3.1 HISTORICAL BACKGROUND:
One cannot imagine a world without colour. Even the prehistoric man must have been so enchanted with the vibrant colours of the sky above, the oceans below and the fauna and flora around, spreading a shimmering array of colours that the first strain of music might have originated from his throat as a person in praise of colour! Since time immemorial, colour has been adding zest to life.

Even in the prehistoric times, the ancestors of man must have noticed the abandons of a multitude of colours worn by nature. With the growth of intelligence in man, he noticed most of the colours he found in nature. When man realized the use of cloth, he learnt to use different types of natural colouring matters to dye clothes prepared from different natural textile fibres such as Cotton, Linen, Wool, Silk, etc. Thus Indigo, Cutch, Logwood, Tyrian Purple and Henna were some of the natural dyestuff used for long for colouring fabrics. However, the method of extraction of these dyes from natural resources and their subsequent application to textile materials are lengthy, laborious and tiresome. Also, these dyes were very costly.

India has been credited with the discovery and use of indigo as it has been used in the textile industry for the last
several thousand years. The name indigo itself owes its origin to this country. Tyrian purple was extracted from two kinds of shell fish. No other dye has been at any time so highly priced as Tyrian Purple. In fact, it was considered to be the supreme emblem of royalty and so called Royal Purple. Among the naturally occurring dyes, the one obtained from madder was bright red shade and Purpurin. Alizarin produced red, pink, and brown. Logwood produced navy blue and black shades. It can be seen from the above history that before the advent of the synthetic organic dyes colours from naturally occurring substances have long been used on textiles. The use of indigo, Alizarine, Tyrian Purple were well-known.

It was the research in organic chemistry, especially in the reactions of aniline, conducted by the famous British chemist Williams Henry Perkin that led directly to the foundation of the modern synthetic dyestuff industry. In his attempts to seek a synthetic route to quinine, he discovered the purple dye mauveine accidentally in the year 1856. It was a moment of profound importance not only to the dyestuff industry but also to the technical progress of the world. Perkin’s synthesis and later commercialisation of Mauevine was followed by another basic dye Magenta in 1859 by a chemist named Vergune of Lyon, France. Oxidation of aniline in cotton fibers was carried out by Lightfoot in 1863 to get a cheap jet black on cotton. A large amount of cotton cloth is still dyed using this dye on umbrella cloth and is known as Aniline
Black. Graebe and Libermann in Germany and Perkin in England succeeded independently in manufacturing alizarine, the active ingredient of madder in 1869. Another landmark in the history of dyestuff is the discovery of Congo Red in 1884 by Bottiger. This dye could be directly used on cotton and was soluble in water but had poor washing fastness. In 1885, Meister Lucius Bruning prepared Para Red, a red pigment insoluble in water but with good washing fastness.

The discovery by Raymond Vidal, a French chemist in 1893, of a greenish black dye laid the foundation of sulphur dyes, which later included blue, green, yellow, brown and orange dyes. Tyrian Purple and Indigo has been in use from the ancient times and both these dyes produced washfast dyeing. It was in 1880 that Von Baeyer established the structure of indigo and was followed by the synthesis of a number of indigoid vat dyes. Rane Bohn prepared indanthrone and it was the first anthraquinoid vat dye and was followed by large number of vat dyes. In 1922, Brader and Sunder converted the vat dyes into the sodium salts of sulphuric esters of reduced vat dyes, which are converted into the original insoluble vat dyes in the fibre by treatment with an oxidizing agent under acidic conditions. These dyes are known as solubilised vat dyes. Around 1912, Frankfurt introduced the anilide of BON acid under the name Naphthol AS to produce azoic colours. Naphthol AS was followed by other similar colours. When cellulose acetate rayon was introduced at the end of the First World
War the then existing dyes could not be used on this fibre. Certain basic dyes were used in dyeing this fibre but had a very limited range of colours. This was followed by various dyes and finally Disperse dyes were found out for acetate rayon as well as for polyester and nylon fibres. Fluorescent brightening of textile was achieved for the first time by Krais in 1929. An announcement of great technical and commercial importance appeared in the journal of the Society of Dyers and Colourists under the column “Manufacturers Publication and Pattern cards”. This concerned a circular on Procion dyes describing colours belonging to a new class of dyes called “reactive” dyes, since the fixation to the fibre is achieved by direct chemical linkage. The introduction of these procion colours may be said to be an important landmark in the development of synthetic dyestuffs. This was made possible through the effort of Stephan and Rattee of ICI in 1956 who were then awarded the Gold Medal of the Society of Dyers and Colourists for the year 1960 for this outstanding achievement.

Although it was Perkin, who discovered the first synthetic organic dye in England, the subsequent developments were dominated not by England but by the European manufacturers. Germany, France and Switzerland followed in quick succession with the development of an array of colours. The American Dyestuff industry followed this, and by the end of the second world war, they were one of
the largest manufacturers of synthetic dyes.

The period from the 1930's until the seventies was one of development, growth, and stability, contributing to a number of other products developed in the chemical industry until the first oil price shock, shook the very foundation of this industry in the seventies. Today the Dyestuff manufacturing industry, which is capital and labour intensive by its very nature, being a batch process manufacturer, is at cross road in the developed economics.

3.2 GLOBAL PERSPECTIVE:
William Perkin, the inventor, was the first to set up a modest manufacturing facility at Greenford Green. Thus the firm of Perkin and Sons was founded in 1857. This brought a revolutionary change and heralded the synthetic dyes era. Soon the U K, France, Switzerland and Germany became the major producers and supplier of synthetic dyes to the world. Technologically advanced countries namely Germany, Switzerland, the U K, France, Italy, the U S A, Japan, the then USSR, Spain and a few East European countries are the main producers of dyes and their intermediate. It is worthwhile to note that the dyestuff units in these countries are large in size and are mainly in the organised sector. For example, although Germany is a major dye producing country, it has only four major units - BASF, Bayer, Hoechst, and Cassella, and they produce more than 1.25 lakh te of dyestuff per year. The international dyestuff market in early seventies and eighties
was dominated by multinationals from Europe and America. The Germans were the unchallenged pioneers and dominant key players in world Dyestuff market during this period.

In order to examine the future prospects of country's exports, it is necessary to quickly review the present scenario of the dyestuff manufacturers all over the world. For the reasons associated with their economies, many large companies have been dropping certain range of dyestuffs which are demanded in smaller quantities and have been concentrating in fewer number. With the exception of four major companies in the world, viz ICI, BASF, Ciba-geigy and Mitsui, all others have discontinued manufacturing the full range of vat dyes and their intermediates, thus creating the large gap in the demand supply in the world market. The developments in the US and Europe offer considerable opportunities for the dyestuff industry in India to capture the exports market in the big way. India should be in a position to push up its exports which have been on the rise. Export opportunities appear good for direct dyes, vat dyes, acid dyes, reactive dyes and organic pigments. Export demand for various dyes intermediates are also expected to be buoyant. In the recent past it has been observed that seven major American companies left the field of dyestuff manufacturing. These players were Allied corporation, Tenneco, Harshaw, American Cynamid, Otto B May, Buffallow and Dupont who stopped making dyes and sold out segments to different
firms. The share-out in the synthetic dyestuff industry has left dominant European manufacturers such as Crompton Knowles, American colour and Atlantic chemicals which presently operate in the dye market in the USA. The share of the production of world dyestuff by different countries is shown in Table 3.1 below.

