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PETROCHEMICAL DOWNSTREAM PROCESSING INDUSTRY IN INDIA

A STUDY PREPARED FOR UNIDO
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STUDY OF PETROCHEMICAL DOWNSTREAM PROCESS INDUSTRY

OBJECTIVES :

The study aims at analysing the contribution of petrochemical downstream industry to economic development by way of case study of the development of this sector in India.

INTRODUCTION :

Makes the statement of the reasons of selecting this sector for study by presenting how an industry of fairly recent origin, technologically modern and capital intensive in the production of basic petrochemicals, contribute to economic development of India.

INDUSTRIAL POLICY FRAME-WORK :

Before going on to the study of processing industry broad outline of Industrial Policy frame-work and its evolution particularly over last 10 years when rapid changes have been brought in, has been presented.

PAST DEVELOPMENTS AND CURRENT STATUS :

The first part of the study is devoted to presenting the past development and the current status of the plastics, synthetic rubbers and synthetic fibres processing industry. The study begins by tracing the initial stages of the industry based on imported raw materials, goes on to present the development of basic petrochemical industry and growth of processing industry.

Further current status of the processing industry in terms of number of units, sizes, investment, geographical spread, employment, value addition etc. is presented. This has been done in three sections in plastic processing, rubber processing and synthetic fibre processing.

MARKET DEVELOPMENTS :

The role of the petrochemical (processed) products in important core sectors such as building, agriculture, transportation, textiles, industry consumer usage, health care etc. has been analysed end use wise and polymer wise over a period of ten years. Analysis of sectoral consumption of Thermoplastics indicates a major consumption in the industrial applications, consumer items and agricultural applications.

In the synthetic rubber, the transportation sector alone claims more than 70% of the share and the rest is shared by the industrial applications. In synthetic fibres, the majore share of course is in the textile sector with smaller share in industrial sector.

GOVERNMENT POLICIES :

Besides these, the study also details the organisation of the petrochemical industry and the related Government policies in terms of incentives, infrastructure, support services, training and testing facidlities, locational and environmental policies. The emphasis is on environmental friendly

being focused in the area of plastic waste recycling k keeping in view the economic situation and employment generation.

The obstacles being faced by the processing industry i.e. fiscal duties, market fluctuations, project implementation and operational problems have also been discussed.

FUTURE :

In the Indian scenario, the main efforts in the coming decade are expected to be directed towards modernization and efficiency improvement. In addition, the alloys and blends, engineering plastics, and advanced composites based on carbon fibres would be developed for speciality applications. The export of products for petrochemical downstream processing industry, would be receiving special attention and inject the latest technology trends into the industry.

1. INTRODUCTION:

1.1. INDIAN ECONOMY - A FEW INDICATORS:

During the last three plan periods, India achieved an annual compound growth rate of about 5% in GNP. The productivity increase in agriculture has made country self-sufficient in food grains. Industrial production has been growing in the last decade at an rate of almost twice the rate witnessed in the previous fifteen years.

1.1.1. GNP, Agriculture & Industrial Production, etc.

Some of the basic economic indicators, are shown below:

Table 1.1

ECONOMIC INDICATORS

	(1980-81 Prices)		(Rs. in Crores)		
	1980-81	60-61	70-71	80-81	88-89
GNP at factor cost	42,644	62,532	89,465	122,571	186,143
Agriculture	24,204	32,793	41,385	48,366	65,689
Manufacturing	6,451	11,790	20,209	29,747	50,734

(Source Economic Survey 1990-91)

The growth performance indicators are given below:

Table 1.2

GROWTH PERFORMANCE

	Percentage change over previous year								
	1980-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89
GNP	7.3	5.8	2.6	7.9	3.8	4.1	3.6	4.2	10.6
Agri-cultural Production	15.6	5.6	-3.8	13.7	-1.2	2.5	-3.7	-0.8	21.0
Indus-trial Production	4.0	9.3	3.2	6.7	8.6	8.7	9.1	7.3	8.7

(Source Economic Survey 1990-91)

1.1.2 Industrial Production:

The Industrial activity whose primary orientation was self-sufficiency and import substitution is now far more broad based and export of manufactured goods is on the increase. In the overall Industrial production, the manufacturing sector (weight 77.1%) has been exceeding the targets and infact compensating for the decline in mining, quarrying and electricity generation sectors (11.5 and 11.4 percent in weight respectively).

Seventh five year plan (1985-86 to 1989-90) target for industrial production was 8.7% per year and 8% in the production of manufacturing sector. Average annual growth achieved for industrial production was 8.5% whereas manufacturing sector has exceeded the target by achieving 8.8%. The performance of different industry groups varied, but one of thesectors that exceeded the targets was chemicals and chemical products (weight 12.51%). Petroleum and coal products in which group rubber and plastic products are also included show growth less than the target. Obviously whatever growth Rubber or plastic products achieved would not compensate for variations of large sectors like petroleum and coal.

1.1.3. Exports

The following table lists the exports of principal groups of commodities:

Table 1.3

EXPORTS BY COMMODITY GROUPS

(Rs. Crores)

Commodity Groups	1970-71	80-81	85-86	88-89 (P)
Agriculure and allied products	487	2057	3018	2998
Ores & Minerals	164	414	785	1015
Mfg. goods	772	3747	6374	14429
Mineral fuels etc.	13	28	655	518
Others	99	465	63	NA
TOTAL	1535	6711	10895	20295

Source: Economic Survey 1990-91

1.1.4 Budgetary Transaction:

The following table gives the statistics of budgetary transactions of some of the recent years.

1.2.2.

The petrochemicals particularly thermoplastics and fibres contribuyte to the national exchequer directly by way of excise and customs duty and other taxes. The volume of duties and taxes paid in 1989-90 by plastic and fibre industry alone is more than 3,000 crores. Most of the revenue is contributed by the petrochemical raw material sector with processing sector conributing minor part.

1.2.3.

This sector earns foreign exchange by way of exports of process products (plastic products, textile and rubber goods). The exports of this sector in 1989-90 are Rs.700 crores.

1.2.4.

Petrochemical downstream process units are major contributor to employment and entrepreneur generation and thereby serving vital need of the economy. Starting from the raw material production to conversion to finished products, the employment potential (both direct and indirect) is generated in cascading manner. The Chart No.1.2.1 shows a typical example of employment generation potential in the chain of petrochemical conversion.

1.2.5.

Petrochemical industry is a High-Tech industry production and processing into end-products need constant upgradation. Such growth and upgradation requires constant inputs of technology, skilled manpower, education and training. This requirement itself creates the whole chain of human resources and institutional structures.

1.2.6.

Petrochemicals initially by substitution and now more effectively supplementation of conventional materials are helping to fulfill the total material demand because of:

- the excellent tailor made prosperities they offer.
- processing ease.
- their lower total energy content.

This process of substitution and then supplementation has followed generally the world pattern in three phases.

I. Substitution of conventional materials.

II. Replacement of non-metalic materials.

III. In structural parts by use of advanced materials like alloys, blends and composites.

The Phase I, which started in the 60's is now reached maturity, while the phase II is now on the "upswing" by increasing use of plastics in packaging water conservation and replacement of wood. Phase III began with use of plastics in automobiles, appliances, office machines, industrial equipments etc. Preparations for continued development of phase III have already begun by structural composite using carbon and other high performance reinforcements. This process is expected to accelerate in the mid nineties, when indigenous production of engineering plastics and speciality polymers begins.

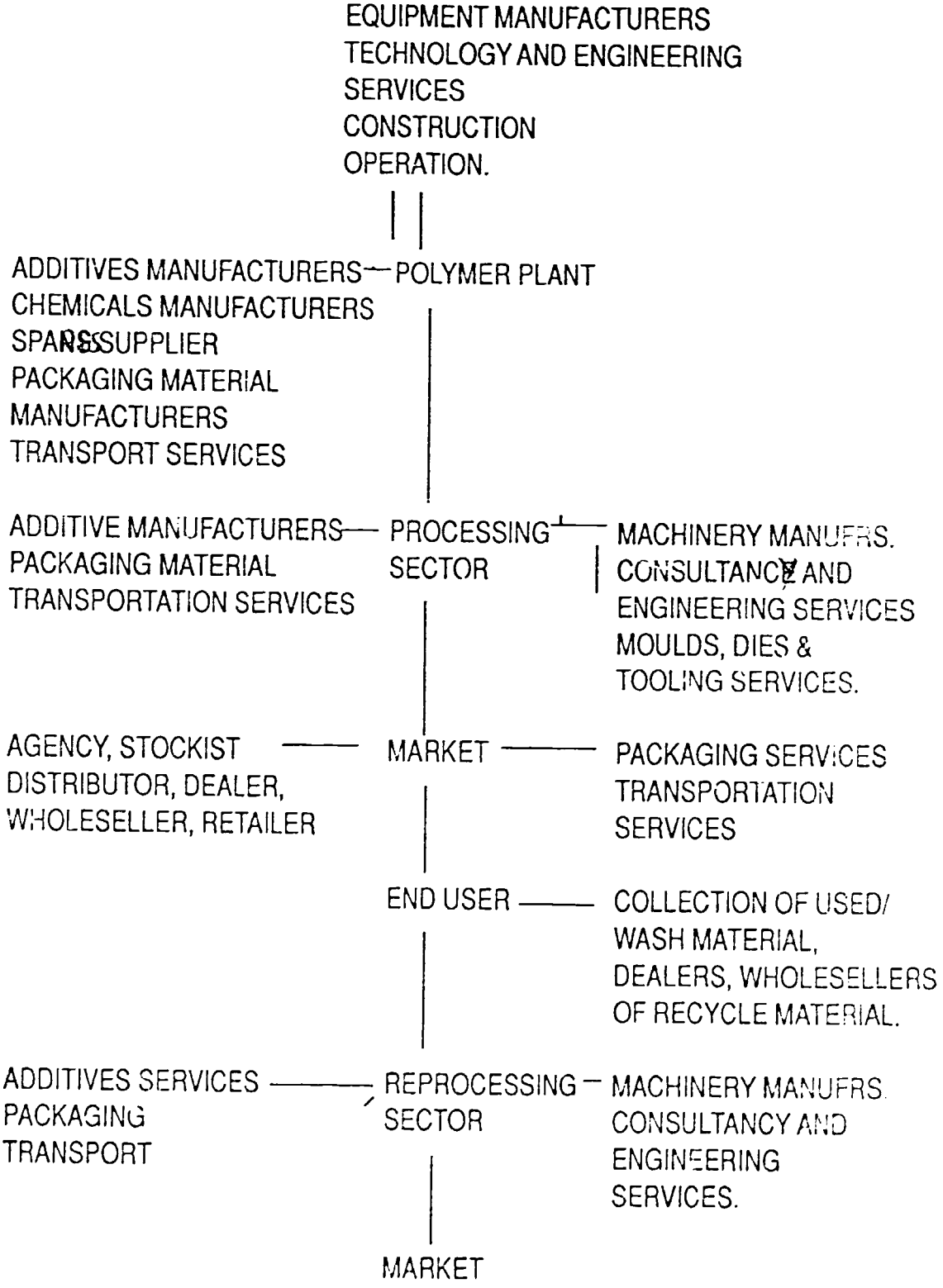
1.2.7.

