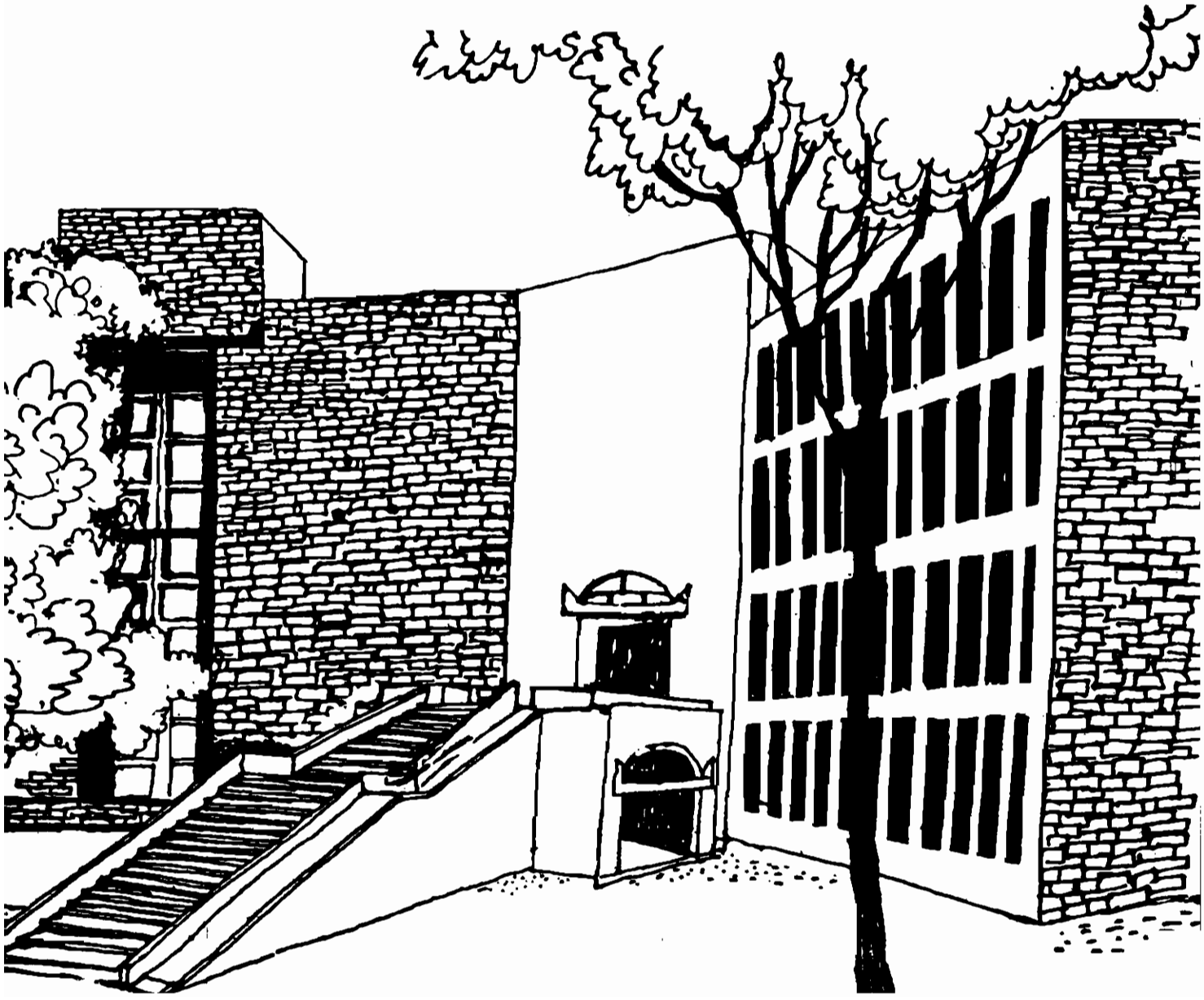
विद्याविनियोगाधिकारः

IIM

AHMEDABAD

Working Paper



The Indian Aluminium Industry
A Perspective

Mukund R Dixit
R. Venugopal

W.P. No. 1255
May 1995

The main objective of the working paper series of the IIMA is to help faculty members to test out their research findings at the pre-publication stage.

Indian Institute of Management
Ahmedabad 380 015, India

The Indian Aluminium Industry
A Perspective

Mukund R. Dixit
R. Venugopal

Abstract

This paper looks at the various facets of the aluminium industry such as government policy, user profile, industry structure, financial and physical performance, exports and imports and firm level management issues, and draws a perspective of the industry. The key observations are as follows:

Till the early seventies private entrepreneurs played a leading role in shaping the industry. The Government entered the Aluminium industry with the setting up of Bharat Aluminium Company but, it gained prominence with the setting up of National Aluminium Company(Nalco).

India has attained net exporter status in Aluminium. The major exports of aluminium are in the form of ingots from Nalco, though more stress is being laid on the export of value added items.

The industry has adopted and assimilated technologies acquired from leading international players. The assimilation of technology has been sufficient to operate plants at designed efficiency levels but has not led to the accumulation of expertise which can be a source for indigenous technological development. No major indigenous technological innovations have taken place in the Aluminium industry.

The user profile has undergone a change over the years and new applications have been found.

Among the major aluminium producing countries in the world, India ranks tenth. India's production of approximately 500,000 tons of Aluminium represented about 3.5 % of the world production of Aluminium and half the production of China. The major constraints in taking a significant place in the world market appear to be steady and uninterrupted supply of power. In the context of liberalisation, investment in this sector by the aluminium companies themselves or agreements with the existing or new comers in the power sector could ease the situation.