<table>
<thead>
<tr>
<th>Country</th>
<th>Quantity('000Te)</th>
<th>% Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>220</td>
<td>22.0</td>
</tr>
<tr>
<td>USA</td>
<td>180</td>
<td>18.0</td>
</tr>
<tr>
<td>Russia</td>
<td>110</td>
<td>11.0</td>
</tr>
<tr>
<td>Japan</td>
<td>90</td>
<td>9.0</td>
</tr>
<tr>
<td>Switzerland</td>
<td>80</td>
<td>8.0</td>
</tr>
<tr>
<td>UK</td>
<td>80</td>
<td>8.0</td>
</tr>
<tr>
<td>France</td>
<td>60</td>
<td>6.0</td>
</tr>
<tr>
<td>India</td>
<td>100</td>
<td>10.0</td>
</tr>
<tr>
<td>Others</td>
<td>80</td>
<td>8.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1000</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Asian Textile Journal August 95.
While the European manufacturers still dominate the world markets, it appears that there is a lot of rationalisation of production, consequently creating a vacuum for certain group of dyestuff. After the disastrous conditions in 1980's, some twenty medium size companies have virtually shut down. The total EEC consumption of organic colorants moved up from 1.56 lakh MT valued at $ 2.62 billion in 1986 to 1.67 lakh MT valued at $ 1.75 billion. In 1986, there were 21 large-scale dyestuff manufacturers in the
USA their number has shrunk presently to 10 in all. There is a considerable reduction in the quantity of dyestuff produced in the USA. This is mainly due to strict pollution control measures adopted by the government to curb air and water pollution. However, the consumption in the textile sector of the USA has not reduced and, therefore the country has started importing large quantities of dyestuff and intermediates in order to bridge the gap. The world market of dyes in value is shown in Table 3.2.

<table>
<thead>
<tr>
<th>Dyestuff Class</th>
<th>Market Share billion US $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid/Mordant/Metalcomplex</td>
<td>1.04</td>
</tr>
<tr>
<td>Azoic</td>
<td>0.45</td>
</tr>
<tr>
<td>Basic</td>
<td>0.40</td>
</tr>
<tr>
<td>Directs</td>
<td>0.46</td>
</tr>
<tr>
<td>Disperse</td>
<td>1.70</td>
</tr>
<tr>
<td>Reactive</td>
<td>1.30</td>
</tr>
<tr>
<td>Sulphur</td>
<td>0.27</td>
</tr>
<tr>
<td>Vats</td>
<td>0.70</td>
</tr>
<tr>
<td>Indigo</td>
<td>0.16</td>
</tr>
<tr>
<td>Others</td>
<td>0.02</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>6.50</strong></td>
</tr>
</tbody>
</table>

Source: Asian Textile Journal August 95.

There was an aggregate growth in the global production of all fibres/filaments in the last decade. The share of cotton in the production all over the world has improved from 48% to 50% at the expense of cellulosics, which have dropped from 11% to 9%. The share of synthetics has remained steady at 36% and that of wool at 5%. The share of cellulose fibres and all fibre in respect of the expected world consumption of dyestuff is shown in Table 3.3.
Table 3.3 WORLD MARKET SHARE OF MAJOR DYECLASS

<table>
<thead>
<tr>
<th>Cellulosic Fibre</th>
<th>%</th>
<th>All Fibre</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulphur Dyes</td>
<td>29.0</td>
<td>Sulphur Dyes</td>
<td>18.0</td>
</tr>
<tr>
<td>Direct Dyes</td>
<td>27.4</td>
<td>Direct Dyes</td>
<td>17.0</td>
</tr>
<tr>
<td>Vat Dyes</td>
<td>19.4</td>
<td>Vat Dyes</td>
<td>12.0</td>
</tr>
<tr>
<td>Reactive Dyes</td>
<td>9.7</td>
<td>Reactive Dyes</td>
<td>6.0</td>
</tr>
<tr>
<td>Azoic Dyes</td>
<td>8.1</td>
<td>Azoic Dyes</td>
<td>6.0</td>
</tr>
<tr>
<td>Pigments Dyes</td>
<td>6.4</td>
<td>Pigments Dyes</td>
<td>4.0</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>Disperse Dyes</td>
<td>16.5</td>
</tr>
<tr>
<td>Acid Dyes</td>
<td></td>
<td>Acid Dyes</td>
<td>16.5</td>
</tr>
<tr>
<td>Basic Dyes</td>
<td></td>
<td>Basic Dyes</td>
<td>4.5</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>Total</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Economic Times 4 May 95

During the late eighties, however, there was the dawn of a new era and many other new entrants started making their presence felt in world scenario in dyestuff. The advanced countries had to yield the ground to the newly-developed and developing countries with regard to the dyestuff manufacturing activity due to the following two main factors. Firstly, dyes are manufactured by batch processes and it has a labour intensive character, and labour is becoming more and more expensive with the passage of time. Secondly, the problems concerning environment and pollution are becoming quite severe. The burden of enduring the increasingly stringent environment and pollution abatement measures and increasing labour costs have forced the developed countries to phase out of dye manufacturing activity, leaving the field open to developing countries. Thus there is a shift in the international market,
thereby providing opportunity to the developing and third world nations to grab the increased share of dyestuff business.

The various factors responsible for this expected scenario are as follows:

(1) Pricing pressure eroding profit margin: Many commodity items are offered at very competitive rates by developing countries. Multinationals who have to support high cost of operation requiring high profit margins, find it non-lucrative to fight for their market share of such products. Hence, this may result in a larger percentage share quantity for the third world nations.

(2) Cost of R&D and new product developing: The cost of developing a new product and its EPA registration is going up all the time and the hope of recovering R&D investment through monopoly selling is becoming difficult as the technology is quickly adopted/developed by others or the product is copied very soon, thereby denying the leverage to the original inventor.

(3) Opening of East European Market: The recent breakup of the USSR has led to major changes in the exports to socialist countries. One now has to deal with various agencies and a vast consumers market has also been thrown open. Western nations and others are trying to take their share of the cake. Western nations do have an upper hand as they are providing technical and financial aid and can expect better deal in return.

(4) Pollution and Effluent Problem: This has become the single biggest factor in restricting the growth of dyestuff
industry in developed nations. Tighter rules and regulations, strict laws, high standards for efficient treatment have forced these countries to look for better opportunities without sacrificing their interest.

(5) Batch process nature of industry: Dyestuff industry is labour intensive and the production consists of various batch operations. European and American multinationals have reduced interest in batch operation-based manufacturing due to the high labour cost involved.

3.3 INDIAN PERSPECTIVE:
India was one of the earliest countries in the world to use dyes from natural resources such as indigo, turmeric, madder and resin. It was the principle supplier of indigo to the textile industry. However, India was importing its entire requirement of synthetic dyes and auxiliaries for the textile industry before 1940. The presence of the well-developed textile industry was mainly responsible for the birth of the dyestuff industry in India. The need for the establishment of an indigenous dyestuff industry was realized during the early part of World War II, when the import of dyes practically ceased and the Indian textile industry had to face a famine with regard to dyes. It was then that the Associated Research Laboratories at Bhatgar near Pune (Now Arlabs Ltd), was established in 1941 to make a beginning in meeting India’s requirement of synthetic dyes by making azoic and vat dyes.

The first official setup to draw up a phased plan for the development of the industry was the Dyestuff Exploratory Committee (1941) appointed by the Board of Scientific
and Industrial Research. In order to make the country self-sufficient, the plan was framed in the initial stage in such a way that the growth would be horizontal, starting from the penultimate stage for making as many dyestuff as possible in almost all the chemical groups in the shortest possible time. But the process was delayed until the conditions of the post-war years eased up.

