CHAPTER VII

VISHAKHAPATNAM - CASE STUDY OF AN OIL REFINERY

Introduction

Vishakhapatnam town (17°42' N and 83°18' E) is situated on the coast of Bay of Bengal, in the northern coastal district of Vishakhapatnam in Andhra Pradesh. The town is 775 km away from Madras and 875 km from Calcutta by railway. It is a flourishing sea port lying in the angle of the bay, formed by the projection seawards of the prominent headland known as the Dolphin's Nose.

On the back drop of the sea and a vast low lying tract to the west of the town, the most suitable site for the development of one of the most modern oil refinery was found in the post-Independence Era. After a thorough engineering study of many possible locations, Vishakhapatnam was selected as the site for the Caltex Refinery in India. The main advantages of Vishakhapatnam are (1) the facilities of a fine deep water harbour for handling large ocean-going tankers, (2) rail access by the South-Eastern and Southern Railways to provide distribution inland and road access for local deliveries, (3) Its nearness to Sumatra - the source of crude oil processed at the beginning. In addition to this (4) the region became a centre of attraction for industrial development (Plate - 13).
Plate - 13

A panoramic view of the Vishakhapatnam Refinery
Plate - 14

The Vishakhapatnam Refinery
An agreement was reached with the Government of India in New Delhi on March 28th, 1953, for the construction of the oil refinery at Vishakhapatnam. A lease was negotiated for the required 515 acre site with the Vishakhapatnam port. The construction work for the refinery started from June, 1955. It started production in April, 1957, with an installed capacity of 0.68 million tonnes, in terms of crude throughout.

**Crude Run**

The harbour at Vishakhapatnam provides access for the vital crude oil supply without which the refinery cannot function. The two oil berths, constructed by the Vishakhapatnam port are 600 feet in length and has a water depth of 30 feet alongside. Medium sized oceangoing tankers can be accommodated here. The crude tankers and the product tankers going to Calcutta and Madras, can be handled simultaneously. Crude tankers are connected to pipelines which conveys the oil to the crude oil storage tanks. There are four such storage tanks, each of which has a capacity of 1,72,000 barrels of crude oil. From these tanks crude oil is pumped into the crude unit where it is heated and passed through distillation towers to separate it into its light and heavy components. Later on underground pipelines were constructed from the sea to the refinery to facilitate the transport of crude to the
refinery. The crude oil for the plant is imported from Saudi Arabia and Iraq (Basrah). But the major share of the crude is now provided by the Bombay High region.

The following table shows the crude oil throughput of the Vishakhapatnam Refinery from 1985 to 1990.

TABLE - 21. (In thousand tonnes)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bombay High</td>
<td>2031</td>
<td>2629</td>
<td>3300</td>
<td>3092</td>
<td>3162</td>
</tr>
<tr>
<td>Arab Mix/</td>
<td>628</td>
<td>1102</td>
<td>600</td>
<td>1106</td>
<td>1105</td>
</tr>
<tr>
<td>(Basrah) Imported</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>2659</td>
<td>3730</td>
<td>3900</td>
<td>4198</td>
<td>4267</td>
</tr>
</tbody>
</table>

Source: HPC.

The crude oil, coming to the refinery is of two types, one with heavy asphalt content and the other one with low asphalt content (Fig. 30). The desalting plants in the refinery are mainly engaged in desalting the crude (Plate 14).
SUPPLY OF CRUDE OIL
(1985-86 TO 1989-90)

Fig: 30
Growth and Development

The Government took over the Caltex Refinery and it came under the Public Sector from 1978. At present it is under Hindustan Petroleum Corporation which has another refinery at Bombay. After nationalisation, for 25 years since its inception, Vishakhapatnam Refinery Expansion Project was completed in 1985 at a cost of ₹ 162 crores. The capacity of the refinery has also increased from 1.50 million tonnes to 4.50 million tonnes in the Seventh Plan period, after the expansion.

Methodology

The study is aimed to show the rate of growth of the Vishakhapatnam Refinery in recent years with the help of Time Series Analysis, development in the labour productivity and production co-efficient of products. As the product mix of a refinery is closely related to the consumption pattern of the hinterland, an analysis of the consumption linkage has also been made to measure the importance of an oil refinery in the economic growth of a region.