Petrochemicals mainly plastics are highly energy efficient in comparison to metal, glass and steel etc. The Chart No.1.2.2 shows that energy requirements for one cubic centimeter fabricated part from a Polymer requires much lower energy than any of the metal parts. The energy requirement shown includes the quantum of hydrocarbon required both for feed-stock is well as fuel for conversion.

1.2.8.

Thus petrochemicals in the form of various products contribute to economic growth by way of being high growth industry coupled with high technology and skilled man-power inputs. This industry contributes to the exchequer substantially by way of duties and taxes. It helps in energy and material conservation in the economy in addition it gives rise to employment generation and scope for new entrepreneural development.

EMPLOYMENT GENERATING AREAS (DIRECT & INDIRECT)



In order to promote a quick and smooth development of small scale industries, an institutional framework has been created alongwith an attractive package of incentives and concessions which have been evolved to motivate and encourage a new generation of entrepreneurs. Major components of the package include concessional finance, concessions in central excise duty, marketing support through reservation of a large number of products for exclusive manufacture in the small scale sector and for exclusive partial purchase from small scale units by Government Departments and Public Sector Undertakings, hire purchase facility for machinery, technical consultancy services, common facility services, testing facilities, industrial accommodation, supply of critical raw materials and provision of other infrastructural facilities.

2.3. This policy to small scale units and further liberalisation has played an important role in development of petrochemical down-stream units and their structure in Indian economy.

Though downstream industries were set up initially on imported raw materials, the real development took place when indigenous material started being available. Import policies and foreign exchange availability played very important role in development of these industries as discussed in detail later.

2.4. In the background of investment limits not requiring licence downstream units with small investment and local machinery to cater to small localised markets particularly for household and consumer items were initially set up. When the investment limit were increased even items for industrial consumption were also brought into the small scale sector. This had given rise to spread of units all over the country with large employment generation. It also gave rise to large number of enterpreneurers for processing, machinery manufacturing, services and financing.

2.5 The introduction of liberal schemes like delicencing and exempted industries registration (EIR) enabled units below a certain limit of investments to register their proposals and go ahead with setting up of the units. These schemes have given almost complete freedom to medium and small enterpreneurs to set up petrochemical downstream units on commercial considerations. Numerous units have sprung in both urban and remote areas covering wide product range to cater to regional markets. This brought about the entry of medium scale units widely into processing area.

2.6. This spread and mushrooming of units after an initial phase excess capacity have resulted in rationalisation of market and production structure. The structure of the downstream processing industry is discussed in the following sections, separately for plastics, rubbers and fibres.

3. DEVELOPMENT OF PLASTIC INDUSTRY IN INDIA

3.1 The plastics industry in India made its beginning with end-products manufacture based on imported resins, started the first resin manufacture in 1948 with a phenol formaldeyde resin plant. The thermoplastic resin production made an entry into India in 1950s. The 1950/60 decade saw the establishment of the first Polystyrene and Low-Density Polyethylene plants of small capacity (of the order of 5,000 tonnes per annum) based on ethylene from industrial alcohol as the raw material and Benzene from coke oven production. In this decade further facilities of thermoset resins were also established.

3.2 In the 1960/70 decade, the Petrochemical based polymers have made an entry into the country. With the establishment of two petrochemical complexes in the Bombay area and with the availability of Ethylene, production facilities for high density polyethylene and PVC were established. Polystyrene plant has been expanded; a second polystyrene plant was also established based on alcohol.

3.3 In the 1970/80 decade, the first petrochemical complex in the public sector started production with large polymer and chemical plants. This made available large quantities of LDPE and PP for the first time. In the decade of 1980/90, the polymer industry has undergone major changes in the development. So far as the resin production is concerned, a gas based petrochemical complex with a cracker of international size has been set up. This complex includes polymer plants of LDPE (80,000 tonnes), LLDPE (16000 tonnes) and PP (60,000 tonnes). These plants are to come into production shortly.

Thus the plastics production which was only around 8,000 tonnes in the early 1950s is now nearly at 3,50,000 tonnes. With the new production from the gas cracker complex, this would go upto around 600,000 tonnes.

The consumption of polymers always outstripped the indigenous availability. Whenever the foreign exchange position is better and the policies permitted the industry imported the resins freely to sustain the downstream processing industry. The consumption which was only slightly more than the production in 1950s is now around 7,40,000 tonnes in 1990. As mentioned above, the gap between the production and the consumption, nearly 400,000 tonnes, is met by imports. The Table below shows the production, import and the apparent consumption after accounting for exports in the last ten years. The details for individual resins are given in Annexure I.

Table 3.1

PRODUCTION AND CONSUMPTION OF PLASTICS

000 tonnes

YEAR	PRODUCTION	CONSUMPTION
1980-81	182	290
1981-82	192	290
1982-83	219	332
1983-84	241	364
1984-85	275	433
1985-86	291	495
1986-87	300	528
1987-88	290	575
1988-89	328	636
1989-90	336	739

4. PLASTIC PROCESSING INDUSTRY:

4.1 The Plastic Processing industry in India is more than 70 years old and has now a sizeable base. The industry made a beginning in 1920s with consumer products such as bags, combs and other decorative products from imported cellulose sheets and rolls. In 1930s, the industry widened the base with imported compression moulding machines. The initial processing was thus confined to thermoset resins. Industry made rapid strides of progress both in terms of range of products of machinery and processes from mid 1940s. At this stage the industry also started catering to high-tech products used in engineering, construction and textile industries.

4.2 Subsequent major development took place in parallel developments to raw material production in the country. The first moulding powder and resin to be produced in the country was phenol formeldehyde moulding powder in 1948. Thermoplastic production began in the country in 1950s with non-petro feedstock base. Poly Ethylene was produced starting from Alcohol based Ethylene and PVC from calcium carbide. The production of Polyestyrene also began based on ethylene from alcohol and coal derived benzene.

4.3 The processing industry which was mainly concentrating on thermoset resins changed over to thermoplastic processing, introducing manufacture of leather cloth (1949), wires and cables (1950), film and lay flat tubing for pakaging (1951), pipes and sheets (1955). The processing sector made rapid strides during the second five year plan (1955-56 to 1960-61); the production of plastic goods and materials increased from Rs.0.75 million to Rs.0.76 million and opening the export venue. During the third five year plan (1960-61 to 1965-66) though the industry has expanded the base, it has not been able to achieve significant progress due to severe foreign exchange constraint.

The plastic processing industry has undergone phenominal change in the late 1960s and 1970s. The change was highly feasible and came abut due to increased availability of raw-materials and new grades. This was accompanied by setting up of large number of new units with imported and indigenous machinery. The range of application has also increased; those applications which could not be developed due to raw material constraint earlier got a fillip during this period. With this, the machinery sector also improved its performance and higher output machines started being manufactured in the country. The whole trend was a shift towards more sophistication in terms of machinery and product development.

4.4 The plastic processing industry has been mainly developed in the small scale sector. This sector characterised by small investments and wide dispersal is left mostly to the entrepreneural development. Number of nation-wide survey were undertaken by various organizations to get a comprehensive profile of this industry as there is not adequate recorded data on these units.

Results of some of these surveys is the following profile:

Table 4.1

PROCESSING INDUSTRY PROFILE

	Upto 1979-80	1985-86	89-90
No. of units	6,500	10,000	15,000
No. of machines	21,500	44,400	1,07,400
Rated capacity ('000 MT)	657	2,243	3,000
Real capacity ('000 MT)	329	1,122	1,500
Investment in plant & M/c (Rs.million)	764	4,183	7,500
R/M consumption ('000 MT)	245	492	739

Though the total number of units is nearly 15,0-00 majority of units are in small scale sector. The number of large units were only 116 units in 1979 and increased to 275 in 1990.

4.5 Investment

Investment in this sector was Rs.760 million at the end of 70s. The additional investment that has taken place from 1985-86 (i.e. in the last five years) is Rs.3600 millions, thus bringing the total investment to about 7500 millions. The growth of the investment is as below:

Table 4.2

(Rs.million)

Year	Investment during the year	Cumulative total investment	Percentage growth per annum
Upto 1960	22.6	22.6	-
1961-1970	14.2	164.6	22
1971-75	25.8	422.6	21
1976	53.6	47.6	13
1977	68.3	544.5	14
1978	15.0	694.5	28
1979	69.7	764.2	10
1980-85	3419.4	4183.6	33
1985-90	3400.0(Est.)	7500	

4.6 Capacity Utilisation

The industry is also characterised by large number of units and large number of machines to low capacity utilisation. This is due to various reasons such as:-

(a) Availability of raw material.

(b) Efficiency of the old and semi-automatic and hand-operated machines.

(c) General tendency of the small operator to operate part of the time only in order to not increase the working capital requirement.

The consumption of raw material shows that the overall capacity utilisation reaches only 50% level on virgin raw materials.

4.7 Sectoral Growth:

The major processes employed in the plastic processing industry are as follows:

i) Extrusion
ii) Injection Moulding
iii) Blow Moulding
iv) Rotational moulding
v) Vacuum forming/Thermo Forming.
vi) Compression Moulding
vii) Others like fabrication, transfer moulding, reaction injection moulding, calendering etc..

The industry is predominently extrusion based followed by injection moulding and Blow Moulding processes. The rest of the processes constitute a very small portion of the capacity. The primary processing industry is presented in Table 4.3 below:

Table 4.3

PRIMARY PROCESSING CAPACITY

Sector	Major End Products	Capacity '000 MT
Extrusion	Pipes/Profiles/Conduits	110
	Blown Film	450
	Woven Sacks	40
	Strappings	10
	Monofilaments	50
	Others	20
Extrusion Coating		15
Injection Moulding		300
Blow Moulding		80
Rotational Moulding		15
Calendering	Films & Sheets	45
Wires & Cables		200
Footwear		100
Others (Special Techniques)	Co-extrusion, BOPP Film, Structural Foam Moulding etc.	85
Total		1500

5. SYNTHETIC RUBBER:

5.1. The Rubber Industry in India is one of the very old industry, the inception dating back to 75 years when a small manufacturing unit was set up in 1922. The beginning of Rubber Industry in India is based on processing of natural rubber. The synthetic rubber made an entry into the rubber processing industry when it was imported in small quantities in 1950s. The first synthetic rubber unit was set up in the 1960s based on alcohol. The alcohol was used for production of ethylene for styrene and also for Butadiene and the final production being SBR. The second synthetic rubber (PBR) plant came up in late 1970s when the first public sector petrochemical complex was commissioned. This plant is based on Petrobutadiene available from the Naphtha cracker. The production and consumption of synthetic rubber in India is given in Table 5.1. Details of individual synthetic rubbers are given in Anneuxre II.