Although a beginning for the establishment of a full scale dyestuff unit in the country was made with the formation in 1947 of the Atul Ltd near Bulsar in Gujarat in technical collaboration with American Cynamid Inc of the USA, production of some Azoic dyes such as Congo red, Direct dyes and Sulfur black commenced only in late September 1952.

Around this time, Amar Dyechem Ltd started the manufacture of naphthol, bases and stabilized salts. Sometime in 1954, the Indian Dyestuff Industries Ltd began the manufacture of Vat dyes. In 1956, Atul Ltd joined hands with Imperial Chemicals Industries to set up ATIC for the manufacture of the Vat dyes and subsequently ICI transferred technology for manufacturing ‘Procion’, i.e reactive dyes. In 1957, Colourchem Ltd, came out with organic pigments, in collaboration with Bayer and Hoechst, subsequently to produce reactive dyes, disperse dyes etc. Around this time Suhried Geigy entered the field in technical collaboration with Geigy of Switzerland with mainly optical brightening agents, followed by acid dyes and pigments. Earlier National Chemical Industries, Delhi had commenced production of rapid dyes and in Mumbai Hickson Dadajee Pvt Ltd had commenced manufacture of the Sulfur black
and also came out with Magenta, a basic dyestuff.

Following Colorchem, Sudarshan Chemical Industries in Pune commenced production of pigment. Around 1961, Sandoz commenced production of acid dyes and subsequently disperse dyes. Chemiequip in Mumbai came onto the scene around 1968 with direct dyes, and went on subsequently to make reactive and disperse dyes. Universal Dyestuff Industries came out in Baroda with vat dyes. Then in 1973, came Jaysynth Dyechem with reactives and subsequently disperse dyes. Early in the eighties, Vinavil dyes was established in Tamil Nadu primarily to produce Napthols and fast bases. BASF entered this field in the middle of the eighties to produce acid dyes. Nirup Synchrome at Hyderabad and Colourtex at Surat came up to produce disperse dyes.

Several foreign dyestuff companies had played a decisive role in the development of the dyestuffs industry in India, particularly in respect of technical assistance, notably ICI Limited of the UK, ACNA of Italy, Ciba Limited of Switzerland, Bayer AG of West Germany, Farbwerke Hoechst of West Germany, BASF of West Germany and Sandoz of Switzerland.

To summarize the growth of dyestuff industry in India let us return to our discussion of the developments in India. This can be divided into three main phases 1950-1960, 1961-1970 and 1971 onwards.
The first phase (1950-60) was highlighted by the development of the industry based on imported peultimate intermediates. During this period, several large-scale as well as small-scale units were started for the manufacture of several group of dyestuff such as Azo, Azoic, Vat, Sulfur and pigments. The year 1956 marked a turning point for the industry because Napthols were produced from raw materials based in India and also vats for the first time. By the end of this phase, plans were afoot to start the manufacturing of intermediates. The growth rate during 1953-60 was 10.4%.

The second phase (1960-70) is marked by the overall growth of dyestuff industry i.e. with respect to growth in number the of units, in the number of items produced and in the amount of total production achieved. This phase also witnessed setting up of capacity for a large number of secondary and tertiary intermediates not only for dyestuff but also for pharmaceuticals, rubber chemicals etc. The manufacture of disperse dyes and reactive dyes also started during this period. The installed capacity of the industry in 1964 was 22980 tonnes comprising 11,170 tonnes in the organised sector and 11,810 tonnes in the small-scale sector. The total production was 11100 tonnes in 1965 and 12150 tonnes in 1966. The capacity of the organised sector in 1970 was 19,300 tonnes and production 13552 tonnes. The growth rate during 1961-70 was 11.8%.

The third phase, 1970 onward, saw the commencement of the production of basic organic intermediates by Hindustan Organics Chemical Ltd, Petrochemical Units like NOCIL, Herdillia and IPCL, which made their beginning in the
sixties and met the demand of certain dye intermediates such as Phenol, Phthalic Anhydride etc. The industry, therefore, grew by leaps and bounds in the eighties and meets almost all the country's dyestuff requirements presently. Also since 1978-79, the Government has been following a two-tier excise duty structure giving excise duty exemption to the units in the small-scale sector. As the result of this development the number of units in small-scale sector has increased remarkable from 100-150 to more than a 1000 over a period of more than a decade and a half. Excise duty concessions, lower overheads, the capacity to react to the changing demands and expertise to produce the limited items gave them an edge over large units. It is worth noting that the demand for most of the dyes and intermediates is dependent on the health of the textile industry. The changing production pattern in the latter has also led to a shift in the output pattern of individual categories of dyestuff. This is due to a large-scale dependence of the dyestuff industry on demand from the textile industry. Indeed it may be said that the slump in demand from the textile industry somewhere around the middle of the first half of eighties was the main factor responsible for the dismal working of the dyestuff units as well as for present colorful period. The general recession in the textile industry and the prolonged strike in the Mumbai Textile Mills in 1982-83 brought about despondency among the dyestuff manufacturers. The growth in the use of synthetic fibres among textiles, however, increased the demand for certain dyestuff like disperse dyes, acrylic dyes and optical whitening agents of special varieties.
Table 3.4 shows the wholesale price index numbers of all commodities vs dyestuff and its percentage change.

<table>
<thead>
<tr>
<th>Year</th>
<th>All commodities</th>
<th>% change</th>
<th>Dyestuff</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981-82</td>
<td>100.0</td>
<td>-</td>
<td>100.0</td>
<td>-</td>
</tr>
<tr>
<td>1982-83</td>
<td>104.9</td>
<td>4.9</td>
<td>100.6</td>
<td>0.7</td>
</tr>
<tr>
<td>1983-84</td>
<td>112.8</td>
<td>7.5</td>
<td>103.5</td>
<td>3.0</td>
</tr>
<tr>
<td>1984-85</td>
<td>120.1</td>
<td>6.5</td>
<td>108.7</td>
<td>5.0</td>
</tr>
<tr>
<td>1985-86</td>
<td>125.4</td>
<td>4.4</td>
<td>119.8</td>
<td>10.2</td>
</tr>
<tr>
<td>1986-87</td>
<td>132.7</td>
<td>5.8</td>
<td>128.7</td>
<td>7.4</td>
</tr>
<tr>
<td>1987-88</td>
<td>143.5</td>
<td>8.1</td>
<td>134.0</td>
<td>4.1</td>
</tr>
<tr>
<td>1988-89</td>
<td>154.3</td>
<td>7.5</td>
<td>138.5</td>
<td>3.4</td>
</tr>
<tr>
<td>1989-90</td>
<td>165.7</td>
<td>7.4</td>
<td>152.7</td>
<td>10.3</td>
</tr>
<tr>
<td>1990-91</td>
<td>182.7</td>
<td>10.3</td>
<td>161.1</td>
<td>5.5</td>
</tr>
<tr>
<td>1991-92</td>
<td>207.8</td>
<td>13.7</td>
<td>191.4</td>
<td>18.8</td>
</tr>
<tr>
<td>1992-93</td>
<td>228.7</td>
<td>10.1</td>
<td>218.1</td>
<td>13.9</td>
</tr>
<tr>
<td>1993-94</td>
<td>247.4</td>
<td>8.2</td>
<td>222.3</td>
<td>1.9</td>
</tr>
<tr>
<td>1994-95</td>
<td>274.5</td>
<td>11.0</td>
<td>230.7</td>
<td>3.8</td>
</tr>
<tr>
<td>1995-96</td>
<td>288.9</td>
<td>5.2</td>
<td>249.3</td>
<td>8.1</td>
</tr>
</tbody>
</table>

Source: Economic Times 4 May 95

From the data in Table 3.4 the two regression coefficient (bxy and byx) were calculated by using the Karlpearsons method. The values of bxy and byx were found to be 1.2 and 0.82 respectively. The value of correlation thus obtained is 0.99. This support the hypothesis that a strong correlation exists in the wholesale price index of all commodities and the wholesale price index of dyestuff. It
shows a very high or near perfect correlation between the wholesale price index of all commodities and the wholesale price index of dyestuff. The regression equation of wholesale price index of all commodities on the wholesale price index of dyestuff is \( Y = 15.39 + 0.82X \). This may help us in predicting the wholesale price index of dyestuff if the wholesale price index of all commodities is known.