Introduction

Discussion of the response of corporations to the new economic policy has tended to focus on end consumer industries. Oft debated topics are the entry of leading international brands, the sale of established Indian brands to multinationals, equity investments of leading international automobile companies in India, multinational joint ventures and buy back arrangements in consumer durable industry. The policy changes vis-a-vis the core sector, their implications, and the core sector response to these changes have received attention only in the case of power sector. Attention of policy makers and academicians needs to be paid to other constituents of the core sector as well. The core sector produces products that form the input to a large number of industries[1]. In the ultimate analysis, therefore, it is the cost efficiency and quality of core sector products that would determine the performance of the economy as a whole. If the industrialisation and globalisation objectives of the new economic policy are to be achieved the core sector needs to be strengthened.

Basic metals sector is a part of the core sector. Over four decades India has developed capabilities to produce ferrous and non-ferrous metals, the oldest being steel and aluminium.Within the group of nonferrous metals aluminium constituted 69% of the total production in 1993-94.

This paper looks at the following facets of the aluminium industry and provides a perspective.

- government policy
- user profile
- industry structure
- financial and physical performance
- exports and imports
- firm level management issues

Government Policy

Till recently, the aluminium industry was regulated by licences and controls. These policies defined the conditions for entry of new companies and import of foreign technology. The regulatory policies constrained the expansion and growth of the private sector. Over the years the Government liberalised this sector. The Industry Policy Resolution of 1956 placed aluminium in the second category. Accordingly, entry was open to both private and public sectors. The industry was subject to price and distribution controls since 1970. The Aluminium Control Order was issued in 1970 fixed uniform ex factory prices.

Distribution controls were introduced in 1975 and firms were required to supply 50% of their production to Electricity Boards as Levy Metal at cash cost without covering depreciation and interest on capital. The balance 50% could be sold by them in the market at market prices. The pricing control worked against the low cost producers. This even led to friction and court battles between the government and the producers.[2] In 1978 dual pricing was abolished. The policy of pooled prices was introduced in October 1978. The customer was offered a uniform pooled price for ingots but individual firms were allowed differential retention prices depending on their cost structure. The difference between the pooled and the retention prices were to be paid by the low-cost producers to the government and the Government in turn reimbursed the high cost producers. Different prices were

---

1. Dutta, Samar., *Report of The Industrial Licensing Policy Inquiry Committee*, New Delhi: Government of India, 1969.

2 This account is based on the recollection of one of the authors of this paper.

allowed for the primary producers at 12% return on net worth at 85% capacity utilisation. Liberalisation began with the abolition of Pricing and distribution controls on Aluminium in 1989. The decontrol was apparently prompted by the resentment of primary producers and the experience with the Aluminum Pool. In 1991 the Aluminium sector was delicensed. Controls on imports and foreign investments were done away with. The immediate response of the existing producers has been to announce expansion and technology upgradation plans. The focus of their efforts has also been on improvement of quality of the metal. New entries have been made in the alumina segment. Till recently the primary sector consisted of four players, two each from the private and public sectors.

User Profile

Use of aluminium is in sectors ranging from utensils manufacturing to aero space. Since 1950, the extent of usage and the profile of users has expanded. The replacement of copper by Aluminium in the electrical industry provided the biggest market for the primary producers[3]. The user profile of Aluminium over the years[4] is as shown in table 1.

Table 1

Sector-wise Consumption of Aluminium (%)

Sector	1950	1960	1970	1980	1993
Electrical	20	41	48	52	35
Utensils and Consumer Durables	53	24	28	19	12
Transport	6	13	8	11	18
Building and Construction	2	1	2	6	6
Machinery/Gen Engg	NA	NA	NA	NA	6
Packaging	10	11	8	6	7
Others (Aero space,defence,etc)	9	10	6	6	16

The utensils sector which accounted for as much as 53% of the Aluminum demand in the years immediately following independence gave place to other user sectors like electricals and transport. It can be noted that non traditional applications such as aero space, defence etc. constitute as much as 16% of the total consumption. The increased demand has been met by increase in domestic production from a meagre 4045 tonnes in 1950s to 496,300 tons in 1992. The imports declined from 39,000 tons to 2300 tons in 92-93. In the next year this increased to 3500 tons. Since 1990-91 the industry has emerged as a net exporter of metal. The next exports were 22.8 million tons in 1990-91. This increased to 101,200 tons in 92-93. This however declined to 79500 tons in 1993-94.

The evolution of the industry structure is discussed in the next section.

Industry Structure

Firms in the Aluminium sector can be classified as primary producers, secondary rollers, secondary extruders, and conductor manufacturers, depending on where they start in the production value chain given in Exhibit-1.

---

3 *Mineral and Metals Review* , Volume XX, No 8 (August), 1994

4 *ibid.*

The primary producers form the core of the aluminium industry. They start with Bauxite and produce primary aluminium ingots through the Bayer and Hall-Heroult processes. They can move further along the value chain and produce rods, extrusions and rolled products. There are at present four companies in the primary sector.

Secondary extruders start with billets, procured from primary producers and extrude them into profiles, and tubes. The secondary rollers procure either slabs or thick hot rolled coils from the primary producers and produce cold rolled sheets, and coils. Conductor manufacturers procure rods from the primary producers and draw them into wires. The total licensed capacity in the secondary sector is 200,000 tonnes per annum. There are about 25 players.

Besides, there is also a tertiary sector consisting of utensil manufacturers and other fabricators who produce end use products from aluminium sheets and extrusions. There are also foil manufacturers who procure foil stock (which is nothing but thin-gauge rolled coil) and further roll the stock down to foils. This sector is diffused with numerous manufacturers located in various parts of the country.

The next part of the paper presents the development of the primary segment.

Early Stage of the Industry

In the early stage of the industry aluminium production in India was confined to the manufacture of utensils from imported metal[5]. The entry of players in the primary and secondary sectors was guided by the availability of collaborations and restrictions of public policy. All the entries in the primary sector were made in collaboration with one or the other leading international company.

