aluinium oxide. It is insoluble in water but rapidly soluble in acids to form aluminium salts but the reaction is reversible and as soon as acid concentration is diminished aluminium chloride formed is hydrolysed and back reaction sets in. This is due to weak basic character of aluminium hydroxide. Aluinium hydroxide also dissolves in a solution of sodium or pottassium hydroxide, forming aluminates; these aluminates are also extensively hydrolysed by water.

Aluinium hydroxide gel is a suspension containing the equivalent of not less than 3.6 per cent and not more than 4.4 per cent Al2O3. The dried gel is white, odourless, colourless, tasteless. It may be suspended in water to make the gel. Aluminium hydroxide gel is used as an antacid and protective in the treatment of peptic ulcers. It is also an astringent and antiseptic used in cases of marked hyperacidity. It is used externally as a mild astringent and dessicant and internally as an antacid and protective. Since it is used as a drug item special care is taken during processing to avoid any contamination and precautions are taken for standardisation to IP grade.

TYPICAL CHEMICAL COMPOSITION

Particulars	Normal	Special	
Al_2O_3 %	65	65.3	
Total Na_2O %	0.3 - 0.4	0.1 max	
Fe_2O_3 %	0.015	0.01	
SiO2 %	0.015	0.01	
Median grain size (um)	50-80	3-40	0.05-3.0
BET surface area (m^2/gm)	< 0.1	< 2	2-12
Whiteness	< 80	80-95	> 95
Nature	Cryst.	Cryst.	Gelatinous
Specific Gravity (gm/cc)	2.42	2.42	2.42
Bulk density (gm/dm^3)	1200	500-1000	160-400

MARKET POTENTIAL

Aluminium hydroxide gel is an important ingredient used in a number of pharmaceutical preparations particularly to arrest disorders of stomach generally predominant in tropical countries. It is consumed by a large number of drug and pharmaceutical units engaged in the manufacture of alkalizer type of products. Most of the manufacturing units for aluminium hydroxide gel are in small scale sector and keeping in view with growing market size, there is sufficient scope for setting up new units in this line of production. Pharmaceutical units lime "Cadila", "Alembic", "Sarabhai" and "Torrent" are situated in the State, requirements can be made by the unit.

Production	World (total) Milliion tons	% total
Total Alumina	42	100
Met. Grade Alumina	38.2	92
Non Met. grade Alumina & Hydrate	3.3-4	8-10
Cost of ATH	140-1340 US$/ton Rs. 5000-26000 Indian Market	

Demand estimate for special Hydrates in India

YEAR :	1978-79	83-84	88-89	93-94
Quantity in Tons:	770	1,220	1,820	2,300

MANUFACTURING PROCESS/TECHNOLOGY

Measured quantity of aluminium sulphate is taken, dissolved in distilled water and the solution is filtered and transferred to a wooden vat. The quantitative amount of sodium carbonate solution in distilled water is added slowly to aluminium sulphate solution and mixture vigorouosly stirred. While the complete conversion of aluminium sulphate to aluminium hydroxide is over it is filtered and the mass is washed with distilled water, for further purification to make it free from water soluble impurities. The cake is dried at 65-70^{o}C. The dried mass is pulverised and packed.

PLANT AND MACHINERY

- CP wooden vats fitted with stirred 3 HP motor and other accessories capacity 300 lts. 2 Nos.
- CP wooden vats 200 litrs.cap. 2 Nos.
- Filter press size 20" x 20" with 20 plates 3 HP motor with wooden plate requirement 1 No.
- Aluminium trays size 3' x 2 1/2' - 100 Nos.
- Drying chamber electrically heated and thermostatically controlled with complete accessories size 10' x 5' 1 No.
- Pulverising machinery cap. 250 ltrs. 300 kg. per 8 hours. 10 HP motor 1 No.
- Dimineralised water plant 1 No.
- Lab equipment
- Misc. viz. tools and equipments

RAW MATERIALS

Alum is manufactured by few units in Baroda, Vapi, Ankleshwar in Gujarat. "Ashok Chemicals" and "Prabhat Chemical Factories" situated in Udepur manufacture aluminium sulphate. Soda ash can be procured from Gujarat Heavy Chemical, Tata Chemical, Saurashtra Chemical or Gujarat Alkalies. Raw material availability is good in the state.

PROJECT SIZE

The project envisages to manufacture 100 mt. with an investment of Rs. 21.00 lakhs.

1.	Land & Building	1.50 lakhs
2.	Plant & Machinery	2.00 lakhs
3.	Capital investment	6.00 lakhs
		9.50 lakhs

Say : **Rs. 10.00 lakhs**

UTILITY

1.	Water	:	5000 litres
2.	Power	:	30 HP
3.	Manpower	:	6 Unskilled, 7 skilled

SUGGESTED LOCATION

The plant can be located in Kapadwanj, Bayad, Jamnagar, Kandla, Mandvi in Kachchh district.

GOVERNMENT POLICY/KEY ELEMENTS

- SSI registration from District Industry Centre.
- Pollution Clearance certificate from Gujarat Pollution Board Gandhinagar
- Affluent treatment arrangement.

LIST OF PLANT AND MACHINERY SUPPLIERS

1. The United Engg.
   61, Simla Road, Calcutta - 6
2. Sathi Engg. Works
   27772 Sing Marg, Delhi-6
3. Rank & Co.
   Wazirpur Indl. Area
   New Delhi
4. Vijaya Industries
   6th Block, 80 Feet Road, Rajajinagar
   Bangalore
5. HR Engineers,
   Peenya Indl. Estate, II Stage, Bangalore

LIST OF RAW MATERIALS SUPPLIERS

1. Bengal Chemical & Pharmaceuticals Works
   4 GC, Avenue, Calcutta - 3
2. Dharmshi Moraji Chem. Co. Ltd
   317-21, Prospect Chemicals, Dr. D.N. Road, Bombay
3. Tata Chemmicals Ltd.
   Mithapur, Gujarat
4. Trifam's Chemache Inds. P. Ltd
   23, Hatkesh North South Road, No.6, Vile Parle (W), Bombay
5. Dhrangadhra Chemicals Works Ltd.
   Dhrangadhra 363 315, Gujarat

LIST OF SOME OF EXISTING UNITS

1. Gayatri Minerals & Chemicals
   34/A Shastrinager, Nizampura, Baroda
2. Melox Chemicals
   355/1 GIDC Chitra , Bhavnagar 364004
3. Elite Chemicals
   Shree Maniprasad, Kalanala, Bhavnagar 364 002

ALUMINIUM STEARATE

INTRODUCTION

Paint, varnish drier, greases, water proofing agent, cement additive, lubricants, cutting compounds, flatting agent, cosmetics and pharmaceuticals industries consume about product. New application is also found in drilling muds to increase the bit bearing life. It is used as a lubricant.

MARKET POTENTIAL

Most of the units are in the region of Kota and Bombay. total installed capacity is 1125 MT in the country. With the rapid growth of paints and varnished industry, in the country, is used in mud chemicals by ONGC. The consumption of aluminium stearate will increase in the coming years. It has good export potential.

MANUFACTURING PROCESS

The process consists of following steps:

1. Preparation of Sodium soap.
2. Testing of sodium soap
3. Preparation of salt solution.
4. Precipitation.
5. Filtration, drying, pulverising and packing.

Caustic soda solution is reacted with stearic acid to prepare sodium of stearate which is subsequently reacted to aluminium sulphate solution to yield aluminium stearate. Solution is taken in washing tank and washed with water. The solution is filtered in centrifugal separator and sent to drier. The dried material is pulverised and packed in bags.

PLANT AND MACHINERY

- Reaction vessels (S.S.)
- Washing tanks (wood)
- Tray drier
- Boiler
- Pumps
- Salt solution tank (M.S)
- Centrifugal separator (M.S)
- Pulveriser
- Filter
- Piping and fitting

RAW MATERIALS

On the basis of one tonne aluminium stearate manufacturing raw materiarls requirements is as follows:

- Stearic acid	968 kg.
- Caustic soda	136 kg.
- Aluminium sulphate	196 kg.

Caustic soda and aluminium sulphate can be purchased from the local manufacturers.Two grades of aluminium stearate are available (a) Technical & (b) Pure.

PLANT SIZE

The project envisage to manufacture ten tonnes per annum with an investment of Rs. 10 lakhs.

1) Land and Building (2000 sq.m)
2) Plant and Machinery
3) Working capital

UTILITY

Water -100 KL
Power - 500 KWH
Manpower - 5 (five)

SUGGESTED LOCATIONS

Unit engaged in manufacturing alum are located at Vatwa, Nadiad, Talod. Such units can be located in Bayad in S.K. Kapadwanj in Kaira, Gandhidham in Kachchh.

GOVERNMENT POLICY/KEY ELEMENTS

- No objection certificate for effluent disposal from Gujarat Pollution Control Board is necessary.
- SSI Registration from DIC of the concerned districts.
- The existing alum manufacturing unit can also undertake this projcet without much additional expenditure.

LIST OF RAW MATERIAL SUPPLIER

1. Key-Sun Enterprises
   A/6, Gautam Dhan Apartment, Bajaj Road
   Vile Parle (W), Bombay - 400 056
2. Indo Chemicals & Minerals
   520 (A), Talvandi
   Kota - 324 005. *(Stearic acid)*
3. Kanoria Chemicals & Industries Ltd.
   3407, GIDC Estate, Ankleshwar - 393 002.

   Branch: Sahyog Bldg., 3rd flr., Opp: Dinbai Tower
   Lal Darwaja, Ahmedabad 380 001 *(Caustic soda)*

LIST OF PLANT AND MACHINERY SUPPLIER

1. Chemsphere Engineers & Constructors Pvt. Ltd.
   Jaihind Bldg., 1, Bhuleshwar
   Bombay 400 002. *(Reactors, Storage Tanks)*
   Phone. 318 996
2. Chemtex Engineering Enterprises
   Plot No. 277, GIDC, Opp. Lal Shed
   B/h. IBP Petrol Pumps, Odhav
   Ahmmedabad - 382 415

LIST OF EXISTING UNITS

1. Chemicals India
   B-2, Industrial Estate, Kota - 324 007.
   Phone - 233369, 27403
2. Laxmi Trading Corpn.
   125/3, GIDC Nandesari
   Dist. Baroda
3. Kaayal Chemicals Pvt. Ltd
   10, Commander in Chief Road
   Madras - 600 105

ALUMINIUM SULPHATE

INTRODUCTION

Aluminium sulphate & allied alums are mostly used for water purification, paper sizing, tonning leather with the expansion of water supply schemes in Urban and rural areas the consumption of these items is expected to increase. There are about 15 small units reported to be operating in the state with 12000 ton per year. Total requirement in the state will be 20000 tonnes by end of the 1990. It is colourless white monoclime crystals.

MARKET POTENTIAL

Aluminium sulphate is widely known by the name alum. Most of the plants are working on batch process. Since the handling expenses both the buyers and sellers can be minimised by transporting alum in solution form, trends are found in industrial circle to build alum plant very near to its consumer industries.

70% of the aluminium sulphate production is consumed for water treatment and to a large extent. Other alums are replaced by aluminium sulphate in water treatment and dyeing processes. The combined installed capacity of existing plants in India is estimated to be about 1,50,000 tonnes per annum. The figure for present consumption is not available. It is reported that a small portion of aluminium sulphate is exported. With the development of the synthetic fibre industry the demand for aluminium sulphate is likely to rise, as there will be more water softening and purification plants coming up. besides, the tremendous expansion possibilities in the paper manufacturing field also indicates the scope of further demand for aluminium sulphate. Demand in 1993 is expected to be 4,30,000 tonnes. Export of alum in recent years have ranged from 14,20,000 tonnes.

MANUFACTURING PROCESS/TECHNOLOGY

Sulphuric acid used for the process if of commercial grade having a concentration of 60^{o}Be.