Table 5.1

TOTAL PRODUCTION & CONSUMPTION OF SR

YEAR	PRODUCTION	CONSUMPTION
1980-81	25,293	47,050
1981-82	28,499	52,650
1982-83	30,290	55,250
1983-84	32,270	62,300
1984-85	37,669	65,400
1985-86	34,758	70,035
1986-87	38,816	71,785
1987-88	44,468	76,410
1988-89	53,758	84,150
1989-90	53,482	91,055

5.2 With the well established rubber goods industry, the synthetic rubbers have also become inputs into the same along with natural rubber already available. The rubber goods industry covers wide range of products particularly categorised into Tyres and non-Tyre products.

6. SYNTHETIC RUBBER PROCESSING INDUSTRY:

6.1. Inception of rubber industry in India dates back to 75 years when a small manufacturing unit was set up in 1922. The rubber goods industry covers a wide range of products categorised as tyres and non-tyre products. The industry is comprising of 30 tyre units about 160 organised sector units and 5000 small scale units spread throughout the country. It has an annual turn over of about Rs.50,000 million and exports of rubber goods are worth 2150 million rupees. It products about 30,000 vital sophisticated rubber products as also mass consumption items and directly employees 3 million people. It consumed nearly 5,00,000 tonnes of all types of rubbers and contributes to national exchequer as various levies - excise customs and cess of about Rs.13,000 million.

It has maintained an annual growth rate of about 8-9% during the last five years. The industry meets most of the domestic demand for rubber products and most of the raw material input by the industry are indigenously produced. Some quantities natural rubber and synthetic rubber are imported to supplement the indigenous availability. The major products apart from various tyres and tubes are footwear, V-Belts, Convair Belting, various types of Hoses. The tyre industry made its beginning in India in 1920s in the form of sales of imported tyres. The first tyre factory was set up in 1936 followed by the second one in 1942. With the increased base of economic and industrial development during the first and second five years plan period the demand for tyres increased giving rise to new capacity. Presently there are about 30 tyre companies with a total capacity of 2,00,000 numbers. Production of rubber goods (tyre and Non-tyre products are presented in Annexure-3).

7. SYNTHETIC FIBRES:

7.1 The synthetic fibre industry commenced production in India in 1962 with Nylon Filament yarn on a very modest scale. This was followed by Polyester Staple Fibre in 1965 and polyester filament yarn in 1969. Polypropylene entered into Indian Synthetic Fibre scene in 1977 with start up of PPSF, PPFY production commenced in 1985. The production of acrylic fibre started only in 1979. Though this industry has been in existence for over 30 years in India, the real growth has been witnessed only in the last ten years with large scale units coming up in the country.

7.2 There are 27 companies who are manufacturers of Synthetic Filament Yarns i.e. PFY, NFY, NTY, PPFY. Similarly, there are 21 plants for PSY, 8 plants to manufacture PSF and 3 plants for PPSF).

7.3 The historical production and consumption of synthetic fibres is shown in Table 7.1:

Table 7.1

PRODUCTION AND CONSUMPTION OF SYNTHETIC FIBRE

000 TONNES

YEAR	PRODUCTION	CONSUMPTION
1980-81	75	96
1981-82	96	127
1982-83	108	147
1983-84	138	177
1984-85	169	187
1985-86	196	231
1986-87	228	268
1987-88	273	289
1988-89	345	354
1989-90	389	373

As seen from the above data, most of the synthetic fibres have witnessed rapid growth in the 80s and the growth of PFY has been the fastest of all. Out of the total synthetic fibres produced in India, Polyester has a share of more than 80%. Interestingly, out of total polyester, PFY is more popular than PSF in India whereas in the world the trend is different.

The following table shows the change in the mix of fibres in India over the last ten years:

Table 8.2

SHARE OF FIBRE CONSUMPTION IN INDIA

Percentage

	1980	1989
Cotton	84	76.2
Cellulosics	11	8.9
Synthetics	4.5	14.3
Wool, silk etc.	0.5	0.5
Filament yarns	1.8	8.7
Staple Fibre	2.7	5.6
TOTAL	100	100

The share of cotton and cellulosics is continuously decreasing while that of synthetics is increasing. Secondly in synthetics the yarn is increasing more than the fibre.

8.3 The organized mill sector is the largest one consisting currently 1054 mills. Out of these 777 are in private sector, 179 in public sector and 98 in cooperative sector. The composite mills out of the above total are 283 and spinning units 771. Present installed spindles are 26.5 million and the number of looms was 184,000 in 1989. In the last 30 years, the number of spindles and looms has not changed much, however, a number of ordinary looms have been replaced by automatic looms (currently at around 60,000 in number) and the spinning side has also been modernised in number of mills.

8.4 The 'decentralised' sector of the industry consists of 'handlooms' and 'Powerlooms'. The number of powerlooms in the country is estimated at 1.1 million while the number of handlooms as estimated as 3.2 million. This sector contributes almost all entire supply of 100% non cotton fabrics and nearly 50% of the blended fabrics.

This sector in many cases is manned by weaker sections of the society and therefore, is extended some protection. It depends upon the organised sector for its inputs of yarns and for processing. With the exception of a few, these looms are slow speed non-automatic looms. This sector in the textile industry claims employment of the million people and its now dominent in the cloth production and use of man-made fibre. The handlooms are spread all over the country while powerlooms are concentrated in some pockets.

8.5 The hosiery industry has very small share (15%) in the total textile fabrics supply. However, this industry is fast growing almost entirely in small scale sector. In spite of the small size of the units this industry has been very well in export market.

8.6 Production of blended and non-cotton fabrics is presented in the following table. Production of all wollen fabrics is presented in Anneuxre - 4.

Table 8.3

PRODUCTION OF BLENDED AND NON COTTON FABRICS

MILLION METERS.

YEAR	MILL	DECENCTRALISED SECTOR	TOTAL
1980	700	2469	3169
1981	926	3025	3951
1982	688	2677	3365
1983	824	2919	3743
1984	793	3005	3798
1985	745	3126	3871
1986	877	3503	4380
1987	806	3500	4306
1988	786	4082	4868
1989	683	4200	4883

Table 9.1

	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90
Housing & construction.	35	34	36	43	54	60	66	74	84	92
Agriculture	70	70	83	96	113	133	134	150	156	188
Transport	8	7	8	10	11	11	12	12	12	15
Textile	-	-	-	-	1	1	2	2	3	5
Industrial Applications	76	77	88	101	113	132	142	157	169	203
Health Care	6	7	8	9	10	10	12	14	17	20
Consumer Items	94	93	109	117	132	143	148	166	185	207
	290	288	332	376	433	490	516	575	628	730

The sectoral consumption in the last ten years show that the dominant consumption is in industrial applications, consumer items and agricultural applications each nearly having 25-30% of the total share. Further productwise analysis shows that film is the most dominant product and thus packaging of industrial and consumer products is the major use of plastics. The two major applications after film are pipes and woven sacks both of which are used for agricultural and industrial applications.

The product and processwise break up also shows that the extrusion is the predominant process used in the downstream processing of thermoplastics. Nearly 75% of the processing capacity is in the extrusion, 20% capacity in injection moulding and blow moulding, the rest of 5% being distributed in various other processes like vacuum forming, calendering, rotational moulding etc..

These sectoral end-use pattern has been derived from the productwise consumption pattern of each of the major thermoplastics i.e. LDPE/LLDPE, HDPE, PP, PVC and Polystyrene. A brief analysis of these polymers consumption into end-products is presented below.

The end-use pattern of LDPE/LLDPE shows that nearly 80% went into the film related application, the rest being injection moulding and extrusion coating. The film is used in packaging of general purpose items, food and non-food related items in addition to agriculture applications like canal lining, cap covers for grain storage etc..

HDPE is primarily used for woven sacks followed by moulding applications with about 60% of this resin being used in these applications. The other applications are pipes and HM HDPE films etc..

The third major polymer, PVC is essentially used in applications like pipes and fittings, wires and cables, film and calendering and footwear. The dominant is the pipes which are nearlyu 45%, followed by wires and cables, calendering and footwear.

The polypropylene find major application in films (40%) followed by injection moulding (25%) and woven sacks.

Polystyrene is mainly used in industrial mouldings (50%) and sheet making.

9.2.3. Future Scenario:

A ten year analysis of pattern shows a progressive development of conventional application with introduction of a few new products and processes. Though there has not been a major change in the product pattern in the 1980s, recent introduction of new products processes and changing demand from industrial and other user sectors, there is llikely to be qualitative change in the processing sector. To cater to these new end-users sectors like automotive and teletronics, agriculture and furniure etc., the processing industry would employ sophisticated machinery and set of the art technology. A beginning has already been made towards this end in the manufacture of these following products and processes:-

- Multi layer co-extrusion
- Processes food packaging
- Mono and Biaxially oriented films.
- Laminations and over-wrappings
- Cross laminated films.
- Wave lock films
- Tarpoulins, fumigation covers and green house films.
- Mono and multi-layer sheet extrusion
- Spectacle frames, security glazing and thermo forming.
- Twin screw extruders for pipes for agriculture and potable water distribution, sewage system.
- Multi layer collapsible tubes for toiletries.
- Red mud PVC corrugated sheets for low cost housing and factory ceilings.

- PP Fibre and filaments for end-uses in industrial filters, GEO textiles, carpets, upholstery, soft luggage, diapers etc..

- Circular and jet looms for fertilizer, cement and chemical sackings.

- Stretch blow moulding for packaging oof oil, mineral water and detergent.

- Injection blow moulding for pharmaceutical and squeeze type bottles.

- Blow moulding from 30 to 250 ltrs. capacity for packaging of industrial liquids chemicals, solvents etc..

- Injection moulding from 50 to 3,750 tonnes locking force tonnage capacity for end-uses like furniture, luggage wear, crates, automotive and electronics components.

- Structural foam and PIP moulding for furniture business machines and certain automotive components.

- Reaction injection moulding, pultrusion and multi-layer bottles to cater to applications in pharmaceuticals, cosmetics and automobile components in case of reaction injection moulding.

In this context in the 1990s, the following have been identified as high growth sectors:-

* Agriculture, forestry and water conservation.

* Automobiles and Transportation.

* Building Construction and Furniture.

* Electronics and telecommunication.

* Medical and Personal Care Products.

* Food processing and packaging.

* Power distribution.

* Exports.

As a natural fall-out of the above developments the beginning of which has already been made, sectors of machinery, auxillary equipment, instrumentation, quality control and testing equipment, will gear themselves to compliment the growth in the plastic processing industry. It is estimated that in order to process nearly 26 lakh tonnes of plastics by 2000AD as envisaged in the earlier section of this report, 10,000 new machines would have to be manufactured and installed. In addition to this, most importantly, the type of configuration and technology of the equipment would have to be much different and may necessitate imports as well as substantial technological upgradation in domestic machine building capacity to be able to manufacture the speciality products as stated above.

From the above study of present status and future scenario of the plastic processing industry it can be summarised that though developments till the end of 80s ldecade has been mostly quantitative with less of diversification and only beginning of modernisation, the decade of 90s is likely to witness more qualitative changes in profile of the industry, structure of the industry and in terms of processes and products. The decade is also likely to witness sophistication in technology, more inclination towards engineering and performance polymers and greater in-roads into industrial applications.