The Aluminium Company of India (Alucoin) was the first Aluminium Company to be registered in 1937, by the JK group in collaboration with Al-Suisse of Switzerland which had contributed 27% of the equity. Alucoin set up an integrated plant in 1944 at Asansol in West Bengal to produce 2000 tons of ingots from bauxite.

Alucoin was followed by the Indian Aluminium company (Indal), was set up as a subsidiary of Aluminium Company of Canada (Alcan) with 60% equity participation. In 1941 a rolling mill was set up by Indal at Belur in West Bengal to cater to the utensil manufacturers of Calcutta. Over the years it covered all the segments of the value chain. This plant produced circular sheets from imported Aluminium ingots. In 1943, Indal set up an Aluminium plant with a capacity of 2500 tonnes per annum,[6] at Allupuram in Kerala. The alumina for producing the Aluminium was imported. In 1948, Indal started Bauxite mining at Lohardoga in Bihar, and Alumina production at Muri, about 135kms away from the Bauxite mines. In 1951 Indal set up a powder and paste plant at Kalwa, and in 1954 undertook major expansion of its rolling mill operations. This was followed in 1955 by an extrusion plant near its smelter at Alwaye. Two more Aluminium smelters were set up by Indal at Hirakud and Belgaum in 1959-1960. In 1961, with a production of about 15,000 tons Indal accounted for 86% of ingots production. Alucoin and Indal also dominated the rolled product sector. Indal enjoyed virtual monopoly in extrusions and powder where it was the only fabricator[7].

---

5 Subbiah, Kannappan; and Burgess, Eugene W., *Aluminium Limited in India*, NPA: Washington, 1962.

6 Mazumdar,A.G., *Aluminium Industry in India*, Economic and Scientific Research Foundation: New Delhi, 1970. p. 25.

7 *ibid.* footnote 1. p32.

The third entry was that of Madras Aluminium Company Limited established in 1960. Its integrated plant, with a capacity of 10,000 tons of aluminium ingots and rods, at Mettur, in Tamil Nadu commenced production in 1965. It had technical collaboration with Montecatini of Italy held 27% of the equity. The fourth entry was made by Hindustan Aluminium Company (Hindalco) registered in 1958 by the Business house of Birlas. It had 27% equity participation and technical collaboration agreements with Kaiser Aluminium, USA. In 1962 Hindalco set up its alumina and smelter plants at Renukoot, in technical collaboration with Kaiser, USA. Its installed capacity in 1962 was 20,000 tonnes per annum (tpa) of ingots. It started producing rods in 1964 and rolled products and extrusions in 1965. The entry of Hindalco brought a powerful player on the scene. With technical collaboration from Kaiser and cost-efficient operations Hindalco soon emerged as the largest Aluminium producer in India and the industry leader.

The sixties saw both Indal and Hindalco increasing the capacity of their smelters. Hindalco raised the capacity of its Renukoot smelter to 40,000 tons in 1965, 60,000 tons in 1967 and to 80,000 tons in 1969[8] . Indal had a capacity of 65,850 tons distributed among its three smelters as follows: Alwaye(Kerala)-15,850 tons per annum, Hirakud(Orissa)-20,000 tons per annum and Belgaum (Karnataka)- 30,000 tons per annum[9] . Further expansion of its Hirakud Smelter was undertaken by Indal between 1969 and 1970 from 20,000 to 24000 tons per annum. Alucoin was producing ingots, rods, sheets, foils and paste at its rated total capacity of 8700 tons. However, Alucoin production was seriously affected in 1970 due to power shortages and labour unrest. The government price control introduced in 1970 also worked adversely for the Company. Alucoin finally closed down in 1973. The production in 1971 was distributed among three private sector companies as follows:

	Indal	Hindalco	Malco	Total
Production (Tons)	78002	79501	12,919	170,422
Percentage	45.77	46.65	7.58	100.00

It can be noted that both Indal and Hindalco were nearly equal in their production performance. Each held a share of 46%. Malco was far behind.

Investment in captive power plant by Hindalco at Renukoot right at the inception besides entering into a 25 year agreement with the UP State Electricity Board enabled it to sustain its production performance. In the 1975-1980 period power cuts from the UPSEB interfered with the Hindalco operations which was met by Hindalco with an expansion of its power plant capacity.

Indal, on the other hand had not thought of setting up its own captive power plant. At its three smelters located in Alwaye(Kerala), Hirakud (Orissa), and Belgaum (Karnataka) the company was dependent on hydel power from the State Electricity Boards (SEBs). It had to bear steep power cuts and increasing power tariffs at all these locations. This led to a fall in its production.

Malco too faced the problem of power shortage and as a result saw a downward swing in its production. As a result, in 1986 the distribution of shares in the production of aluminium was as follows:

---

8 "Hindalco: Company of the Year", *Minerals and Metals Review*, Volume XX, No 6 (June),1994. p 24.

9 same as footnote 3

	Hindalco	Indal	Malco	Balco	Total
Production (Tons)	122,059	37,455	11,013	89,453	259,980
Percentage	46.95	14.41	4.24	34.41	100.00

In terms of ranking Indal was overtaken by a public sector entrant, Bharat Aluminium Company (Balco).

Public Sector Entry

Bharat Aluminium Company, the first public sector Company in the Aluminium sector, came on the scene in 1976 with a production of 24,000 tons of ingots and rods from its Korba Smelter. It was established in 1968 to set up integrated Aluminium plants at Korba (MP) and Koyna (Maharashtra). Initially, the Korba project was taken up in technical collaboration with a Hungarian company. An Alumina plant to produce 200,000 tpa of alumina was set up in Korba in 1973. The aluminium plant went into production in 1975 with an installed capacity of 25,000 tpa. The Extrusion Plant and Rolling Mills were commissioned in 1978 and 1980 respectively. Balco could however reach its full production capacity by only 1984.

Hindalco continued to be the industry leader, having raised its capacity to 95000 tpa in 1972 and to 120,000 tpa in 1981. Indal raised the capacity of its smelters to 117,000 tons by 1981 and regained its position in the industry.

