

CHAPTER 8

WORLD SCENARIO OF ALUMINIUM

8.1 INTRODUCTION

Bauxite is mined in as many as 27 countries in the world⁽¹⁾. The production which was only 87.9 million tonnes in 1981, continued to rise steadily (except in 1982 and 1983) and reached record level of 112.18 million tonnes in 1990⁽²⁾. World production of alumina also continued the upward trends since mid 80's in response to the strong demand for aluminium metal⁽²⁾.

World production of aluminium has increased by 4 times during the last three decades from 4.5 million tonnes in 1960 to 17.8 million tonnes in 1990. Australia ranked first in the world in the production of bauxite in 1990 with a production of 40.697 million tonnes, contributing 36.7% of the total world production, followed by Guinea, Jamaica, Brazil, India and USSR. **These five** countries together contributed 43% of total production. India ranked 5th in the production of Bauxite in 1990 with a production of 5.00 million tonnes. As far as production of aluminium is concerned USA ranks first in the world contributing 23% followed by erstwhile USSR-12%, Canada 9% Germany 4% and Norway 5%⁽²⁾.

It has been estimated that the known world Bauxite reserves are sufficient to meet the cumulative demands even in 21st century.

The production of Bauxite Alumina and Aluminium for 1981 to 1990 by countries is given in table No: 8.1, 8.2 and 8.3 respectively.

8.1.1 World Production of Bauxite

A brief review of the bauxite production during the first half of this century is given here to have an idea of the level of production and the status of production during the two world war periods.

A) During 1900-1950

The production was only 0.87 lakh tonnes in 1900. During the period of world war I (1914-1918) and world war II (1939-1944) the world production of Bauxite increased considerably to meet the increasing demand of the aluminium metal for the military uses. During the 1st world war the production touched 1.0 million tonnes in 1917 which came down to 0.33 million tonnes in 1921 after the war. Similarly during the II world war period, there was an extra ordinary increase in world bauxite production which shot up to 13.8 million tonnes in 1943, which was the highest production recorded during the half century 1901-1950. After the world war II it drastically came down to 3 million tonnes in 1945, and thereafter gradually rose to 8.3 million tonnes in 1950. The trend in production during 1900 to 1950 and number of producing countries is given below. There were only three countries producing bauxite in 1900, which rose to 20 by 1950⁽³⁾.

Year		Production (tonnes)	No. of producing countries
1900		87,959	3
1910		355,848	5
1917	World war I	1,027,490	
1920		901,193	10
1930		1,628,871	14
1940		4,335,564	20
1943	World war II	13,822,569	
1950		8,370,277	20

B) During 1951-1990

The international trade in Bauxite increased after 1970 and the production also increased proportionately. The trend in the world production of bauxite during last four decades is given below⁽⁴⁾.

<u>Period</u>	<u>World production in '000 tonnes</u>
1951 - 1960	1,82,271
1961 - 1970	4,03,351
1971--1980	7,85,255
1981 - 1990	9,22,309

The production has been on an increasing trend in response to the strong demands for the aluminium metal, which is consumed in many major sectors like, power, transportation, construction, packaging etc.

In the 1980's, Australia, Guinea, Brazil, Jamaica, China, India, USSR, Suriname, Hungary and Greece have been the major producers of bauxite in the world.

World production of bauxite country wise during 1981-1990 is given in table No: 8.1.

8.2 REVIEW OF PRODUCTION - COUNTRYWISE

Following are the main bauxite producing countries in the world and have been ranked based on the production in 1990⁽²⁾.

<u>Country</u>	<u>Production in 1990 in '000 tonnes</u>
1. Australia	40,697
2. Guinea	16,500
3. Jamaica	13,983
4. Brazil	8,750
5. India	5,000
6. USSR	4,200
7. China	4,000
8. Suriname	3,267
9. Yugoslavia	2,952
10. Hungary	2,600

The above countries together contribute 90% of the total world production⁽²⁾.

8.2.1 Australia

As may be noted from above, Australia has been the largest bauxite producer of the world. There are seven major producing mines as given below⁽⁵⁾.

<u>Owner</u>	<u>Mine</u>	<u>Location</u>
1. Comalco Pvt.Ltd.	Weipa	North of the Cape York Peninsula, Queensland
2. Nobalco Pvt. Ltd.	Gove	Northern Territory
3. Alcoa	Del Park	Darling Range
	Huntly	Darling Range
	Willowdate	Darling Range, South of Perth, in Western Australia
4. Reynolds Australia Aluminium Ltd.	Mount	Darling Range
	Saddle back	Darling Range.

Australia is also the largest bauxite and alumina exporter in the world. The country does not utilise all its alumina production for making aluminium because the domestic primary aluminium industry is relatively small as compared to the country's raw material production capacity⁽⁵⁾. There are seven alumina refineries in Australia, Port land smelter is one of the largest in the world, having a capacity of 300,000 tonnes of aluminium ingot per year⁽⁵⁾. In 1988-89 Australian mining industry was adversely affected by the rise in the value of the Australian dollar which made export more expensive in the world market and thereby was lagging in competition in the world market. But still it was a pioneer in bauxite and alumina production. Australia's revenue earned by exporting bauxite, alumina and aluminium is second highest, next to coal^(6 & 7).

In near future expansion of Tomago aluminium smelter, and Wagerup aluminium refinery, from present capacity of 240,000 tonnes to 280,000 tonnes and 850,000 tonnes to 1.48 million tonnes respectively will further step up the production of aluminium in Australia. Western Australia smelters are also under construction and planned to produce 360,000 t/year. The production of aluminium in Australia was 1.23 million tonnes during 1990⁽⁶⁾.

8.2.2 Guinea

Guinea is the second largest producer of bauxite after Australia, which produced 16.5 million tonnes in 1990 contributing 15% of the world production. It derives 90% of the foreign exchange earnings from bauxite and possesses

about one third of the world's bauxite reserves⁽⁸⁾. There are three main producing mines having a total capacity of 14.5 million tonnes per year. The details of mines are given below⁽⁸⁾:-

	<u>Mine/Owner</u>	<u>Location</u>	<u>Producing capacity</u>
1.	CBG (Operated by compogine des bauxite de Guinea)	Sangaredi	9.5 million tonnes/ year
2.	Frignia (Fringuies cor- sortium)	Kimbo	2 million tonnes/ year
3.	Kindia (Bauxites de Kindia)	Kindia	3 million tonnes/ year
			14.5 million tonnes/ year =====

8.2.3 Brazil

Brazil is the third largest producer in the world. Bauxite mining operations started in early 1940's, since then the production has been rising. The production which was only 0.3 million tonnes in 1980^(3,4) shot up to 8.75 million tonnes in 1990 showing a steep increase by 29 folds in a decade.

There are six aluminium projects and four smelters⁽⁹⁾. Much of the mineral industry is in the hands of private sectors. In 1986 Companhia Brasileira de Alumínio (CBA) Smelter was believed to be the lowest-cost plant in the world⁽¹⁰⁾. In 1989, Brazil government imposed controls on the price of aluminium in the domestic market which discouraged the producers from selling to local market and there by local consumption fell down⁽¹¹⁾. Later the Government lifted price control which encouraged the producers to increase Aluminium production and also for the expansion of their plants⁽¹²⁾.

Companhia Vale do Rio Doce (CVRD) has planned to double their output from 165,000 to 340,000 tonnes/year by 1992. Their Alunorte aluminium refinery is to start in 1994. CBA has plans to double the production upto 340,000 tonnes/year by 1995 by installing a new smelter.

Brazil is now the western world's fifth biggest aluminium producer producing 0.935 million tonnes in 1990. Brazil's electrical energy price which is about \$30 per 1000 kwh is said to be the highest among aluminium producing countries in the western world. The energy cost accounts 25 % of aluminium production costs in Brazil⁽⁵³⁾. Therefore presently Brazil is not internationally competitive in Aluminium, because of very high energy costs and lack of new investment in technological improvements. But still it's production and export level is going to be maintained because it is considered more expensive to stop production and export than to continue the production.