The production trend from 1980-81 to 1989-90 of the Vishakhapatnam Refinery has been computed by the Time Series Analysis by fitting the second degree parabola. The trend has been represented by the equation:

\[ Y = a + b X + c X^2 \]

where \( a, b \) and \( c \) = constants of parabolic variation
parameters.

\( X \) = time

\( Y \) = Estimated trend value.

**TABLE 22. Production and Trend Value.**

<table>
<thead>
<tr>
<th>Years</th>
<th>Production ('000 tonnes)</th>
<th>3 yearly moving average ('000 tonnes)</th>
<th>Trend Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980-81</td>
<td>1208</td>
<td></td>
<td>9.57</td>
</tr>
<tr>
<td>1981-82</td>
<td>1067</td>
<td>1093.00</td>
<td>575.26</td>
</tr>
<tr>
<td>1982-83</td>
<td>1004</td>
<td>1016.33</td>
<td>1107.37</td>
</tr>
<tr>
<td>1983-84</td>
<td>978</td>
<td>1046.33</td>
<td>1605.90</td>
</tr>
<tr>
<td>1984-85</td>
<td>1157</td>
<td>1524.33</td>
<td>2070.85</td>
</tr>
<tr>
<td>1985-86</td>
<td>2438</td>
<td>2349.00</td>
<td>2502.22</td>
</tr>
<tr>
<td>1986-87</td>
<td>3452</td>
<td>3175.33</td>
<td>2900.01</td>
</tr>
<tr>
<td>1987-88</td>
<td>3636</td>
<td>3663.33</td>
<td>3264.22</td>
</tr>
<tr>
<td>1988-89</td>
<td>3905</td>
<td>3816.00</td>
<td>3594.85</td>
</tr>
<tr>
<td>1989-90</td>
<td>3970</td>
<td></td>
<td>3891.90</td>
</tr>
</tbody>
</table>
This shows the industry is probably attaining stability. The period, after 1985 expansion programme experienced a sharp rise in the trend. In the next five years the industry shows almost complete utilisation of capacity, and the later period curve corroborates with the 3 yearly moving average (Fig. 31).

The employment, however, has remained more or less stable, though the production has gone up gradually. The average manpower of the refinery has increased from 1033 in 1985-86 to 1103 in 1989-90. From this it appears that the employees are equipped to produce more if capacity of production increased further. The crude throughput per employee is 3.86 thousand tonnes in 1989-90 whereas it was 3.95 tonnes in 1988-89. This shows that with more automation and modernisation manpower requirement has become less.

The refinery products are categorised into three. The Light Distillates, Middle Distillates and Heavy Ends. The Light distillate products are LPG, Low Automatic Naptha and High Automatic Naptha, Motor spirit. The Middle distillate products are Aviation Turbine Fuel, High Speed Diesel Oil, Light Diesel Oil. The Heavy End products are Fuel Oil, Low Sulpher Heavy stock and Bitumen.
PRODUCTION AND TRENDS OF VISHAKHAPATNAM REFINERY

$y = a + by + cx$

3 Yearly moving average
Trend line

Fig: 31
The production of Oil refining industry is very much related to the consumption, that is, which product has a larger market in the hinterland area. Again the product mix of the refinery is determined mainly by (1) the quality and availability of the crude (2) the regional product pattern of the demand for the oil products and (3) the processing technology of the refinery concerned.

On the percentage of crude, the share of middle distillates are maximum (Fig. 32). The table below shows the category-wise production analysis of the Vishkhapatnam refinery in respect to the crude supplied.

**TABLE 23.**

<table>
<thead>
<tr>
<th>Products</th>
<th>Percentage on Crude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light distillates</td>
<td>21.8</td>
</tr>
<tr>
<td>Middle distillates</td>
<td>51.3</td>
</tr>
<tr>
<td>Heavy Ends</td>
<td>18.6</td>
</tr>
</tbody>
</table>

Source: HPC.

Increase in the percentage share of middle distillates and light distillates and decrease in the share of heavy ends are deliberate attempts to balance the crude mix with the market demand. This has been possible due to
REFINERY PRODUCTS ON CRUDE INTAKE

Fig: 32
the secondary processing units like Catalytic Cracking etc. The production of light distillates has decreased from 1985-86 to 1989-90 due to utilisation of more heavy Bombay High crude.