The production in 1982 was as follows.

	Hindalco	Indal	Malco	Balco	Total
Production (Tons)	90,735	70252	14,346	43,454	218,787
Percentage	41.47	32.11	6.56	19.86	100.00

The latter half of the eighties saw the entry of National Aluminium Company(Nalco) on the scene. Nalco was established in 1981 to set up a giant Aluminium complex based on East Coast Bauxite reserves. Nalco entered into technical collaboration agreements with Aluminum Peschiney of France. It was financed to the extent of $960 million by a consortium foreign creditors[10]. Nalco was envisaged to produce 8 lakh tons of Alumina and 2.18 lakh tons of ingots and rods. Nalco started production of Aluminium in 1987 with an installed capacity of 25,000 tpa of aluminium ingots. The project was considered to be very ambitious. The workability of the project was questioned. Defying this the Nalco smelter began production of Aluminium metal in 1987 and the picture with regard to production of Aluminium in 1990-91 was as follows[11].

	Hindalco	Indal	Nalco	Balco	Malco	Total
Production (Tons)	139,022	64,760	151,281	91,745	2520	449,328
Percentage	30.94	14.41	33.67	20.42	0.56	100.00

10 "Nalco: Company of the Year", *Minerals and Metals Review*, Volume XVI, No 6(June), 1990.

11 Source: *Minerals and Metals Review*, Volume XIX, NO 8 (August), 1993.

It can be seen that Nalco came in late and overtook all the existing players. The entry of Nalco showed new strategic options to the industry in respect of product standards, markets, technology, and management methods.

In the nineties Nalco expanded its production further towards its designed capacity of 218,000 tpa and Hindalco too expanded capacity to 170,000 tons .The production share in 1992-93 was as follows:

	Hindalco	Indal	Nalco	Balco	Malco	Total
Production (Tons)	162,346	38,651	191,069	91,333	0.00	483,399
Percentage	33.58	8.00	39.53	18.89	0.00	100.00

It can be seen that Nalco's share has increased further to 39.53%.

Thus the industry has developed an oligopolistic structure having players from both the private and public sectors. The public sector player who entered late has come to occupy a dominant position. One of the private sector player has maintained his position by steady expansion supported by early strategic investment decisions that assured steady supply of power. The other private players are lagging behind. The entry of the public sector also brought in changes in the Government policies.

New Entrants

As noted in the previous section, in 1991 licensing and import controls were done away with. So were the restrictions on foreign investment. Responses to these policies have been as follows.

* So far, there have been no new entrants in the primary aluminium sector. The existing companies have announced their expansion plans. Hindalco has expanded its smelter capacity to 170.000 tpa as of 1994 and is set to further expand to 210,000 tpa in the next 4-5 years.
* The new policies, however, have provided impetus to the setting up of new units to produce alumina. The projects that are expected to commence are:
  - The Rs 1993 crore project of L&T for a 1 million tpa of alumina.
  - The Rs 2171 crore project of Indal to be undertaken jointly with the Tatas and Norsh-Hydro of Norway, of a similar capacity.
  - The Rs 711 crore project of Karnataka Telecables for an alumina unit of 500 thousand tpa capacity.

Strategic Response to the New Policy

The following statements provide a guide to the strategic response of the companies to the new policies.

Hindalco

Hindalco is well aware of challenges from other producers. It endeavours to keep cost of production low by optimum utilisation of resources...wide markets...covering all sectors... Hindalco is one of the most cost-efficient producers in the world. It would continue to be so.[12]

12 Interview of the President of Hindalco with *Mineral and Metals Review* (August 94 issue)

Indal

Indal has been famous as a producer of high quality extrusions and sheets for specialised applications domestically. Its strategy has been elucidated by its President Tapan Mitra as follows [13]:

In its chosen businesses Indal has to become world class over the next few years in cost quality and service.

Balco

Balco's strategy for the coming years has been explained as one of concentrating on value added production rather than capacity expansion[14], in an interview to the journal alluded to above. It had commissioned Dastur & Co to suggest ways and means of revival of the Bidhanbag unit of Balco. Based upon their suggestion Balco is set to move into AAAC conductor production. The liberalised environment has been utilised by Balco to seek technical assistance from Kaiser, USA for a Soviet-aided smelter and it hopes to produce super pure aluminium soon. Balco would also produce thin sheets and packaging foils.

Nalco

Nalco is set to continue to concentrate on exports which had brought huge earnings thus far. It would also produce high quality billets for domestic consumption by secondary units.

One can note from the contemplated response that the players have chosen different axes for building their strategies. In view of the changes in policies and the early response, one can expect that the sector to be dynamic in the years to come.

The following factors emerge from the above analysis.

* Production of aluminium was pioneered by private entrants.
* Early Government policies and power supply problems led to slow growth of the private players .
* The industry is spread through out the country.
* Public sector enterprises entered late but achieved dominance.
* In a short span Nalco, a public sector undertaking emerged as industry leader in terms of share of production.
* Gigantic projects to manufacture alumina from East Coast Bauxite by new entrants in the wake of liberalisation and export demand.
* The sector can be expected to be dynamic in the years to come.

The core sector poses unique management challenges. The initial investments are high and decisions relating to capacities, location and technology are not easily reversible. Hence there is a tendency to lock the organisation into a particular strategy. Relations with suppliers and buyers are difficult to break. A power company, for instance, cannot be asked to stop the supply of power or increase it suddenly to another consumer. Nor can customers be persuaded to switch over to a new substitute overnight. Hence responses to public policy of core sector companies need longer lead time.

---

13 *ibid*

14 *ibid*

Financial and Physical Performance

In this section we consider the financial and physical performance of the primary producers.