8.2.4 Jamaica

Bauxite production was only 0.3 million tonnes in 1952. Thereafter ore production was rising every year and reached 16 million tonnes in 1974⁽⁴⁾. There was a low production trend during 1975, to 1979 and the production fell down to 11.5 million tonnes in 1979. It is due to the Bauxite levy imposed by the government and increase in the price of oil. Bauxite mining industry and alumina industry in Jamaica is dominated by American and Canadian corporations with Government participation. The world wide over supply of aluminium and competition from Australia and Brazil reduced the Jamaican share of bauxite output to 10 % of world's production in 1979, which was 21% in 1970. There was further fall of production of bauxite from 12 million tonnes in 1980 to 6 million tonnes in 1985⁽¹³⁾. The major reason for this has been the high cost of imported fuel oil which **also** resulted in the fall of export of bauxite by 50% and alumina by 7%⁽¹⁴⁾. This situation changed in 1988, when the government replaced the old bauxite levy system introducing minimum rate of per ton for bauxite linked to Average Realized Price (ARP) for aluminium metal. This resulted in the ultimate rise in production of bauxite to 13.98 million tonnes in 1990 and 2.8 million tonnes alumina which is highest since 1974⁽¹⁵⁾.

A major expansion of Alumina partners of Jamaicas (Alpart) is now underway with the signing of a US \$ 250 million agreement by the Government with the aim of increasing Alparts; present capacity from 1 million tonnes to

2 million tonnes in the next five years.

8.2.5 Union of Soviet Socialist Republic (Now Commonwealth of Independent States (CIS))

There was no aluminium production before the October revolution in the country⁽¹¹⁾. Mining activity started in the year 1931 producing 11,600 tonnes bauxite⁽³⁾. The production reached 5.3 million tonnes in 1970 and 6.4 million tonnes in 1981.

In the five year period 1981-86, aluminium industry was one of the fastest growing nonferrous industry in U.S.S.R. It is the only country in the world, which is extracting aluminium from the ore other than bauxite as well. As the bauxite is of low grade, aluminium is also obtained from nepheline and alunite. During 1980, 80 % of primary aluminium production was derived from bauxite, 16% from nepheline and 2% from alunite.

Aluminium is being produced more for export than for domestic consumption. Primary and Secondary aluminium is exported to European countries, Japan and United states. High grade bauxite is imported from Guinea, Greece, Yugoslavia, Hungary and India⁽¹⁷⁾. In Northern Siberia, native aluminium was reported to have been found in 1978. During the period 1986 to 1989 there was a significant rise in aluminium production in the country inspite of the fact 50% of raw material requirements (Bauxite & Alumina), was imported from other countries⁽¹⁸⁾.

8.2.6 China

China started Bauxite mining operations in 1936, when 30 tonnes was produced. After 1941, there has been significant rise in output of bauxite from 10,200 tonnes in 1941 to 4 million tonnes in 1990⁽³²⁾. The bauxite resources are estimated at 1200 million tonnes out of which 400 million tonnes are considered to be of industrial grade. China's four aluminium bases are at Guizhou, Henan, Spanding and Shanxi. Out of total bauxite reserves in China, one third can be strip mined and the remaining by underground method. Bauxite is mined at present mostly by open cast mining method⁽¹⁹⁾.

There are four plants producing aluminium oxide and 30 electrolytic refineries. China produced 750,000 tonnes and 850,000 tonnes of aluminium in 1989, and 1990 respectively^(20,21). China's present production capacity is around 1 million tonnes per year.

8.2.7 Suriname

The occurrence of bauxite deposits was found first in the basin of the Cottica river in 1915. Exploration was carried out by the Surinaamsche Bauxite Maatschappij and mining right obtained in 1917 and the production of bauxite started in 1922. It was 18,800 tonnes initial which reached upto 2 million tonnes by 1950. Suriname was the leading producer in 1947 producing 1.8 million tonnes bauxite and held the top position for 10 years⁽¹³⁾. In 1957, it held the second position and in 1969 became the third largest producer of the bauxite in the world⁽¹⁴⁾.

The production during 1990 was 3.2 million tonnes bauxite, 1.53 million tonnes alumina and 20,000 tonnes aluminium.

The mining operations are carried out by three major companies viz-Suralco, Billiton and Paranam. Suralco operates mines at Moengo and Paranam. Billiton operates Kankantrie and Para mines producing about 60 % country's bauxite production. The reserves are limited and likely to be exhausted around 1996⁽²³⁾. Suriname's major mineral industry is bauxite and alumina which accounts for about 80% of the country's export revenue⁽²⁴⁾. Production and export have fallen however from 1980 to 1988 due to Civil War in the country⁽²⁵⁾. It is understood Moengo and Onverdacht deposits are likely to be exhausted and prospects of bauxite mineral industry are not too bright in the country, because of the depletion of reserves.

8.2.8 Yugoslavia

Bauxite production started in Yugoslavia in 1915⁽²⁶⁾. The first Bayer process alumina plant was built up in the vicinity of Lajbljana (Moste) as early as 1906⁽⁵⁰⁾. The production of bauxite was 27,860 tonnes in 1920, reached to 200,892 tonnes in 1950⁽³⁾ and further rose to 3.3 million tonnes

in 1980⁽²⁷⁾. Yugoslavia is the leading European producer of bauxite and has the largest alumina production capacity in Europe with five plants, having a total capacity of 1.72 million tonnes⁽²⁷⁾. Vlasnia mine which is operated by Bosnia Hercegovina is the largest mine in the country, producing more than 40% of the total production⁽²⁸⁾. Other producing mines are Posusje, Listica Stolac and Citluk⁽²⁹⁾. The production of aluminium in 1990 was 2,90,000 tonnes. For deep seated deposits underground mining is resorted for the production of ore, and for shallow deposits opencast mining continues. In the period from 1970 to 1978, underground mining accounted for about 12% production and now it is estimated to be 37%.

8.2.9 Hungary

The first bauxite deposit was discovered in Gant (Transdanubia) area in 1926 and was exploited by opencast method. This mine was considered to be one of the biggest operations in the world in 1930's⁽³¹⁾. Production of bauxite in Hungary was 31,696 tonnes in 1930 which reached to 1 million tonnes⁽³⁾ in 1943 and it further rose to 2.6 million tonnes in 1990.

The deposits are found mainly in areas prone to Karstic water. Because of the water problem opencast mining has become very difficult. In recent years bauxite is increasingly extracted by underground method from zones below Karstic water level. Most of the mines currently worked are underground mines and mining is continued, by lowering the water table by means of drilled shafts. By this method for every tonne of bauxite produced, the cost of pumping of 95 m³ water is involved⁽³¹⁾. During 1981 to 1989, the production of bauxite was steady around 3 million tonnes/year⁽²⁾. Aluminium consumption in this country is higher than that for any other metal⁽³²⁾. Out of net revenue earned by Hungary, 20% comes from aluminium industry⁽³³⁾. In order to satisfy environmental requirements various bauxite deposits, which could be worked only by lowering the karstic water table, can probably not be exploited in near future⁽³¹⁾.

8.2.10 Greece

Mining of Bauxite in Greece Started in 1924 with a production of 2,300 tonnes, which reached to 2.2 million tonnes in 1970^(3,4). Even after 20 years in 1990, the production was only 2.7 million tonnes. High cost of production, low productivity and high excise rates for electric power appear to be bottle necks in the development of Aluminium industry in Greece⁽³²⁾.

8.2.11 Guyana

Bauxite Mining operations in Guyana started in 1916 and produced 2070 tonnes of bauxite in 1917, which just in three years rose to 31,883 tonnes in 1920⁽³⁾. The production was rising steadily upto 1970. The highest production recorded so far was in 1969 at 43 lakhs tonnes⁽⁴⁾. Thereafter the production was falling and it was 12.8 lakh tonnes in 1989⁽²⁾.