The wholesale price index for the dyestuff recorded an average growth rate of about 6 per cent during the period 1982-83 to 1990-91 as compared to around 7 per cent by the all commodities index. The large-scale reliance of demand for dyestuff on the textile units has also contributed to this price scenario. It can be replaced gradually by a more broad-based demand pattern for the industry’s unhindered growth. Even as the long drawn-out strike in the textile mills brought to light the vulnerability of the working of the dyestuff industry’s working vis-a-vis the former, it also provided an opportunity for survival in the form of export efforts. The enforcement of the stringent pollution control measure in the developed countries, their higher labour and other cost of production and the declining value of rupee against the world currencies, all combined to provide excellent prospects for pushing up exports. In the process, problems on the raw-materials front constrained the industries, effort at higher production over exports. In fact, shortage and rising prices of some of the crucial inputs like nitric acid, nitrobenzene, oleum, Dimethyl sulphate etc have hampered the industry’s efforts.
to step up output and exports. In view of the upward trend in the demand for dyestuff from the consuming industries and the rising exports, the cost of production have to be controlled to make the domestic product competitive.

Dyestuff industry since a batch process is labour intensive and offers substantial employment opportunities. Currently, there are about 50000 skilled and unskilled persons employed in the industry. It also generates indirect employment in other sectors such as the chemical industry, the engineering industry, transport industry etc. The dyestuff manufacturers are mainly located in Gujarat and Maharashtra and the industry is highly fragmented with as many as a thousand small-scale units. Dyestuff manufacture on a small-scale is virtually non-existent in the developed countries. The total current production of dyestuff in the country may be put around 1,00,000 tpa indicating the share of small-scale units at 45% in the total output. The fixed capital invested in the dyestuff industry's organised sector is around Rs. 200 crore at historical cost. The production of dyestuff has increased at an annual average rate of 7 per cent during the last six years. There is a spurt in capacity utilization particularly noticeable after 1986-87, increasing from 60.3 per cent to 79.0 per cent in 1990-9. The increase in capacity utilization in 1987-88 is exclusively attributed to the export opportunities for dyes and intermediates. It is not fully justified to state that the opportunities of export dyes have arisen due to environmental problems in the west. There are still numerous world-scale plants running there. What has happened is the selective closure of plants producing
certain classes of dyestuff due to a combination of several factors including economic viability. In fact, in the developed countries the industry is gearing itself towards service industries or in the realm of supertechnology involving heavy automation. They are averse to entering into industries involving the handling of coloured substance and hazardous chemicals. This had given the necessary boost to the Indian dyestuff industry, which has a sound foundation of technology and a ready infrastructure of highly qualified technical manpower available at a very low cost. As the expanding exports and domestic demand for the various dyestuff is likely to be more durable one at this juncture, the industry should strive to hold their products, prices and offer quality products at a competitive price. The face of the Indian dyestuff industry is certainly changing for the better. Efforts to revitalize the textile industry are expected to boost the domestic demand for dyestuff. Coupled with the export boom, it becomes obligatory for the units to implement anti-pollution measures while official policies are geared to enable the industry to strive for efficient and pollution free dyestuff production.

3.4 ROLE OF SMALL-SCALE SECTOR (SSI):
As already mentioned, the SSI sector constitutes an important sector of the dyestuff industry. The future of the industry is closely linked to the healthy growth of the organised as well as SSI sector. The share of the SSI sector in the total dyestuff production in the country was 20 per
cent in 1975 which has increased to 25 per cent in 1985, around 35 per cent in 1990 and about 40 per cent currently. Additionally, the SSI sector contributes 50 per cent of the dyestuff exports, and the export outlook is considered to be the major incentive for the production by this sector. In view of the rising demand for dyestuff, the share of the small-scale sector in the production and export is expected to increase substantially in the coming year. Presently, there are over a thousand units engaged in the production of all type of dyes. As the small-scale sector went on growing, they captured both the domestic as well as foreign markets. But the tilt has been more in favour of the foreign markets. On the other hand, the units in the organised sector concentrate on the domestic markets. This explains why the share of small-scale sector in the total dyestuff exports is higher than its share in the total production. In the case of intermediates' exports, it accounts for nearly sixty per cent. The government encourages the small-scale sector as it is labour intensive. Since 1978-79, the government is following a two-tier excise duty structure giving excise duty exemption to the units in the small-scale sector. Various proposals are being made by the Dyestuff Manufacturer Association for increasing the exemption limits and reducing the excise duties. The marketing of the small units is routed through the export houses established by the units in the organised sector and the independent merchant exporters. Some units have their own export outlets. For their exports, the units get the benefits as per the government rules and regulations.

Low capacity, pollution, diseconomies of scale are some of the major problems faced by the small-scale sector of the dyestuff industry. The capacity utilization in the small-scale sector is very low due to the shortage of raw materials. But now it is learnt that the situation
has improved. This is mainly because the raw material manufacturing units like Hindustan Organic Chemicals have expanded their production capacities.

The rapid growth in the dyestuff manufacturing units in the small-scale sector has resulted in considerable amount of pollution. Due to lack of capital, all units cannot adopt high technology which can control pollution. At the same time, however, the government has proved to be faulty in its policies. With a view to encouraging the small-scale sector in the dyestuff industry, the Government reserved the manufacture of dyestuff like Pthalocyanine Blue, Dimethyl Sulphate, Napthols etc only for the small-scale units. But these dyestuff are hazardous to the workers and the environment. For want of sufficient funds, the small units cannot provide safe methods for producing such dyestuffs. To control the pollution, common treatment plants are being built. This has been done in Vapi under Gujarat Industrial Development Corporation (GIDC). Similarly common testing facilities are also constructed to facilitate quality control. This will help in the boosting of its exports by this sector.

To avoid further fragmentation in the small-scale sector and to ensure some economics of scale, the government should fix minimum economic scale of production. Presently, the average annual production of each unit in this small-scale sector is only around 30 te. Going by the present trends, one can easily foresee the major role which the small-scale sector will play in the coming
years.

Reliable data on the performance of the small-scale units is not available and is difficult to obtain. Most of these units have been producing and exporting Azo Dyes, Reactive Dyes and simple intermediates.

3.5 DYESTUFF CLASSIFICATION AND APPLICATION: The growth in the dyestuff industry has to be seen in the light of the growth of the end-user Industries viz textiles, paper, leather etc. Of all these end-user industries, the textile industry has been the one which has been consuming as much as 75-80 per cent of the output of the dyestuff industry. Therefore, it is understandable that the growth of the dyestuff industry necessarily depends on the growth of the textile industry and the dyes industry swings with the fortune or problems of the textile industry. The dyestuff range constitutes many types of dyes and normally these are grouped according to their application. A brief note on each class of Ready made dyes is outlined here.