The reactor is a lead lined steel tank provided with a paddle agitator (Lead lined) steam coil and thermometer.

Crude bauxite is finaly ground to 200 mesh size and charged into the reactor. Sulfuric acid is slowly added and the mass is agitated throughly. Live steam is run to the reactor and temperature of the mixture maintained at $105^{o}$to 110^{o}C. The reaction will be completed within 15 to 20 hours. An excess of bauxite is added to the reaction mmixture so as to keep 0.1 to 0.2 percent of soluble aluminium oxide excessin the mixture. At the end of the reaction the strong solution obtained is run to the settling tank. here, the solution is diluted with sufficient amount of water to enable easy settling of undissolved sluges present in the mass. Coloured iron salts in the form of ferric sulfate is converted to its ferrous salts by adding to some reducing agents, commonly barium sulfide in the form of balck ash. Sodium sulfide, Sodium bisulphite or sulphur dioxide also can be used for this purpose. When the sludges settle the clear solution from the top is decanted. The sludges are washed several times to regain the alum present in it and these washings are combined with the decanted liquor.

The process is made continuous, generally by using a battery of combined reaction and settling tanis. In Dorr Process reactors are put in series and reducing agents are added at the last reactor. The reaction mixture from the last reactor is sent to a series of thickeners, operating counter currently whrer sludges are separated and washed thoroughly. Glue is added to the first thickner as a coagulant.

The clear solution is concentrated in leadlined evaporators till the density of the liquor reaches about 35^{0} Be to 56^{0} Be. Concentrated solution is run to flat iron cooling pans where it solidifies. The cake is broken with chisel and ground to a uniform powder for shipment.

Commercial aluminium oxide contains 13 moles of water instead of theoretical 18 moles and usually it will be basic in nature due to excess alumina content.

Anhydrous alumina can be got by dehydration . Yield of aluminium sulphate based on aluminium oxide is 90 to 95 per cent.

PLANT AND MACHINERY

- Digester (Mild steel, lead lined)
- Settling tanks (mild steel, lead lined or concrete)
- Evaporators (mild steel, lead lined)
- Cooling pans (iron) or concrete floor
- Crushing and grinding mills like jaw, crusher and ball mill
- Steam boiler
- Transfer pumps
- Storage tank

RAW MATERIALS

Basis : 1 Tonne aluminium sulphate (17%) Al_2O_3

-	Bauxite (55% Al_2O_3)	0.34 tonnes
-	Sulfuric Acid (60^{0} Be)	0.57 tonnes
-	Black Ash (70% Bas)	6.5 Kgs.
-	Flake glue	0.2 kg.
-	Coal	320 kgs.
-	Electricity	20 Kwh.

Bauxite can be purchased from the existing bauxite lease holders of the State.

PROJECT SIZE

Total project cost for 6000 tonnes per annum will be Rs. 24.00 lakh.

		Rs. in Lakhs
1.	Land & Building	5.00
2.	Plant & Machinery	15.00
3.	Capital investment	4.00
	Total :	24.00

UTILITY

Water	-	100 KL
Power	-	500 KWH
Manpower	-	5 (five)

SUGGESTED LOCATION

Unit engaged in manufacturing alum are located at Vatwa, Nadiad, Talod. Such units can be located in Bayad in S.K., Kapadwanj in Kaira, Gandhidham in Kachchh.

GOVERNMENT POLICY/KEY ELEMENTS

- No objection certificate for effluent disposal from Gujarat Pollution Control Board is necessary.
- SSI Registration from DIC of the concerned districts.
- The existing alum manufacturing unit can also undertake this project without much additional expenditure.

LIST OF RAW MATERIAL SUPPLIER

1. Key-Sun Enterprises
   A/6 Gautam Dhan Apartment, Bajaj Road
   Vile Parle (W)
   Bombay 400 056 (Aluminium Sulphate)
2. Indi-Chemicals & Minerals
   520 (A), Talvandi, Kota-324 005 (Stearic acid)
3. Kanoria Chemicals & Inds. Ltd.
   3407, GIDC Estate, Ankleshwar - 393 002 (Caustic Soda)

LIST OF PLANT & MACHINERY SUPPLIER

1. Chemsphere Engineers & Constructors P. Ltd.
   Jaihind Bldg; Bhuleshwar
   Bombay - 2 (Reactors, Storage Tanks)
2. Chemtex Engg. Enterprises
   277 GIDC, Odhav, Ahmedabad

LIST OF EXISTING UNITS

1. Allipo Chemicals
   49 GIDC Makarpura, Baroda-10
2. Key-Sun Enterprises
   A/6 Gautam Dhan Apartment Bajaj Road
   Vile Parle (W), Bombay-566
3. Mittolia Chemicals
   13/1 GIDC, Ankleshwar-2

CALCINED BAUXITE

INTRODUCTION

Calcination of bauxite is carried out to remove either partly or wholly combined water hydration. It may be done with a number of aims in view. Low temperature calcination is done for activated bauxite which are used for decolouring, oil cleaning and many catalytic applications. Moderate temperatures are used for obtaining absorbent bauxite for dehydration of oils, gases as also in conveersion of alcohol to ethylene. Heating the bauxite over 600 ^{o}C usually destroys catalytic and absorbent properties.

Heating over 1200^{o}C to 1450^{o}C turns bauxite into a dense hard and non absorbent calcined variety for the manufacture of refractories, abrasives and electrically fused aluminiware.

MARKET POTENTIAL

Saurashtra and Kachchh bauxite is superior grade. The ore from Jamnagar area was exported on a large scale in international market. Due to establishment of new refractory units and abrasive units in State, product has good demand in refractory and abrasive industries. With an installed manufacturing capacity of 11 lakh tonnes of fire-clay and high alumina refractories, the demand for refractory in the country by 1989-90 is estimated 7.2 lakh tonnes. Abrasive industry is another sector where product can be used. At present 115,000 tonnes abrasive grade Calcined Bauxite demand exists in the country, it is also planned to add another 6000 tonnes during 8th plan period. Considering above estimates, calcined bauxite has good potential in the refractory and abraqsive sector.

MANUFACTURING PROCESS/TECHNOLOGY

The raw bauxite lumps with 1/2" to 2" size are feed to rotary kilns. Rotary kilns with 60-150 feet length and diameter 6'-8" with less than incline of 1" per foot and 0.7 to 1.5 revolutions per minute is to be adjusted depending upon required temperature and size of Rotary kiln.

The firing is to be controlled by automatic thermocouples. The temperature is to be attained are about 1150^{o}C for abrasive grade and 1450^{o}C for refractory grade and the production of 3-5 tonnes per hour. The yield is about 60 to 65% of the feed. Discharge can be collected at the other end of the kilns, in fine mesh semi Calcined Bauxite dust containing of about 5 to 10% LOI and 70 to 75% Al_2O_3.

PLANT AND MACHINERY

The following machineries are requried for the erection of the plant.

- Jaw crusher 1 No.
- Rotary Kiln 1 No. with or without cooler arrangement
- Electric Motor 5 No.
- Oil Tank 1 No.
- Automatic temperature controller.
- Burners, Oil firing pump.

RAW MATERIALS

Bauxite lease can be acquired in the unreserved areas of Jamnagar, Kaira, Sabarkantha, Junagadh districts. Raw bauxite can be purchased from existing lease holders or from the Gujarat Mineral Development Corporation. Specification of the ore desired for the calcination should be low in lime and ferric and high in Alumina. Desired raw ore specifications are Al2O3

Minimus 58% and above Fe_2O_3 to 3% SiO_2 3/4%, CaO 0.7%, TiO_2 2/3%.

PROJECT COST

It is envisaged to manufacture 120 tonnes of calcined bauxite per month involving Rs. 140 lakhs investment.

		Rs. in lakhs
1.	Land & Building	20.00
2.	Plant & Machinery	85.00
3.	Capital investment	34.00
	Total :	140.00

UTILITY

1. Power - 2250 units per month
2. Waer - 1500 liters only for staff & labours
3. Manpower - Skilled - 8
   - Unskilled - 20
4. Furnace Oil/Coal - 6.12 KL/290 tonnes per month

SUGGESTED LOCATIONS

Plant can be located in the bauxite resource rich districts like Jamnagar, Sabarkantha, kaira, Kachchh. For fuel LPG or oil is required so availability of oil and bauxite are the main criteria for the location. Loking to the new industrial policy covering concerned potential talukas, it can be located in Dehgam, Kapadwanj, Bayad, Dakor, Kalyanpur places. The cost of transportation of raw bauxite from selected mines is also required to be considered for arriving at cost factors.

GOVERNMENT POLICY/KEY ELEMENTS

- Calcination of bauxite is now eligible for State incentives, as per 1990-95 policy.
- Calcination is not considered as a value added item by Govt. so priority for the grant of bauxite lease is not considered at the time of sanction of lease.
- Certificate from the Gujarat Pollution Board is necessary as lot of dust is generated during calcination.

LIST OF PLANT & MACHINERY SUPPLIERS

1. Saboo Engineering Works
   PB NO. 3, Kuchaman Road
   341509 Rly. Station Nawacity
   Rajasthan
2. Sayaji Iron & Engg. Co. Ltd.
   Chhani Road
   Barod 390 002
3. Door-Oliver House
   Chakala, Andheri (East)
   Bombay 400 099

LIST OF RAW MATERIAL SUPPLIERS

1. Bombay Mineral Supply Co.
   Vazir Falia
   Jamnagar

2. Gujarat Mineral Development Corporation
   Khanij Bhavan
   Opp. Nehrubridge, Ashram Road
   Ahmedabad 380 009

3. Saurashtra Calcine Bauxite & Allied Industries
   'Raghuvanshi' 3, Bhojeshwar Plot
   Porbandar 360 575

LIST OF SOME OF EXISTING UNITS

1. Saurashtra Calcined bauxite & Allied Industries
   117-119 GIDC Industrial Estate
   PO Porbandar 360 577
   Tel.No. 23223 Fax 22723

2. The Bombay Mineral Supply Co. Pvt. Ltd.
   Vazir Falia
   Jamnagar 361 001
   Tel.No. 78533 Fax 0288-555500

3. Orient Abrasives Ltd.
   GIDC Industrial Estate
   Porbandar

4. Carborundam Universal Ltd
   Okhaport

CALCINED & TABULAR ALUMINA

INTRODUCTION

Tabular alumina is characterised by low porosity, high density, low permeability, good chemical inertness etc.

TYPICAL CHEMICAL COMPOSITION

Particulars	Values
Al_2O_3%	upto 99.5
SiO_2 %	max. 0.5
Fe_2O_3%	max. 0.5
Na_2O%	0.05-0.45
Grain size	50-400 um
BET Surface Area	0.5-1 m2/gm
Specific Gravity	3.9 g/cc
App. specific gravity	3.5-3.65 g/cc
Bulk Sp. gravity	3.5-3.64 g/cc
Hardness	9(Mon's scale)
Open Porosity	< 5%
Closed Porosity	5-8%
App. Porosity	5 gcc
Water Absorption	0.83-2%
PCE (Pyrometric cone equivalent i.e. resistance to fire)	40 (30 for silicate bricks)

Calcined alumina containing a high percentage (75-100%) of α-alumina (corundum), the most thermodynamically stable form. Generally manufactured by calcining aluminium hydroxide in rotary kilns at around 1400°C. Produced in a very wide range of grades depending on soda content (the main impurity), crystal size and morphology, and the percentage of α-Al_2O_3 and transitional alumina phases. Presence of the latter enhance the measured area. Calcined alumina with an α-Al_2O_3 content approaching 100%, that has been recycled or sintered at just under the fusion point of α-alumina (-2040°C), although in practice the fine crystal size and addition of mineralisers can bring the temperature down to 1700-1850°C. This results in the formation of large (50-500μ), flat tablet-shaped crystals of corundum. Commonly produced in shaft kilns, tabular alumina is characterised by low porosity, high density, low permeability, good chemical inertness, and high refractoriness.