Bauxite is the Guyana's primary mineral export and contributes about 40% of export earnings. Bauxite is mined in three areas, the major mines are being located at Linden. Guyana is the second largest producer of calcined grade bauxite in the world after China, which is used in refractory industry⁽³⁶⁾. In 1973 Denmara Bauxite company and in 1975 Raynold's Metals were nationalised. Guyana Mining Enterprise Ltd. (Gymine) controls the whole Guyana's Bauxite mining and alumina production operations⁽³⁶⁾. Country's only alumina refinery is at Linden, owned by Guyana's Bauxite Industry Development Corporation (Bidco)^(37,38). The plant is having a capacity of 2 million tonnes/year alumina which it is understood, is further going to be increased by 1 million tonnes/year by 1995⁽³⁷⁾.

8.2.12 France

Mining activities for bauxite in France started in the end of the last century⁽³⁾. In the year 1900 the production was 58,500⁽³⁾ tonnes which rose to 3.24 million tonnes in 1974, amounting to 4% of the world's production⁽⁴⁾. Since then the production was decreasing every year and in 1990 the production was only 0.56 million tonnes. It is expected

that the production of aluminium will increase in future as Pechiney has plans to construct an aluminium electrolysis plant at Dunkirk with a capacity to produce 200 Kt/year⁽³⁹⁾.

8.2.13 United State of America

United states is still today the leading producer of aluminium. The bauxite is mined since the early part of the current century. The production of bauxite was only 23,556 tonnes in 1900 reached to a level of 1.3 million tonnes in 1950⁽³⁾. The maximum production was in the year 1970 which was 2.11 million tonnes. Since 1981 to the end of 1990 the production was on a low trend and it was only 560,000 tonnes during 1990^(4,2). Although the production of bauxite was going down, but the production of aluminium was going up every year. In the recent years, the domestic bauxite was not used for the production of primary aluminium metal. Metallurgical grade bauxite was imported mainly from Guinea, Jamaica, Australia and Brazil⁽⁴⁰⁾: There are thirteen companies in USA operating 23 smelters producing 4 million tonnes aluminium. Bauxite mining areas are at Alabama, Arkansas and Georgia.

There has been a continued strong demand for cell grade alumina, which was met by imports. About 90% of the bauxite consumed in the United States is for making alumina.

8.2.14 Venezuela

Bauxite mining in Venezuela started very recently in 1982 when bauxite was discovered at Los Pijignaos. The reserves of high grade bauxite are estimated to be 200 million tonnes⁽⁴¹⁾. Some new mines have also been opened in 1986 and 1988⁽⁴²⁾. The prominent mine Bauxivane which was opened in 1986 had a production capacity of 30,000 tonnes which rose to remarkable figure of 2.1 million tonnes in 1989 in a span of three years only^(42,43).

Venezuela currently has two aluminium smelters which are at Venalum and Alcasa areas with a combined capacity of 666,000 tonnes/year⁽⁴³⁾. There was a significant boost in the production of bauxite, which rose from 1275 tonnes in 1986 to 771,000 tonnes in 1990. Most of the Unwrought metal is exported to Japan⁽⁴³⁾. Aluminium industry in this

country is the second largest revenue earner after petroleum. Three more areas of bauxite deposits have been discovered and a production of 1.5 million tonnes to 2 million tonnes/year is envisaged by 1992. Venezuela anticipates an annual export of 1.4 million tonnes of aluminium by 1994 and 2 million tonnes by 2000 (42).

8.2.15 Indonesia

The bauxite mining activities started in 1935 with a production of 16,700 tonnes which rose to 531,150 tonnes during 1950. After 1950's though there is steady production of bauxite but the aluminium industry is not really much active. Some of the smelting plants had to be closed in 1986 due to low price of aluminium in the world market (45). The Inalum smelter (225,000 tpy capacity) has slowed down its production because of cut in power. The aluminium production in Indonesia has come down for 219,000 tonnes in 1986 to 186,000 tonnes in 1990.

8.3 MINING METHODS

In general opencast mining method is followed in most of producing countries. About 90% of bauxite is produced by opencast method. In Australia, Guinea, Jamaica, Suriname, Guyana etc. opencast mining is followed and Underground mining method is adopted in Greece, Hungary and U.S.S.R. Around 10% production of the bauxite comes from underground mines and most of it is produced in Hungary.

Majority of lateritic bauxite deposits are mined by opencast method with drilling and blasting. But in case of predominantly unconsolidated pisolitic deposits e.g. at Weipa located on Cape York Peninsula, Queensland Australia, it is mined by using rippers, no blasting is required.

The majority of Karstic bauxites which are deeply located are mined by underground methods. Though not much literature is available on the underground mining technology used in USSR and Greece, it is reported that commonly Room and Pillar method or stoping is practiced. Underground water problems are common especially in the Hungarian mines where bauxite deposits are associated with weathered limestone.

The list of the important bauxite producing mines in the world are given in table 8.4 for a reference.

Salient details of the mining methods followed in some of the prominent bauxite producing countries are given below:-

8.3.1 Australia

There are three prominent bauxite mineralised areas in Australia viz. Queensland, Darling ranges in Western Australia and northern territory. The working mines are given below⁽⁵⁾.

<u>Name of Mine</u>	<u>Operating Company</u>
Weipa	Comalco Pvt.Ltd.
Gove	Nobalco Ltd.
Delpark	Alcoa
Huntley	
Wollow dale	
Mount	Raynolds Australia
Saddle back	

Weipa Bauxite Mine

Weipa Bauxite mine is operated by Comalco Pvt.Ltd. and is located in North of Cape York Peninsula, Queensland, Australia. The deposit is the largest single deposit in the world. The deposit occurs in the upper portion of flat-lying laterite that extends for more than hundred miles along the west coast of the Cape York Peninsula. The bauxite bed ranges in thickness from one metre to 10 metres and is covered by soil overburden of one metre thick and is heavily forested. Average ore thickness is about 4.4 m. The lease area covers about 2590 sq.km. containing an estimated 4000 million tonnes of ore.

The deposit was discovered in 1956. Comalco took a lease the following year and shipped out its first production in 1960. The production steadily rose by late seventies it reached 10 million tonnes. In 1990 the mine produced 9.8 million tonnes of bauxite and the target for 1991 was 10.8 million tonnes.

During the wet season (December to April) the trees are cleared from the area using 160 horsepower bulldozers. The overburden is removed by scrapers and dumped on an area

which ~~is~~ already mined out and afforestation is taken up in this area.

Rippers are used as ore body being soft enough does not require blasting.

The loading operations are carried out by wheel mounted front end loaders. The ore is hauled by bottom dump trucks and trailers to the crushing plant 17 km away from the mine. The capacity of trucks is 85 tonnes payload and that of bottom dump trailers is 150 tonnes pay-load.

The ore is crushed and washed to improve the grade before loading into ships (47).

Gove Bauxite Mine

Gove bauxite mine is located in the north eastern corner of Arnhem Land, Northern territory, Australia, operated by Gove Aluminium Limited. There being no road or rail access to Gove, transport in and out of Gove is only by sea or air. Regular commercial airline flights link Gove to Cairns and Darwin.

Project construction commenced in 1969. The technology for the Bayer process alumina plant was supplied by Alusuisse. The first shipment of bauxite was in June 1971 and of alumina in August, 1972. The designed output of 1 million tonnes of alumina per year has been achieved in 1977.

The bauxite deposit at Gove is of lateritic type and occurs on an extensive plateau some 50 to 60 m above sealevel. The lease area is 40,000 hectares. The average thickness of the ore body is 3.5 m and is overlain by less than one metre of overburden.

Mining is being carried out by opencast method. New areas of the mine have been opened at the rate of 100 hect. per year. Trees in the area are removed by using chains attached to bulldozers. Top soil and overburden are removed by scraper and spread over worked out areas of the deposit which will be rehabilitated.

The bauxite ore is loosened by ripping or blasting. The loosened or blasted material is loaded by front end loaders into dumper/dump trucks which carry it to crusher.

The machinery deployed in the mine are one scraper, three bulldozers, three front end loaders and seven rear dump trucks. The capacity of rear dump truck is 77 tonnes.

Approximately 1000 tonnes of bauxite per hour are treated in a two stage crushing and screening plant. The crushed ore is stored in bins prior to being transported by a 18.7 kilometres long belt conveyor system to the plant and to export stock piles. There are two stock pile areas, each having 2 million tonnes capacity.