Acid and Metal complex dyes: Acid dyes are considered ideal for dyeing and printing on wool, silk, polymide and regenerated protein fibres. Other important uses are in dyeing of leather, paper, ink and in preparation of paints. 1:2 metal complex dyes have been known to wool dyes since 1950. Their merits are high all-round fastness, simple application method conducive to preservation of wool quality, and high bath exhaustion.
Basic Dyes: These dyes represent an important class of dyes. The first synthetic dye, Mauve of Perkin, belongs to this group of dyes. Some of the oldest cotton dyes also belong to this group. For example, Magenta, Brilliant Green, Chrysodine, Bismark Brown, Auromine etc were dyes being used on wool and silk. These dyes have a wide use for the colouring man-made fibre like acrylic fibres, modacrylic fibre, modified nylon and polyester fiber etc. They are also used in colouring of paper and leather. Most of these class of dyes are reserved for the small-scale sector.

Direct Dyes: These dyes are an important category of dyes and are mainly used in cellulosic fibres. These dyes are used in the dyeing of cotton, rayon, jute, paper, etc. These are also used for application on leather, silk, nylon, union materials, bast fibres and for many other miscellaneous purposes. These dyes are soluble in water and are applied directly on cotton and therefore, dyes similar to these are called direct dyes. These dyes have poor washing fastness.

Disperse Dyes: When secondary acetate and triacetate rayons were developed, the new rayon yarn and fabric could not be dyed with the then existing dyes. For dyeing these fabrics, water insoluble dyes were found and finally ground and dispersed in water with the help of a suitable dispersing agent before dyeing. These are called acetate dyes or disperse dyes. Disperse dyes are mainly used for dyeing and printing of polyester fabrics. To a certain extent, these
are also used for dyeing of nylon and acrylic fibres. Disperse dyes comprise both azo and anthraquinone-based dyes.

Reactive dyes: The introduction of new types of dyes, the reactive dyes, in 1956 by ICI in England marked a new landmark in the development of synthetic organic dyestuff. Reactive dyes are an entirely novel class of colouring matter. They are now extremely popular owing to the fact that they are available in bright colours and can be mixed with each other without any difficulty. Reactive dyes find their application in the dyeing and printing of cellulosis fibres. The different class of reactive dyes are 'M' brand—highly reactive, 'H' brand less reactive, requiring more severe fixation condition, 'E' brand having moderate reactivity, 'H-E' brand especially developed for exhaust dyeing. Reactive dyes are classified as cynuric chloride based and vinyl sulphone-based dyes. A particular characteristic of the reactive dyes is that they react with the fibre and so have an excellent washing fastness.

Sulfur dyes: These dyes are used in the organised and handloom sector, and are well-known to dyers, and are in use over the years by them on jiggers, and standing bath without any problem. Sulfur dyes are insoluble in water and they have to be temporarily converted into a soluble form prior to application on cotton. In order to have affinity towards cotton and applied in that form, followed by conversion into the original insoluble form of the dye.
to give washfast dyeing.

Vat Dyes: These dyes are mostly derived from anthraquinone and have high all-round fastness properties. They can be broadly classified into two main subclasses, anthraquinone and indigoid vat dyes. Vat dyes are insoluble in water. When applying them on cellulosic fibres, it is necessary to convert them into soluble leuco state like sulphur dyes by means of sodium hydrosulphide in the presence of caustic soda. Vat dyes are available in all type of qualities like powderfine, powder, acracone and supradisperse and printing paste form.

Optical Brightners: These are a special class of white dyes which are similar to direct cotton dyes. They may as such be applied like direct dyes. These are colourless compounds having affinity to cotton. These have the property of florescence, by their nature, due to which they absorb ultra violet light and brighten the textile fibre. Therefore, these are called fluorescent brightening agents. Since this whitening has an optical effect, they are also called optical brightening agent or optical whitening agent. Earlier optical whiteners were developed mainly for cotton and other cellulosic fibre. Now special optical brighteners are available for synthetic fibre, plastic, detergents etc.

Ingrain dyes: As this class of dyes are formed inside the fibre substance, these are called ingrain dyes. The dyes belonging to this class are not ready-made dyes and are
found in the fibre substance by the dyers or printers in the textile mill or handloom sector from two components usually called napthols and base. The coloured substance formed from these components is insoluble in water. The pigment thus formed contains an azo group and hence, it is called an azoic pigment. During the formation of the pigments, diazotisation of base is used in which ice is required and, therefore, these pigments are also called ice colours. Amines, similar to anilines, such as para-phenylene diamine also produce good black shades. Since the final black shades are produced by oxidation, these are called oxidation colours. Some of the inorganic metal oxides are coloured and it is possible to form this oxide in the fibre substance by first treating the textile material with a water soluble salt of the metal followed by carrying out an appropriate chemical reaction Lorn buff, manganese brown, chrome yellow, chrome orange etc are some colours produced in this manner. These are called mineral colours.

3.6 MANUFACTURING PROCESS FOR DYES:
The manufacturing of dyes is broadly a four-tier process. The first stage involves the production of primary petrochemicals from naptha or natural gas. In the second stage, the primary petrochemicals are used to manufacture nitroaromatics. The third stage involves producing dye intermediates from the nitroaromatics. In the fourth stage, these dye intermediates are used to manufacture dyes.

The primary petrochemicals like benzene and toluene are
produced from either naptha or natural gas. Naptha is a derivative of petroleum. In the nineteenth century, petrochemicals were produced from coal-tar distillation and thus the dyes manufactured during that period were known as coal-tar dyes or aniline dyes. Now, the primary petrochemicals are solely derived from either naptha or natural gas.

The primary petrochemicals, benzene and toluene, are reacted with inorganic chemicals like nitric acid and sulphuric acid to form nitroaromatics. Nitroaromatics are not only used to manufacture dyes, but are also used for producing pharmaceuticals, rubber chemicals and pesticides. These nitroaromatics react with inorganic chemicals to form dye intermediates. These dye intermediates are used to manufacture various dyes. Dyes are manufactured from dyes intermediates through the batch process and the size of each ranges typically from 1.5 to 5 tonnes. The batch process is quite labour intensive and, therefore, India enjoys a cost advantage owing to cheap labour.

The main processes in the manufacture of dyes and intermediates are filtration and drying. The plant and equipment include reaction vessels, filter press, air compressor, vacuum pumps and spray dryers. All the equipment required for the manufacture of dyes is manufactured indigenously. The Indian dyestuffs industry has become competitive in the technology of dyes mainly because of collaborations with multinational companies like Hoechst, Bayer, Sandoz, ICI etc. The Indian dyestuff
industry has the capability to manufacture most of the
critical equipment like reaction kettles. Now, the
technology plays a key role in the manufacture of handful
of dyestuffs like vat dyes, disperse dyes, and pigments,
which are also capital intensive. These select dyes are
manufactured by the companies in the organized sector
only. The technology to manufacture azoic dyes, basic dyes,
reactive dyes and direct dyes is easily accessible. And as
a result small-scale sector units have a large presence in
these segments. Technology to manufacture dyes is easily
available and production is not that difficult. What is really
difficult is gaining market acceptance for dyes. It takes
time to be perceived as a reliable manufacture of quality
dyes. A few chinks still exist in the technology of dyes.
The dyes segment lags behind in filtration, drying, material
handling, automation, safety management and pollution
control.

The raw materials are extremely important in the dyestuffs
industry as they account for more than 50 per cent of the
cost of production. The raw materials for dyes are actually
dye intermediates. But the manufacturing chain of dyes
extends all the way back to petroleum and it is meaningless
to delve into dye intermediates alone. So the important
raw materials in each stage are as under.

