CHAPTER 1
INTRODUCTION

The progress of industrialisation over the last thirty five years has been a striking feature of India's economic development. The progress of industrialisation was launched as a conscious and deliberate policy measure in the early fifties. In pursuance of this policy, large investment has been made in building up capacity over a wide spectrum of industries. Industrial production has made rapid strides in terms of variety, quality and quantity. There has also been a substantial diversification of the industrial base during this period with the consequent ability to produce a very broad range of industrial goods. Self-reliance has been achieved in basic and capital goods industries. Indigenous capabilities have now been established to the point of virtual self-sufficiency, so that further expansion in various sections such as mining, irrigation, power, chemicals and transport and communication can be based primarily on indigenous equipment.

The progress in industrialisation has also fastened the emergence of entrepreneurship and the development of wide variety of technical, managerial and operational skills.

A significant aspect of industrial development during this period has been the predominant role assigned to the public sector in the establishment of basic industries. Public sector has taken the initiative for the development of various industries such as steel, non-ferrous metals.
Petrochemicals, coal, fertilizers and heavy engineering.

1.1 Study of Petrochemical Industry in India

Petrochemical industry plays a significant role in the economic development of a country. At a certain stage of economic development the entire industry may look to petroleum as a prime source of raw materials since the availability of traditional raw materials may turn out to be too limited in supply in order to meet the total requirements of industrial development. The petroleum route for petrochemicals is cheaper and can improve the balance of payment problem, thus, providing a boost to overall industrialisation not only through direct import substitution but also through stimulation of other industries. When India has reached such a stage of economic development the above factors become important. Further, it also becomes necessary to decide as to how the petrochemicals industry should be launched or organised and how its growth should take place with due regard to the availability of technical and financial resources. This can be done with a careful study of the present state and nature of the petrochemical industry, together with its evolution in the countries where it is well established. As in a number of other contemporary fields, the petroleum based chemical industry received an impetus during and after the second world war. The need for developing alternative materials to replace traditional materials in this period
encouraged the large scale and positive growth of the petrochemical industry.

It can not be denied that petrochemicals are becoming more and more relevant to the Indian economy. Their growth has been quite fast. Between 1970-71 and 1984-85 the index of total industrial production rose from 100 to 193.6 that of petrochemicals production increased by over three times to reach 368.6. The value of output has also increased from a mere Rs.150 crores in 1970-71 to about 2,200 crores in 1984-85 (Table 1.1). It can be seen from inter-temporal comparison given below that the growth in petrochemicals production was very fast in seventies, it slowed down in eighties.

TABLE 1.1

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<tr>
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<tbody>
<tr>
<td>a) Index of total industrial production</td>
<td>100</td>
<td>154</td>
<td>193.6</td>
</tr>
<tr>
<td>b) Index of petrochemicals production</td>
<td>100</td>
<td>325.1</td>
<td>368.6</td>
</tr>
<tr>
<td>c) Manufacturing (Total Industry) value of output [Rs.Crores]</td>
<td>13455</td>
<td>61685</td>
<td>95000</td>
</tr>
<tr>
<td>d) Manufacturing petrochemicals value of output [Rs.Crores] (exclusive of excise duty)</td>
<td>150</td>
<td>1606</td>
<td>2200</td>
</tr>
<tr>
<td>e) Percentage of (D) in (C)</td>
<td>1.11</td>
<td>2.60</td>
<td>2.32</td>
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Source: Commerce Research Bureau and IPCL for petrochemicals

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When one talks of Indian economy, after the major industries like steel, engineering and textile; petrochemicals are considered as the fourth largest industry. This industry has contributed a great deal towards the industrial development of our country. The reason for this seems to be that the end products of this industry have entered in almost all walks of human life including food, clothing, shelter, health care, industrial machinery, consumer durable etc. At present, this industry in India is experiencing a quantum jump due to the consumption of products like synthetic fibres, plastics, synthetic rubber and various chemicals at a growth rate of 15% to 18% per annum. The contribution of the chemical industries to the nation's total output has risen from 8% in early seventies to 40% in late eighties. The end products of petrochemicals like drugs, dyestuffs, plastics, varnishes, paints etc. have also achieved a remarkable increase in their production. The petrochemicals products help the human needs directly by raising the basic standard of living and indirectly through agriculture, water management, building construction etc. The growth of this industry in India is quite recent as compared to other countries. Hence there is a great scope for its expansion. The significance of this industry has increased due to a great emphasis for the expansion for long term projects in
the recent five year plans.