MARKET POTENTIAL

Global demand for calcined and tabular alumina is estimated to be roughly in the order of 0.8-1.0m. tpa and 300-350,000 tpa respectively. Tabular alumina is used almost exclusively in refractory applications and demand can be correlated approximately with steel output. The numerous grades of calcined alumina are consumed in a very wide range of refractory, ceramic and other applications, but the market is split in volume terms roughly as refractories 60-65%, tiles and glazes 25-30%, insulators 10% and wear resistant ceramics and others 5%.

A wide range of calcined and tabular aluminas are utilised in almost the entire spectrum of non-basic refractory applications, covering bricks, shapes, low and ultra-low cement castables, gunning and ramming mixes and calcium aluminate cements. The key advantages of alumina in its main markets are summarised in the following table.

Tabular & Calcined Alumina - Main Market Divisions

Market	Aluminium type	Key advantages of alumina
Refractories		
Low & ultra-low cement castables, other mono-lithics, bricks & shaped products, spinels	Tabular aluminas, wide range of low-normal soda & reactive calcined alumina	High hot Modulus of Rupture; good flowability & handling properties; high thermal shock resistance; good mechanical strength & abrasion resistance
Whitewear		
Glazes, frits	Intermediate-normal soda calcined	High mechanical & chemical resistance; controlled degree of whiteness & matt/shining effect
File bodies, hotelware	Intermediate-normal soda calcined; range of crystallinity	High strength
Wear resistant ceramics		
Grinding media, mill linings, wear & impact plates	Low-intermediate soda, medium crystallaine calcined	Dense, texture free matrix; high abrasion & wear resistance; high impact strength
Electrical Insulators		
Spark plugs	Low soda, medium crystalline calcined	High electrical resistance; dielectric strength; mechanical strength
High voltage insulators	Low-intermediate soda, calcined	Good electrical resistance; electrical strength; mechanical strength
Electronic Components		
Substrates, housings resistors	Low soda, medium crystalline	Excellent electrical insulation; high thermal conductivity & dielectric strength; texture-free ceramic matrix
Engineering Ceramics		
Thread/wire guides pump parts, seals, cutting tools, bioceramics	Low soda, reactive aluminas	Texture free homogenous microstructure; high mechanical strength; good wear & abrasion resistance; defined surface properties

Extra high alumina refractories >90% Al_2O_3 are one of the major consumers of calcined and tabular alumina. With characteristics such as high fusion point, excellent strength, low creep, high density and low porosity, high thermal shock resistance and good resistance to abrasion and chemical attack tabular alumina in particular finds use in critical areas where abrasion or thermal shock are problems.

Within the steel industry, there is a global trend to utilising higher performance refractories that have longer service lives, giving improvements in the cost of refractory/tonne of steel in each part of the steel making process. This is providing increasing opportunities for very high alumina products at the expense of products such as superduty firebrick. High alumina, ultra low cement and no cement castables are areas of particular interest and the alumina manufacturers are investing considerable R&D in developing higher performance reactive aluminas and sintered alumina aggregates. While the overall effect of these changes on alumina demand by volume may be neutral, the effect on demand in value terms will certainly be positive.

MANUFACTURING PROCESS

The great majority of calcined alumina is manufactured by the calcination of alumina trihydrate (ATH) produced during the Bayer process. Smaller quantities of high purity calcined alumina is produced through a variety of chemical means, such as successive recrystallisation of ammonium aluminium sulphate; by distilling, hydrolising then calcining aluminium alkoxide; or by subjecting aluminium metal pellets submerged in pure water to spark discharge (Iwatani Process).

The Bayer process is the first stage of manufacture - crushed or ground bauxite is fed into digestion tanks where it is reacted with caustic solution at temperature of 140-280°C. Impurities (mainly iron oxides and silica) are settled or filtered out of the resulting alumina hydroxide solution which is then cooled to 50-70°C and may be diluted. The solution is then mixed with large quantities of seed crystalline ATH and is agitated in crystallisers for 30-48 hours. The resulting slurry is classified; with the coarser fraction (typically >0.044mm) going forward to be used further while the finer fraction is filtered and recycled as seed for subsequent crystallisation. The alumina depleted solution is filtered, re-concentrated and fed back into the process. The washed and filtered ATH becomes the feed for calcination in rotary kilns, sometimes combined with gas suspension calciners, or flash calciners to produce calcined alumina. During calcination, α-Al_2O_3 crystals replace the ATH crystals without destroying their shape and structure.

PROJECT COST

The project envisage to manufacture 600 tpa with an investment of Rs.108 lakhs as under:

- Land & Building	: Rs. 20 lakhs
- Plant & Machinery	: Rs. 50 lakhs
- Working Capital	: Rs. 38 lakhs
Total	: Rs.108 lakhs

PLANT & MACHINERY

Mixer, briqueting press, high temperature furnace, jaw crusher, rollcrusher, ball mill, magnetic separtor, etc.

LOCATION

Project can be located at Gandhidham, Mandvi in Kachchh district. GMDC proposed alumina plant in Kachchh calcined alumina is a simultaneous product alongwith alumina.

RAW MATERIALS

Calcined alumina is raw feed which can be imported. It can abe purchased from INDAL, Carborandum Universal Ltd.

TECHNOLOGY SUPPLIER

National Metallaurgical Society
Jamshedpur-831 007

APPLICATIONS

Because of its excellent thermal spalling resistance, high temperature strength & abrasion resistance, chemical & thermal inertness & purity, the major applications is in refractories (consuming more than 50% mostly in steel industry). Also found application as an inert catalyst support & heat exchange media, saggers for firing electronic & technical ceramics, fillers for plastics, resins, investment casting molds, ceramic parts & production of electric insulators.

PRESENT MAJOR PRODUCERS:

WORLD: ALCOA Chemie, VAW & ALOXID

INDIA: Not known

PROBABLE CONSUMERS IN INDIA:

Carborundum Universal Ltd.

Orissa Industries Ltd.

Ipibel Refractories Ltd.

Bharat Refractories Ltd.

India Fire Bricks & Insulation Co. Ltd.

COATED ABRASIVES

INTRODUCTION

Abrasive grains are mostly manufactured if Jamnagar district. 'Orient Abrasive', 'Western Abrasive' 'Emery India Pvt. Ltd.' are the leading manufacturers in the State. In addition to above, there are other units located at Jamkhambhaliya, Hapa in Jamnagar district.

Coated abrasive are papers and cloth coated with cattle hide glue, shellac or technical gelatine adhesive and covered with abrasive grains. Coated abrasives includes (i) Sand Paper, (ii) Emery paper, (iii) Fused crystalline (iv) Gasket paper (GArnet cloth), (v) Silicon carbide paper, (vii) Flint paper, (viii) Emery Cloth etc. These coated abrasives are further available in the form of sheets of 9" x 11", tolls, belts, discs and tapes.

Coated abrasive are considerably used in removing rust or worn out paint of metal surfaces, sizing of metals and wood. They are invariably used right from small cobbler, carpenter to a huge railway coach works, body building, automobile, general engineering industries. The abrasive help in keeping metal and wood surface clean even and smooth by its chracteristic abrasive effect on the product. They are also employed in rubbing down in auto-serving works.

MARKET POTENTIAL

The demand is obviously huge and is being presently met by the manufacture of large and small scale sector units located in Gujarat, Madras, Calcutta, Delhi, etc. There are two types of abrasive making units - one making abrasives by hand made system and the other one is machine made. There is a vast scope for setting up these units in small scale sector to meet with the internal market. The demand comparatively increases on the development of industries like railways, general engineering, paint, leather and wood based products and house building activities.

MANUFACTURING PROCESS

The paper ream of rollis first fixed in the machine and one end of it is connected to the end of abrasive coating machine. The trade mark number of abrasive, variety of abrasive and address of the company are printed on the back side of the sheet in such a way at the finishing stage that each paper contain the above particulars. The sheet is passed through a set of rollers and then to glue coated roller where in the consistency of the hot glue is maintained. the glue is heated in a kettle on a water vat at 60^{o}C after adding the water content specified earlier. The glue coated sheet passed through a trimmer to get removed excess glue and then to abrasive zone. Abrasive sieved particles (if necessary warmed) are allowed to drop on glue coated paper by gravity fore. In some of the machine, abrasive grains are sprayed against the glue coated paper. This process is better compared to gravity system. The grit paper is then travelled through a hot zone wherein heat is circulated uniformly by fans. A second coating is again given on the grit and then allowed to dry for slice and piece cutting. The cut pieces are then inspected and packed for stering and despatching.

PRODUCTION DETAILS AND PROCESS OF MANUFACTURE

The scheme envisages to produce 12000 reams of coated abrasives paper and cloth of any one of the following varieties on demand.

No.of Abrasive	Trade Designation	Market Potential
24	Extra coarse	As per order
30	Extra coarse	As per order
36	Coarse	Good market
40	Coarse	Possess good market in considerable quantities
50	Medium	
50	Medium	
80	Fine	
100	Fine	
120	Fine	
150	Extra fine	Very rarely the demand comes
180	Extra fine	
200	Super fine	

A ream comprises 500 sheets of coated abrasives of standard size of 297x210 m.

RAW MATERIALS

Adhesive based good quality kraft or mania paper possess flexibility with substance in any of the following four ranges shall be used as a backing material. It should possess tensiles strength to the following tune after coating Grams per sq.mtr.

70 to 75, 90

100, 110, 120

150 to 170

200 to 220

110 GSM is largely used and be considered the best sized paper for abrasives. Heavy Binny Drill, Light binny drill or plain weave cloth as specified by the purchaser may use for backing. The cloth shall be free from any imperfection that may effect its service ability.

Adhesive

The adhesive must be good quality glue suitable for the manufacture of coated abrasives. Cattle hide glue or a mixture of cattle hide glue and gelatin is generally used. The glue may be dissolved in water in ratio mentioned in the trade designation.

Glue : Water	Trade Designation
1:2	Fine
1: 0.8	Coarse
1:5	For second coating on coarse

In the latest and automatic precesses of manufacture of sand paper wherein so called gravity and clectrostatic methods of coating of abrasive are used glue and synthetic resins are employed as adhesives.

PLANT AND MACHINERY

Plant and machinery required for this project are available indigenously.

PLANT LOCATION

A plant to manufacture coated abrasive can be established in the district of Jamnagar or in Sabarkantha district.

COST OF PROJECT

The project cost to manufacture 12,000 ream p.a. of coated abrasives would be of the order of Rs.11.00 lakhs, considering following presumptions :

1. The unit will work normally on a single shift per day for 300 working days in a calender year.
2. Only six hours production per day is taken into consideration for sales and profit network.
3. The production capacity estimated is at 12,000 reams per annum.

		Rs. in lakhs
1.	Land & Building	1.40
2.	Plant & Machinery	5.15
3.	Raw materials	1.25
4.	Working Capital	3.20
	Total :	11.00

QUALITY CONTROL AND STANDARD

Indian Standard Institution (ISI) has drawn specifications for coated abrasives. These IS specifications relate to the quantities of backing to be employed, forms and diensions of the products, grandings of grits used, tensile strength of finished abrasive papers, width etc. The relavant standars specification is : IS 715-1962 for coated Abrasive Glue Bended.