Sales and Profits

Exhibit II furnishes the sales and profits of the companies during 1988-89 to 1992-93. Nalco emerges as the biggest producer with sales reaching Rs.1170 crore in 92-93. Hindalco is the next major producer, followed by Indal and Balco. While Hindalco and Indal increased their profits by more than 100% in 89-90 (the year following price decontrol), Nalco increased its profits by as much as 728%. Balco, however just managed to stay out of the red. Despite being an early entrant, Balco is ailing. Compared to this the sales and profits have been growing at an annual rate of 35% for Hindalco, while the other private sector producer Indal registered a negative profit growth rate in 90-91 an 91-92. This can be traced to the closure of its Belgaum Smelter due to power supply problems. Indal performance picked up later. Malco has not recovered at all. Nalco has realised a positive growth rate of profits in 92-93 after facing decline in profits in the earlier two years. The four players have reported differences in their performance. Indal continues to perform well. As noted earlier this is due to certain strategic investments made earlier.

Physical Performance

Exhibit III presents a build up of installed capacity and capacity utilisation in the aluminium industry. Since 1988-89 the capacity has remained the same at 6,10,000 tons. The utilisation has improved. In 1992-93 the capacity utilisation was 84.10 per cent.

Consumption of Inputs

The average norms for the consumption of inputs are depicted in exhibit IV. It is to be noted that the figures in the exhibit pertain to norms and not actual consumption. Unlike Steel,the Aluminium industry has no Handbook of Annual Statistics and therefore specific input consumption data is hard to come by. However, in view of the fact that the main producers have all achieved the designed technological parameters, the designed norms can serve as an approximate measure of the parameters for input consumption. The specific consumption of electricity for the aluminium industry has come down drastically with the commissioning of Nalco. As far as the raw material inputs are concerned the consumption of pitch has registered a fall, again owing to the commissioning of Nalco whose designed pitch consumption level is low.

Exports and Imports

The aluminium sector, emerged as the net exporter in 1990. Exhibit V furnishes details of the exports and imports for the years 1986-87 to 1992-93. From a net import of Rs 180 crore into a net export of Rs 440 crore, the Indian Aluminium industry has definitely come a long way in the past 7 years.

The net-exporter status of India is mainly due to Nalco which has obtained registration with the London Metal Exchange (LME). Nalco's metal commands a premium in the international market.

Hindalco exported 20,000 tonnes of aluminium in 1993[15] .The mix consisted of ingots wires ,rods, extrusions and rolled products. Indal also made a significant contribution to the export of value-added products.

---

15 *Economic Times*, May 12, 1994.

The prices of aluminium metal in the international market have been fluctuating widely before ruling steady at $1600 per tonne since March 94. the ratio of the domestic to international prices has fluctuated between 1.1 and 1.2 during 1989-1992. [16] (The domestic prices are exclusive of excise and the international prices are on cif basis). Even after taking into account the excise duty of 25% prevailing in 93-94 the 36% duty offers adequate protection to the domestic aluminium producers.

Firm Level Management Dimensions

Structure and People

There are many similarities in the organisation and management of the aluminium companies. The differences have been in their organisation of the marketing function. Nalco appears to have provided a lead in bringing new management style to the aluminium industry.

The aluminium companies have opted for a functional-geographically differentiated structure. The Head Office of the Company plays a key role at the apex of the organisation as the originator of policies and guidelines. The extent of decentralisation depends on the geographical spread of the company. The geographical dispersion of the Indal plants for example has necessitated decentralisation of authority and responsibility at the plant level. Each plant is headed by a Works Manager. The company has set up regional sales offices.

The plants of Hindalco are located at Renukoot and the Marketing and Head Offices of the Company are also located there. The structure of the Hindalco organisation is, therefore, more centralised. Hindalco also has regional offices at important cities. [17] Balco has its Head Office at New Delhi. Till recently its Marketing Office was also located at New Delhi. In 1992, in an effort to improve co-ordination between Marketing and Operation, its Marketing Office was transferred to Korba. The Company had regional sales Offices at important locations since its inception. In 1992, in an effort to get closer to the customer, 10 more additional sales offices have been opened by the Company.

The issue of Indianisation of management was relevant in the case of Indal. The others were local companies. Among the public sector companies the issue has been one of tenure of the managing director. "Indianisation" of top management at Indal was achieved over years. Balco was headed by bureaucrats until 1980 when the Resident Director of its plant at Korba was appointed as the Chairman and Managing Director. After his retirement, a top manager from the steel sector was chosen to be the Chief Executive. The present incumbent hails originally from the Steel sector. Balco's Executive and Supervisory manpower consists of people who were employed with Alucoin, Hindalco and Malco and those who were recruited afresh and trained by the company both at its works and abroad in the erstwhile Soviet Union.

The two distinguishing features of Indal management are - merit based reward systems and access to the global pool of technical and managerial manpower of ALCAN. Nalco has brought in new management style to the aluminium industry. Its head office is located at Bhubaneswar. Its plants are at Damonjodi and Angul, all in the state of Orissa. Like other aluminium companies it is organised functionally. It has regional sales offices. The central marketing office is at Bhubaneshwar. A notable feature of Nalco is the speed of decision making. Since exports are a vital part of its operations, it has evolved computerised systems to monitor LME prices and a Committee of senior managers at the

16 *Tax Reforms Committee Final Report Part II*, New Delhi: GOI, Ministry of Finance, 1993. p71.

17 "Hindalco: Company of the Year", *Minerals and Metals Review*, Vol XX, No 6 (June) 1994.

head office are authorised to conclude sales agreements quickly. Most of Nalco's orders are concluded over the phone or by FAX- the documentation is done later[18]

Unlike the early entrants Nalco had the advantage of recruiting employees with experience in the aluminium and other metal sectors. The top management of Nalco had experience in the Steel sector. Over the years vacancies in top managerial positions have been filled by internal promotions. Nalco's managerial and supervisory manpower consists of people who have had prior experience, particularly in Balco or Hindalco and also fresh recruits. The executives of Nalco were trained at the plants of Al-Paschiney of France as part of the technical collaboration agreement.