9.3 SYNTHETIC RUBBER :

The following Table presents the consumption of Synthetic Rubber in core economic sector for the last ten years :-

TABLE 9.2

('000 tonnes)

	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-
Housing & Construction	Negligible									
Agriculture	Negligible									
Transport	36.0	38.0	40.0	45.6	48.1	50.2	52.5	55.9	60.0	64
Textile	-	-	-	-	-	-	-	-	-	-
Industrial applications	3.0	3.4	3.7	4.2	5.0	5.9	6.1	6.8	7.2	7
Health care	Negligible									
Consumer products	8.0	10.6	11.5	12.5	12.3	14.0	13.2	13.8	16.9	20
TOTAL :	47.0	52.6	55.2	62.3	65.4	70.1	71.8	76.5	84.1	91

The sectorwise consumption of synthetic rubber shows that major consumption is in the transport sector amounting for more than 70%. The other two areas are the industrial applications (wires and cables, belting) and consumer products (footwears). Though there is some consumption in health care and agriculture (rubber tubing etc.) this is negligible and quantitative data is not available. The future scenario for this sector does not appear to be very different and the present trend is expected to continue.

9.4 SYNTHETIC FIBRES :

The sectoral consumption of synthetic fibres for the last ten years is presented in the following Table :-

('000 tonnes)

TABLE 9.3

	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-
Housing & construction	-	-	-	-	-	-	-	-	-	-
Agriculture	-	-	-	-	-	-	-	-	-	-
Transport	13	15	20.0	19.0	22.0	28.0	25.0	29.0	34.0	40.

10. **ORGANIZATION OF THE INDUSTRY:**

The petrochemical processing industry is mainly in the decentralised/delicenced sector. Basically the industry has been developed in small and medium scale sector to cater to geographically nearby areas and local markets.

Study of the profile of the plastic processing industry shows that average investment in plastic processing unit is of the order of Rs.0.25 million with a capacity of 130 MTs. The production level is about 60-65 tonnes (50% capacity utilization) with an average turn over of Rs.1.0 million. The profile of the industry shows that it is developed as largely low technology low capital investment industry. In this sector 75% of the units are in small scale with product manufacturing on single machine utilisatilon, out of the 25% in the large scale sector only about 5% of the units are with a capital investment ranging between Rs.5 to Rs.50 million.

The rubber goods industry is also similarly distributed into large number of small units except for automotive tyre units. Presently there are 30 units producing automotive tyres and tubes. The other rubber goods like belting, foot-wears, hoses etc. are produced in large number of units spread all over the country e.g. there are more than 400 units producing rubber foot-wears, almost similar number for belting, seats etc..

The synthetic fibre processing industry is distributed between the organized mill sector and decentralised weaving and knitting sector. The organised mills sector is the main consumer of staple fibres (Polyester Staple Fibre and Acrylic Fibre). The mill sector consists of 1054 mills of which 179 are in public sector and 98 in cooperative sector, the rest being in private sector. The decentralized sector consisting of hand-looms, powerlooms and hosiery units is all in private small entrepreneurs, and the main consumer of filament yarn.

Since most of the industry is small entrepreneur oriented, the ownership of these units is in private sector except for a few public sector textile mills.

Cooperation within the Industry:

With the wide spread of the units, both in terms of geographical areas and in terms of products, there is considerable competition as well as inten-dependence. Most of the time these units join hands in obtaining raw-materials and other infrastructure. In order to solve their problems or present developmental plans and policies formulations to Government, they normally chose to have a common platform by forming industry associations. Sometimes in order to further their interest, small sectorwise or productwise associations have also been formed.

They also recently initiated joint action in promoting R&D and product development by forming cooperative research associations and setting up jointly funded research programmes.

11. GOVERNMENT POLICIES IN THE AREA OF PETROCHEMICAL PROCESSING SECTOR

11.1. INCENTIVES:

The historical development of the industry in small and medium sector has been mainly due to the special role assigned by the Government Policies to the small scale sector in industrial development and incentives provided for such development. The small scale sector has been given this role because of its inherent advantage of low capital intensity and higher employment generation coupled with decentralisation and regional dispersal of industrial activity.

In order to promote this development, a package of incentives and concessions have been evolved over a period. The package includes concessions in financing and in duties and taxes. The marketing support is extended through reservation of large number of items for production in the small scale sector only and also exclusive/partial purchase for bulk requirements of large undertakings, Government organisations etc..

The recent policy measures initiated are:-

(i) Commencement of operation by Small Industries Development Bank of India (SIDBI).

(ii) Liberalisation of the Single Window Scheme introduced in 1988.

(iii) Liberalisation of Central Excise exemption scheme of small scale industries, and

(iv) Raising of ceiling on investment in plant and machinery for small scale industries.

SIDBI has become operative in 1990 with a network regional and branch offices. The new initiative are in the area of support service for technological upgradation and modernisation and simplification of existing procedures.

Single window scheme has been liberalised for raising the eligibility limits of project costs and working capital from 5 lakhs and 2.5 lakhs rupees to Rs.10 lacs and Rs.5 lacs respectively to ensure credit to the smaller of small scale units from single agency.

The turnover limit for exemption of excise duties has been enhanced from 15 lakhs to 20 lakhs for units manufacturing single product.

11.2 Infrastructure:

Apart from package of incentives, Government has developed dedicated industrial Estates and District Industry Centres to provide infrastructure and support facilities for small and medium entrepreneurs. In some States, special centres for plastic and rubber processing have been developed which has given a further filip to this industry in that area.

11.3 Support Services:

With the nature of the industry in being low capital intensive and the proliferation of units has helped in spreading of the knowledge base in setting up such units. This industry has been growing on the technical advice and support provided by the following organisations:-

(i) Raw material manufacturers.

(ii) Machinery manufacturers.

(iii) Government support organisations/Institutions.
Such as Director of Industries.
Small Industries Service Institute
National Small Industries Corporation.

11.3.1. The Government support organizations have provided servies in the nature of promotion of new entrepreneurs and units. They have helped in products/project identification. Some Agencies have helped in identifying source of finance and preparation of project profiles. Government took initiative and actively participated in all efforts to develop specific application contributing to economic development. Formation of a National Committee on Use of Plastics in Agriculture and special Committee to look into development of plastic furniture to substitute wood are examples of this special effort. Other developments like cap covers for foodgrain storage, platic containers for vegetable oil packaging, plastic crates for fruit and vegetable transport and storage, plastic black board for educational institutions have received active support from Government.

11.3.2. Raw material manufacturers have always been offering technical services to the processing industry mainly to develop wider consumption base of raw materials. They have well equipped application development centres with relevant macinery and manned by technically qualified people. Because of these facilities, they are in a position to offer technical services and solve problems faced by the processing units. The type of services offered by raw material manufacturers are:-

Guidance on applications of the raw material i.e. what type of products and projects can be set up based on utilization of the particular polymer.

Preparation of product profiles on such applications to enable lprospective entrepreneurs to acquire an understanding into basic idea about the project.

Services for selection of appopriate grades of raw material relevant to the end use.

Testing facilities both for raw material and end-product in a varying degree.

Services for experimentation and trial on production of particular end-product by way of installation of important machinery which may be required for end-product manufacturing.

In-plant guidance and supervision for processing of a particular polymer, and manufacture of end-products.

Initiative and active efforts to popularise specific applications based on utilisation of the concerned polymer, especially applications involving market development and acceptance of lbyusers.

11.3.3. The machinery manufacturers have also been contributing to processing industry in the form of technical and consultancy services. Normally services like appropriate selection of equipment, erectilon and installation and trial running of the equipment are the key requirements in the pre-investment phase of the unit. In the post investment phase, production snags-arising out of the equipment failure, modifications of equipment to suit the products selected by the entrepreneurs and trouble free maintenance and operations, ae the services needed by any unit.

Machinery manufacturers, have been rendering pre-investment related technical services as a part of the package of offering plant and equipment for a particular product. Not only this, the machinery manufacturers also have been providing lot of technical help as well as guidance on product selection, market end-uses and selection and training of technical personnel for the plant.

Leading companies have by and large eloborate technical services deptt. and after sales service deptt. to provide assistance in smooth operation of plant and machinery after the commercial production starts as also trouble-shooting during the initial period of operation. By offering periodical and regular visits of their sales engineering these companies render technical help to the units which may have installed their plants in maintaining the production output, determining process parameters etc. Hence, to this extent units needs for technical consultancy services in the area of machinery selection, installation and start up is taken care of.

Companies manufacturing raw materials machinery and equipment conduct short-term courses for their customers in processing of raw materials and applications, utilisation and maintenance of specific machines.

Few polytechnics are also offering courses for technicians required by the polymer industry.

11.4 Training Facilities:

11.4.1. Presently some Universities, Engineering Institutes and Polytechnics have established courses for training of different categories of personnel required by the Polymer Industry. These may be classified as courses in Polyer, Chemistry, Polymer Technology, Plastics Technology, Plastics Engineering, Plastic Technician etc., depending on the emphasis on any specific area of specialisation. Courses in Chemical Engineering and Mechanical Engineering also provide Plastic/Rubber Technology as an elective subject. A list of institute offering different level of courses is given in the Annexure - 10. Most of these institutes impart training at the Post-Graduate, Under-Gradate or Diploma level, and are of one to four years duration. The nature of training includes theoretical lectures, laboratory practicals, project work, disseration, and practical training in relevant industry. Few personnel who are trained in overseas Universities are also employed by the Industry.

Special mention may be made of the Central Institute of Plastics Engineering and Tools, located at Madras with extyension centres in various institutes was set up with UN assistance and more, extension Centres are also planned during the eighth Plan by them. They are well equipped and cffer lvarious courses in Mould Design, Fabrication, Processing and Testing of Plastics for different categories of technical personnel.

The Plastic and Rubber Institute (Indian Section) presently Indian Plastics Institute has been greatly responsible in promoting several training programmes. It has taken a leading part in arranging many refresher courses during the last 15 years, at different centres. In addition, it has successfully made efforts to train persons, for the examinations held by the Plastics & Rubber Institute (London). Seminars are also arranged on different topics, by technical institutes like Plastics & Rubber Institute, All India Plastic Manufacturer Association, etc. Some people are required for plastic processing industry and about 25000 persons would be required in the rubber processing industry. Since the synthetic fibre processing goes alongwith the textile industry, the separate estimates of requirement has not been taken up.

11.4.2. The manpower requirements in the Polymer Industry are broadly in two categories; for raw material manufacture and for down-stream processing industry. The requirement for raw material manufacturing would be highly skilled and technically qualified and not very large in numbers. These are broadly met by high level technical institutions like Institute of Technology, advance engineering colleges etc. with a few institutions offering specialised courses. However, the requirement of manpower for down-stream processing industry is large in number and skilled workers are required. Since the dispersal of down-stream units is large in number and also spreadover wider geographical area, the number of trained Technicians would be larger in the Indian context. Presently a plastic or rubber processing unit of average size is employing 50-60 people out of which 15-20 are supervisory category and the remaining being Operator level. Based on this data, the investment and conversilon tonnage ratio, it is assumed that about 10 persons for 100 tonnes processing are required. Based on the demand estimates it is projected that about 2,50,000.