MACHINERY SUPPLIERS

1. M/s Universal Abrasive
   Prakash Talkies, Mangalhat
   Hyderabad

   Suppleirs of Emery Cloth
2. M/s Binny Textiles
   Thambuchetty Street
   Madras

RAW MATERIAL SUPPLIERS

Craft Paper

1. M/s Punalur Paper MMills
   Punalur, Kerala
2. M/s Unicrafts
   Anderson Street
   Madras

Glue

1. M/s Bawa Gelatine India Ltd
   202 Katrabasian, Fatehpuri
   Delhi-6
2. M/s Suresh Chandra & Sons
   68 Vidya Apartment
   Chowpathy band Stand, Siri Road
   Bombay
3. M/s Shaw Wallace & Company
   8/9 Thambuchetty Street
   Madras
4. M/s Indo chem (P) Ltd
   52/54 Ratna Bazaar
   Madras

Flio (Uncalcined)

1. M/s Alirox Abrasives
   Arcot, Sale
   Dist. Tamilnadu
2. M/s Sri Lakshmi Emery Co.
   31, Algapura Main Road
   Salem

Emery Grit

1. M/s Sandeep Abrasive
   A/7 M P Shah
   Udyognagar, Jamnagar
2. M/s Western Emery Industry
   GIDC Dhrol
   Dist. Jamnagar
3. M/s Prince Emery (India)
   GIDC Udyognagar, PO Khambhaliya
   Dist. Jamnagar
4. M/s Dipak Emery (India)
   Near Ravi Petrol Pump
   Hapa, Dist. Jamnagar

EMERY GRAINS

INTRODUCTION

Jamnagar district is well-known for its bauxite production. Emery lump and grains are manufactured in small scale by private sector in Hapa and Jhamkhambhaliya. At present there are 10 units producing 46,300 tonnes capacity in the State. The two units are in operation in the Mehsana district utilizing Sabarkantha bauxite resources.

Emery grains in various grades and sizes are used for making grinding wheels, emery paper, emery cloth and paste for grinding and sharpening of various Industrial Products and tools. Emery powder is also used as brushing and polishing in electroplating shops and ball mills for removing the upper skin of pulses.

MARKET POTENTIAL

Emery grains being a consumable product, there is continued demand for it. Besides, due to the general indusrtrialisation and growth of engineering and metallurgical industries, a general trend in the increase is use of abrasive materials is noted. This industry will, therefore, have ample opportunity of development not only for present but in the near future also.

MANUFACTURING PROCESS/TECHNOLOGY

Pearl coke grits and raw bauxite in the form of small lumps and charged in the vertical kiln in alternate layers and sintered at a temperature of about 1300°C to 1400°C depending upon the impurities present in the bauxite. The lumps obtained from the kiln are first crushed in jaw crusher and then in roller crusher. The project is then separated out in different grades with the help of vibrating screens and packed in 50 kg. bags for sale.

PLANT AND MACHINERY

-	Vertical Kilns for calcination	3 Nos.
-	Air blower complete with pipe fiting valve etc.	1
-	Jaw crusher, capacity one ton per hour	1
-	Double roller crusher complete with 15 HP motor	2 Nos.
-	Vibrating screen with 2 HP motor	2 Nos.
-	Multi graders with screens, vibrating type 3 HP motor	2 Nos.
-	Water deepwell pump including water pipe line	1
-	Storing drums, weighing scale etc.	
-	Installation & erection charges @ 10%	
-	Office equipment & furniture.	

RAW MATERIALS

Raw bauxite 200 tonnes at @ Rs. 110/- per ton and per coal grit 100 tonnes @ Rs. 1200/- per ton. Raw bauxite can be purchased from the existing bauxite leaseholders.

PROJECT SIZE

It is desired to manufaacture five tonnes of emery grains per day on single shift basis involving cost of Rs. 12.00 lakhs.

		Rs. in lakhs
1.	Land of 3000 sq.mtrs. & building of work-shed 350 sq.mtr.	3.00
2.	Machinery & Equipment	4.00
3.	Working capital for 3 months	5.00
	Total :	12.00

UTILITY

1.	Water	:	100 litres
2.	Power	:	50 HP
3.	Manpower	:	9 skilled, 20 unskilled

SUGGESTED LOCATIONS

Dehgam, Bayed are the ideal location in Ahmedabad and Sabarkantha districts. New industrial policy 1990-95 has included Bayad in Category I and Dehgam in category II for subsidy. Kapadwanj and Thasra are also another locations where Kheda bauxite resources can be utilized.

GOVERNMENT POLICY/KEY ELEMENTS

- SSI registration from General Manager Office.
- Coal supply from the allotment of Industries Commissionerate office.
- Captive mine can be acquired under MCR 1960 from the State.

LIST OF PLANT & MACHINERY SUPPLIERS

1. Shri Vishwakarma Udyog Works
   Bedeshwar, Jamnagar
2. Lokmanya Engineering Works
   26, Bharat Khand Cotton Mills Compound
   Naroda, Ahmedabad 380 016
3. Kusum Engineering Co. Ltd
   25, Swallow Lane, Calcutta -1
4. Amic Inudstries Pvt. Ltd
   10 BT Road, Calcutta-56
5. Hayee Engineers
   Sentinel House No.2, Second Floor
   Arthur Bunder Road, Colaba
   Bobay 400 005

LIST OF RAW MATERIALS SUPPLIERS

Bauxite leaseholders who are able to supply raw bauxite from the Sabarkantha and Kaira districts are mentioned below.

1. Gayatri Corporation
   2, Mata Indl. Estate
   B/h Ritanagar Vastral Road
   Amraiwadi, Ahmedaabd 26
2. Jay Vijay Minerals Mill
   Desai Nagar
   Talod 383 215 S.K
3. Jayantilal D. Patel
   P.O Talod, Ta. Prantij
   Dist, Sabarkantha

LIST OF SOME OF EXISTING UNITS

1. Arati Industries
   Phase II, GIDC Indl. Estate
   Mehsana
2. Gujarat Abrasives Products
   Opp. Petrol Pump
   P.O Vijapur 382 870
3. Western Emery Industries
   GIDC Dhrol
   Dist Jamnagar

HIGH ALUMINA REFRACTORY BRICKS

INTRODUCTION

Refractory industry is a mineral based and labour intensive. To ease the unemployment situation in rural and tribal areas of Kachchh, Bharuch, Sabarkantha districts, this sector can contribute significant result. It is an important feeder industry to various consuming industries including Core Industries like Iron & Steel, Fertilizers, Petrochemical, Cement, Ceramic and Metallurgical industries. practically 75% of the refractories produced in the country are being consumed by iron & steel industries. The rest part goes to cement, glass, thermal power plants in non steel sectors.

The choice of refractories depends upon the specific conditions in the furnaces and the scope of inter-change-ability between one type of refractory and another is some what limited. The growth and development of Refractory Industry is mainly linked with the development of Iron & Steel Industry which consumes nearly 75% of total out of Refractories.

Refractory materials are defined as those resistant to heat and having a melting temperature of not less than 1580°C (Seger cone 26). There are many substances both metal and non-metals (oxides, carbides nitrides) that satisfy the foregoing definition. But for obvious reasons metals cannot be used in the construction of furnace hearths or chambers. The choice is therefore for other materials occuring in nature, mostly as oxides, hydroxides, carbonates, sulphates etc. These are both cheap and available in abundance in nature.

The function of a refractory lining is not only to withstand high temperature, but also to resist temperature fluctuation, slag and metal penetration, abrasion and erosion by hot gases, molten slags and metals. The project profile envisages the manufacture of high alumina refractory.

MARKET POTENTIAL

The modernisation of "Rourkela Steel Plant", "Durgapur Steel Plant", "Indian Iron & Steel Co. Ltd." challenged the refractory industry. It took up the challenge and have produced sohphisticated high alumina bricks for stoves. Manufacturers are well equipped and fully geared to meet the requirement submerged nozles, shrounds. Industry is on the threshold of change. Project can be set up in the medium scale. They are twenty units who are able to adopt changed pattern of demand and producing quality.

With the changed pattern of practices followed by consuming industries, the requirement of refractory bricks are increasing. Twentyeight units covering 7,57,426 MT/A licensed capacity are manufacturing high alumina refractories. Above capacity includes ordinary fire-clay. Nearly 90% of the refractory grade bauxite is exploited from the State. They are utilised in eastern sector refractory units. At present four high alumina refractory units with install capacity of 30,000 MT/A are in operation in the State.

The demand for refractories in the country by 1989-90 is estimated to be about 7.2 lakh tonnes of fire-clay and high alumina refractory.

Gujarat and its neighbouring States of Maharashtra, Rajasthan and western parts of Madhya Pradesh and Southern region of Uttar Pradesh are all fast growing in industries and offer potential marketing area. State has seven large cement factories, three fertilizer plants, re-rolling mills, iron foundaries, non-ferrous metal industries and textile mills, but only four medium scale units are in operation to manufacture of high alumina refractory. The raw materials and machines required for the manufacture of high-alumina refractory are available in the indigenously. fuel to be utilised for the kiln is considered L.D oil. If gas can be made available for kiln, it can be switched to natural gas. In view of above, there exists a scope to set-up few units for the manufacture of high-alumina refractories.

MANUFACTURING PROCESS/TECHNOLOGY

The main raw materials are bauxite, fire-clay, while in smaller quantity, bentonite, kyanite, sillimanite, diaspore, pyrophilite are needed. Refractory are shaped mainly by three different processes.

(1) Hand moulding (2) Partly hand-moulding and partly pressing (3) dust pressing

In the raw mixture powder after proper ratioing a water is added in the mixing machines. Mixing machines of double shaft mixer or counter current mixer are utilised. Material after thoroughly mixed fed into-deairing pug mill for extrusion. The extruded mass which comes out in the shape of a continuous column is cut to required lengths and are then shaped by pressing in suitable presses, at a pressure of about 1500 lbs/sq.m inch. These bricks are allowed for drying in hot chambers or in summer in well ventilated rooms. After dyring the bricks are loaded in kiln for firing at the temperature of about 1600°C to 1700°C. The kiln is allowed for cooling. The cooling must be done very slowly. When the kiln is sufficiently cooled, the bricks are taken out from the kiln and are tested. For medium scale project consultancy services is offered by "S.S.Das Ceramic Consultancy Services" Berhampur district Ganjam Orissa. For large scale project enrolling investment upto Rs. 600 crores Joint Sector Herbison woker can offer consultancy.

PLANT & MACHINERY

- Jaw crusher
- Pulveriser
- Muller Mixer 2 Nos.
- Pipe mill
- Continuous ball mill
- Travelling weighing machine
- Electric motors
- Laboratory equipments & aparatus.
- Disintrigrator
- Perforated bottom Pan Mill
- Friction screw press 2 Nos.
- Magnet
- Compresser & tools
- Vibrating
- Oil tank, burner, blowers, pipeline, fitter, oil heater

RAW MATERIALS

The main raw materials used are bauxite and fire-clay Calcined bauxite can be purchased or calcination from raw bauxite can be done simultaneously either in down draft or rotary kilns. Kyanite, sillimanite can be purchased from Rajasthan.

For the establishment of the kiln, it is proposed to have oil fired kilns which is both economical and easy for the operation. In future, it can be converted into gas fired on the availability of the natural gas. The requirements for high alumina bricks characteristic on the basis of percentage of alumina applicable to machine moulded refractory bricks are essential as mentioned below:

Sl. No.	Characteristics	Requirement		
		35 % Alumina bricks	55% Alumina bricks	60 % Alumina bricks
1.	Al_2O_3 Percent, Min.	35	55	70
2.	Fe_2O_3 Percent, Max.	2.5	2.5	3.5
3.	Pyrometric cone equivalent (Orton) Min.	30	34	36
4.	Permanent linear change	± percent at 1350 °C for 5 h	± percent at 1400 °C for 2 h	± percent at 1500 °C for 2 h

5.	Refractoriness under lead (RUL) in, min.	1300 °C	1400 °C	1450 °C
6.	Apparent perosity, percent, Max.	25	25	23
7.	Cold crushing strength kgf/cm^2 Min.	250	300	400

PROJECT SIZE

The project envisages to manufacture of 40 MT of green high alumina brick per day with a two shifts at an estimated cost of Rs. 1.55 crores, mostly refractories of 35% & 55% alumina bricks.