The yield Co-efficient of the different products of the Vishakhapatnam Refinery in 1989-90 is as follows:

(In thousand tonnes)

- LPG: 31.76
- Motor Gasoline: 252.64
- Naptha: 646.63
- Kerosene: 450.07
- HSD: 8107.98
- LDO: 27.06
- FO: 142.63
- LSHS: 680.66
- Bitumen: 58.72

High speed diesel is the largest single product of the refinery. This is mainly due to increase in the demand for diesel in road transportation and railways.

The production of low sulphur heavy stock is the second highest, which is used as fuel oil in industries and power houses.
The production of naptha occupies a significant proportion in the total production profile mainly due to the rising demand of the Coromandal Fertilizer Plant.

From the year 1988-89 Vishakhapatnam Refinery has started to produce Jute Batching Oil (JBO) from Bombay High Crude to cater to the jute industry of eastern India. This is a product diversification endeavour. The refinery is also producing Wash Oil to cater the demand of the Vishakhapatnam Steel Plant (Fig. 33).

The Output Pattern and its relation to regional demand

The refinery is marketing its product mainly to the states of Andhra Pradesh, Orissa and Madhya Pradesh. These three states together constitute 12% of the total consumption of India.

Among the products HSD has the maximum demand in the hinterland of the refinery. Railways and transport sector is the biggest consumer of HSD. For the railways the product is being transported to Bilashpur, Shadol and the local Waltair railways.

LDO has the maximum demand in the industrial sector. The production of LDO in the Vishakhapatnam refinery is not very high though the number of industries using the product is quite high. The important consumers are National Aluminium Company - Damanjodi, Talcher Tharmal
Power Station, Orissa Cement Ltd.- Rajgangpur, Madhya Pradesh Electricity Board - Chachai.

LSHS and furnace oil which has a high yield coefficient of the refinery after HSD, is mostly used in the industrial furnaces, specially in the thermal power stations. The important consumers are NTPC, Bhadrachalam and Korba Talcher Thermal Power Station, Paradeep Phosphate and National Aluminium Corporation, Angul, Ordnance Factory Bhandara, Hindusthan Steel Limited Bhilai and Vizag Steel Plant.

Naptha produced in the refinery is totally consumed by the Coromondal Fertilizer Factory at Vishkhapatnam.

Kerosene is mostly used in the household sector. With the price rise of the petroleum products and more rural electrification the consumption of kerosene has a downward trend in the hinterland of the refinery (Appendix -VII).

Utilisation of petroleum products in the agricultural sector is less in the hinterland compared to the other areas of the country. This is mainly due to availability of other energy resources especially coal in the states like Madhya Pradesh and Orissa.
Plate - 15

Transportation of Petroleum products by railways at Vishakhapatnam
Motor spirit is mainly used in the big cities of Andhra Pradesh like Hyderabad, Warangal, Vijayawada, Waltair. ATF is utilised by the airports of the state, mainly Visnakhapatnam, Hyderabad and Vijayawada (Fig. 34). These products are mainly transported through railways from the refinery. The Coromandal Fertiliser receives naptha by pipelines. The local demand is mainly met by roadways. Recently a project has been undertaken to construct a pipeline from Vishakhapatnam to Hyderabad at a cost of Rs. 200 crores (Plate 15).

Conclusion

The above discussion shows the optimum location of a refinery depends upon its resource base, the consumption trend and above all the transportation of input and output at minimum cost. But India will have to produce more oil products and hence more refineries are needed to cater the problem of product imbalance. Even after the acceleration of exploration activities for crude oil, India will have to import the crude and it is much cheaper to import also. Again new ONGC crude of the offshore regions are heavy and produce less light and middle distillates, which products we need most. The new refineries can be established with
market side location and with more secondary and tertiary recovery technologies to maximise the yield from the refineries. With proper demand management, the regions of consumption must be self-sufficient with the yield from the refinery of the region.

The location of the Vishakhapatnam Refinery was mainly due to the availability of port facility as the industry was based on imported crude oil, at the beginning. But later on with large scale market participation of the refinery, in the consuming areas, the growth rate is quite significant. The capacity utilisation was 59.1% in 1985-86 but it is 94.8% in 1989-90. The operation cost of the refinery was ₹ 16 crores in 1985-86 but it is ₹ 29 crores in 1989-90. The capital expenditure has also increased from ₹ 7 crores in 1985-86 to ₹ 62 crores in 1989-90 (Plate 16).
Plate - 16

Ecological balance in the Vishakhapatnam Refinery
References

1. Caltex Refinery - Vishakhapatnam, a booklet published by the Caltex Oil Refining (India) Ltd.