11.4.3 The growing needs of the training would require establishment of additional facilities either in the existing institutes or by setting up new institutes. Apart from this, the most important requirement is continuous update of the content of the courses available including information on new materials, new techniques. The equipment in these institutions must be updated periodically to keep the training in line with the state of art technology.

It is also essential to offer refresher courses to the existing man-power in the industry at all levels.

11.5 Testing Facilities for Plastic Industry:

There are number of R&D organizations testing laboratories and institutions offering test, services in polymwer area. In addition there are specialised Govt. and semi-Govt. organizations engaged in training, testing and consultancy. A few of the major ones are listed below:-

i) Central Instt. of Plastic Engg. & Technology, Madras

ii) Indian Institute of Packaging, Bombay.

iii) Gujarat Industrial Research & Devp. Agency, Baroda.

iv) Indian Institute of Chemical Technology, Hyderabad.

v) Regional Research Laboratory, Bhubaneshwar

vi) Centre for Scientific & Industrial Consultancy. Indian Institute of Science, Bangalore.

vii) Regional Resting Laboratory, Madurai.

viii) Indian Institute of Technology, Madras.

ix) Central Food & Technological Research Institute, Mysore.

In addition to the training programmes, CIPET is equipped with fulfledged design wing, tool room facility and testing centre. The institute with the elaborate set up available can provide various tests on raw material and end-products particularly with reference to plastic packaging which is widely used.

GIRDA is an Industrial Research Laboratory equipped to offer training assistance and guidance with reference to raw materials, finished products, quality control etc.. The institute is equipped with facilities and expertise for quality assurance development testing.

The other institute mentioned above provide various facilities for Polymer testing, analytical facilities and certain amount of consultancy services.

11.6 Locational Policy:

A unit is naturally guided by the commercial considerations. like new raw material availability, market proximity. However, these commercial considerations are combined with incentives available like sales-tax concessions and other concessions given by the State or Central Government when the units are located in backward areas. Both the State and Central Governments encourage location of industrial units in backward area by giving incentives. The main aim behind this is to create employment in such areas as well as make these areas as part of the main-stream development.

11.7. Backward and Forward Integration:

The past development pattern of down-stream industry in medium and small scale sector has kept the raw-material and processing units separate. With the growth of consumption and the markets, some of the processors in the recent past have been making forays into basic resin/raw material manufacture. Some large synthetic filament yarn consumers have entered into production of filament yarn, a few tyre companies are planning synthetic rubber production and large Polyestyrene and PVC consumers are planning resin facilities.

Similar backward integration has also been taking place in the form of large users entered into plastic and rubber processing. Examples are in automobile and appliances manufactures setting up large moulding units for captive consumption. However, these are of very recent origin.

Forward integration of Polymer manufacturers entering into conversion areas has not really taken place in India basically because of the structure of the processing industry. However, with growth when large convertion units emerge in the field, it is expected that some of the polymer manufacturers may enter into the highly specialised areas or for exports.

11.8 Environmental Policies:

The Environmental Policy applicable to Petrochemical downstream industry is the policy being followed by the industry in general. It may be mentioned that the present environmental Act defines Petrochemical units and Polymer unit as in the category of polluting industry which require special clearances from the State and in some cases Central Government. However, environmental awareness is bringing about changes in the attitude of the industry.

The most interesting phenomina in the petrochemical area is the plastic waste recycling. With the economic situation and employment requirements, the collection and recycling of the plastic waste has been an economic activity in the Indian Processing Industry. Therefore, the problem of solid waste pollution has not arisen. This economic activity has given rise to other problems like non-standard material and not so scientific methods of the recycling. Recent efforts have been to channelise this effort into more scientific output and use of the recycle material in areas where it is acceptable.

13.2 The processing technologies are also going to undergo changes with upgradation and adoption of new process technologies. There will be an increasing trend towards meeting the specific requirements of end-users either by designing the product or tailoring the raw-materials into Alloys and Blends. The processing techniques for the Alloys and Blends would also need to be adopted and absorbed. A few of the trends in the processing technology that are going to be emerging are:-

- Strech blow moulding of multilayer, multiwalled blow moulded container.

- Reaction injection moulding (RIM), reinforced reaction injection moulding and reactive processing of synthesized alloys using extruders and minireaction.

- Coextrusion of multilayered a high barrier films.

- Lithography with the help of UV lasers and liquid photo polymers to make prototypes without any tooling, with in hours or minutes. This is the latest development to help industry of engineering and high tech components.

- novel techniques of blending immiscible polymers.

- Injection moulding and screw extrusion of UHMUPE which till recently could only be processed by raw extrusion.

- Insert and outsert moulding particularly in the field of teletronics.

- Lay fibre reinforced technology with improved performance over conventional short fibre/chopped fibre reinforcement and machines capable of feeding such long fibres.

- Gas assisted injection moulding system for better quality and greater flexibility in product design.

- Plasma treatment/polymerisation for surface coating technology to improve the performance of moulded or extruded products.

- Enhanced control system using microprocessors, computer and servicing devices e.g. controlled thickness variation in blow moulded products.

- Automation and robotics.

- Improved auxillary equipment e.g. in line trimming, assembling and packaging of processed parts.

- Design improvements resulting in increased through put with better quality and reduction in weight per part.

- Machines tailored for increasing productivities e.g. continuous injection moulding.

13.3 Taking into the overall market developments, the processing technologies and the products, the new applications likely to be witnessing a fast growth in the Indian market are:-

- Plastic furniture for both out door and indoor use with emphasis in designer concept.

- Plastic doors, window and other profiles and panels in building and construction/interior decor and even transportation (railways/automobiles etc.).

- Plastic material handling "Systems" comprising of composite lpallets, plastic crates and bins, plastic conveyer chains and links and components thereof, bottling plants, plastic liners etc..

- Integrated water management "Systems", comprising of plastic pipes and fittings, water storage tanks, minor irrigation equipments (plastic sprinklen nozzles and drip irrigation) plastic pumps etc..

- Export oriented components manufacture for various industrial components required.

- Conducive compounds for defence and electronics.

- Blow moulding multilayer containers for packing pesticides, chemical and automobile applications.

- Large plastic tankers for transportation of hazardous chemicals.

- Moulded TPE items for oil field, process and transportation industries.

13.4 In addition to the above developments on commodity plastics, there is going to be a very strong growth in alloys and blends and engineering plastics for performance products. The new performance plastics are expected to enter into automobile, teletronics, aerospace and defence and high temperature applications for engineering components in the near future. In addition to these alloys and blends it is also foreseen that advance composits like carbon fibre composits would be entering into the performance market. In the fibre processing sector, new areas like spun bonded fabrics and geo-textiles are likely to enter into the market in the rubber down-stream area, new products like thermo-plasti elastomers, blends with plastics are making an entry and are likely to grow faster.

13.5 With the balance of payment position in India, the exports are going to be a major focus for any industry including the petrochemical down-stream processing industry. Apart from efforts to export the production from Indian market, the Indian Industry is gearing itself to obtaion the data on the markets available abroad in terms of product design, specifications and other requirements and cater to it. This export thrust is likely to inject the latest technology trends into the industry. The new technologies would be environmental friendly and energy efficient.

14. CONCLUSIONS AND RECOMMENDATIONS:

14.1. The petrochemical down-stream processing industry in India has developed in the small and medium sector with low capital investment and llow technology giving rise to large employment and very wide geographical dispersion. This has been achieved by giving package of incentives and continuous liberalisation of policies.

14.2 The liberalisation process has also been accompanied by encouragement and support for modernisation and upgradation of technology. However, the recent liberalisation of industrial policy is likely to give a fililp of this effort of modernisatilon as the existing units would have to compete in a situation of more policies and markets.

14.3 The new Industrial Policy opens up the venues for growth and competition thus creating an environment for improving the efficiency.

14.4 The competitive environment thus reached would also stimulate the units to go in for research and development for future growth. The industry would thus mature and grow in a competitive atmosphere.

14.5 The support and incentives for modernisation and establishment of R&D would have to be continued.

14.6 The requirement of the industry in terms of new technologies, skilled man-power, automatic and modern machinery would have to be met by additional investment and establishment of necessary institutions.

14.7 Facilities for the critical inputs like additives moulds and dies and other facilities should be created.

14.8 Promotional efforts to lend active support to applications which are of socio economic relevance must be continued so that the maximum advantage of these materials is derived for the economic growth.

ANNEXURES

ANNEUXRE I

PRODUCTION AND CONSUMPTION OF MAJOR THERMOPLASTICS

YEAR	PRODUCT	PRODUCTION	IMPORT	EXPORT	000 TONNE'S CONSUMPTION
1980-81	ABS	1.2	0.3		1.5
	HDPE	24.3	36.9		61.2
	LDPE	87.3	4.0		91.3
	PP	16.7	1.4		18.1
	PS	10.3	0		10.3
	PVC	42.2	66.4		108.6
	TOTAL	182	109		291
1981-82	ABS	1.8	0.2		2.0
	HDPE	31.7	26.0		57.7
	LDPE	92.7	2.2		94.9
	PP	20.6	1.4		22.0
	PS	7.9	4.6		12.5
	PVC	37.3	64.6		101.9
	TOTAL	192	99		291
1982-83	ABS	1.8	0.2		2.0
	HDPE	32.7	41.3		74.0
	LDPE	106.2	1.0		27.0
	PP	24.0	3.0		27.0
	PS	12.6	4.4		17.0
	PVC	41.7	63.1		104.8
	TOTAL	219	113		332

YEAR	PRODUCT	PRODUCTION	IMPORT	EXPORT	CONSUMPTION
1983-84	ABS	1.8	0.3		2.1
	HDPE	36.2	43.1		79.3
	LDPE	99.7	1.7		101.4
	PP	24.0	8.7		32.7
	PS	15.3	5.8		21.1
	PVC	64.0	63.4		127.4
	TOTAL	241	123		364
1984-85	ABS	2.6	0.2		2.8
	HDPE	39.0	51.2		90.2
	LDPE	107.2	21		128.2
	PP	27.0	8.9		35.9
	PS	16.0	3.7		19.7
	PVC	83.3	73.0		156.3
	TOTAL	275	158		433
1985-86	ABS	3.5			3.5
	HDPE	40.0	75		115.0
	LDPE	101.9	43		144.9
	PP	23.6	18		41.6
	PS	17.0	8		25
	PVC	105	60		165
	TOTAL	291	204		495

YEAR	PRODUCT	PRODUCTION	IMPORT	EXPORT	CONSUMPTION
1986-87	ABS	5.0	0.3		5.3
	HDPE	41.0	89.0		130.0
	LDPE	87.8	38.7		126.5
	LLDPE		3.5		3.5
	PP	24.0	26.5		50.5
	PS	20.1	16		36.1
	PVC	123.1	54		177.1
	TOTAL	301	228		529
1987-88	ABS	5.0	0.5		5.5
	HDPE	37.7	97.0		134.7
	LDPE	79.6	57.5		137.1
	PP	25.9	31.0		6.9
	PS	22.0	18.0		40.0
	PVC	119.8	80.0		199.8
	TOTAL	290	284		574
1988-89	ABS	6.2	0.5		6.7
	HDPE	39.5	104.6		144.1
	LDPE	82.6	53.4		136.0
	LLDPE		9.5		9.5
	PP	38.3	27.0		65.8
	PS	24.7	15.0		39.7
	PVC	136.7	98.0		234.7
	TOTAL	328	308		636