1.	Land & Building	0.40 crore
2.	Plant & Machinery	0.70 crore
3.	Capital Investment	0.45 crore
	Total :	1.55 crore

UTILITY

1.	Power	:	250 HP (per month)
2.	Water	:	5000 ltr. (per month)
3.	Fuel oil	:	250 kilo litre (per month)
4.	Manpower	:	27 (skilled 17, unskilled 10)

SUGGESTED LOCATIONS

On the availability of raw material, power, it is a dvisable to locate the unit in Jamnager, Jhamkhambhaliya in Jamnagar or Dehgam in Ahmedabad, Kapadwanj in Kaira District.

GOVERNMENT POLICY/KEY ELEMENTS

- Bauxite with specification of Al2O3-5% to 61%, Fe2O3-0.05% to 2%, TiO2-1.70% to 2.60%, Sio2-1.50% to 5.50%, L.O.I 31%, CaO+MgO+Alkali 1%(Max) or calcined bauxite with 85-87% Al2O3, 2.75% to 3.75% Fe2O3, Tio2 3.75%, Sio2 6-7%, CaO+MgO+Alkali 0.50% to 0.75% are desired. So arrangement have to be made from existing lease holders or captive mines in unreserved area can be procured.
- Chamber kiln builders from West Germany or England can be engaged for the erection.
- Laboratory for the testing final product as per ISI standard must be erected.

LIST OF PLANT & MACHINERY SUPPLIERS

Press mixer

1. Modern Fabricators & Engg. Works
   Saijpur, Ambawadi, B/h Mahadev's Mandir
   Naroda Road, Ahmedabad 380 002
2. Vijay Surgical & Engg. Works
   32, Uttar Gujarat Audhyosik Vasahat
   Opp. Forge & Blower, Naroda Road
   Ahmedabad 380 002
3. Tools Engineering Works
   Patel Market, Sunder Vas
   Udaipur 313 001

Chamber kiln Builders

1. Karl August Heimsoth Industries
   Tunnel - Ofenbau GmbH, Hildesheim, West Germany
2. Oms Ittner & CIE
   Koln Braunsfed, West Germany
3. Georg Mendheim
   Industries of enanlagen
   8 Munchen - 27, West Germany
4. Gibbsons Bros. Ltd.
   PO Box 19, Dudley Worcesthire, England

Consultant

1. Ceramic Minerals Consulting
   D-6255 Dornburg, Lang endernbach , UK
2. S.S Das Ceramic Consultancy Services
   Berhampur, Dist. Ganjan, Orissa

LIST OF RAW MATERIAL SUPPLIERS

1. Gujarat Mineral Development Corpn.
   Khaniji Bhavan, Opp. Nehru Bridge
   Ashram Road, Ahmedabad 380 009
2. The Bombay Mineral Supply Co. Pvt. Ltd
   Vazir Fali, Jamnagar 361 001
3. Saurashtra Calcine Bauxite & Allied Industries
   118-119, GIDC Indl. Estate
   Porbandar 360 577

LIST OF EXISTING MANUFACTURERS

1. Gujarat Refractories
   908, Shilp, Nr. Municipal Market
   Navrangpura, Ahmedabad 380 009 *(Oil fired kiln)*
2. Natraj Ceramic & Chemicals Industries Ltd.
   PO Box 10, Khambhaliya 361 305
3. Inter Kiln refractory Ltd.
   12/4 GIDC Kadi
   Dist. Mehsana *(Gas fired kiln)*
4. Special Refractory Industries
   72, GIDC Estate
   Vatva, Ahmedabad *(Down draft kiln)*
5. VRW Refractories
   (A Unit of MAC Industrial Products Ltd)
   Plot No. 1513, G.I.D.C Kerala Industrial Estate
   Dholka
   Phone - 027147 - 38356

HIGH ALUMINA CEMENT

INTRODUCTION

The Indian cement industry, despite dire predictions is alive and kicking. India occupies the Fifth position among the cement producing countries of the world. Cement industry is to develop export market. The Eighth plan lays great emphasis on export of cement. The plan projects exports in 1996-97 will be about 5 million tonnes.

Big houses are planning cement plants in Madhra Pradesh, Rajasthan and Gujarat in the western sector. State of Gujarat is very rich in bauxite, limestone and marine gypsum. At present, the product is imported from abroad. All the raw material required for the special cement is easily available in Jamnagar and Kachchh districts. The product can be manufactured in SSI sector.

MARKET POTENTIAL

Kiln lining in cement, steel glass, fertilizer need high temperature with standing high alumina refractory. Highy alumina cement can be an import susbsitute for the similar types of cements being imported. It has good market in steel, fertilizer and power plants sector.

PROCESS

High alumina cement (45-78% alumina) can be manufactured from indigenous raw materials like bauxite/technical alumina/hydrated alumina and limestone/calcite with minor addition of other ingredients at the maturing temperatures ranging from 1300°C, 1350°C, 1400°C, 1450°C and 1500°C respectively, after usual conventional processing like crushing, grinding, vibromilling, dewatering, drying, firing and fine grinding of the cement sinters/melt to cement fineness. The process enables in minimising (i) the temperature of sintering (ii) the high cost infrastructural facilities in the form of machinery and kilns and the cost of production of unit and products.

COST OF THE PROJECT

The cost of 1000 tonnes capacity of high alumina cements (45-50%, 400-T, 65-66% 300 T & 75-78% A/203 type 300 T) per annum will need investment of Rs.72.00 lakhs and has around 24% profitability.

	Rs. in lakhs
Land & Building	6.00
Plant	45.00
Working capital	21.00
Total	72.00

SUGGESTED LOCATION

Raw material availability of bauxite, limestone is good in Jamnagar and Kachchh districts. The plant can be located in the Jamnagar and Kachchh districts. Site of the plant should be in Kalyanpur taluka of Jamnagar district or in the Mandvi taluka of Kachchh district.

RAW MATERIALS

The main raw materials required are limestone, bauxite, both the minerals are available in good quantity in the State.

9.0 LARGE SCALE BAUXITE BASED PROJECTS IN PIPELINE IN THE COUNTRY

9.1 Birla have come forward for setting up aluminium and bauxite based units in Kerala. According to the State Industry Ministry Mrs. K.R. Gauri, Birlas have offered to invest Rs. 600 crores for exploiting the State's bauxite resources in Cannannore and Kasargode districts. A decision will be taken on Birla's offer as soon as the survey by KSIDC is completed and the project report submitted. Another industry in which Birlas have shown interest, of late, is aluminium. The proposal is to set up integrated aluminium complex.

9.2 Essar group is bidding to revive a project to produce alumina from bauxite deposits in Ratnagiri district of Maharashtra. This project is reported to have been officially sanctioned and will be carried out by the Essar Investment Ltd. There is talk of shipping this alumina to the Middle East for smelting. Such an arrangement would fall in very well with the Essar group's on- going attempts to accord more business to its shipping division from new Essar ventures. Aluminium Penchinery, the French collaborator of Nalco, is likely to tie up with Essar in the Ratnagiri project.

9.3 Larsen & Toubro Ltd has plans to set up a Rs. 1080 crore project to exploit the vast untapped bauxite deposits in Andhra Pradesh. The project, tentatively sited at Krishnadevipeta in Visakhapatnam district of Andhra Pradesh, will manufacture one million tonnes of sandy alumina, the intermediate in the manufacture of aluminium. Andhra Pradesh has abundant deposits of bauxite, the basic raw material. During 1970s, two projects were proposed - one in Orissa and other in AP - to exploit the bauxite deposits in the two States.

9.4 Larsen & Toubro proposes to set up a 100% export oriented alumina unit at Visakhapatnam. The total investment on the project would be Rs. 1080 crores, which includes a foreign exchange component of Rs. 397 crore. The company's application is before the special board of approvals for 100% EOUs/Free Trade Zones set up in the union Commerce Ministry.

9.5 Gujarat Mineral Development Corporation has signed M.O.U with M/s Raythcon Engineers & Constructors U.S.A for 600,000 tonnes per year Alumina plant integrated with 70 MW cogeneration and 3 MGPD evoporative desalination facilities.

9.6 Saurashtra Calcine Bauxite & Allied Industries Ltd is implementing two projects viz. (1) project of the calcined Bauxite by Rotary kiln process at village - Bhatia. T: Jam-Kalyanpur. Dist: Jamnagar with an installed capacity of 36000 MT per annum and (2) grinding unit for calcined bauxite at GIDC industrial estate, Porbandar with an additional installed capacity of about 12,000 MT. per annum.

MAJOR EQUIPMENT & MACHINERY

Jaw-cum-Roll Crusher, Impact Mill, Edge Runner, Vibratory Tube Mill, Magnetic Separator, Extrusion, Pug Mill, Sieving Machine, Mixer, Drying Chamber, Furnace.

UTILITIES

Power	: 500 KVA
Water	: 400 KL
Personnel	: Skilled - 15 ; Unskilled - 37

TECHNOLOGY SUPPLIERS

1 Central Glass & Ceramic Research Institute
Calcutta-700032

2 National Council for Cement & Building Materials
M-10 South Extension II, Ring Road
New Delhi-110 049

Technology will be released through National Research & Development Council on royalty basis or on a charge basis.

RAW MATERIAL SUPPLIER

Bauxite

1 Gujarat Mineral Development Corpn.
Khanij Bhavan, Opp Nehru Bridge
Ashram Road, Ahmedabad-380 009

2 Bombay Mineral Supply Co.
Vali Faliya, Jamnagar

3 Bharatkumar Prabhudas Makhecha
Kedareshwar Road, PO Porbandar
Dist. Junagadh

Limestone

1 RJ Trivedi & Sons
Sherbagh, PO Gadu, Tal. Veraval
Dist. Junagadh

2 Pethalji Nathabhai
PO Junagadh

MACHINERY SUPPLIERS

1 M/s Jyoti Ltd (Furnace)
PO Chemical Industry
Baroda-390 003

2 M/s Lokmanya Engg Works (Extrusion, Pug Mill, Mixer)
26 Bharat Khand Cotton Mills Compound
Naroda Road
Ahmedabad

3 M/s Sayaji Iron & Engg Co. (Jaw Crusher)
Chani Road
Baroda-390 002

ANNEXURES

Typical Analysis of Alumina Used in the Production of Aluminium

Description	Percentage
Chemical Composition	
Silica (SiO_2)	0.02
Iron oxide (Fe_2O_3)	0.02
Tatanium dioxide (TiO_2)	0.003
Phosphorus Pentoxide (P_2O_5)	Nil
Potash (K_2O)	Nil
Sulfur trioxide (SO_3)	Nil
Soda (Na_2O)	0.45
Calcium oxide (CaO)	0.02
Lead (Pb) Nil	
Alumina (Al_2O3)	Bal.
Ignition Loss and Water Absorption:	
Loss on ignition (1,000°C)	0.67
Water absorption (bone dry-basis)	3.16
Screen Analysis (Tyler mesh):	
+48	Nil
-48+100	0.5
-100+200	53.5
-200	46.0
-325 (Wet on original sample)	12.0

Activated Alumina:

Activated alumina is a highly porous and granular form of aluminium oxide having preferential absorptive capacity for moisture from gases, vapors and some liquids. When saturated it can be reactivated by the controlled application of heat within the range of 350° to 600°F to drive off the moisture. It is used as a drying agent, catalyst or catalyst carrier.

Calcined Alumina:

Calcined alumina is a high purity alpha-alumina produced by heating at 2000° to 2300°F hydrated alumina (Al2C3.3H2O) precipitated from sodium aluminate liquor in refining of bauxite ores by the Byer process. Production of aluminium is the principal use of calcined alumina. Various grades of calcined alumina are produced under carefully controlled conditions for the manufacture of fused alumina abrasive and high temperature refractories. High grade ceramic shapes are made from alumina calcined at 2700° to 2900 °F with a high melting point of 3700°F and a hardness of 9 on Mohs' scale.