Quality Management

Quality in the aluminium sector can be analysed under the following heads:

- Purity of the virgin metal.
- Quality of the extrusions and rolled products from the point of view of end-use.

The purity of Indian aluminium metal till recently, was not of international standards if one considers the criteria of registration with the London Metals Exchange as the yardstick. The London Metal Exchange requires the purity to be 99.7% besides other conditions. The Indian smelters were not capable of producing metal of this purity. Nalco has been able to get the registration with LME. It obtained the registration in 1989.

The quality of the Extrusions manufactured in India are reported to be lacking in precision finishing, dimensional consistency across the extrusion and surface finish. Indian extruders are reported to be lacking in their capability to produce anodising quality aluminium with the exception of a few[19]. The reasons have been traced to the need for upgradation of existing technology[20].

As far as rolled products are concerned the oft-repeated complaint seems to be the lack of uniformity of thickness and waviness of the sheets. As a result the international competitiveness suffers. For example, foreign consumers require tension levelling of sheets. In the absence of such facilities,a primary producer stands to lose a bulk order. An intermediary procures sheets from the primary producer, levels them and fabricates letter boxes which he exports for a modest profit[21]

Technology Management

The basic technology of Aluminium making has not changed over the years. Aluminium continues to be extracted by the Bayers and Hall-Heroult processes. Improvements have been made in the process to make it more energy efficient and provide higher extractive efficiency. Regarding downstream products such as rolled products and extrusions, technological upgradation has meant improvements in the process control and equipment design to ensure better mechanical properties. Technological changes have also meant developing process parameters and successfully casting alloys of Aluminium and further rolling or extruding these alloys.

---

18 "NALCO: The Company of The Year", *Minerals and Metals Review*, Volume XVI, NO 6 (June) , 1990.

19 See *Minerals and Metals Review*, Vol XVIII, No 8, August 92, p56.

20 See Interview with A.K.Agarwalla, President, Hindalco in *The Economic Times*, 12th May 1994.

21 See article by P.S.Rao erstwhile CMD, Balco, in *Minerals and Metals Review*, Vol XV, No 8, Aug 89.

Acquisition and Assimilation of Technology

The industry has acquired technologies from multiple sources. Canadian, French, Italian, Hungarian, Italian, Soviet and French companies have provided the technologies. The assimilation process has been satisfactory but the upgradation and development processes leave much to be desired. The difficulties in assimilation and upgradation have varied from company to company.

Research and Development

In house R&D centres for Aluminium exist at Hindalco, and Balco. They have developed know how in minor technological areas such as heat-treatment for alloys. They have yet to achieve break through in developing know-how for setting up new plants. To achieve breakthrough in this direction of Jawaharlal Nehru Aluminum Research And Development Centre was set up in 1990 at Nagpur. It is expected to achieve the following objectives:

* Development of the know-how and basic engineering packages for future alumina/aluminium plants to be set up in the country based on indigenous resources.

* Set up a data bank with all the available information on the latest alumina/aluminium technology.

* Helping in technological improvements of existing units.

* To provide extensive help to R&D staff of the in house units.

As regards alloy making, the Defence Metallurgical Research Laboratory and the Defence Research and Development Organisation are also engaged in the development of new alloys especially those belonging to the Aluminium eitheum series. The Indian Institute of Science is also engaged in similar work.

The following accounts of some efforts at developing new alloys can serve as an indicator of the direction of R&D efforts.

The development of AAAC (All Aluminium Alloy Conductors) in place of aluminium conductors can reduce losses in transmission and distribution by 20%. Pioneering work in this field has been done by a private sector unit in conjunction with the primary producers. They have succeeded in developing and supplying such conductors to the State Electricity Boards. The alloy property rods were manufactured at the premises of the primary producers Hindalco and Balco after repeated trials in which the customer was allowed to participate.[22]

In India aluminium-lithium alloy development started in 1985 at the DRDO. Initial difficulties in procuring pure metal were overcome when Nalco started production and supplied about 10 tonnes. There has however been no headway so far as far as commercial production of these alloys are concerned.

The indigenisation of aluminium alloys for space applications has been going on at ISRO for two decades. So far very few alloys have been indigenised and the thrust is still on imports.Many of the alloys supplied by the primary producers do meet quality standards but companies were willing to

---

22 For a detailed account see Galada. "Close co-operation between primary producers and users resulted in AAAC development", *Minerals and Metals Review* ,Vol XVII, No 8, August 92. p 54.

supply only if a "minimum order quantity" condition was satisfied. The costs were also higher than the price of the imported alloy.

The Indian aluminium industry had undertaken various projects for upgradation of the alumina technology in the period 1985-1990. Exhibit VI furnishes details of technological upgradation schemes undertaken by the primary aluminium producers, their cost and expected benefit per tonne of aluminium produced.

We can note the following from the exhibit.

* Very few companies have gone in for big budget schemes.
* The areas chosen are in the nature of modification and upgradation of existing technology.

Rolling and Extrusion Technology

The extrusion presses installed at the primary producers' premises are more than a decade old. The extrusion presses at Balco, for example, were installed in the early eighties. They do have micro-processor control but are handicapped because of the absence of pullers. Indal and Hindalco too had extrusion presses which were capable of producing extrusions of quality sufficient to meet most of the ordinary applications but not precision jobs. Hindalco has installed a modern Conform Extrusion press recently.

The rolling mills installed in the Indian aluminium Industry are also of old vintage. Retrofitting of the mills has been undertaken in the eighties at Hindalco and Indal. Balco's rolling mill has been retrofitted recently in 1993. The retrofitting has mostly had to do with installation of automatic gauge control mechanisms. Hindalco is to install a state-of-the art rolling mill in 1995.