ANNEXURE II

TOTAL PRODUCTION & CONSUMPTION OF SBR & PBR

YEAR	SBR		PBR	
	PRODUCTION	CONSUMPTION	PRODUCTION	CONSUMPTION
1981-82	16,561	24,305	11,416	12,470
1982-83	13,669	24,365	16,045	14,510
1983-84	20,081	26,290	11,470	16,920
1984-85	20,826	28,290	16,457	17,360
1985-86	19,889	31,585	14,732	18,520
1986-87	22,963	31,925	15,411	19,735
1987-88	29,106	33,420	14,488	20,925
1988-89	37,866	39,095	15,650	22,920
1989-90	38,084	38,945	15,150	24,630
1990-91	37,908	41,613	15,202	25,642

YEAR	PRODUCT	PRODUCTION	IMPORT	EXPORT	CONSUMPTIO
1987-88	AF	22.0	1.2		23.2
	NFY	34.2	0.2		
	NTC	26.4	3.2		
	PFY	111.7	5.3		
	PSF	78.7	6.1		
	TOTAL	273	16		289
1988-89	AF	26.5	7.7		
	NFY	35.9	0.3		
	NTC	26.9	9.0		
	PFY	143.3	7.6		
	PSF	112.4	5.4	21	
	TOTAL	345	30	21	354
1989-90	AF	31.6	7.6		
	NFY	38.8	0.2		
	NTC	35.0	3.8		
	PFY	155.9	6.0		
	PSF	127.7	6.4	42	
	TOTAL	389	26	42	373

AF	ACRYLIC FIBRE
NFY	NYLON FILAMENT YARN
NTC	NYLON TYRECORD
PFY	PLYESTER FILAMENT YARN
PSF	POLYESTER STAPLE FIBRE.

ANNEXURE IV

ITEM	UNIT	1960	1965	1970	1975	1980	1983	1984	1985	1986	1987	1988	1989
Auto tyres	million Nos.	1.5	2.6	4.0	5.6	7.8	9.6	10.6	11.6	12.8	13.0	14.6	14.7
Cycle tyres	-do-	10.8	18.1	21.0	24.5	26.7	30.2	32.7	34.0	33.6	35	26	26
Rubber footwear	Lakh Pairs	46.4	530.4	447.4	397.5	435.1	360.5	371.5	371.5	413.0	372.1	379.4	22.9
Fan belts	million Nos.	1.1	1.5	2.3	2.5	2.2	2.7	2.9	2.9)))	16.5	16.5	10.7	13.9
Tubes	-do-	0.9	2.0	3.4	4.5	8.2	11.4	12.8	13.7)				
Rubber transmission and conveyor belting	tonnes	2400	5136	5596	7420	9080	9698	9508	9092	7500	7500	10747	11816
Rubber hoses	'000 Mtrs.	3593	6848	5211	5000	4922	2439.4	5204.5	5725.5	5500	5500	2860	3757
Rubber cots & aprons	million	-	-	NA	391	470	550	605	755.5	600	600	895	993

ANNEXURE V

PRODUCTION OF WOVEN FABRICS

(IN MILLION METERS)

	MILL MADE			DECENTRALISED SECTOR			TOTAL (MILLS AND DECENTRALISED SECTOR		
	COTTON	BLENDED & NON-COTTON	TOTAL	COTTON	BLENDED & NON COTTON	TOTAL	COTTON	BLENDED & NON-COTTON	TOTAL
[illegible]	3476	700	4176	4838	1769	6697	8314	2469	10873
[illegible]	3142	936	4073	4973	2099	7072	8120	3025	11145
[illegible]	[illegible]	603	3035	5490	1989	7079	7937	2677	10514
[illegible]	[illegible]	821	3528	5911	2095	8006	8615	2919	11534
[illegible]	[illegible]	793	3366	6257	2212	8469	0	3005	11835
[illegible]	[illegible]	745	3411	6634	2382	9016	[illegible]31	3126	12427
[illegible]	[illegible]	877	3337	6812	2626	9438	9272	3503	12775
[illegible]	[illegible]	806	3114	7309	2694	10093	9617	3500	13117
[illegible]	[illegible]	736	2859	7033	3296	10329	9106	4032	13138
[illegible]	[illegible]	665	2674	7261	3517	10778	9252	4200	13452

ANNEXURE- VI

SECTORWISE CONSUMPTION - THERMOPLASTICS

GROWTH IN CONSUMPTION OF COMMODITY POLYMERS (1980-81 TO 1989-90)

END USE POLYMER	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/ 80-81)
HOUSING & CONSTRUCTION											
PP/HDPE	0.5	0.8	1.5	1.3	1.8	3.5	3.5	5.0	7.1	7.8	35.60
PVC	34.7	32.7	34.0	40.5	51.7	555	61.3	68.3	75.9	82.8	10.16
PS	0.1	0.3	0.5	0.6	0.6	0.6	0.8	0.9	0.9	1.0	29.15
TOTAL	35.3	33.8	36.0	42.8	54.0	59.6	65.6	74.1	83.8	91.6	11.19
AGRICULTURE											
LDPE/LLDPE	33.0	35.5	42.8	49.0	57.0	65.0	60.5	68.5	67.6	78.3	10.07
EVA	16.5	15.0	20.1	20.8	22.5	32.5	34.0	36.5	37.8	49.5	12.98
PP	0.3	0.5	0.6	0.8	0.8	0.5	1.0	1.9	3.8	7.5	45.92
PVC	20.7	19.3	19.5	25.3	33.2	35.0	38.3	42.3	47.1	53.1	11.05
TOTAL	70.4	70.2	82.9	95.7	113.4	133.0	133.8	149.2	156.3	188.3	11.55

TRANSPORT											
PVC	7.9	7.4	7.4	9.5	10.6	10.4	11.1	11.9	13.2	13.9	6.48
PE	0.1	0.1	0.3	0.3	0.3	0.4	0.5	0.5	0.6	0.7	23.12
TOTAL	8.0	7.5	7.7	9.8	10.9	10.8	11.6	12.5	13.8	14.6	6.87
TEXTILE											
PP	0.1	0.3	0.3	0.5	1.1	1.2	1.7	2.4	3.4	5.0	54.55
TOTAL	0.1	0.3	0.3	0.5	1.1	1.2	1.7	2.4	3.4	5.0	54.55

[illegible] IN CONSUMPTION OF COMMODITY POLYMERS (1980-81 TO 1989-90)

[illegible]	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/ 80-81)
[illegible]											
[illegible]	35.3	36.0	39.2	46.8	45.3	42.5	32.7	35.0	34.5	42.0	1.95
[illegible]	19.5	18.0	24.3	24.3	25.5	30.0	31.3	31.5	32.5	35.5	6.88
[illegible]	4.7	5.5	6.3	8.2	9.4	11.8	13.1	14.6	16.7	19.0	16.93
[illegible]	26.6	24.0	24.7	30.6	35.6	36.6	44.4	53.8	64.1	69.6	11.28
[illegible]	8.2	9.8	14.2	17.6	16.1	21.9	26.2	31.2	37.1	41.2	19.65
TOTAL	94.3	93.3	108.7	117.4	131.9	142.8	147.6	166.0	184.8	207.3	9.15
[illegible]											
[illegible]	22.5	22.5	25.6	28.5	30.0	32.5	32.3	36.5	35.5	42.0	7.18
[illegible]	25.2	24.6	29.7	34.0	40.0	52.5	54.8	57.0	59.8	75.0	12.88
[illegible]	9.5	11.5	14.0	17.7	18.9	20.6	24.1	28.5	34.8	44.5	18.72
[illegible]	16.4	16.1	17.0	18.6	21.5	23.5	27.0	30.0	33.3	34.9	8.79
[illegible]	2.0	2.0	2.0	2.3	2.2	2.8	3.7	4.7	6.0	6.7	14.28
[illegible]	75.6	76.7	88.1	101.1	112.6	131.9	141.9	156.7	169.2	203.1	11.61

GROWTH IN CONSUMPTION OF COMMODITY POLYMERS (1980-81 TO 1989-90)

AGRICULTURE

END USE POLYMER	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/ 80-81)
FOOTWEAR											
LIQUID MILK	6.5	7.0	8.0	10.0	14.0	17.0	15.0	15.5	16.3	19.5	
DAIRY PACKING OF FOODS	5.5	5.5	6.5	7.0	7.3	8.0	7.5	8.0	8.0	10.0	
PACKING OF FOOD	4.0	4.0	5.0	4.0	3.0	2.5	3.5	5.0	5.0	5.5	
PERISABLES BITUMEN MAT.	3.5	4.5	5.0	4.0	3.0	2.5	3.5	5.0	5.0	5.5	
CANALS/RESERVOIR LINING			0.5	0.7	1.0	2.0	2.0	2.5	2.8	3.0	
CAP LINERS	2.0	2.5	3.0	5.0	6.5	8.0	6.0	7.0	4.0	4.5	
MULCH FILMS	6.5	6.5	8.0	10.0	10.5	12.0	12.0	15.0	18.0	20.0	
EMULSIONS											
[illegible]	2.5	3.0	4.0	5.5	7.5	9.5	7.0	7.5	6.5	7.0	
OTHERS											
[illegible]	2.5	2.5	2.8	2.8	1.8	1.0	1.5	2.0	1.5	2.3	
TOTAL	33.0	35.5	42.8	49.0	57.0	65.0	60.5	68.5	67.6	78.3	10.07

END USE POLYMER	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/ 80-81)
HDPE											
PIPE	7.0	7.0	7.0	6.0	5.0	5.0	5.5	6.0	6.5	7.0	
WOVEN SACKS	5.5	5.5	7.0	11.0	13.5	20.0	21.0	23.0	24.0	35.0	
MONOFILAMENTS	4.0	2.5	4.1	3.8	4.0	7.5	7.5	7.5	7.3	7.5	
TOTAL	16.5	15.0	20.1	20.8	22.5	32.5	34.0	36.5	37.8	49.5	12.98
PP											
WOVEN SACKS	0.3	0.5	0.6	0.8	0.8	0.5	1.0	1.9	3.8	7.5	
TOTAL	0.3	0.5	0.6	0.8	0.8	0.5	1.0	1.9	3.8	7.5	45.92

GROWTH IN CONSUMPTION OF COMMODITY POLYMERS (1980-81 TO 1989-90)

END USE POLYMER	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/ 80-81)
PVC											
PIPES & CONDUITS	19.7	18.1	18.3	23.3	30.8	32.5	35.3	38.3	42.6	48.3	
FITTINGS	1.0	1.1	1.3	2.0	2.4	2.5	3.0	4.0	4.5	4.8	
TOTAL	20.7	19.2	19.5	25.3	33.2	35.0	38.3	42.3	47.1	53.1	11.05
GRAND TOTAL	70.4	70.2	82.9	95.7	113.4	133.0	133.8	149.2	156.3	188.3	11.55