The mined out area is fertilised and seeded with native trees, shrubs and grasses just prior to the rainy season. Between 80 to 100 hectares are rehabilitated every year. Some 1050 hectares of the lease area has been mined out so far and over 900 hectares has been rehabilitated.

Upto 1988, 30 million tonnes bauxite has been exported primarily to alumina refiners in Japan, West Europe, North and South America and USSR. Bauxite and special grade lateritic bauxite have also been supplied to cement producers in the United Arab Emirates, Oman Saudi Arabia and the USA⁽⁴⁸⁾

8.3.2 Brazil

Mining is carried out by opencast methods in Brazil. The major mine is Trombetas, which is located in Para State.

Trombetas Bauxite mine

Trombetas bauxite mine operated by Mineracao Riado Norte S/A (MRN). The bauxite deposit occurs as lateritic horizons capping large plateau. Mining operations are in progress at Saraca, Almeidas and Avi-so Plateaus. Total estimated bauxite reserves are 1200 million tonnes with average grade of 50% alumina and 4.5 % reactive silica.

Conventional openpit mining techniques are adopted and presently operations are confined to three blocks namely A, B and C Blocks. A and B each has a walking dragline with 13 M³ bucket to strip and side cast the overburden into the mined out area. Each cut has a width of 28 m and the blocks are 3 km. long. The average overburden depth varies between 7-10 m. thickness stripping of overburden is done by scrapers.

In blocks A and B, the ore is loaded either by back-hoe or front end loaders into 35 tonnes highway dumpers after blasting. Holes are drilled in the hard ore body in a 3m x 3m grid pattern and blasted using ANFO. Slurry explosive are used in the rainy season. Hole depths vary between 1.5 m and 2.2m.

The excavated ore is transported to a central crusher, reduced to 75 mm and then conveyed to a rail-loading station. Thereafter it is transported by rail to Trombetas 30 km. away, where washing, drying and ship loading facilities are available.

Before starting actual mining, clearing of the area is taken up one year in advance. For this purpose dozers are used to remove the larger trees, which are transported to the sawmills, while the smaller ones burnt and used as fertilizer.

List of the machineries used for mining is given below :-

Item	No	Capacity	Manufacturer/Model
Dragline	2	13 m ³	Bucyrus - Eire
Backhoe	3	4.6 m ³	Northwest
Off-highway trucks	6	32 t	Caterpillar 769
	8	32 t	Wabco-Haulpak 35 C
Scraper	1	24 m ³	Caterpillar 631
	4	24 m ³	Terex 524
Dozer (Track)	11	300 hp	Caterpillar D8K
Dozer (Wheel)	2	300 hp	Caterpillar 824
Front-end-Loader	6	5.4 m ³	Caterpillar 988
Mobile Drill	2		Mobile Drill
Grader	1	225 hp	Huber-wab-Co.
	1	125 hp	Caterpillar

8.3.3 Guinea

Bauxite occurrence close to the coast have been known since the beginning of the century. In 1920-21 first exploration rights were granted to the Societe des Bauxite de Midi (SBM), a french subsidiary of Alcan. However, systematic exploration of promising zones started only in 1948. In Guinea there are four major bauxite mines (51).

i) Sangaredi mine (Boke deposit)

Sangaredi Bauxite mine is operated by Compagnie des bauxite de Guinea (CBG). It is best known for its export of high grade bauxite. The deposit is spread over an area of 146 km² with an estimated reserves of 4700 million tonnes.

Mining operation are carried out by opencast method. Drilling and blasting is carried out for breaking the ore, which is sticky and hard. ANFO has been used for blasting. Broken material is loaded by shovels into ore cars which transport the ore to crusher at the port of Kamsar.

As per the production data during 1988-89, this mine was the largest in the world producing about 10 million tonnes bauxite in a year⁽⁵¹⁾.

ii) Friginia mine

Friginia mine is located in Kimbo area, about 100 km north of Conakry.

Opencast method is adopted for mining. The hard ore is drilled and blasted. The blasted material is loaded into dumpers by power shovels, and transported to crushers. After crushing the bauxite is conveyed by belt conveyor either to the train loading stations for export or to a stockpile for use in local alumina plants.

Average production of this mine has been 2 million tonnes per year⁽⁵¹⁾.

iii) Kindia mine (Debet deposit)

Kindia bauxite mine (in Debet deposit) is operated by office des Bauxites de Kindia (OBK) and is located at Kindia, approx. 100 km. north west of Conakry. The mining operations had started in the mid 1974.

The bauxite is capped with thin soily overburden which is removed by bulldozers. Drilling and blasting is carried out for breaking the hard bauxite ore. The blasted bauxite is loaded by electric shovels into mine trucks which convey the bauxite over a distance of 2.5 km. to the crusher. The annual production capacity of this mines is 3 million tonnes bauxite.

8.3.4 Guyana

There are three major producing mines in Guyana. e.g. Linden, Ituni and Kwakwani. All the mines are highly mechanised.

Deposits of all the above mines are having 4 to 18 m thick bauxite orebody and the overburden thickness being 18 m and above. The stripping ratio at Linden and Ituni mines is high about 10:1. Primary stripping removes the upper sandy formation with unbedded clays. Stripping is usually done with bucket wheel excavators.

Guyana Mining Enterprise has six wheel excavators at Linden and the largest one is capable of excavating 3500 tph.

Secondary stripping of the hard clay is usually done with draglines. The dragline deployed at East Montgomery mine has 21 cu.m. bucket capacity and the dragline at Kwakwani is 17 cu.m. bucket capacity⁽⁵²⁾.

The Kwakwani mine has deployed a fleet of scrapers including bulldozers to strip the sandy formation. A 8 cu.m. dragline excavates the clay formation. Smaller draglines and power shovels load the blasted ore in the train having 30-35 cars of 15 tonnes capacity each.

At Karakara mine the working face is 900 m long and direct rail loading at the face is practised.

In the other mines trucks are used for transport of ore upto rail loading siding. Stockpiled material is loaded by front-end loaders into the railcars for further transport.

^u
Guyana Mining Enterprise controls the whole of Guyana's bauxite mining and alumina production operations⁽³⁶⁾.

8.3.5 Hungary

In Hungary one third of bauxite production comes from opencast mining and two-thirds from underground mines, the depths of workings ranging from 200 to 300 m. A working depth upto 500 m is now considered to be economically viable.

Currently 75% of bauxite production comes from the Bokony group of Bauxite mines at Topoka town, north of Lake Bolaton and the rest comes from the Fajermagye Bauxite Co. Kinesesbanya⁽⁵³⁾.

Halimba III Mine

The occurrences in the Halimba district are layered deposits, average thickness being 7 m but also increases upto 30 m at places. The mean ore grade is 5.7 module. (Module is the term used to denote the ratio of alumina to silica. A figure around 7 is considered to be ideal grade for feeding to the alumina plant.)

The Halimba III is an underground bauxite mine. The mine is completely mechanised and all trackless equipments are in operation. The mine's productive area is currently some 3.9 km². The total length of active underground roadways is 22 km.

The deposit has been opened by means of twin vertical shafts and a 1500 m long incline, through which all the mined bauxite is transported by conveyor. The deepest point of the mine is upto 400 m.

Two vertical shafts serve for ventilation and for the transport of men and material as well (53).

At present mining activity is in progress at four levels, the highest at +50 m above sea level and the lowest at -60 m below sea level.

The ore is won by taking rooms of cross section 3.5 m x 3.0 m in the ore body. Rooms are advanced by drilling 1.6 m long holes with compressed air drills and blasted. For loading the blasted ore Atlas Copco Cavo 310 loader or LHD of 1.4 m³ and 2.0 m³ capacity are used, which give an average output of 46 t/shift.

The hanging wall being weak loading operations are done mechanically with remote control by the operator standing safely in a fully supported place. For supporting the back aluminium props and bars are used supplemented by wooden staves where necessary.

The loaders transport the ore to ore passes, and transported to surface by an incline conveyor belt driven at a speed of 3.14 m/Sec. On reaching the surface the ore is moved by a revolving drum arrangement to 50 tonnes capacity

storage bins and from the bins it is transported by trucks to alumina plant at Ajka 4 km away from the mine⁽⁵³⁾.