In the first stage involving the manufacture of benzene and
toluene, naptha and natural gas are the important raw
materials. Naptha and natural gas are the basic feed-stocks
for the manufacture of petrochemicals. Benzene is generally manufactured using naptha which is available from twelve refineries owned by the public sector oil companies. The combined throughput capacity of these refineries is 52 million metric tonnes. Naptha is in short-supply in the country. Its price is controlled and is higher than the prevailing international prices. Imports are much cheaper, but the port facilities to import naptha are owned by the public sector oil companies. Several companies in the private sector like Mangalore Refineries Petroleum Ltd, Reliance Petroleum and Essar Oil are also setting up refineries. Thus, the supply of naptha will increase in the near future. As regards natural gas, it is made available by Gas Authority of India Ltd.

In the second stage, the important raw materials in the manufacture of nitroaromatics are benzene and toluene. Benzene is far more important a feed-stock than toluene.

In the third stage, the important raw materials in the manufacture of dye intermediates are nitroaromatics like aniline, acetanilide, nitrobenzene, nitrochlorobenzene and nitrotoluenes. Nitrotoluenes can be classified into ortho-nitrochloro-benzene (ONCB), para-nitrochloro-benzene (PNCB) and meta-nitrochloro-benzene (MNCB).

Another important group of raw materials used in the manufacture of dye intermediates are napthalene-based chemicals like Beta Naphthol. Beta Naphthol is used to produce dye intermediates like tobais acid and k acid. Beta
Naphthol is derived from napthalene which is produced from coal tar. Napthalene is also used to manufacture another dye intermediate called h acid. SAIL is the biggest supplier of napthalene in India. But, its supply is insufficient and it is being imported from countries like Russia, Egypt, Australia and Korea.

The important raw materials in the fourth stage involving the manufacture of dyes are dye intermediates. More than 600 types of dyes intermediates are used in the manufacture of dyes. The major dye intermediates include h acid, anthraquinone, metanilic acid, j acid and tobias acid. Most of the companies in the organized sector as well as the small-scale sector manufacture the dye intermediates. The prices of dye intermediates are driven to a large extent by the prices of nitroaromatics, the price of which in turn depends on the prices of benzene and toluene. Thus, any price increase for benzene and toluene sparks off an upward revision in all the subsequent products. The price rise in benzene and toluene led to an increase in the prices of nitroaromatics which, in turn, led to a rise in price of dye intermediates.

An important group of chemicals that is used in all the stages of the manufacture of dyes are the inorganic chemicals like sulphuric acid, nitric acid, oleum, caustic soda and hydrochloric acid. Most of the inorganic chemicals are freely available in India.
The structure of the dyestuffs industry is fragmented. There are 37 units in the organized sector and more than 1000 units in the small-scale sector. Most of these units are located mainly in Gujarat and Maharastra. The organized sector accounts for 70 per cent of the total dyestuff production and the small-scale sector for the rest.

The dominant presence of small-scale industrial (SSI) units is due to the introduction of excise duty concessions and reservation of certain dyes in the seventies. It is difficult to understand the rationale for encouraging the small-scale sector in this particular industry. The introduction of excise concessions to small-scale sector was due to political reasons. The government acted out of enthusiasm without considering the fact that these units had no resources to treat effluents.

The quality of dyes manufactured by the small-scale sector cannot be considered to be on par with that of the organized sector. They are able to sell only because of lower cost. India is a country where anything cheap would sell.

3.7 TECHNOLOGY STATUS:
While the Indian technology is not in any way lagging behind in ‘core’ production units like reaction kettles or their materials of construction, which have remained the same, and are not expected to change much anywhere in the world, a huge technology gap exist in some important areas like (1) Filteration, (2) Drying, (3) Materials handling, (4) Automation, (5) Risk analysis and hazard prediction, (6) Pollution Control etc. The equipment presently employed by the industry in these
areas is obsolete and inadequate.

The technology of dyestuffs manufacture varies widely from relatively simple, as in the case of direct Azo dyes, to extremely sophisticated for vat and disperse dyes. The manufacture of vat dyes starts from the basic organic chemicals and proceeds through lengthy and distinct stages which, in many cases, may run through ten or twelve intermediates. The dyestuffs and organic pigments produced currently in India meet nearly 95% of the domestic need from the point of view of hue/fastness. However, a gap certainly exists in the newer and the more economic dyestuffs of the same or of similar hue/fastness and the newer products are designed for economy, ease of application, higher fixation efficiency, fastness properties and superior colour yields.

In the sixties and the seventies Government was prudent enough to allow import of know-how of the dyestuff industry, from the advanced countries like the UK, Germany, Italy, Switzerland and the USA which factor was responsible to a large extent in the country achieving near self sufficiency in a short period of time. The dyestuff industry is now well-established and the technology already purchased has not only been well absorbed, but has been developed further by those units which have established their own R&D facilities. Therefore, for the expansion of the capacity for dyestuffs which are already being manufactured in India, no further import of technology is necessary.
There was newer dyes which have been developed in the West such as dyes for synthetic fibre, technically superior reactive dyes and pigments for specialised uses. The massive scale of investment made in research and development in western Europe and the USA for discovering new and improved dyes is beyond the resources of any entrepreneur in India. It was important that the Indian textile industry be not handicapped in its export efforts for want of such new and superior dyes which are already available to its competitors in the West. It is, therefore, permitted to import technology from abroad in the case of such new dyes. The advance of technology in the western countries is very rapid and, advantage should be taken wherever possible to import technology in the sophisticated and selected areas to achieve rapid economic progress. This will also afford Indian technical personnel an opportunity to work in the factories of foreign collaborators abroad and learn the latest techniques of efficient and economic operation. If a blanket ban is put on the flow of foreign technology and if we were to depend entirely on our R&D efforts, then it would take several years for us to catch up with the latest developments in the West. In the mean time we would have to depend on expensive imports.

Dyestuff technology in India is outdated. The result of poor quality technology is manifold, with deficiencies in the poor plant layout and low yield engineering efficiency, high energy inputs, hazardous processes, high solid and liquid wastes, harmful emissions, manual contact with chemicals worthless by-products, resulting in, poor end-product quality.
The DMAI Action Plan suggests the following innovations in product and process technology viz process technology, innovation, innovation in unit processes, product innovation in dyes, the modernisation of operations and the modernisation of unit operations.

For cutting the cost of production, the following suggestions are made in the areas of plant operations: (a) Use of one pot processes obviating the need for isolation of intermediates; (b) Replacement of solvents by water whenever possible; (c) Working in closed systems, ensuring the safety of workers from toxic fumes, dust, etc; (d) Conversion of batch processes into continuous one; (e) Introduction of mechanization to reduce manual contact and physical exertion; (f) Maximization of yield and optimization consumption norms in respect of raw materials and utilities by process improvements; (g) Deriving benefits from economies of scale by building bigger plants, using better processes etc; (h) Improving effluent disposal and waste recoveries; (i) Improving maintenance standards; (j) Upgrading manpower skills; (k) Introducing automation in material handling; (l) Improving the quality of products, and (m) Improving inventory control as a means to control interest costs.

Some of the steps suggested to control major hazards include the identification of situations with potential for major hazards, examining methods of elimination or control of hazardous situations, preparations of emergency plans etc. For combating pollution, it is suggested that we use
technologies which limit impact on environment, treat all waste to ensure minimum impact on environment, select product/process to ensure by-product recovery, check air pollution etc.