10.0 GLOSSARY

Bauxite:

Bauxite is a rock composed principally of the aluminium oxide minerals, gibbsite, beehmite and diaspore. Gibbsite is a trihydrate (Al_2O_3. $2H_2O$). Boehmite and diaspore are monohydrates ($Al_2O_3.H_2O$). Major impurities in the bauxite ores are iron oxides, aluminium silicates and titanium oxides. Types of bauxite ores are generally identified as Jamaican, Surinam and European. The Jamaican type is a mixture of both trihydrate and monohydrate minerals and containing about 50% Al_2O_3, 1 to 2% silica and 20 to 30% iron oxite. The Surinam type is mainly the trihydrate gibbsite usually containing 50% or more Al_2O_3, 2 to 15% silica and 5 to 15% iron oxide. The European type contains the monohydrates, boehmite and diaspore and is about 55% alumina, 4% silica and 10 to 20% iron oxide.

Crude Bauxite:

Crude bauxite is bauxite as mined containing from 5 to 25% free moisture.

Activated Bauxite:

Activated bauxite is used as an absorbant to refine sugar syrups and liquors, dehydrate and filter petroleum products, and act as a drying agent in industrial processes. It is processed by crushing and heating selected bauxite at 250° to 350° F to remove free water. After further crushing and screening it is thermally activated, the temperatures differ depending on the various uses of the product. the activated bauxite is cooled to 300°F and screened and deironed. It can be regenerated repeatedly for a number of cycles by controlled heating.

Dried Bauxite:

Dried bauxite is prepared by heating crude bauxite in a drying kiln at about 1,100°F for 15 to 40 minutes to reduce the free moisture to less than 1%. Uncontrolled heating may cause calcining and reduce the solubility of the alumina hydrate in the Bayer process.

Calcined Bauxite:

Calcined bauxite for the abrasive and refractory industries is processed by heating in kilns at 1700°to 2900°F depending on the use for about 1 to 1 1/2 hours to reduce total volatile matter including the chemically combined water in the ore to less than 1%. About 2 tons of crude ore produces 1 ton of calcined bauxite. Bauxite specifications vary with plant and ultimate use. National stockpile specifications for all grades except chemical have been established.

Red Mud:

Red mud, the residue that results after alumina, is extracted from bauxite by the Bayer process, consists largely of a complex sodium aluminium silicate and iron oxides. In the combination process the red mud is the feed to a subsequent lime-soda sinter step. The residue from the combination process is called brown mud or sinter mud and contains calcium silicates and iron oxides but little sodium aluminium silicate.

Alumina:

Alumina is aluminium oxide Al2O3, the calcined product of Bayer or combination processes. Corundum, emery, ruby and sapphire are natural mineral forms. In the commercial form it is a fine white powder containing about 0.5% impurities. A typical analysis of alumina used in the production of aluminium is given in the the following table.

Annexure-1

Bauxite Prospecting Report in Gujarat State

Sr. No.	Title of the Report	Year	District
1.	Report on the investigation for bauxite in some villages of Mandvi tal. Kutch dist.	1963-64	Kutch
2.	A report on the investigation for bauxite in some villages of Lakhpat tal. Kutch dist.	1964-65	"
3.	Report on the bauxite deposits in Kumkma Lakhond, Satapur, Ratnal, Mamura, Wamoti(M) Wamoti(N) & Bhunjai villages of Kutch dist.	1964-65	"
4.	Report on the bauxite deposits of Kutde, Jarjkok, Narodi Nandra and Balachar(N) village, Kutch dist.	1964-65	"
5.	Report on the bauxite deposits of Nagrach village, Kutch dist.	1965-66	"
6.	Report on the bauxite deposits in Amreli, Bhavnagar and Junagadh districts	1965-66	Amreli, Bhavnagar Junagadh
7.	Report on prospecting of bauxite deposits in some of the villages of Kalyanpur Mahal, Jamnagar dist.	1966-67	Jamnagar
8.	Report on the assessment of bauxite reserves in the lease areas of Jamnagar dist.	1966-67	"
9.	Report on the bauxite deposits in some of the villages of Kalyanpur Mahal, Jamnagar dist.	1966-67	"
10.	Report on the assessment of bauxite deposits in Kutch dist. Part I, II & III	1967-68	Kutch
11.	Report on Bulsar bauxite investigation carried out during the F.S. 1968-69 - 1969-70	1968-69 & 1969-70	Bulsar
12.	Report on investigation for bauxite in some villages of Mandvi & Mundra tal.of Kutch dist.	1970-71	Kutch
13.	Appendix No.1, the report on the assessment of bauxite deposits in Kutch dist.	1970-71	"
14.	Apendix No.3 of the report on the assessment of bauxite deposits in Kutch dist.	1970-71	"
15.	Sabarkantha(Harsol) bauxite scheme	1970-71	Sabarkantha
16.	Report on investigation for bauxite in some villages of Thasra, Kaira dist.	1970-71	Kaira
17.	Report on investigation for bauxite in Khanni villages of Abdasa & Lakhpat tal.of Kutch dist. (compiled report)	1971-72	Kutch
18.	Report on investigation by drilling for bauxite in villages of Nakhatrana & Abdasa tal. of Kutch dist.	1972-73	"

Tabular Alumina:

Tabular alumina, also Al_2O_3, is prepared by heating $Al_2O_3.3H_2O$ to slightly below the fusion point of alumina (3700^oF). It is used in refractories, in insulators and as a filter in plastics.

Alunite:

Alunite is generally known as "Alumstone". It is hydrated sulphate of aluminium and potassium/sodium formula - $K_20.\ 3Al_2O_3,\ 4SO_3,\ 6H_2O$.

Boehmite:

Monohydrate of alumina, $Al_2O_3\ H_2O$. Forms under non-tropical weathering conditions from aluminous minerals. High richer in alumina content than trihydrate is difficult to digest.

Cliachite:

A colloidal form of hydrated alumina. $Al_2O_3\ NH_2O_3$ with a variable H_2O content. Occurs as a solidified hydrogel of Al and other constituents Fe, Ti and Mn.

Diaspore:

Monohydrate of alumina, $Al_2O_3\ H_2O$. Forms under non-tropical weathering conditions from aluminous minerals. Though richer in alumina content than trihydrate, is difficult to digest.

Diasporogllite (Sporogellite):

A collodial form of hydrated alumina $Al_2O_3H_2O$. Though the water content is variable is nearer to a monohydrate. Occurs as a solidified gel.

Gibbsite:

Trihydrate of alumina $Al_2O_3.3H_2O$. Gibbsite the trihydrate form of alumina is a common constituent of bauxite occurences in tropical and sub-tropical lauxie lauxie deposits, is eminently suitable for alumina manufacture as it is easy to digest.

Laterite:

Residual deposit of hydrated Al, Fe, Mn, Tie, etc. formed under tropical and sub-tropical weathering conditions.

Latosoil:

Reddish residual soil associated with --- formed in tropical and sub-tropical climate.

Natroalutite:

It is also hydrated sulphate of aluminium in which sodium replaced potassium in past giving natroalumite.

Alunite group consists of Rhombohedral sub-systems having following minerals, is isomorphous group.

Alunite $K_2A16\ (OH)\ 12\ (SO_4)4$

Natroalunite $Na_2A16\ (OH)\ 12\ (SO_4)4$

Jarosite $K_2Fe_6\ (OH)\ 12\ (SO_4)4$

Natrojarosite $Na_2Fe_6\ (OH)\ 12\ (SO_4)4$

Plumbojarosite pb $Fe_6\ (OH)\ 12\ (SO_4)4$

1.	2.	3.	4.
36.	Report on concealed bauxite in the area between Jarjek & Kharuva vill. of Abdasa tal., Kachchh dist.	1977-78 to 1979-80	Kutch
37.	Report on the investigation of bauxite near Ambaliyara vil. tal. Bayad, dist. Sabarkantha	1984-85 to 1985-86	Sabarkantha
38.	A Geological report on the detailed survey carried out for bauxite & siderite around vill. Jhulovi & Saran of Lakhpat tal. of Kutch dist.	1972-73	Kutch
39.	Report on the investigation of bauxite near Ambaliyara Chandrej & Vasani villages of Bayad tal., Sabarkantha dist. (complied report)	1983-84	Sabarkantha
40.	Report on concealed bauxite deposits around Netra & Badiara village of Nakhatrana tal. of Kutch dist.	1986-87	Kutch
41.	Report on Bulsar bauxite	1970-71	Bulsar
42.	Field report of detailed exploration by drilling for concealed bauxite around villages Wamoti (Nani), Duban and Khanai of Abdasa tal of Kutch dist.	1980-81	Kutch
43.	Report on the investigation of bauxite near Ambaliyara, Amapur villages of Bayad tal. of Sabarkantha dist.	1986-87	Sabarkantha
44.	Report on concealed bauxite deposit of Bayad tal. of Sabarkantha dist.	1987-88	Sabarkantha

Source: Directorate of Geology & Mining, Meghaninagar, Ahmedabad.

1.	2.	3.	4.
19.	Report on pre-detailed mineral survey work special ref. to bauxite in Bhachau & Rapar tal. of Kutch dist.	1974-75	Kutch
20.	Report on the concealed bauxite deposits in some of the villages of Kalyanpur tal. of Jamnagar dist. (complied report)	1974-75	Jamnagar
21.	Report on investigation for bauxite in Kutch dist.	1974-75	Kutch
22.	Report on concealed bauxite in the area of Kalyanpur tal. of Jamnagar dist.	1976-77	Jamnagar
23.	Report on Kutch bauxite drilling scheme at Wanotital, Abdasa of Kutch dist.	1976-77	Kutch
24.	Report on continuation of drilling for concealed bauxite at village Kotadi tal. Mandvi, Kutch dist.	1982-83	"
25.	An interim report on investigation concealed bauxite by drilling around village Rasalia, tal. Nakhatrana, dist. Kachchh	1984-85	"
26.	Field report on the detailed exploration by drilling for concealed bauxite around village Kotdi Mahadavpuri of Mandvi tal. of Kutch dist.	1981-82	"
27.	Field report of the detailed exploration by drilling for concealed bauxite around village Khandi of Nakhatrana tal. of Kutch dist.	1983-84	"
28.	Report on the investigation of bauxite near Ambaliyara in Sabarkantha dist.	1979-80 to 1983-84	Sabarkantha
29.	Report on concealed bauxite deposits around Rasalia, Notra village, Nakhatrana tal.,Kutch dist.	1985-86	Kutch
30.	A report on bauxite deposits near Mural Dungari, Kalipuri & Ghadi village of Sabarkantha dist.	1977-78 to 1979-80	Sabarkantha
31.	An interim report on Ambaliyara bauxite drilling scheme in Sabarkantha dist.	1981-82	"
32.	Report on concealed bauxite deposits in parts of Mandvi, Nakhatrana & Abdasa tal. of Kutch dist.	1970-75	Kutch
33.	Appendix No.1 the report on assessment of bauxite deposits in Kutch dist.	1974-75	"
34.	Report on pre-detailed mineral survey in Bhachau tal. of Kutch dist. with ref. to look for bauxite in laterite zone	1974-75	"
35.	A report on the pre-detailed survey for concealed bauxite & bentonite in parts of Prantij & Himatnagar talukas of Sabarkantha dist.	1976-77	Sabarkantha

19. Kumardhubi Fireclay & Silica Ltd
Chartered Bank Building
Calcuta-1
Loc: Kumardhubi, Dhanbad, Bihar
Cap: 130000 T/annum