Water problem

In this bauxite mine, a big problem is the heavy water in-rush into the mine workings. However, as the mine water is crystal clear and fit for drinking it is being supplied to the adjacent population. Also water supply is made to the Ajka alumina plant and local thermal power station.

Thus only 22% of the mine water pumped is directly utilized the rest goes to lake Balaton. This helps in bringing down level of water pollution in the lake as clear water gets added day by day. Thus mine water is usefully utilised. The entire dewatering system has been automated by regulating all the high duty pumps⁽⁵³⁾.

8.3.5 Suriname

At present there are two mines producing bauxite in Suriname.

i) Moengo bauxite mine

The mine is located about 95 km. east of Paramaribo in the coastal area and is operated by Suriname Aluminium Company (Suralco)⁽²²⁾.

The bauxite is covered by top soil. The thickness of bauxite layer is 3 to 5 m only.

In the earlier periods after stripping the overburden drilling of holes was done by mobile auger drills to a depth of 4.5 m on a 3x4 m pattern. Holes were charged with bagged ANFO and Deta Prime. The broken ore is loaded with steam shovels and transported by train to the crusher.

Now mining is done with backhoe and the ore is heaped with a dozer and loaded with front end loaders into 35 tonne trucks and hauled to a stockpile. Thereafter it is loaded in railcars and transported over a distance of 17 km. to the crushing and drying plant.

The drying plant is now reportedly closed, as no export of bauxite is planned in the near future. The current mine capacity is 1.4 million tonnes per year.

ii) Leyldrop bauxite mine ⁽²²⁾

Leyldrop bauxite mine is located in Paranam district and is operated by Suriname Aluminium Co. (Suralco).

The bauxite is covered by the top soil of 20-30 m thickness.

Because of the problem of surface water in the ore bearing zone, firstly a drainage system, consisting of main channels and secondary ones leading to a sump is constructed.

After pumping out the water collected in sump, the thick overburden is stripped by dragline. Overburden is cast-back later into mined out panels. Bulldozers are used to heap stripped material from the dragline. The hard ore exposed has to be drilled and blasted whereas soft ore is ripped. Loading is also done with dragline into 50 tonnes trucks and hauled over a distance of 12 km. to the refinery. At present the mine is not working ⁽²²⁾.

iii) Onverdacht bauxite mine

The onverdacht bauxite mine is located in Paranam district and is operated by Billiton Maatschappij Suriname.

The average thickness of bauxite bed is six metres. The thickness of the overburden which consist of sand, silt and clay, varies from 5 to 25 m.

Cutter head suction dredges are used to remove the soft primary overburden and the bucket wheel excavator and draglines for secondary stripping. After stripping the ore is drilled and blasted which is loaded into 50 tonnes trucks with the help of draglines. The ore is transported by trucks to the refinery at 10 km. distances ⁽²²⁾.

The production rate is about 2 million tonnes of bauxite per year.

8.3.7 United State of America

The mining is carried out by both opencast and underground methods. About 90 percent of bauxite produced in USA comes from opencast mines.

Arkansas is the major bauxite producing mine in USA. Mining is carried out by stripping operations. Draglines, scrapers, shovels, and trucks are used for mining and transport. Stripping ratio is as high as 13:1.

8.4 EXPANSIONS IN PRODUCTION CAPACITY

The proposed expansion in production capacity during 1991-1995, by major producers of Bauxite, alumina, aluminium are given at table No: 8.5, 8.6, and 8.7.

<u>Name of the country proposing expansion</u>		<u>Expansion planned in the production of</u>
Venezuela	Y	Bauxite
Jamaica	Y	
Brazil	Y	
Guyana	Y	
Australia	Y	Alumina
Brazil	Y	
Jamaica	Y	
Algeria	Y	Aluminium
Australia	Y	
Bahrain	Y	
Canada	Y	
Ireland	Y	
India	Y	
Iran	Y	
Norway	Y	
Qatar	Y	
Saudi Arabia	Y	
Trinidad	Y	
United Arab Emirat	Y	
Venezuela	Y	

TABLE B.1.1 PRODUCTION OF BAUXITE - BY COUNTRIES

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Australia	25,441,392	23,625,042	24,372,231	31,536,913	31,177,617	32,383,773	34,131,721	36,192,000	38,583,000	40,697,000
Guinea	12,822,000	11,827,400	12,986,000	14,738,000	14,329,000	12,439,000	16,282,000	16,834,000	16,523,000	16,500,000
Jamaica	11,605,977	8,157,652	7,724,983	8,605,000	6,216,900	6,953,000	7,702,000	7,316,000	9,601,000	13,983,000
Brazil	4,048,545	3,469,928	4,281,241	5,302,577	6,251,000	5,418,259	6,376,650	7,727,600	8,665,000	8,750,000
India	1,955,000	1,954,261	1,929,272	2,035,646	2,016,000	2,662,200	2,778,678	3,402,000	4,768,000	5,300,000
USSR (East-White)	6,400,000	6,400,000	6,300,000	6,200,000	6,400,000	6,275,000	5,700,000	5,900,000	4,600,000	4,200,000
China	1,800,000	1,950,000	1,900,000	2,000,000	2,100,000	2,900,000	3,200,000	3,500,000	4,000,000	4,000,000
Suriname	4,125,000	3,060,000	2,793,000	3,375,000	3,738,000	3,731,000	2,522,000	3,434,000	3,530,000	3,267,000
Yugoslavia	3,249,000	3,668,000	3,500,367	3,347,000	3,538,000	3,458,917	3,354,000	3,033,794	3,252,000	2,952,000
Greece	3,248,822	2,887,855	2,435,246	2,296,225	2,453,798	2,314,962	2,466,500	2,533,100	2,576,000	2,700,000
Hungary	2,914,000	2,627,000	2,917,000	2,994,000	2,915,000	3,022,297	3,101,000	2,906,000	2,644,000	2,600,000
Sierra Leone	609,625	632,000	785,200	1,042,000	1,144,700	1,242,000	1,391,000	1,379,000	1,562,000	1,600,000
Guyana	2,395,900	1,783,100	1,087,300	2,484,700	2,206,400	2,073,918	2,351,496	2,154,367	1,321,000	1,600,000
Indonesia	1,203,390	700,247	777,869	1,003,233	830,471	649,881	635,309	505,804	862,000	1,206,000
France	1,865,000	1,687,000	1,661,000	1,607,000	1,504,000	1,379,000	1,271,000	977,700	720,000	560,000
Turkey	589,727	508,391	306,350	131,573	213,752	280,401	259,075	269,015	562,000	515,000
Malaysia	700,866	589,000	501,790	680,434	491,304	566,170	182,125	360,798	355,000	398,000
China	181,300	63,500	70,400	48,500	124,500	204,000	195,000	287,300	347,000	381,000
Romania	400,000	380,000	420,000	460,000	500,000	500,000	480,000	500,000	313,000	300,000
Dominican Republic	405,720	152,250	-	-	-	-	186,671	167,800	151,000	150,000
USA	1,510,000	732,000	679,000	856,000	674,000	510,000	576,000	588,000	-	-
WORLD TOTAL	87,900,000	77,300,000	77,500,000	91,400,000	88,800,000	89,000,000	95,700,000	100,500,000	105,695,000	112,180,000

Source : i) World Mineral Statistics 1981-85

ii) Bauxite, Alumina & Aluminium Year Book, 1969

iii) For 1990 - USBM - Mineral Industry Survey - 23 Aug. '91 Aluminium Monthly.