It is to be noted that Nalco, the most modern Indian plant does not have rolling and extrusion facilities. As a result its appearance on the scene did not contribute to the upgradation of the technological level of extrusion and rolling, as it did in the case of smelter technology.

Issues for the Future

India's position in the world

The country-wise production for some major aluminium producing countries is furnished in exhibit VII. The production figures pertain to the production of primary aluminium within the geographical limits of the country concerned. Among the major aluminium producing countries in the world, India ranks tenth. India's production of approximately 500,000 tons of Aluminium represented about 3.5 % of the world production of Aluminium and half the production of China. The major constraints in taking a significant place in the world market appear to be steady and uninterrupted supply of power. In the context of liberalisation, investment in this sector by the aluminium companies themselves or agreements with the existing or new comers in the power sector could ease the situation. There is also the option of going outside where the power is cheap to get the alumina converted. The initial activity has to start here as the bauxite reserves are present here. Exhibit VIII gives the details of the bauxite reserves in India. The other constraint would be technology. Given the liberalised environment the foreign producers may like to sell the output rather than provide technology. R&D efforts need to be strengthened to focus on building capabilities to design and construct smelters that are cost effective and can produce high quality metal, improve 'energy efficiency' and applications. The technology upgradation plans should continue. So should be the concern for quality of metal sold in India and outside.

On the management side, the emphasis on speed of response and flexibility should be sustained. The skills in developing marketing domestically and internationally should be augmented. The orientation has to change from distribution and rationing to customer satisfaction. While the domestic demand is high it is helpful to accelerate the export efforts to keep in shape and learn to meet the highest quality standards.

Summary

Industry Evolution and Structure

The evolution of the aluminium industry is of more recent origin than that of steel,dating back to 1943. Till the early seventies private entrepreneurs played a role in shaping the industry. The Government entered the Aluminium industry with the setting up of Balco. It was only in 1987 with the commissioning of Nalco that the public sector has gained prominent position. Nalco has set new standards for the industry.

Unlike in the case of steel where a secondary sector exists for the production of liquid steel from scrap, there are no secondary producers of molten aluminium.

Technology

The industry has adopted and assimilated technologies acquired from leading international players. The assimilation of technology has been sufficient to operate plants at designed efficiency levels but has not led to the accumulation of expertise which can be a source for indigenous technological development.
No major indigenous technological innovations have taken place in the Aluminium industry. Increments in technological levels are dependant on imported technology. The technology gap between advanced countries and India has narrowed in the case of aluminium owing to the infusion of contemporary technology at Nalco.

Quality

Rolled products are the main problem-products in Aluminium. Common complaints are: waviness of sheet, non-uniformity of gauge, inability to supply wider sheets etc. Unwrought Aluminium produced by Nalco has the distinction however of being comparable to the best in the world in purity. Players other than Nalco have yet to obtain international certification for quality.

Net Exports

India has attained net exporter status in Aluminium. The major exports of aluminium are in the form of ingots from Nalco, although more stress is being laid of late on the part of the primary producers on the export of value added items. The domestic prices of Aluminium are at par with the LME prices which have steadied around $1600 per tonne. Further, the principal exporter, Nalco is reportedly able to command a premium over the international prices because of its high purity. Thus Aluminium metal in the unwrought stage appears to be competitive internationally.

Exhibit 1

Production Value Chain of Primary Aluminium Producers

BAUXITE

CAUSTIC SODA

ALUMINA

ALUMINIUM

INGOTS RODS EXTRUSIONS ROLLED PRODUCTS

SCRAP

Exhibit II

Sales and Profits of Primary Aluminium Producers

Private Sector						
	Hindalco		**Indal**		**Malco**	
	Sales	**Profits**	**Sales**	**Profits**	**Sales**	**Profits**
Dec 83	209.60	3.28	141.75	(6.22)	11.76	(4.43)
Dec 84	272.30	9.78	229.10	8.58	35.14	(0.92)
Dec 85	287.28	4.92	238.62	11.34	32.52	(1.38)
Dec 86	321.79	9.75	243.91	7.69	42.68	(6.23)
Dec 87	344.52	20.02	277.55	4.58	23.87	(1.92)
Mar 89	563.54	31.46	451.21	27.72	34.38	(0.12)
Mar 90	608.07	64.41	545.67	58.49	36.88	(1.38)
Mar 91	471.63	64.81	567.90	51.73	28.72	(1.62)
Mar 92	855.86	88.04	520.44	34.26	5.83	(8.36)
Mar 93	975.57	115.49	763.37	42.90		
Source: *Stock Exchange Directory*, Vol 12, 1993.						

Public Sector				
	Balco		Nalco	
	Sales	Profits	Sales	Profits
March 89	367.68	5.21	472.2	18.93
March 90	416.57	-13.6	885.14	156.86
March 91	467.55	0.14	905	71.94
March 92	518.6	0.91	981.96	59.15
March 93	513.18	1.86	1169.4	119.42
Source: *Statistical Profiles of 200 PSEs*, Bombay: CMIE, 1994.				

Exhibit III

Installed Capacity and Capacity Utilisation

'000 tonnes.

Year	Installed Capacity	Production	% Capacity Utilisation
1950-51	4.0	4.1	102.50
1959-60	18.2	18.0	98.90
1964-65	73.0	55.0	75.34
1965-66	88.0	62.0	70.45
1969-70	131.0	135.0	103.05
1970-71	165.0	167.0	101.21
1971-72	175	181	103.43
1972-73	195	176	90.26
1974-75	210.0	127.0	60.48
1975-76	246.0	185.0	75.20
1976-77	266.0	209.0	78.57
1977-78	291.0	181.0	62.20
1978-79	321.0	214.0	66.67
1983-84	362.0	220.0	60.77
1988-89	610.0	427.0	70.00
1990-91	610.0	449.0	73.61
1991-92	610.0	483.0	79.18
1992-93	610.0	513.0	84.10

Source:
1. For 1950-51 to 1990-91: *Aluminium Industry in India*, New Delhi: Institute of Economic and Market Research, 1992. p21.
2. For years 1991-92 & 1992-93: *Minerals and Metals Review*, Vol XIX, No 8, Aug 1993.