GROWTH IN CONSUMPTION OF COMMODITY POLYMERS (1980-81 TO 1989-90)

(KARSPOS)

END USE POLYMER	80-81	81-82	82 83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/ 80-81)
PVC											
DIVERSIFIED SAT.SEP.EPC.)	3.0	2.5	2.5	2.5	2.2	2.	2.0	2.0	2.0	2.0	
[illegible]	4.9	4.9	4.9	7.0	8.4	8.4	9.1	9.9	11.2	11.9	
TOTAL	7.9	7.4	7.4	9.5	10.6	10.4	11.1	11.9	13.2	13.9	6.48
P.											
[illegible] MFG CAR MOLDING	0.1	0.1	0.3	0.3	0.3	0.4	0.5	0.5	0.6	0.7	
TOTAL	0.1	0.1	0.3	0.3	0.3	0.4	0.5	0.5	0.6	0.7	
GRAND TOTAL	8.0	7.5	7.7	9.8	10.9	10.8	11.6	12.5	13.8	14.6	

GROWTH IN CONSUMPTION OF COMMODITY POLYMERS (1980-81 TO 1989-90)

TEXTILES

END USE POLYMER	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/ 80-81)
FIBRE/FILAMENTS	0.1	0.3	0.3	0.5	1.1	1.2	1.7	2.4	3.4	5.0	
[illegible]	0.1	0.3	0.3	0.5	1.1	1.2	1.7	2.4	3.4	5.0	54.55
GRAND TOTAL	0.1	0.3	0.3	0.5	1.1	1.2	1.7	2.4	3.4	5.0	54.55

GROWTH IN CONSUMPTION OF COMMODITY POLYMERS (1980-81 TO 1989-90)

CONSUMER ITEMS:

END USE POLYMER	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/ 80-81)
LD/LLDPE											
TOYS, PROTECTIVE WARE, ETC.	10.5	11.0	11.5	9.6	14.5	10.5	9.0	10.0	9.0	11.0	
INSPECIFIED FILMS & BAGS	13.5	13.5	14.2	12.8	15.8	16.5	10.0	10.0	9.0	10.5	
CARRIER BAGS	1.0	1.0	1.5	2.0	2.5	2.0	2.0	2.0	2.0	2.5	
HALF ROUND CABLE	1.8	2.0	2.5	3.0	2.5	2.5	2.0	2.0	2.0	2.5	
INJ.MOULDINGS	8.5	8.5	9.5	9.5	10.0	10.0	8.2	9.0	10.5	12.0	
TOTAL	35.3	36.0	39.2	36.8	45.3	42.5	32.7	35.0	34.5	42.0	1.95
HDPE											
INJ.MOULDINGS	19.0	17.0	22.5	22.0	22.0	25.0	26.0	26.0	26.0	28.0	
[illegible]	0.5	1.0	1.8	2.3	3.5	5.0	5.3	5.5	6.5	7.5	
TOTAL	19.5	18.0	24.3	24.3	25.5	30.0	31.3	31.5	32.5	35.5	6.88

END USE POLYMER	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/ 80-81)
											PP
SHEETS & PIPES	0.1	0.2	0.2	0.3	0.4	0.5	0.7	1.0	1.4	2.0	
STRAPPING CABLE & SEAL	0.3	0.5	0.5	0.9	1.1	1.3	1.4	1.6	1.8	2.0	
BO FILM	4.3	4.8	5.6	7.0	8.0	10.0	11.0	12.0	13.5	15.0	
TOTAL	4.7	5.5	6.3	8.2	9.4	11.8	13.1	14.6	16.7	19.0	16.93

GROWTH IN CONSUMPTION OF COMMODITY POLYMERS (1980-81 TO 1989-90)

CONSUMER ITEMS:

END USE POLYMER	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/ 80-81)
PVC											
CALENDERED SHEETS	6.5	6.0	6.0	6.5	7.0	8.0	10.5	14.0	17.0	18.5	
L/CLOTH SPREAD COATING	2.1	2.1	2.1	3.0	3.6	3.6	3.9	4.3	4.8	5.1	
FOOTWEAR	16.0	14.0	14.5	16.0	19.0	20.0	22.0	23.5	26.0	26.2	
OTHER (FLEX HOSE, SLSH MLDG.)	2.0	1.9	2.1	5.1	6.0	5.0	8.0	12.0	16.3	19.8	
TOTAL	26.6	24.0	24.7	30.6	35.6	36.6	44.4	53.8	64.1	69.6	11.28
PS											
REFRIGERATORS, A/C'S	1.5	2.0	3.0	3.8	3.0	3.8	4.4	5.0	5.7	6.0	
RADIO, TV, 2 IN 1, TAPE RECS	1.0	1.5	2.3	2.8	2.5	5.0	6.2	7.8	9.7	11.0	
CASETTES	3.0	3.0	5.0	6.0	6.5	7.5	8.8	10.3	12.0	13.0	
JOYSTICK, STAMPS, [illegible]	0.5	0.7	0.9	1.0	1.0	1.3	1.5	1.7	2.0	2.2	

[illegible] POLYMER	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/ 80-81)
[illegible]	0.2	0.2	0.3	0.4	0.4	0.5	0.7	1.0	1.4	2.0	
[illegible] HOUSEWARE [illegible] DEFENCE)	1.5	1.8	2.1	2.8	1.9	2.7	3.2	3.8	4.6	5.0	
[illegible]	8.2	9.8	14.2	17.6	16.1	21.9	26.2	31.2	37.1	41.2	19.65
[illegible] TOTAL	94.3	93.3	108.7	117.4	131.9	142.8	147.6	166.0	184.8	207.3	9.15

SPECIES OF CONSUMPTION OF COMMODITY POLYMERS (1980-81 TO 1989-90)

INDUSTRIAL APPLICATIONS:

[illegible]	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/ 80-81)
[illegible]											
[illegible]	8.0	8.0	9.0	10.5	11.5	11.5	10.0	11.0	10.0	11.0	
[illegible]	1.0	1.0	1.0	1.5	2.0	3.0	4.0	5.0	5.0	7.0	
[illegible] PRODUCTS	7.0	7.0	7.3	7.5	8.0	8.4	8.5	9.0	9.0	10.0	
[illegible]	3.0	3.0	3.8	4.0	4.0	4.1	4.3	4.5	4.8	5.5	
[illegible]	0.5	0.5	0.8	1.0	1.5	2.0	2.5	3.0	3.0	4.0	
[illegible]	0.5	0.5	1.0	1.3	1.3	2.5	1.5	2.0	2.2	2.3	
[illegible]	2.5	2.5	2.8	2.8	1.8	1.0	1.5	2.0	1.5	2.3	
[illegible]	22.5	22.5	25.6	28.5	30.0	32.5	32.3	36.5	35.5	42.0	7.18
[illegible]											
[illegible]	14.0	14.0	15.0	16.0	18.0	20.0	21.0	21.0	22.0	25.0	
[illegible]	1.2	1.6	1.8	1.0	1.0	0	0	0	0	0	
[illegible]	5.5	5.5	7.0	11.0	12.5	20.0	21.0	23.0	24.0	35.0	

[illegible] USE POLYMER	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARS (%) (89-90/ 80-81)
[illegible]											
PACKAGING	2.Ø	2.Ø	2.Ø	2.3	2.2	2.8	3.6	4.6	5.8	6.4	
STRUCTURAL FOAM	Ø	Ø	Ø	Ø	Ø	Ø.1	Ø.1	Ø.2	Ø.2	Ø.3	
TOTAL	2.Ø	2.Ø	2.Ø	2.3	2.2	2.9	3.7	4.7	6.Ø	6.7	14.23
GRAND TOTAL	75.6	76.7	88.1	1Ø1.1	112.6	131.9	141.9	156.7	169.2	2Ø3.1	11.61

ANNEXURE - VII

SECTORWISE CONSUMPTION OF SYNTHETIC RUBBER

	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90
TRANSPORT										
[illegible]	25050	28460	30801	33222	34981	35757	37461	40225	44407	51129
[illegible]	5389	6335	7050	7820	8120	9220	9620	9981	10012	7416
[illegible]	2072	2999	3237	3547	3954	4092	4180	4327	4153	4224
[illegible]	704	819	970	1022	1093	1128	1250	1325	1487	1527
TOTAL	34021	38613	40058	45611	48148	50197	52511	55858	60053	64296
INDUSTRIAL APPLICATIONS										
[illegible]	2829	2904	3179	3625	4378	5122	5250	5824	6212	5947
[illegible]	173	242	237	277	305	354	422	470	494	512
TOTAL	3002	3145	3416	3902	4683	5476	5672	6294	6706	6459
HOUSING & CONSTRUCTION:										
[illegible]	171	243	236	277	304	354	423	470	494	512

	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90
[illegible]										
[illegible]YEAR	5005	6121	6670	7140	7792	8695	8990	9498	12263	15340
[illegible] PRODUCTS	4848	4527	4870	5370	4473	5313	4189	4290	4628	4448
[illegible]	9853	10648	11540	12510	12265	14008	13173	13788	16891	19788

ANNEUXRE VIII

ENDUSE CONSUMPTION - THERMOPLASTICS

TONNE

	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/80-81)
[illegible] MILK	6.5	7.0	8.0	10.0	14.0	17.0	15.0	15.5	16.3	19.5
[illegible] ACTICS										
[illegible] OODS	5.5	5.5	6.5	7.0	7.3	8.0	7.5	8.0	8.0	10.0
[illegible] TISSUED FOOD	4.0	4.0	5.0	4.0	5.5	5.0	6.0	6.0	5.5	6.5
[illegible] BAGS										
[illegible] LAR.	.5	1.5	5.0	4.0	3.0	2.5	3.5	5.0	5.0	5.5
[illegible] ICS	6.0	8.0	9.0	10.5	11.5	11.5	10.0	11.0	10.0	11.0
[illegible] S	1.0	1.0	1.0	1.5	2.0	3.0	4.0	5.0	5.0	7.0
[illegible]	.0	7.0	7.3	7.5	8.0	8.4	8.5	9.0	9.0	10.0
[illegible] PRODS. [illegible] BAR- [illegible] S E T.	10.5	11.0	11.5	9.6	14.5	10.5	9.0	10.0	9.0	11.0
[illegible] [illegible] [illegible] BARS	13.5	13.5	14.2	12.0	15.0	16.5	10.0	10.0	9.0	10.5
[illegible] FISH [illegible] [illegible] ING	.5	0	0.5	0.7	1.0	2.0	2.0	2.5	2.8	3.0
[illegible]	.0	2.5	3.0	5.0	6.5	8.0	6.0	7.0	4.0	4.5

[illegible]	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/80-81)
[illegible]	6.5	6.5	8.0	10.0	10.5	12.0	12.0	15.0	18.0	20.0	
[illegible] BAGS	1.0	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.0	6.0	
[illegible] POLYBAGS	2.5	3.0	4.0	5.5	7.5	9.5	7.0	7.5	6.5	7.0	
[illegible] [illegible]S.	3.0	3.0	3.8	4.0	4.0	4.1	4.3	4.5	4.8	5.5	