TABLE B.2 : PRODUCTION OF ALUMINA COUNTRIES - 1981-1990

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990 (e)
United Kingdom	90,361	88,103	93,100	105,000	109,700	109,500	79,000	114,000	116,000	115,000
France	1,235,521	1,086,700	1,009,600	1,035,500	734,200	740,000	712,000	551,000	480,000	664,000
Germany, Federal Republic of	1,650,636	1,509,866	1,580,223	1,700,622	656,579	1,559,604	1,312,828	1,162,786	1,174,000	1,175,000
Greece	490,168	403,634	410,000	482,410	248,366	307,190	518,415	514,650	521,000	566,000
Irish Republic	-	-	66,000	675,000	155,400	685,490	777,574	842,600	891,000	805,000
Italy	786,357	698,329	466,000	625,000	363,000	404,200	457,600	460,500	722,000	752,000
Czechoslovakia	149,283	151,219	152,456	150,000	150,000	153,345	149,517	162,651	170,000	200,000
German Democratic Republic	45,164	46,085	42,156	43,239	46,695	46,350	50,600	64,000	60,000	50,000
Hungary	792,000	743,000	835,512	811,000	796,000	856,333	857,612	873,232	882,000	826,000
Romania	558,000	514,000	512,000	552,000	548,000	555,000	584,000	580,000	611,000	400,000
Soviet Union	3,600,000	4,000,000	4,175,000	4,200,000	500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,200,000
Spain	655,230	673,000	729,000	742,000	476,000	489,000	524,000	576,000	945,000	900,000
Turkey	131,400	84,204	57,420	75,120	113,204	144,396	95,232	181,670	201,000	185,000
Yugoslavia	1,037,227	1,018,334	1,009,695	1,135,000	1,138,026	1,116,716	1,113,000	1,060,041	1,168,000	1,200,000
Guinea	679,000	578,000	564,000	550,000	565,000	555,400	530,000	593,000	619,000	631,000
Canada	1,208,000	1,127,000	1,116,000	1,126,000	1,019,000	1,015,000	952,690	992,576	1,048,000	1,087,000
Jamaica	2,556,057	1,761,135	1,853,940	1,751,000	1,511,800	1,578,000	1,622,000	1,520,000	2,221,000	2,869,000
USA	5,560,000	4,130,000	4,000,000	4,545,000	3,465,000	3,105,000	4,150,000	4,650,000	5,000,000	5,230,000
Brazil	518,900	551,700	628,500	891,200	1,095,500	1,196,800	1,365,000	1,487,850	1,632,000	1,600,000
Guyana	170,000	73,135	-	-	-	-	-	-	-	-
Suriname	1,248,000	1,052,000	1,154,000	1,237,000	1,242,000	1,471,000	1,363,000	1,632,200	1,567,000	1,532,000
Venezuela	-	-	594,000	1,142,000	1,110,000	1,268,745	1,360,012	1,284,036	1,212,000	1,293,000
China	700,000	800,000	800,000	800,000	1,300,000	1,400,000	1,450,000	1,530,000	1,500,000	1,500,000
India	482,519	485,000	480,000	569,000	373,000	393,000	425,000	776,000	1,419,000	1,455,000
Japan	1,619,000	1,212,000	1,378,000	1,468,000	873,000	644,000	465,000	508,000	466,000	459,000
Taiwan	19,000	-	-	-	-	-	-	-	-	-
Australia	7,079,009	6,630,507	7,230,526	8,780,702	3,791,501	9,243,220	10,109,290	10,510,514	10,800,000	11,231,000
World Total :	33,700,000	29,400,000	30,900,000	35,200,000	3,600,000	32,700,000	34,600,000	36,100,000	38,529,000	40,105,000

(e) Estimated

Source for 1989 & 1990 : Usan Mineral Industry Surveys Bauxite Quarterly August 30, 1991.

Notes : (1) Where possible figures in this table show the alumina equivalent (Al₂O₃) of total hydrate produced, whether or not calcined.

TABLE NO. 8.3. F. PRODUCTION OF ALUMINIUM (PRIMARY) BY COUNTRIES (1981-90)

Country (1)	(IN TONNES)									
	1981 (2)	1982 (3)	1983 (4)	1984 (5)	1985 (6)	1986 (7)	1987 (8)	1988 (9)	1989 (10)	1990 (e) (11)
United Kingdom	339,183	240,806	252,525	287,900	275,373	276,000	294,000	300,000	297,000	290,000
France	435,609	390,413	360,793	341,518	293,100	322,000	323,000	328,000	335,000	326,000
Germany, Federal Republic of	728,896	722,754	743,313	777,165	745,373	765,000	738,000	744,000	742,000	720,000
Greece	148,230	136,612	137,210	138,750	125,222	124,000	127,000	151,000	145,000	150,000
Italy	273,845	232,861	195,694	230,202	224,120	243,000	233,000	222,000	220,000	232,000
Netherlands	261,983	250,925	235,351	249,170	250,603	266,000	276,000	278,000	274,000	258,000
Austria	94,219	93,908	94,200	95,833	94,106	93,000	93,000	95,000	93,000	89,000
Czechoslovakia	32,684	33,830	36,156	31,635	31,725	33,000	32,000	32,000	30,000	32,000
German Democratic Republic	60,000	58,000	57,000	58,000	60,000	61,000	62,000	61,000	60,000	50,000
Hungary	74,253	74,221	74,039	74,202	73,832	74,000	76,000	75,000	75,000	75,000
Iceland	73,476	75,241	76,077	80,359	73,400	76,000	85,000	82,000	89,000	88,000
Norway	633,585	638,091	713,014	765,083	712,406	726,000	806,000	864,000	859,000	845,000
Poland	66,000	42,700	44,400	46,000	47,000	48,000	48,000	48,000	47,000	48,000
Romania	242,000	208,000	223,000	244,000	220,000	269,000	268,000	260,000	250,000	180,000
Soviet Union	2,400,000	2,400,000	2,400,000	2,300,000	2,300,000	2,300,000	2,400,000	2,400,000	2,400,000	2,200,000
Spain	396,600	366,500	357,500	380,800	370,100	350,000	341,000	323,000	352,000	355,000
Sweden	82,329	81,324	84,935	79,625	83,700	78,000	81,000	99,000	97,000	96,000
Switzerland	82,221	75,256	75,971	79,173	72,742	80,000	73,000	72,000	71,000	72,000
Turkey	40,400	36,300	31,045	36,639	54,150	60,000	42,000	57,000	57,000	60,000
Yugoslavia	172,483	217,338	258,174	267,500	270,000	282,000	244,000	260,000	250,000	290,000
Cameroon	65,400	78,900	77,400	74,154	81,600	84,000	79,000	87,000	86,000	91,000
Egypt	142,000	141,000	140,200	172,500	178,500	175,000	179,000	173,000	173,000	179,000
Ghana	190,500	174,200	42,500	-	48,500	125,000	150,000	161,000	169,000	174,000
South Africa	83,701	105,500	161,300	167,400	164,600	170,000	171,000	172,000	170,000	166,000
Canada	1,115,691	1,064,795	1,091,213	1,221,585	1,282,316	1,355,000	1,540,000	1,535,000	1,555,000	1,570,000
Mexico	43,237	44,180	39,706	43,988	42,744	37,000	65,000	71,000	72,000	68,000
USA	4,689,000	3,274,000	3,353,000	4,099,000	3,500,000	3,037,000	3,343,000	3,544,000	4,030,000	4,048,000
Argentina	133,500	140,500	136,400	137,600	139,900	148,000	153,000	154,000	155,000	162,000
Brazil	256,418	299,054	403,744	454,999	549,630	757,000	843,000	874,000	935,000	931,000
Suriname	40,520	42,500	33,600	22,592	28,785	29,000	2,000	10,000	10,000	20,000
Venezuela	314,105	273,632	335,304	386,000	403,501	424,000	440,000	455,000	500,000	546,000
Bahrain	141,300	171,700	171,700	177,300	174,500	178,000	180,000	182,000	184,000	188,000

e/- Estimated

Contd. -2-

Table 8.3 Contd.