Exhibit IV

Average Consumption Norms for Input per Tonne of Aluminium

Input	India	World	India(Best)	World(Best)
Alumina(T)	1.91-1.98	1.9-1.98	1.95	1.90
CP Coke	.374-.425	.4-.45	.408	.40
Pitch(T)	.106-.206	.10-.15	.106	.10
Cryolite	.018-.04	.02-.04	n.a.	.02
AlF3	.020-.04	.02-.04	.02	.001
CaF(T)	.001	.001	n.a.	.001
Carbon Anode	.44-.565	.41 - .48	.44	.41
DC Power(kwh)	13742-17600	13000-16000	13742	13000

Source : *Aluminium Industry in India*, New Delhi:IEMR,1992. P62

Exhibit V

Imports and Exports Aluminium from India

Year	Export	Import	Net
89-90	27.4	39.0	-11.6
90-91	35.4	12.6	22.8
91-92	67.5	9.1	58.4
92-93	103.5	2.3	101.2
93-94	83.0	3.5	79.5

Source: *Minerals and Metals Review*, Vol XX, No8, Aug 94, p102.

Exhibit VI

Technology Upgradation Schemes Implemented by Primary Aluminium Producers

Scheme/Project	Unit Code	Year	Cost(Rs Lakhs)	Benefit (Rs per Tonne)
Smelter Technology				
Increasing angle of contact stud	021	1986	6.4	150
Increasing driven length of stud	021	1986	4.5	50
New cathode design	021	1986	8.1	240
Cell modification with Kaiser technology	020	1986	4400	800
Widening of anode area	021	1986	1.0	200
Microprocessor control of voltage	021	1986	1.2	200
DO	024	1984	16.4	19.6
Alumina Technology				
Dual temp. Control for 2-stage precipitation	021	1985	25.5	54
Revamping insulation	021	1984	9.0	6.0
Gas suspension calciner	020	1986	803	240
Double digestor	020	1988	1126	140
Modification of calciner with UNIDO technology	040	1987	800(Est)	160
Modifications in digestion etc	040	84-86	35	75
Source: *Energy Audit of Aluminium Industry*, New Delhi:BICP,1988. p158.				

Exhibit VII

Countrywise Break up of Aluminium Production

'000 tons

Country	1991	1992
FRG	690.3	602.8
France	286.1	417.7
Greece	152.4	152.8
Iceland	89.2	89.9
Italy	217.7	160.7
Netherlands	263.9	235.1
Norway	881.9	860.5
Spain	355.2	359
UK	293.5	244.2
Yugoslavia	314.0	172.2
Bahrain	213.7	292.5
India	503.9	496.3
UAE	239	244.6
Canada	1821.6	1971.8
USA	4121.2	4042.1
Brazil	1139.6	1195.2
Venezuela	609.7	566.2
Australia	1228.6	1236.1
CIS	2300	3200
China	905	1090

Exhibit VIII

Bauxite Reserves of India (million tonnes)

State	Proven	Probable	Possible	Total
A.P	54.63	47.93	376.6	479.10
Bihar	17.60	17.68	37.98	73.26
Madhya Pradesh	60.43	64.61	68.87	193.91
Maharashtra	63.46	12.21	26.47	102.14
Orissa	272.00	203.79	1025.79	1601.47
Uttar Pradesh	9.39	0.64	4.00	14.02
Others	21.17	49.86	77.43	189.66
Total	534.89	491.67	1627.10	2653.66

Source: Tamotia, "Bauxite Reserves of India" *Minerals and Metals Review*, Vol XX, No 8,1994.

Reference

1. **Kannappan, Subbiah; and Burgess, Eugene W.,** *Aluminium Limited in India*, NPA: Washington, 1962.

2. **Dutta, Samar.,** *Report of The Industrial Licensing Policy Inquiry Committee*, New Delhi: Government of India, 1969.

3. **Mazumdar,A.G.,** *Aluminium Industry in India*, Economic and Scientific Research Foundation: New Delhi, 1970. p25.

4. *Transnational Corporations in World Development, Third Survey*, London: Graham and Trotman Limited, 1985.

5. **Venkatraman,R.N. and Kalra,** *Aluminium Industry in India*, New Delhi: NCAER, 1987.

6. *Aluminum Industry in India*, New Delhi: DGTD, 1987.

7. *Energy Audit of The Aluminium Industry*, New Delhi: Government of India, Ministry of Industry, 1988. p 25.

8. "Nalco Obtains LME Registration", *Minerals and Metals Review*, Vol XV, No 7, July 1989.

9. *Minerals and Metals Review*, Vol XV, No 8, Aug 89.

10. "Nalco: Company of the Year", *Minerals and Metals Review*, Volume XVI, No 6(June), 1990.

11. *Aluminium Industry in India*, New Delhi: Indian Council for Economic and Marketing Research, 1992.

12. **Galada.** "Close co-operation between primary producers and users resulted in AAAC development", *Minerals and Metals Review*, Vol XVII, No.8, August 92. p54

13. *Minerals and Metals Review*, Vol XVIII, No.8, August 92, p56.

14. *Minerals and Metals Review*, Volume XIX, No.8, August 93.

15. "Tax Reforms Committee Final Report Part II", New Delhi:GOI, Ministry of Finance, 1993. p71.

16. "Interview with A.K.Agarwalla, President, Hindalco", *The Economic Times*, 12th May 1994.

17. *Minerals and Metals Review*, Annual, XX,5, May 1994.

18. *Minerals and Metals Review*, Volume XX, No 8 (August), 1994.

19. "Hindalco: Company of the Year", *Minerals and Metals Review*, Volume XX, No6 (June),1994.