Some of the causes of pollution are lack of modernisation of waste recovery and source reduction pollutant, urging the small-scale units to take up primary treatment of their waste streams at least such as naturalization, solids removal, removal of colour etc.

3.8 VARIOUS REQUIREMENTS:
Requirements of Dyestuff industry can be broadly classified in to following headings:
Requirements of Intermediates: A large number of intermediates, the majority of which are cyclic in constitution, are required for the production of the dyestuffs. For the purpose of this, 244 cyclic intermediates have been identified. The total requirement of the 244 cyclic intermediates is estimated to be one lakh te/annum. Of this, most of the intermediates are produced indigenously and a few intermediates are at present imported.

With regard to the availability of the intermediates, adequate quantities are very important for the development of the dyestuff industry and, therefore integrated schemes involving manufacture of both intermediates and dyestuffs should be given preference over schemes based on the
manufacture of dyestuffs from penultimate intermediates. These would also result in a more economic utilization of scarce resources/infra-structure.

The shortages arising out of the sudden spurts in demand can, to some extent be mitigated by due flexibility of the interchangability of the total capacity. The demands for most products change with the time and this is particularly true for dyes, the use of which depends heavily on fashion trends. In the case of most dyestuff, the pattern of demand has changed drastically in the last fifteen years. The Government, therefore, have no objection in allowing the import of the all required raw materials irrespective of the raw materials which had been mentioned in the original application for the industrial license. This would help the requirement of the consuming industry and thus minimize the need for imports.

Requirements of Raw Materials: About 90-95% of the value of the raw materials required at present for the manufacture of dyestuffs and their intermediates are available indigenously. The requirement of imports varies from 5% to 10 % depending on the class of dyestuff produced. With the projected growth in the production of dyestuff the requirement of raw materials will increase proportionately and increasing gaps will emerge between the requirement of the industry and the indigenous availability.
No matter what steps are taken to increase the production of the raw materials, there are certain items such as mercury, iodine, and sulphur, the imports of which cannot be avoided as our natural resources for these raw materials are scarce. The best that can be done, therefore is to conserve these materials and utilize them in as economical a way as possible and also to recover them wherever such recovery is technically feasible.

**Requirement of Plant and Machinery:** In the initial stages of dyestuffs manufacture in this country, almost the entire requirement of plant and equipment was imported. Most of the commonly used plant and machinery required for the manufacture of dyestuffs is now available indigenously. These include mild steel, cast iron, stainless steel, lead-lined and rubber-lined reaction kettles and tanks, fibre-glass reinforced plastic vessels, low pressure autovalves, filter presses, rotary filters, centrifuges, clarifiers, different types of pumps, dryers, evaporators, grinders, mixers, fans and blowers of different capacities and materials of construction. Even the glass-lined equipment of small and medium size capable of limited duty is available. The plant and machinery for utilities such as boilers, water treatment, refrigeration and compressed air are also available indigenously. Currently, about 5% of the total requirement of plant and equipment needs to be imported. Glass-lined equipment is manufactured indigenously.

There is scope for the installation of facilities for
fabrication of the equipment currently imported and also for encouraging improvement in quality. Foreign collaborations are being allowed in order to achieve rapid self-sufficiency in respect of items currently imported and there are more manufacturers for each type of equipment and this ensures high quality.

Utilities Requirement: The requirement of utilities such as electricity, water and furnace oil for the production of dyestuffs increases with the increase in demand. One of the ways of minimizing the demand on the scarce energy resources is to undertake manufacturing operations on a large-scale. For example, if a particular dye is manufactured in a 5000 litres capacity reactor, it may require 10 HP power of agitation but if it is made in a 10000 litres capacity reactor, then it will hardly require 13 HP power for the same purpose. Thus, there will be savings in terms of power consumption by undertaking its manufacture on a large-scale. Government should encourage large-scale manufacturing operation wherever possible so that it will result in the saving of energy and also in terms of better productivity.

Manpower Requirement: Currently, there are about 50000 skilled and unskilled persons employees in the dyestuff industry. While dyestuff industry offers direct employment in the various manufacturing units, it generates indirect employment in other chemical industries from which it obtains its raw materials in the engineering industries,
ancilliary workshops which supply and maintain chemical plant and equipment, in transport and other trades. It is estimated that the dyestuffs industry creates jobs for six men indirectly for every single man employed directly.

3.9 OPTIMUM PLANT SIZE:
It is well known that in the West, there are only a few large companies that are involved in the manufacture of dyestuffs and production on a small-scale is virtually non-existent. In Germany, for example, there are four units producing more than 1,25,000 tepa. of dyestuffs and so is the case in the UK and other advanced countries. Production facilities of the order of 1,000 to 5,000 tepa. for a single class of dyes are not uncommon in the West as scale of manufacture is considered to be an important factor in cutting down the cost of production. On the other hand, in our country there was about 1000 units making a mere 45000 per year. Looking to the smaller scale of production of dyestuff, the number of units in our country is far too large and the cost of production is bound to be high as a result.

The determination of optimum plant size for the purpose of production for the sale of dyestuff in the domestic market is somewhat a mute exercise. As much as 50 to 60% of the cost of making dyestuffs in India is the cost of raw materials and the element of labour cost is low. Therefore, as long as production is carried out efficiently, the products made even in the smaller units can be sold in the domestic market in competition with larger units which usually have high
overheads. The scale of production, however, assumes importance as soon as we consider exports. Because of the cheapness and abundance of labour in our country, we need not go in for as large size units as in the West to compete in the international market. Nevertheless, taking into account the current high cost of plant and equipment including the treatment of effluent, the production of most dyestuffs in new plants on a scale smaller than 500 tepa. is unlikely to be economic in spite of our cheap labour. There is the need to strike a balance between social obligations on the one hand and economy of scale on the other in order to expand the quantum of exports and meet the international competition in a pragmatic manner.

A two-tier excise duty structure has been incorporated in the union budgets from 1978-79. The policy of selective exemption in excise duty to small-scale sector has not only put the organised sector at a competitive disadvantage resulting in poor capacity utilization, but has also caused an adverse impact on the national economy and the environment. Production capacities have been deliberately fragmented in order to remain within the exemption limit. This has created unnecessary duplication of assets resulting in the wastage of scarce resources which has directly affected the production of dyestuffs. Over the years, the organised sector, which has been struggling to remain competitive by reducing the cost of production through technology upgradation/modernisation even after incurring heavy expenditure on pollution control, safety measures and higher wages for organised labour, is finding it extremely difficult to perform to its optimum capacity in view of the vast difference in excise duty structure.
3.10 RESEARCH AND DEVELOPMENT:
The dyestuff and dyestuff intermediates industry has been gaining ground due to many important scientific discoveries. A large number of products outside the field of dyestuffs—e.g., synthetic fibres, rubber chemicals, pesticides, pharmaceuticals, explosives, plastics, polyurethanes, etc—are the fruits of research originally carried out in the laboratories of dyestuff manufacturers in the West.

Over the last few years, considerable progress has been made in the field of Research and Development in India and all the large-scale manufacturers now have well-established R and D laboratories manned by qualified technical personnel. The various national laboratories are also striving their best to develop technology that could be of use to entrepreneurs, particularly in the small and medium-scale sectors. A National Research Development Corporation has been established by the Government of India with the sole objective of making available the processes for chemical products developed in the various National Laboratories under the CSIR.