-2-

1	2	3	4	5	6	7	8	9	10	11
China	30,000	370,000	400,000	425,000	425,000	410,000	615,000	800,000	825,000	850,000
Dubai	106,000	148,739	151,170	155,400	153,200	155,000	155,000	162,000	160,000	-
India	212,844	216,679	204,764	267,502	266,496	257,000	265,000	375,000	375,000	433,000
Indonesia	-	30,500	114,766	198,960	216,620	219,000	202,000	185,000	222,000	186,000
Iran	12,500	45,000	39,300	42,400	43,000	40,000	40,000	40,000	40,000	49,000
Japan	770,602	350,706	255,500	286,728	226,547	140,600	41,000	35,000	35,000	34,000
Korea, Dem.P.R. of	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	-
Korea, Republic of	17,506	15,226	12,629	18,252	17,695	19,000	22,000	18,000	17,000	4,000
Taiwan	30,532	10,120	-	-	-	-	-	-	-	-
Australia	379,427	380,796	478,190	757,798	851,286	882,000	1,004,000	1,150,000	1,244,000	1,234,000
New Zealand	153,979	163,420	218,610	242,651	240,635	236,000	252,000	264,000	260,000	260,000
Total :	15,700,000	15,500,000	14,300,000	15,500,000	15,400,000	15,413,000	16,385,000	17,608,000	17,980,000	17,617,000

Source :- i) World Mineral Statistics 1981-85

ii) Bauxite, Alumina & Aluminium Minerals Yearbook - 1989.

iii) For 1990 - USBM - Aluminium Monthly August 23, 1991.

TABLE NO: 8.4 : MAJOR BAUXITE MINES OF THE WORLD

COUNTRY	LOCATION	MINE	MINING METHOD	PRODUCTION/YEAR
North America				
United States	Arkansas	Alcoa	Openpit	500,000 to 1 million tonnes
	-do-	Reynolds mine	Openpit	-do-
Central and South America				
Brazil	Minas Gerais	Alcan	Openpit	300,000 to 5,00,000 tonnes
	-do-	Alcominas	Openpit	-do-
	-do-	CBA	Openpit	-do-
	Para	Trombetas	Openpit	+3 million tonnes
Dominican Republic	Pedernales	Cabo Rojo	Openpit	500,000 to 1 million tonnes
Guyana	Kvekuaní	Bermine	Openpit	1 million to 3 million tonnes
	Linden	Linden mines	Openpit	+3 million tonnes
Haiti	Miragoane	Reynolds	Openpit	500,000 to 1 million tonnes
Jamaica	Calendon	Breadnut Valley	Openpit	1 million to 3 million tonnes
	St. Elisabeth	Essex Valley	Openpit	+3 million tonnes
	St. Catherine	Everton	Openpit	500,000 to 1 million tonnes
	Manchester	Kirkvine	Openpit	1 million to 3 million tonnes
	St. Ann	Lydford	Openpit	+3 million tonnes
	St. Ann	Water Valley	Openpit	+3 million tonnes
	Suriname	Paramaribo	Moengo	Openpit
	Leydrop	Paranam	Openpit	500,000 to 1 million tonnes
	Onverdacht	Bulliton	Openpit	+3 million tonnes
Australasia				
Australia	N. Australia	Del Park/ Huntly	Openpit	+3 million tonnes
	N. Territory	Gove	Openpit	-do-
	N. Australia	Jarrahdale	Openpit	-do-
	Queensland	Weipa	Openpit	-do-
	N. Australia	Huntley	Openpit	-do-
	N. Australia	Mt. Saddleback	Openpit	-do-
	N. Australia	Willowdale	Openpit	-do-
Europe				
France	Var	Blanquette/ Combercave	Openpit/ Underground	150,000 to 300,000 tonnes
	Herault	La Rouquette/ Montplaisir	Underground	-do-
	Var	Mazaugues	Underground	-do-
	Var	Peygros	Underground	300,000 to 500,000 tonnes
	Var	St. Julien/ Tourves	Underground	150,000 to 300,000 tonnes
	Var/Herault	Union des Bauxite	Openpit	150,000 to 300,000 tonnes
	Greece	Elikon	Bauxite Elikonoe	Underground/ Openpit
	Elikon	Bauxite Destomon.	Underground/ Openpit	300,000 to 500,000 tonnes
	Elefsis-Itea Lania	Bauxite Elefsinos (Skalistiri)	Underground/ Openpit	500,000 to 1 million tonnes
	Parnassos	Bauxite Parnassos	Underground/ Openpit	1 million to 3 million tonnes
Africa				
Ghana	Aveso	Aveso	Openpit	300,000 to 500,000 tonnes
Guinea	Sengaredí	CBG	Openpit	+3 million tonnes
	Kimbo	Frigula	Openpit	1 million to 3 million tonnes
	Kindia	Kindia	Openpit	1 million to 3 million tonnes

Table B-4 Contd

COUNTRY	LOCATION	MINE	MINING METHOD	PRODUCTION/YEAR
Sierra-Leone	Moyamba	Sierra Leone Ore and Metals	Openpit	500,000 to 1 million tonne
Asia				
India	Madhya Pradesh	Amarkantak	Openpit	300,000 to 500,000 tonnes
	Bihar	Sagro Hills	Openpit	-do-
	Maharashtra	Chandgad	Openpit	-do-
	Bihar	Renduapat	Openpit	-do-
	Tamil Nadu	Shevaroy	Openpit	150,000 to 300,000 tonnes
	Orissa	Damanjodi	Openpit	1 million to 3 million tonnes
Indonesia	Bintan	Kijang	Openpit	1 million to 2 million tonnes
Malaysia	Johore	Pengerang	Openpit	500,000 to 1 million tonnes
Turkey	Mugla	Milas	Openpit	150,000 to 300,000 tonnes
	Konya	Seydisihit	Openpit	500,000 to 1 million tonnes

Source : Mining Magazine - January, 1987

**TABLE 8.5 : EXPANSIONS IN PRODUCTION CAPACITY FOR BAUXITE
PLANNED DURING 1991-1995 (THOUSAND TONNES/YEAR)**

Location	Owners/Partners	Capacity at the end of 1990	Expansion	likely completion date	Comments
Brazil					
Pocos de Caldas, Minas Gerais	Alcoa	550	+ 50	1991	Expansion for local refinery at same location
Driximina, Para	Alcoa Mineracao, 60% Alcoa 40% Billiton	-	+2500	1992/93	Under study, may reach 4 million tonnes per year by 1995.
Guyana					
Aroaima	50% Reynolds 50% Government	-	+1500	1991	Production to increase to 2 million tonnes per year by 1994.
Linden	Guymins	1500	+1500	1993	Exhaustion of one open pit, opening of another, mainly non-metallurgical bauxite
Jamaica					
Breadnut Valley	Jamalco 51% Government 49% Alcoa	1500	+ 550	1991	
Manchester	Jamalcan 93% Alcan 7% Government	-	+2500	1991	To replace Williams field which has exhausted the reserves.
Lydford, St. Ann	Jamaica Bauxite Mining (Government)	-	+2500	-	Re-Opening discussed (mine closed in 1984)
Venezuela					
Los Pijiguas, Rorima	Bauxiven (Government)	3000	+3000	Mid-90s	

SOURCE: UNCTAD SECRETARIAT.

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**TABLE NO. 8.6: EXPANSIONS IN PRODUCTION CAPACITY FOR ALUMINA
PLANNED DURING 1991-96 (THOUSAND TONNES/YEAR)**

Location	Owners/Partners.	Capacity at the end 1990	Expansion	Likely completion date	Comments
<u>Australia</u>					
Gove, N. Territory.	Nabalco 70% Alusuisse 30% Gove Alumina	1450	+ 150	1992	
Wagerup, W. Australia	Alco of Australia 55% Alcoa	850	+ 600	1992/93	
Worsley, W. Australia	Worsley Alumina 50% Reynolds 37.5% Billiton 12.5% Kobe Alumina Associates	1350	+ 150	End 1991	Capacity may be further increased to 2.25 million tonnes per year
Weipa, Queensland	Comalco	-	+1000	mid-90s	New Project at existing mine, feasibility study under way
<u>Brazil</u>					
Barcarena, Para	Alunorte	-	+1100	1993/94	No definite decision on start-up taken
Sao Luis, Maranhao	Alumino de Maranhao (Alumar) 65% Alcoa 35% Billiton	730	70	1992	
<u>Greece</u>					
Gulf of Corinth	Hellenic Alumina (Government)	-	+ 600	1993/94	Collaboration Greek/USG : Governments.
<u>Guyana</u>					
Mackenzie Linden	Guymine (Government)	-	+ 300	1992/93	Reopening under study
<u>Ireland</u>					
Aughinish	65% Alcan 35% Billiton	900	+ 100	1991	
<u>Italy</u>					
Porto Vesme, Sardinia,	Buralumina 52% Aluminio Italia 30% Comalco 18% Clarendon	100	+ 200	1991	
<u>Jamaica</u>					
Clarendon	Jamalco 51% Government 49% Alcoa	800	+ 200	1991	
Essex Valley	Aluminium Partners of Jamaica (Alpart) 65% Kaiser, 35% Hydro Aluminium	1250	+ 350	mid-90s	Re-opened in 1989, after being closed in 1985. Further expansion under discussion

1	2	3	4	5	6
Trelawny	Government Alcan	-	1000	mid-90s	Feasibility study being carried out
Venezuela Ciudad Guayana	Interalumina 96.5% Government, 3.5% Aluisse.	1300	+ 700	1992	Further expansion possible

Source: UNCTAD Secretariat.