LAND USE	80-81	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARC (%) (89-90/80-
[illegible]	1.0	1.0	2.0	2.5	2.5	5.0	3.0	4.0	4.3	4.5	
[illegible]	1.0	2.0	2.5	3.0	2.5	2.5	2.0	2.0	2.0	2.5	
[illegible]	8.5	8.5	9.5	9.5	10.0	10.0	8.2	9.0	10.5	12.0	
[illegible]	0	0.3	0.5	0.5	0.5	1.0	2.0	3.0	4.9	5.5	
[illegible]	5.0	5.0	5.5	5.5	3.5	2.0	3.0	4.0	3.0	4.5	
[illegible]	0.5	0.5	0.8	1.0	1.5	2.0	2.5	3.0	3.0	4.0	
[illegible]	91.3	94.8	100.0	116.0	131.0	143.5	129.0	145.0	144.6	170.0	7.15

	80-81		82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/80-8
[illegible]	11.0	11.0	14.0	22.0	27.0	40.0	42.0	46.0	48.0	70.0	
[illegible]	8.0	5.0	8.2	7.5	8.0	15.0	15.0	15.0	14.5	15.0	
[illegible]	1.0	2.0	3.5	4.5	7.0	10.0	10.5	11.0	13.0	15.0	
[illegible]	7.0	7.0	9.0	6.0	5.0	5.0	5.5	6.0	6.5	7.0	
EXTRUSION											
[illegible]	1.2	1.0	1.0	1.0	1.0	0	0	0	0	0	
[illegible]	19.0	17.0	22.5	22.0	22.0	25.0	26.0	26.0	26.0	28.0	
[illegible]	11.0	14.0	15.0	16.0	18.0	20.0	21.0	21.0	22.0	25.0	
[illegible]	41..	57.6	74.0	79.0	88.0	115.0	120.0	125.0	130.0	160.0	11.27

	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/80-8
[illegible]	[illegible]	9.5	11.3	14.0	15.9	20.0	22.0	24.0	27.0	30.0	
[illegible]	[illegible]	0.3	0.7	1.2	1.3	2.0	2.8	4.0	5.4	8.0	
[illegible]	[illegible]	1.0	1.1	1.5	1.5	1.0	2.0	3.8	7.6	15.0	
[illegible]	1.0	1.5	2.3	3.0	3.0	2.5	2.9	3.5	4.2	5.0	
[illegible]	0.1	0.2	0.2	0.3	0.4	0.5	0.7	1.0	1.4	2.0	
[illegible]	0.5	1.0	1.0	1.8	2.1	2.5	2.8	3.1	3.5	4.0	
[illegible]	7.0	8.0	9.0	10.5	10.5	10.0	12.0	14.0	16.0	20.0	
[illegible]	[illegible]	0.1	0.2	0.2	0.2	0.3	0.4	0.5	0.7	1.0	
[illegible]	[illegible]	0.3	0.3	0.5	1.1	1.2	1.7	2.4	3.4	5.0	
[illegible]	[illegible]	21.9	28.0	32.9	36.0	40.0	47.3	56.3	69.4	90.0	19.51

	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/80-81)
	39.4	36.1	36.5	46.5	61.5	65.0	70.6	76.5	85.2	96.5	
	2.0	2.3	2.5	4.0	4.8	5.0	6.0	8.0	9.0	9.6	
	4.7	4.8	4.9	5.2	7.0	8.0	9.0	10.0	11.0	11.5	
	0.5	0.7	1.0	2.0	2.0	2.0	3.5	4.5	5.5	6.4	
	0.5	0.5	1.0	1.2	2.5	3.0	4.0	5.5	6.5	7.0	
	1.0	2.5	2.5	2.5	3.2	2.0	2.0	2.0	2.0	2.0	
	50.0	46.9	48.4	61.4	80.0	85.0	95.1	106.5	119.2	133.0	11.48

	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/80-81)
[illegible]	22.0	26.0	27.0	28.0	32.0	35.0	38.0	41.0	44.5	45.5	
[illegible]	6.5	6.0	6.0	6.5	7.0	8.0	10.0	14.0	17.0	18.5	
[illegible] SPREAD COATING	7.0	7.0	7.0	10.0	12.0	12.0	13.0	14.2	16.0	17.0	
[illegible]	16.0	14.0	14.5	16.0	19.0	20.0	22.0	23.5	26.0	26.2	
[illegible] FLEX HOSE											
[illegible]	2.0	1.9	2.1	5.1	6.0	5.0	8.0	12.0	16.3	19.8	
[illegible]	58.5	54.9	56.6	65.6	76.0	80.0	91.5	104.7	119.8	127.0	8.99
[illegible]	103.5	101.8	105.0	127.0	156.0	165.0	186.6	211.2	239.0	260.0	10.20

	80-81	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/80-81)
[illegible]	1.5	2.0	3.0	3.8	3.0	3.8	4.4	5.0	5.7	6.0
[illegible] IN 1,[illegible]	1.0	1.5	2.3	2.8	2.5	5.0	6.2	7.8	9.7	11.0
[illegible]	2.0	3.0	5.0	6.0	6.5	7.5	8.8	10.3	12.0	13.0
[illegible]	2.0	2.0	2.0	2.3	2.2	2.8	3.6	4.6	5.8	6.4
[illegible]	0.5	0.7	0.9	1.0	1.0	1.3	1.5	1.7	2.0	2.2
[illegible]	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.7	0.8
[illegible]	0.3	0.4	0.5	0.6	0.6	0.9	1.0	1.1	1.1	1.2
[illegible]	[illegible]	0.2	0.[illegible]	0.1	0.1	0.5	0.7	1.0	1.4	2.0
[illegible]	0.1	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.5
[illegible]	[illegible]	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.1
[illegible]	[illegible]	0.2	0.5	0.6	0.6	0.8	0.9	1.1	1.2	1.3

	80-81	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	CARG (%) (89-90/80-81)
	0	0	0	0.1	0.1	0.1	0.3	0.4	0.4	0.5	
		1.8	2.1	2.8	1.9	2.7	3.2	3.8	4.6	5.0	
		12.4	17.2	21.0	19.6	26.0	31.5	37.7	45.0	50.0	
		288.5	331.2	375.9	433.6	489.5	514.4	575.2	628.0	730.0	10.82

ANNEUXRE IX

ENDUSE WISE CONSUMPTION OF SYNTHETIC RUBBER

	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90
AUTO TYRES & TUBES	25050	23460	28801	33222	34981	35757	37461	40225	44407	51129
CYCLE TYRES & TUBES	5395	6335	7050	7820	8120	9220	9620	9981	10012	7416
FOOTWEAR	5005	6121	6670	7140	7792	8695	8990	9498	12263	15340
BELTS & HOSES	2829	2904	3179	3625	4378	5122	5250	5824	6212	5947
CABLE JOINT	2872	2999	3237	3547	3954	4092	4180	4327	4153	4224
LATEX GOODS										
DIPPED										
SANITARY GOODS	701	819	970	1022	1093	1128	1250	1325	1487	1527
CABLE & WIRES	347	485	473	554	609	708	845	940	988	1024
OTHER PRODUCTS	4848	4527	4870	5370	4473	5313	4189	4290	4628	4448
TOTAL	47050	52650	55250	62300	65400	70035	71785	76410	84150	91853

ANNEXURE - 10

TRAINING AND EDUCATILONAL FACILITIES

SL. NO.	INSTITUTION/UNIVERSITY	DEGREE OFFERED
1.	Calcutta University	Offer a part of a paper as Polymer Science in M.Sc. Chemistry degree.
2.	I.I.T., Kharagpur	- do -
3.	Sardar Patel University Vallabha Vidyanagar	Post-graduate Course in Polymer Chemistry
4.	University of Rajasthan, Jaipur, Rajasthan	Post-graduate course in Polymer Chemistry
5.	Calicut University, Calicut	Post-graduate course in Polymer Chemistry.
6.	Jabalpur University, M.P.	Few chapters of Polymer Chemistry in M.Sc. course
7.	Punjab University,	Polymer Science & Engineering offered as an elective to final B.Sc. (Chem. Engg.) and Advanced Topics in Polymer Engg. offered M.Sc. (Chem.Engg.)
8.	Dibrugarh University, Assam	Part of a paper as Polymer Science in Physical Chemistry in M.Sc. degree.
9.	Kalyani University, West Bengal	Part of a paper as Polymer Science in Physical Chemistry in M.Sc. degree.
10.	Himachal Pradesh University, Shimla	Polymer Chemistry as part of specialization in M.Sc. (Organic Chemistry)
11.	Gorakhpur University	Special one Semester paper on Polymer Chemistry in M. Sc. (Final Semester).
12.	I.I.T. Bombay	Offers various subjects on Polymers in M.Sc.
13.	Madras University	M.Sc. in Polymer Chemistry.

POLYMER TECHNOLOGY/ENGINEERING

SL. NO.	INSTITUTION/UNIVERSITY	DEGREE OFFERED

TEXTILE INSTITUTES IN INDIA

1. A.C.College of Technology, Madras
2. College of Textile Technology, Hugli, W.B.
3. Govt. Institute of Textile Chemistry Technology, Ludhiana.
4. Govt. Polytechnic, Patna.
5. Indian Institute of Handloom Technology, Varanasi
6. Institute of Jute Technology, Calcutta.
7. PSG Polytechnic, Kanpur.
8. Govt. Central Textile Institute, Coimbatore.
9. Govt. Central Weaving Institute, Kanpur.
10. College of Textile Technology, W.B.
11. SS Marichettiar Institute of Textile Technology, Kumarapalayam, Tamil Nadu.
12. Faculty of Technology and Engineering, Baroda.
13. Govt. Central Textile Institute, Kanpur.
14. University of Bombay, Deptt. of Chemical Technology.
15. IIT, New Delhi, Textile Department.
16. Institute of Textile Technology, CPT, Madras-20.
17. PAC Ramaswamy Raja Polytechnic, Rajapalayam, Tamil Nadu
18. Punjab Institute of Textile Technology, Amritsar.
19. Thyagaraja Polytechnic, Salem
20. Govt. Shri Krishna Rajendra Silver Jubliee Technology Institute, Karnataka.
21. Sasmira Institute of Man-Made Textile, Bombay.
22. Weaver Service Centre, Varnasi
23. Victoria Jubliee Technical Institute, Bombay.
24. Industrial Training Institute, Jammu Kashmir
25. Technology Institute of Textile, Bhavani, Rajasthan.
26. Central Polytechnic, Trivandrum
27. Govt. Polytechnic, Cannanore, Kerala.
28. R.C.Technical Institute, Ahmedabad
29. Tari Bhavsionghai Polytechnic, Bavnagar, Gujarat.
30. Industrial Training Institute, Jammu Kashmir
31. Govt. Institute of Printing Dying and Hosury Technology, Ludhiana.
32. Govt. Institute of Garment Technology, Amritsar.
33. MG Technical Textile Institute, Bombay.
34. MBCH Govt. Polytechnic, Guntur, AP
35. National Institute of Design, Ahmedabad