Among petrochemicals, plastics play a very important role in the nation as well as in the state economy of Gujarat. Their potential to replace traditional materials like metals, wood, paper etc. has made plastic a very important substance both in industry and consumers. Plastics require a very low energy for its conversion as compared to metals into industrial and consumer goods. Therefore, these materials have proved to be very important for various uses in innumerable fields.

India has potentially large yet unexplored reserves in oil energy. The scope of this industry is unlimited not only in developing a wide range of our small and medium scale industries but also in achieving a break through in agricultural production with chemical fertilizers as the main plank of the agricultural strategy. Indian economy has registered a remarkable growth recently and has established many new demands in the fields of capital and consumer goods. We are facing today the shortages of materials like cotton, wool, steel, non-ferrous metals, fats etc. There is a wide gap between our food requirements and their availability. To meet the shortages with the help of substitute materials in order to enable it to meet in the most economical way, petrochemicals are of wide range and variety with innumerable end products. Refinery production of basic organic chemicals like Ethylene, Naphtha, Methanol,
Benzene, Dyestuffs, Synthetic fibres, Plastics etc. are used in its downstream industries like leather, electronics, nuclear, textile, paints, dyestuffs etc.

On one hand petrochemicals contribute considerably in value-addition and resource generation and on the other hand, contribute in competitive alternatives like fertilizers, fuel, power generation, material resources (oil and gas).

Investment in the field of petrochemicals give one of the highest return on a rupee invested; hence there is a continuous increase in investment in this field.

1.2 Petrochemicals: What they are?

Petrochemicals come in a variety of forms when available from the crust of earth. Their range of applications have made them one of the most important sector for industrial development since World War-II. It can be named second to electronics. Petrochemicals undergo various processes after which they are transformed into innumerable products.

It has been found out that there is no such product as a "Petrochemical" as all the products based on petrochemicals can be obtained from alternative sources. The reason being that before 1920s there was no use of petroleum and its products but for fuel carbon black was of course manufactured and used as fuel from different gases.
since 1872. However, the quantity produced was too little in relation to its use as a feed stock for various industries. Hence, petroleum and its products got greater importance. Another reason for their extensive use was that they are easily available and their the cost is also relative lower as compared to the feed stocks like coal, agricultural wastes and vegetable oils which are of little use except in the cases where substitutes are not easily available.

1.3 Petroleum and its Products

As stated before, petrochemicals are essentially the chemical compounds derived from petroleum sources. A number of chemical products are obtained from the abundantly available raw materials which include crude oil, natural gas, refined petroleum fractions and refinery gases. One of the refinery product called naphtha becomes the feed stock for petrochemical sector. Naphtha can also be of a great use in order to make petrol. The bulk of petrochemicals obtained from common hydrocarbons are broadly grouped as under:

Paraffins (saturated) : Methane, Ethane, Propane (iso and normal) etc.

Olefins (unsaturated) : Ethane, Propylene, Butylenes (butene 1 and 2, and isobutylene) etc.

Aromatics : Benzene, Toluenes, Xylenes etc.
The most important of these chemicals is Ethylene. Next is Propylene followed by Butylene and Butadine. The components go by the collective name of Olefins. They are obtained either from naphtha or from natural gas by cracking. Cracking is a figurative term used to depict the breaking up of long hydrocarbon chains into shorter chains comprising Ethylene, Propylene, Butylene and the other three important bulk chemicals that constitute a family known as Aromatics. The simplest compound in this chain is Benzene. Aromatics are present in different proportions in Crude Oil.

The peculiarity of petrochemical compound is that the most of the products can be made from more than one hydrocarbon raw materials, depending on the availability of feed stock and economic feasibility of the processes.