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TABLE 8.7: EXPANSION IN PRODUCTION CAPACITY FOR PRIMARY ALUMINIUM PLANNED DURING 1990 to 1995
(THOUSAND TONNES/YEAR)

Location	Owner/Partners	Capacity at the end of 1990.	Expansion	likely completion date	Comments
<u>Algeria</u>	Government	-	♦ 220	1991	Under construction
<u>Australia</u>					
Portland, Victoria	45% Alcoa of Australia 35% Aluvia (Victoria Government) 10% First National Resource Trust 10% China International Trust and Investment corp.	330	♦ 60	1992	Expansion studied partly contingent on power supply condition.
Newcastle, New South Wales	Tomago Aluminium 35% Pe chinney, 35% Gove Alumina, 15% Australia Mutual Provident society 12% VAW 3% Hunter Douglas	240	♦ 180	1993/95	Feasibility study of expansion is now being carried out.
Bunbury, W. Australia	Kemerton Aluminium, 49% John Holland Holdings 49% Wardkey 2% Pennant Holdings	-	♦ 185	1994/95	Feasibility Study being carried out
<u>Bahrain</u>	Aluminium Bahrain (Alba) 75% Government 20% Saudi Public Investment Fund 5% Breton Investments	225	♦ 235	1992	
<u>Brazil</u>					
Sorocaba, Sao Paulo	Companhia Brasileira de Aluminio	180	♦ 30	1991	Further expansion by 40,000 tonnes per year possible by 1993/94
Sao Luis, Maranhao	Aluminio de Maranhao (Alumar) 65% Alcoa 35% Billiton	350	♦ 30	1993	Expansion studied
Aratu, Bahia	Alcan	58	♦ 30	1993	Under study

1	2	3	4	5	6
<u>Canada</u>					
Laterriere, Alcan Quebec		150	♦ 50	1991	Production started in December 1989, last phase entering production early 1991.
Sept Iles, Quebec	Alouette 20% Austria Metall 20% Hoogovens 20% Ste Generale de Financement de Quebec 20% VAW 13.33% Kobe Steel 6.67% Marubeni Corpn.		♦ 215	1992	May be expanded to 430,000 tonnes per year by 1995.
Deschamault, Quebec	Alumax	-	♦ 215	1992	
<u>France</u>					
Dunkerque	Pechiney	-	♦ 215	1992	Under construction
<u>Iceland</u>					
Straumsvik	Atlantal 40% Alumax 30% Granges 30% Hoogovens	-	♦ 200	1994	Under study
<u>India</u>					
Angul, Orissa	National Aluminium (Government)	218	♦ 115	mid-90s	Under study
Renukoot, Uttar Pradesh	Hindustan Aluminium (Private)	135	♦ 117	1993/94	Government permission sought
Korba, Madhya pradesh	Bharat Aluminium (Government)	100	♦ 50	mid-90s	
Irth (Islamic Rep.) Bandar Aboas	65% Government 35% International Development Corpn.	-	♦ 220	1995	Agreement signed 1990
<u>Malaysia</u>					
Bintulu, Sarawak	Hydro Aluminium State Government Private interests	-	♦ 120	mid-90s	Under study

1	2	3	4	5	6
<u>New Zealand</u>					
Tiwai Point	NZ Aluminium Smelters 79.4% Comalco 20.6% Sumitomo	257	♦ 130	1992/93	30,000 tonnes to be added through up-grading of existing plant, 100,000 tonnes through additional potline, all contingent on power supply conditions
<u>Nigeria</u>					
Ikot Abasi	Reynolds Government Private interests	-	♦ 180	1992/93	
<u>Norway</u>					
Ardal	Hydro Aluminium	180	♦ 20	1992	
Husnes	Sor Norge Aluminium 50.3% Hydro Alum. 49.7% Aluisse	68	♦ 32	1993/95	
Lista and Mosjoen (2 smelters)	Mosjoen Aluminium 50% Alcoa 50% Elkem	205	♦ 163	mid-90s	Expansion possible depending on power supply conditions
Sunddal	Hydro Aluminium	140	♦ 100-200	mid-90s	New plant under study, would partly replace old smelter.
Moj Rana	Hydro Aluminium	-	♦ 200		Under study
<u>Qatar</u>					
Umm Said	Doha Aluminium 30% International Engineering consultant. 30% United Aluminium Fabricators 15% Ameri 10% China National Metals & Minerals Import & Export Corp. 15% Private Interests	-	♦ 150	1994/95	
<u>Saudi Arabia</u>					
Yanbu	Alujain Corp of Saudi Arabia 60% Xenel Industries & National Industrialization Co.,	-	♦ 214	1995	Expandable to 360,000 tonnes per year

1	2	3	4	5	6
	8% Alumix 8% British Aerospace 8% China Steel 8% Pechiney				
<u>Trinidad and Tobago</u>	Trinidad and Tobago and Jamaican Governments	-	200	mid-90s	Joint venture based on alumina from Jamaica. Under study
<u>United Arab Emirates</u>					
Umsal Quweib	Umalco 30% Government 30.5% United Aluminium Fabricators 21% International Engineering Consultants 10% China National Metals & Minerals Import & Export Corpn. & China Everbright Holdings 8.5% Amari	-	+ 240	-	Project status uncertain
<u>United States of America</u>					
Bellingham, Washington	Alumax	263	+ 9	1991	
<u>Venezuela</u>					
Puerto Ordaz	Alumino del Caroni (Alcasa) 84.25% Government 15.75% Reynolds	215	+ 180	1992	
Puerto Ordaz	Industria Venezolana de Aluminio (Venalum) 80% Government 20% Japanese Consortium	405	+ 50	1993/95	
Puerto Ordaz	Alusur 40% Sural 40% Alcoa 20% Government	-	+ 115	1993/95	Expandable to 180,000 tonnes per year.
Puerto Ordaz	Alumsa 40% Austria Metall 30% Alcasa 30% Pechiney	-	+ 180	1993/95	Construction not yet started

1	2	3	4	5	6
Puerto Ordaz	Aluyena 49% Government 49% Italimoianti and Techint 2% Private	-	♦ 180	1993/95	Expandable to 360,000 tonnes per year
Puerto Ordaz	Aluguay Government Alumax	-	♦ 180	mid-90s	Construction not yet started
Puerto Ordaz	Alica 57.5% Inversiones Ripasa 25% Government 17.5% Dr. Alberto Vollmer Group	-	♦ 246	1993/95	
Puerto Ordaz	Aldanca 36% Calesdos 36% Organization Diego Cisneros 18% Government 10% Reynolds	-	♦ 190	1993/94	Construction not yet started
Puerto Ordaz	Vexal de Aluminio - ASEA Bro. Boveri Government	-	♦ 180	mid-90s	Construction not yet started
Puerto Ordaz	Kojovan 45% Republic of Korea interests 35% Japanese inte- rests 20% Government	-	♦ 140	mid-90s	Capacity to double later in 1990s.
Puerto Ordaz	Unnamed Project Reynolds Mitsubishi Organization Diago cisneros Government International Finance Corporation	-	♦ 200	mid-90s	Under study

Source : UNCTAD Secretariat.

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