20. Orissa Industries
PO Barang, Cuttack, Orissa
Loc: Lathikata, Sundergarh, Orissa
Cap: 37000 T/annum

21. Orissa Cement Ltd
Rajanganapur, Orissa
Loc: Rajanganapur, Dist.Sundergarh
Orissa

22. Reliance Firebricks Pottery Co Ltd
11/12 Esplanale Mansions
Calcutta
Loc: Chanch, Dist.Dhanbad, Bihar

23. Stoneware Pipes(Madras) Ltd
Trivellore Rly. Station
Dist.Chingelput, Tamil Nadu
Loc: Trivellore, Chingelput, T.N.
Cap: 2600 T/annum

24. Tube Supplies Ltd
South India House, PO Box 60
99 Aremension St., Madras
Loc: Virugambakkam, Chingelput,TN
Cap: 6500 T/annum

25. Valley Refractories Pvt Ltd
40-V Vivekanand Road
Hariyana Nivas, 1st floor
Calcutta-7
Loc: Maithon Road, Dhanbad,Bihar
Cap: 36000 T/annum

26. Haryana Refractories Pvt Ltd
17 Ganeshchandra Avenue
Calcutta-13
Loc: Vallabgarh, Gurbaon, Haryana
Cap: 6000 T/annum

27. Modern Refractories
MIDC Hinghna Road, Nagpur
Loc: MIDC Hinghna Road, Nagpur
Cap: 2000 T/annum

B. Calcination

1. Carborandum Universal
Vottiyur
Madras
Loc: Okha, Gujarat
Cap: 30000 T/annum

2. Hyderabad Abrasives & Allied Inds.
1-4-453 Bholakpur
Secundrabad-500 003
Cap: 150 T/annum

3. The Ishwar Industries
Ishwarnagar, New Delhi
Loc: Ishwarnagar, New Delhi
Cap: N.A

4. Tube Suppliers Ltd
Vadapayhani Refractory Works
Madras
Loc: Virugambakkam, Madras
Cap: 750 T/annum

5. Orissa Cement Ltd
Refractory Works, Rajgangpur
Dist.Sundergarh, Orissa
Loc: Raajgangpur
Cap: 5000 T/annum

6. Harish Tava Refractories Pvt Ltd
HO Modi House
Ranchi, Bihar
Loc: MC Cheskeiganj
Cap: N.A

7. Sheveroy Pvt Ltd
Yercand, Salem, Tamil Nadu
Loc: Yercand, Salem, T.N
Cap: N.A

C. Abrasives

1. Carborandum Universal
11/12 North Beach Road, PB No.1677
Madras-600 001
Loc: Kalamassery, Ernakulam, Kerala
Cap: 7000 T/annum

2. Abrasives Tools Pvt Ltd
PO Palalikarani
Madras-600 072, Tamil Nadu
Loc: Pallikarani, Madras, TN
Cap: 72000 T/annum

3. Emery India Pvt Ltd
Krishna Kunj, Jamnagar, Gujarat
Loc: Bedeshwar, Jamnagar
Cap: 300 T/annum Emery grain & powder

4. Flexoplast Abrasives India Pvt Ltd
Plot No.10, Off Dr Moses Road
Worli, Bombay
Loc: MIDC Indl.Area, Chickalthana
Dist.Aurangabad, Maharashtra
Cap: 300 t/annum Emery grain & powder

Annexure-2

List of Bauxite Based Industries

A. High Alumina Refractories

1. Gujarat Refractories Ltd
908 Ship, Nr Municipal Market
Navrangpura, Ahmedabad
Loc: Sanand, Dist.Ahmedabad
Cap: 4800 MT/annum

2. Interkiln Refractories Ltd
12/1 GIDC Estate, PO Kadi
Dist. Mehsana
Loc: Kadi, Dist. Mehsana
Cap: 5400 MT/annum

3. Shri Natraj Ceramic & Chem.Inds.
PO Khambhaliya
Dist. Jamnagar
Loc: Jamkhambhalia
Cap: 1500 MT/annum

4. Special Refractories
72 GIDC Estate, Vatva
Ahmedabad
Loc: Vatva
Cap: 5000 MT/annum

5. ACC Ltd
Ament House, 121 Maharashi
Kanti Kurve Road, Bombay-400 020
Loc: Jabalpur, Madhya Pradesh
Cap: 30000 T/annum

6. Behar Firebricks & Potteries Ltd
Strand Road, Calcutta-700 001
Loc: Mugma, Dhanbad
Cap: 69400 T/annum

7. Belpahar Refractories Ltd
Belphahar, Orissa
Cap: 110,000 T/annum

8. Bharat Refractories Ltd
PB No.1, Bokaro Steel City
Dhanbad-827 001, Bihar
Loc: Bhandaridah, Dist.Giridih
Cap: 24000 MT/annum

9. Burn & Co Ltd
10-C Hunderford St.
Calcutta-700 017
Loc: Gulfurbari, Mugma, Dhanbad
Cap: 2500 MT/month
Loc: Niwar, Dist.Jabalpur, MP
Cap: 24000 MT/annum
Loc: Durgapuri(N), Burudwan, W.B
Cap: 9000 MT/annum
Loc: Ranigunj No.2, Dist.Burdwan,W.B
Cap: 12000 MT/annum
Loc: N.Civil Lines, Jabalpur
Cap: 25440 T/annum

10. Dalmia Ceramic Industries
Dalmiapuram, Tamil Nadu
Loc: Dalmiapuram, Trichy, Tamilnadu

11. Harish Tara Refractories Pvt Ltd
123-A Manohar Pukar Road
Calcutta
Loc: Ma Cluskieganj, Ranchi, Bihar

12. Harry Refractories & Ceramic Works Pvt. Ltd
Harry House, 640 Rabindra Sarini
Calcutta-3
Loc: Kalupathan, Nirsachati, Dhanbad
Cap: 2200-2400 T/annum

13. Hind Refractories Ltd
135 Bipalbi Rash Bihari Basu Road
Calcutta-1
Loc: Durgapur, Burudwan Dist., W.B.
Cap: 15000 T/annum

14. Hindustan Refractories & Ceramic P.Ltd
20 Netaji Subhas Road
Calcutta-700 001
Loc: Durgapur, Burudwan Dist., W.B.
Cap: 9000 T/annum

15. India Firebricks Induction Co Ltd
138 Medows St., Fort
Bombay-400 001
Loc: Marar, Dist.Hazaribagh, Bihar
Cap: 50000 T/annum

16. India Refractories
91 RN Mukherjee Road, Calcutta-1
Loc: Kulti, Dist.Burudwan, W.B.
Cap: 36000 T/annum

17. Ishwar Industries Ltd
PO Ishwarnagar, New Delhi-110 020
Loc: Niwar, Dist.Jabalpur, MP

18. Kharkharee Firebricks Works
91, Stephan House, 5th Floor
Dalhousie Sq.East, Calcutta-1
Loc: Kharkharee, Dhanbad, Bihar

7. GK Chemical Inds. Pvt Ltd
2764 Indgah Road, Sadar Bazar
Delhi-110 006
Loc: Vil.Sindhawali, Meerut Road
Muzaffarnagar-251 003
Cap: 110 T/annum

8. Hindustan Commercial Corp.
9/A Lal Bazar Street, 3rd Floor
Calcutta-700 001
Loc: 1-2-3 Kali Prasanna Singhe Rd
Calcutta
Cap: N.A

9. Indo Alkaloids & Pharmaceutical
112-C 1/B GIDC Estate, Nandesari
Baroda-391 340, Gujarat
Loc: GIDC Nandesari, Baroda
Cap: 60 T/annum

10. Kaayal Chemicals Pvt Ltd
10 Commander-in-Chief Road
Madras-600 105
Loc: F1& F2 SIPCOT Indl.Complex
Gummidipundi-601 201
Cap: N.A

11. Laxmi Trading Corpn.
Islampura St. Harawala Blg.
Compound, Bombay-400 004
Loc: 125/3 GIDC, Nandesari
Cap: N.A

12. Marathawala Chemical Ind.P.Ltd
Machlikhand Road, Maharashtra
Loc: S.No.43/2 Satara Road
Usmanpura, Ahmedabad
Cap: 1500 T/annum

13. Mittal Dhatu Rashayan Udyog
E-81 Indraprastha Indl.Area
Kota-324 005, Rajasthan
Loc: E-81 Indraprastha Indl.Area
Cap: 300 T/annum

14. Phenochem Industries
13/6 Punjabi Bagh (East)
New Delhi-110 026
Loc: 45 Phase II, NOIC, New Delhi
Cap: 90 T/annum

15. Para Chem Products
Parijat, Sheth CG Road, Ellisbridge
Ahmedabad
Loc: 5/25 Muni.Indl.Estate
Bapunagar, Ahmedabad
Cap: 100 T/annum

16. Piyush Chemicals & Pharmaceuticals
Pvt Ltd
Block AA-30, Salt Lake
Calcutta-700 064
Loc: Balgopalpur I.E, Balasore
Cap: 360 T/annum

17. Pushpamangal Chemicals
Thana Textile Rope Works Compound
Adj.Babusheth's Petrol Pump
LBS Marg, Thane-400 601
Loc: Thana Textile Rope Works
Compound, LBS Marg, Thane
Cap: 400 T/annum

18. Roschem Industries
226 Shapurji Bharucha Compound
12th Khetwadi Main Road
Opp Bhagini Samaj
Bombay-400 004
Loc: 122 GIDC Vapi, Gujarat
Cap: 5 T/annum

19. Shyam Chemical Products
F-477 Indraprastha Indl. Area
Kota, Rajasthan
Loc: F-477 Indraprastha Indl.Area
Cap: 30 T/annum

20. Soni Chemical Industries
3 Badriah Garden Street
Madras-600 003
Loc: PP Koli St., Brooks Estate
Chrompet, Madras, T.N.
Cap: 240 T/annum

21. Shree Devikarumariamman Chemical
Industries
49 Gangaiamman Koil Street
Vadapalani, Madras-600 026
Loc: SP-38 Phase-17, III Main Road
SIDCO Indl.Estate, Madras
Cap: N.A

22. Synthorg (Mysore) Pvt Ltd
831 Gokulam III Stage
Mysore-570 002
Loc: C-56 Indl.Estate, Yadavagiri
Mysore-570 020
Cap: N.A

5. Hyderabad Abrasives & Allied Inds.
1-4-453 Bholakpur
Secunderabad-500 003, A.P
Loc: Bholakpur, Secunderabad, AP
Cap: 25 MT/annum

6. Indian Abrasives
Industrial Area, Faridabad
Haryana
Loc: Faridabad, Dist.Xurgan, Haryana
Cap: 800 T/annum

7. Alirox Abrasives Ltd
PO Yercaud-636 601
Dist. Salem, Tamil Nadu
Loc: Yercaud, Salem, TN
Cap: 560 T/annum

D. Aluminium Sulphate

1. Allipo Chemicals
49 GIDC Makarpura
Baroda-390 010, Gujarat
Loc: GIDC, Baroda, Gujarat
Cap: 160 T/annum

2. Ankur Chemical Works
4007 Ajmeri Gate
Delhi-110 006
Loc: Vil.Alipur, Delhi
Cap: N.A

3. Key-Sun Enterprises
A16, Gautam Dhan Apt, Bahah Rd;
Vile Parle (W), Bombay-400 056
Loc: Vapi GIDC, Gujarat
Cap: N.A

4. Laxmi Chemicals
S-2/4 Industrial Estate
Angul-759 122
Dist. Denkanal, Orissa
Loc: Indl.Estate, Angul, Denkanal
Cap: 1800 T/annum

5. Mittolia Chemicals
503/504 Indl. Estate, Angul
Dist.Denkanal 759 122, Orissa
Loc: GIDC, Ankleshwar, Gujarat
Cap: 1800 T/annum

6. Shri Krishna Chemicals
206 Surat Sadan
88/89 Surat Street
Bombay-400 009
Loc: Plot-119, Silvasa Road
GIDC Vapai, Gujarat
Cap: N.A