The common techniques employed in petrochemical manufacture are the thermal and catalytic cracking, oxidation, hydrogeneration, alkylation, chlorination, polymerisation, dehydrogeneration, isomerisation, solvent extraction, crystallisation and other related processes. Further, the manufacture of petrochemicals involves the application of a number of continuous physical operations such as distillation, extraction, filtration, mixing, pumping etc.

Various petrochemical products obtained from Paraffins, Olefins, Aromatics are further processed and new components are obtained. This is supplemented by a number of colour
Plastics, Rubbers and Fibres

One of the most important transformations of petrochemical products is polymerization. It is a process through which various combinations of several molecules of one single compound like Ethylene or Propylene gets transformed into a long chain. The compounds of this nature and process are also known as Polymers and the material from which they are derived is called Monomers.

Plastics derived from petrochemicals can be broadly categorized as follows:

Plastics such as low density and high density Polyethylene, commonly known as LDPE and HDPE. Polypropylene and Polyvinyl chloride which are commonly known as PP and PVC are all obtained from Ethylene and its products.

The most important derivative of the Butadene stream is Polybutedine rubber and Synthetic rubber such as Sturin Butadine rubber and Polybutadine rubber which are commonly known as SBR and PBR in abbreviated form. Synthetic fibres (such as nylon, polyester and acrylic fibre) are the products of a blend of olefins and aromatics derivatives. Intermediates such as Ethylene, Propylene, Benzene, Dimethyl, Terephthalate, DMT, Caprolactum etc. which in turn are used in the manufacture of various petrochemical items.
1.4 Growth of Indian Petrochemical Industry

There are around fifteen oil refineries in public sector in India. Hence substantial amount of crude petroleum and its products are available. The major products from these refineries are LPG, naphtha, petrol, aviation, turbine fuel, kerosene, HSD oil, asphalt sulphur extracts and refinery fuel.

It is observed that most of the petrochemicals are manufactured from the petroleum feed stock like naphtha and gas and also from alcohol and calcium carbide. So far as naphtha has been the dominant feed stock in the country. Natural gas is also now being used for the production of petrochemicals e.g. Maharastra Gas Cracker Complex (MGCC) is using natural gas as its feed stock. A couple of other petrochemical projects are also proposed to be set up based on natural gas. The cyclic availability of alcohol combined with periodical changes due to government levies renders the alcohol route for petrochemicals undependable. Similarly, the use of calcium carbide for the manufacture of petrochemical products such as PVC is constrained by the fact that the route is energy intensive.

Naphtha is a most important feed stock for petrochemicals, fertilizers and power generation etc. which are the basic and key industries. The petrochemical industries can boost up by providing a "high multiplier effect". For instance, in case of Maharastra gas cracker
complex, a rupee invested leads to generation of 51 paise of business opportunities. Hence Indian petrochemical industry received a tremendous boost during the last two decades.

The seeds of the Indian petrochemical industry were sown in sixties. National Organic Chemical Ltd. (NOCIL) and Union Carbide India Ltd. (UCIL) were the pioneers. The roots grew stronger in 1969 with the setting up of all IPCL complex at Vadodara -- a large state sector investment with a grass-root naphtha cracker and 14 associated down stream units. IPCL embodied the trunk of the industry and by 1977-78 it produced a host of products that branched out to every other arena of Indian industry. The process of growth to the present stage of flowering demanded skills in managing high technology, capital-intensive projects, developing indigenous fabricators and materials suppliers, operating to capacities, maintaining safety and product quality, maintaining the ecological balance, developing markets from nascent levels, laying stress on nationally important sectors, developing Indian man power expertise and technology absorption. Thus, petrochemicals have been steadily establishing a base from the early seventies onwards. The reason for their tremendous growth is that the traditional materials like wood, metals etc. are getting scarce. Petrochemicals have proved to be the perfect and more economical substitutes for all these materials. Their versatile usages can not be denied in industrial as well as
household sectors. Hence in the coming decade the emphasis of India's development will be towards the rapid industrialisation and accelerating growth of some industries such as chemicals and chemical products, plastics, petrochemicals in electronics, agro-based industries and engineering plastics. It can be observed that the petrochemical industry is the key industry of 21st century. Looking to its significant importance it has been taken for a detailed analysis in this study.