7. Spee Chemical Industries
118/523 Kaushalpuri
Kanpur
Loc: E3 Pindi Indl.Area, Kanpur
Cap: 1000 T/annum

E. Aluminium Fluoride

1. Iegis Chemical Inds. Ltd
Baldota Bhavan, 117 MK Marg
Churchgate, Bombay-400 030
Loc: GIDC Estate, Vapi, Gujarat
Cap: 2000 T/annum

2. Navin Floridne Industries
(Chem.Dvn.of Mafatlal Fine Spg.
& Mfg. Co Ltd
Mafatlal Centre, Vidhan Bhavan Road
Nariman Point, Bombay-400 021
Loc: Bhestan, Surat, Gujarat
Cap: N.A

F. Aluminium Stearate

1. Arun Industries
303-A Vrindavan, Raamchandra Lane
Malod (W), Bombay-400 064
Cap: 300 T/annum

2. Asian Organo Industries
E-79 Indraprastha Indl. Area
Kota-324 005
Loc: Indraprastha Indl.Area, Kota
Cap: 300 T/annum

3. Calcium Products
14-B Kesi, Jafferkhan Pet
Madras-600 095
Loc: 14-B Kesi, Jefferkhan pet, Madras
Cap: 300 T/annum

4. Chemicals India
B-2 Industrial Estate, Kota-324 007
Loc: B-2 Indl.Estate, Kota
Cap: N.A

5. Eflochem
12/17 Municipal Colony, Malakpet
Hyderabad-500 036
Loc: 12/17 Municipal Colony
Cap: 200 T/annum

6. Evergreen Industries
F-24(I) Indraprastha Indl. Area
Road No.2, Kota-324 005
Loc: F-24(I) Indraprastha Indl.Area
Kota
Cap: 1000 T/annum

Annexure - 4

Bauxite Lease Holders in Gujarat State

(As on 31.12.1995)

Sl. No.	Name and address	Village	Taluka	Area (in Hecters)	Period of lease	Date of execution
1	2	3	4	5	6	7
1.	Bombay Minerals Supply Co. Ltd. Vazir Faliya, Jamnagar - 361 001 T.No.2970/4920 Fax No. 0288-555500	Mota Asota, Mewasa Habardi, Bhopaka Khakharda	Kalyanpur	682.38.92	20	09.07.58
2.	Emperial Mining Syndicate Ranjit Road, Jamnagar	Kenedi, Navadra	Kalyanpur	85.00.00	20	29.08.62
3.	-do -	""	""	13.57.00	20	14.03.63
4.	Prabhudas Vitthaldas Makhecha PO No. 80, Porbandar, Junagadh T.No.20354, 20154 Fax: 0286-23618	Virpur, Kenedi	""	70.82.00	20	15.10.63
5.	Kantilal Mohanlal Mehta Vidhyanagar Main Road, Rajkot	Mahadeviya,	""	168.35.00	20	20.02.64
6.	Gujarat Mineral Dev. Corp. Ltd Khanij bhavan, Ashram Road Ahmedabad-9. T.No.402475-6 Fax: 079-6561082	Mewasa	""	186.95.00	20	01.12.69

Annexure-3

Price Structure of High Alumina Bricks in Gujarat State

Sr. No.	Name & Address of the Unit	Product	Capacity	Price per MT
1.	Special Refractories PH-I, Plot No.79, F-Road GIDC, Vatva, Ahmedabad-382 445 Phone: 5831243, 5830404 Fax: 079-5830404	A) IS-6 30% to IS-8 40% B) Al_2O_3 60% to 70%	250 MTPM -	Rs.2600-2800/- Rs.5000-6000/-
2.	Shri KD Sanghvi Interkilan Industries Ltd Sanghvi Chambers, Nr. Navrangpura Police Station Navrangpura, Ahmedabad-380 009 Phone: 6421589, 6564759	A) Al_2O_3 70% to 80% B) Basic refractories depending upon the product & its appalication	2500 MT	Rs.5500-6000/- Rs.13000-35000/-
3.	Madhu Refractories Ltd 8-A National Highway Morbi-363 642 Phone: (02822) 40511, 40911; (02828) 87751-2-3-4 Fax: (02822) 40011	Al_2O_3 30% to 60% Al_2O_3 60% to 80%	500 MTPM 1000 MTPM	Rs.2500-6000/- Rs.6000-10500/-
4.	VRW Refractories Himadri Chambers-1 403/404, 4th Floor, Nr Toran Dining Hall Ashram Road, Ahmedabad-380 009 Phone: 6421218	A) 70% Al_2O_3 B) Basic Refractories	500 MTPM -	Rs.6000/- Rs.15000/-
5.	Nataraj Ceramic & Chemical Industries Ltd(A) 4, Scindia House New Delhi - 110001 Phone: 3314692	(A) Al_2O_3 70% to 80% (B) Monoliths	3000 tonnes per day	

1	2	3	4	5	6	7
15.	M/s Orient Abrassive Ltd. G.I.D.C. Ind. PO Box No. 13 Porbandar, Junagadh	Mewasa	""	3.14.44	20	10.06.81
16.	Saurashtra Cement & Corp. Ind. Ltd Nanavad, Junagadh	Rann	""	32.37.48	20	26.07.78
17.	Bharat Abrassive & Chemicals Ind. Kedareshwar Road Porbandar 360 575 Phone: (0286) 20154 Fax: 0286-23618	Kenedi	""	32.37.48	20	16.10.79
18.	Umedrai Harishankar Vora Snehmilan, Dhanbad 826 006	Kenedi	""	1.04.17	20	18.02.85
19.	Carborandum Universal Ltd. 11/12 North Beach Road Madras	Hadmatiya	""	3.64.00	20	28.02.80
20.	Yogita Allied & Calsite Products Khakroad, Porbandar, Junagadh	Gaga	""	37.76.72	20	16.01.80
21.	Bhaskar Stonewel Pvt. Ltd. PO Ishwarnagar, New Delhi	Kharkharda	""	27.51.86	20	----
22.	M/s Raghvanshi Refractory Station Road, Bhatia, Jamnagar	Virpur	""	20.23.42	20	30.06.82
23.	Malkan Arunkumar Gordhandas C/o P.G. Malkan, Advocate Porbandar, Khambhadiya, Jamnagar	Virpur	Kalyanpur	05.18.00	20	11.08.81
24.	M/s West Assessive Industries Super Market Bedi Gate Jamnagar	Hadmmatiya	""	25.14.12	20	19.05.80

1	2	3	4	5	6	7
7.	M/s Carborandum Universal Ltd. Tiam House Annexe, 28 Rajaji Salai Madras-600 001 T.No.511652, 517836 Fax No.510318	Mota Asota	""	164.70.66	20	15.01.80
8.	-do-	""	""	1.41.64	20	15.01.80
9.	-do-	""	""	14.16.40	20	08.05.81
10.	-do-	""	""	30.35.13	20	08.12.81
11.	Gopal Rajgariya C/o Orient Abrassiv Ltd. 1012, Anurag Bhavan, 16 Kasturba Gandhi Marg New Delhi	Mewasa	""	8.91.00	20	28.03.77
12.	M/s Orient Abressive Ltd G.I.D.C, Ind. PO No. 13 Porbandar 360 577 T.No-22425, Fax-0286-20139	""	""	4.04.68	20	27.06.79
13.	M/s Orient Abrassive Ltd. G.I.D.C Ind. PO No. 13 Porbandar 360 577	Virpur	Kalyanpur	13.48.31	20	12 02.80
14.	M/s Saurashtra Calcine Bauxite & Allied Industries Galaxy Appt., Ground Floor, Porbandar 360 575 T.No. (0286) 23223, 21784 Fax No. (0286) 41370	Rann	""	05.27.00	20	20.04.79

1	2	3	4	5	6	7
36.	Mineral & Minerals Corporation B-9, Sugam Mahavir Appt. Jamnagar	Nandana	""	58.67.93	20	29.05.82
37.	Saurashtra Calcine Bauxite & Allied Industries E-9, Super Market, Jamnagar	MotaAsota	""	32.37.48	20	03.08.83
38.	~~Saurashtra Calcnde Bauxite &~~ Allied Industries, E-9, Super Market, Jamnagar	Mewasa	Kalyanpur	33.18.54	20	16.08.83
39.	Bhupatray Shivram Opp. Pump house, Dhebar Road Rajkot	Gaga	""	34.32.74	20/	---
40.	Dalmia Ceramic Ind. Ltd. Tiruchirapalli, Tamilnadu	Mahadeviya	""	32.37.48	20	04.08.83
41.	Harjivandas Parsotam Thanki East India Plot, Porbandar Junagadh	Mahadeviya	""	32.37.47	20	17.10.83
42.	Naresh P. Makhecha Prabhudas Vitthaldas Makhecha Vithal Nivas, Porbandar, Junagadh	Mota Asota	""	30.35.13	20	30.01.84
43.	M/s Saurashtra Calcine & Bauxite Industries	Kenedi	""	01.23.84	20	21.05.83
44.	M/s Saurashtra Calcine & Bauxite Industries, E-9, Super Market Jamnagar	Mewasa	Kalyanpur	00.80.94	20	06.09.84
45.	M/s Industrial Minerals East India Plot, Porbandar Junagadh	Lamba	""	32.37.48	20	---

1	2	3	4	5	6	7
46.	M/ Orient Abrassive G.I.D.C Area, PB No. 13 Porbandar, Junagadh	Mewasa	Kalyanpur	2.36.74	20	11.05.84
47.	Vinodray J. Pandya Panchnath Road, Rajkot	Lamba, Bhatia	""	54.08.61	20	14.06.60
48.	Mineral & Minerals Corporation Vazir Fali, Jamnagar	Nandana	""	1.21.41	20	25.03.85
49.	M/s Parshuram Pottery Works Morbi, Rajkot	Mewasa	""	89.00	20	06.05.86
50.	M/s Sandeep Abrassive Industries A-7, M.P. Shah Udyognagar Jamnagar	Bhogat	""	29.77.49	20	29.05.87
51.	M/s Carborandum Universal Ltd. PB No. 1677, 28 Ravji Road Madras	Mewasa	""	84.98	20	14.10.87
52.	M/s Harisiddh Enterprise 11, Swami Narayan Building Gandhidham, Kachchh	Mewasa	""	3.02.00	20	07.04.86
53.	M/s Bharat Abrassive Ltd. Kedareshwar Society, Porbandar, Junagadh					
54.	M/s Orient Abrassive Ltd. 1011, Anurag Bhavan 16, Kasturba Gandhi Marg New Delhi	Mewasa	""	2.46.86	20	19.06.90

1	2	3	4	5	6	7
55.	M/s Natraj Ceramic & Chemical Industries PB No. 10, Khambhaliya	Habardi	""	1.93.00	20	03.08.92
56.	M/s Saurashtra Calcnde Bauxite & Allied Industries, 116, 119 G.I.D.C Estate Porbandar, Junagadh	Mewasa	""	1.22.20	--	18.03.91
57.	M/s Natraj Ceramic & Chem. Ind. PB No. 10, Junagadh	Habardi	""	12.30.00	20	01.11.91
58.	M/s Carborandum Universal Ltd. PB No. 2272, Tiruchirapalli, Tiruvantipur, Madras-16	Mewasa	""	10.95.65	20	---
59.	M/s Carborandum Universal Ltd. PB No. 2272, Tiruchirapalli Madras-16	Mahadiviya	Kalyanpur	04.46.17	20	27.02.92
60.	Mrs. Vimanan Ajaykumar Makhecha Vimal Nivas, Station Road, Porbandar	Virpur	Kalyanpur	178.00		
61.	Dollarnath Mulji Thanki Ravadi Plot, Nr. Kamla Baug Porbandar	Lamba	""	13.40.52	20	08.05.81
62.	Natraj Ceramic & Chem. Industries PB No. 10, Khambhalia	Habardi	""	21 68.10	20	16.11.92

Source: GMDC.