Most of the efforts in R and D in India have so far been directed toward development rather than research. Barring a few instances the R and D carried out in the Indian laboratories has been concerned mainly with process trouble-shooting, modification of existing processes to improve yields and quality, substitution of imported raw materials, and adoption of processes for new products
which have been developed in the Western countries using
as their base the information in the foreign scientific and patent literature
published abroad. There has been very little research done in India to
discover new dyes or new class of dyes. This observation is supported
by the fact that there are very few dyes, if any, which were developed
and manufactured in India for the first time before they were developed
anywhere else. It is in this area of new dyes that our R&D efforts need
to be directed with greater vigour.

Having absorbed the Western technology acquired through
purchased or development having reached a fairly high
level of technical competence in manufacture of dyestuffs, it should now
be our endeavour to improve upon the already existing knowledge so as
to atleast maintain parity with the Western manufacturer, if not to surge
ahead of them. And this can be only done by undertaking pure research
as distinct from development, no matter how expensive such pure research
is.

The Western countries which have been the large dyestuff
producers have been spending resources of the order of 5
to 10% on their turn-over annually on R&D and technology
upgradation over the years. The Indian dyestuffs should
aim for atleast between 5 to 10% of the turnover toward
R&D. As far as the expenditure on the basic research is
concerned, it would be a little difficult for small-scale
units to use funds for this. If we look at the profit of the
organised units, the net profits are in general range of 3
to 10% of the turnover. This indicates that even the healthy
organised units do not have the resources to spend 5 to
10% of their total turnover on research. This is where the industry has to look to the government for helping them mobilize their resources in view of the high mobility of technology in the sense that before a unit can take advantage of its own research, other units get to know of this technology and take advantage of it. This results in companies shying away from going to research institutions or even to do it on their own in their laboratories because of high mobility in people. So there should be some measures taken to help industry solve this problem and to ensure for them the advantage of research that they engage in.

3.11 GOVERNMENT POLICIES:
The chronology of change of excise duty structure since 1961-62 is shown in Table 3.5.

It can be seen that the two-tier excise duty structure has been incorporated in the union budget for 1978-79. The policy of selecting exemption in excise duty to the small-scale sector has not only put the organised sector at a competitive disadvantage resulting in poor capacity utilization but has also caused adverse impact on the national economy and environment. Production capacities have been deliberately fragmented in order to remain within the exemption limit. This has created unnecessary duplication of assets resulting in wastage of scarce resources. Moreover, failure to install equipments for pollution control and safety by the small-scale sector
Table 3.5  Excise Duty Rates for Synthetic Organic Dyestuffs

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<th>Year</th>
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</tr>
<tr>
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<td>1980-81</td>
<td>31.50%</td>
<td>NIL UPTO Rs. 5 LAKH SALES AND 23.625% UPTO Rs. 10 LACS SALES</td>
</tr>
<tr>
<td>1981-82</td>
<td>31.50%</td>
<td>NIL UPTO Rs. 7.5 LAKH SALES AND 23.625% UPTO Rs. 15 LAKH SALES</td>
</tr>
<tr>
<td>1982-86</td>
<td>31.50%</td>
<td>NIL UPTO Rs. 2.5 LAKH SALES AND 15.75% UPTO Rs. 15 LAKH SALES</td>
</tr>
<tr>
<td>1986-88</td>
<td>35.00%</td>
<td>NIL UPTO Rs. 15 LAKH SALES AND 25% UPTO Rs. 75 LAKH SALES</td>
</tr>
<tr>
<td>1988-89</td>
<td>36.75%</td>
<td>NIL UPTO Rs. 15 LAKH SALES AND 26.25% UPTO Rs. 75 LAKH SALES</td>
</tr>
<tr>
<td>1989-90</td>
<td>31.30%</td>
<td>NIL UPTO Rs. 15 LAKH SALES AND 21.00% UPTO Rs. 75 LAKH SALES</td>
</tr>
<tr>
<td>1990-91</td>
<td>31.50%</td>
<td>NIL UPTO Rs. 20 LAKH SALES AND 21.00% UPTO Rs. 75 LAKH SALES</td>
</tr>
<tr>
<td>1991-92</td>
<td>33.00%</td>
<td>NIL UPTO Rs. 20 LAKH SALES AND 22.00% UPTO Rs. 75 LAKH SALES</td>
</tr>
<tr>
<td>1992-93</td>
<td>34.50%</td>
<td>NIL UPTO Rs. 20 LAKH SALES AND 23.00% UPTO Rs. 75 LAKH SALES</td>
</tr>
<tr>
<td>1993-94</td>
<td>25.00%</td>
<td>NIL UPTO Rs. 30 LAKH SALES, 15.00 % ABOVE 30 LAKH UPTO Rs. 50 LAKH SALES</td>
</tr>
<tr>
<td>1994-95</td>
<td>20.00%</td>
<td>NIL UPTO Rs. 30 LAKH SALES, 10.00 % ABOVE 30 LAKH UPTO Rs. 50 LAKH SALES</td>
</tr>
<tr>
<td>Onward</td>
<td>20.00%</td>
<td>NIL UPTO Rs. 30 LAKH SALES, 10.00 % ABOVE 30 LAKH UPTO Rs. 50 LAKH SALES</td>
</tr>
</tbody>
</table>

Source: Perspective plan of the dyestuff industry, Economic Times 4 May 95 and Economic Times 6 April 96.

units has resulted in environmental pollution and poor working conditions for the labour, incurring substantial social costs.

Over the years the organised sector, which has been striving hard to remain competitive by reducing the cost of
production through technology upgradation/modernisation even after incurring heavy expenditure on pollution control, safety measures and higher wages for the organised labour, is finding it extremely difficult to do so in view of the vast difference in excise duty structure. There is an urgent need, therefore, to rationalize the excise duty to not more than 10% from the present level of 20% for the organised sector. The small-scale sector should be exempted from the payment of excise duty. This will also be in line with the government’s objective of promoting the small-scale sector.

The effect of high excise duty on dyestuffs is a large-scale avoidance/evasion of excise duty on dyestuffs. This has brought corruption at low levels and huge generation of black money. The exchequer does not receive its legitimate revenue from excise duty on dyestuffs. The collection improved in 1990-91 as compared to earlier years in spite of the fact that the basic rate of excise duty on dyestuffs was reduced from 35% to 30% in 1988-89, and further to 20% in 1992-93.

One of the most unfortunate outcomes of high excise duty on dyestuffs is the unprecedented disturbance it has caused in the normal working of the companies in the organised sector. The organised sector with its higher cost on employees’ welfare, environment protection, quality control and safety measure by far cannot compete with the non-duty paying sector. However, very high excise duty has
made even the best of the plants in the duty-paying sector, with better economy of scale and efficiency, totally uncompetitive against the non-duty paying sector. Incipient sickness and virtual stagnation have engulfed this once growing sector. A pursuit of growth has thus turned into a struggle for existence.

The performance of well-managed companies has been steadily declining since the imposition of very high excise duty on dyestuffs in 1978-79 on the one hand and an irrational excise duty structure for dyestuffs on the other. The ministry of finance should reduce excise duty on dyestuffs to a realistic level of 10% for sales above Rs. 50 lakh. For sales below Rs. 50 lakh, excise duty on dyestuffs should be kept at 5% for all manufacturers. Any excise duty above 10% will not fetch additional revenue to the exchequer except from a few companies. It may be pertinent to mention here that excise duty on dyestuff can be avoided/evaded rather easily.

If excise duty on dyestuff is brought down to a reasonable level of 10%, the exchequer will receive atleast 100% higher revenue after three years of reduction due to the following reasons. Firstly, the incentive to avoid/evade excise duty will vanish completely. Infact, entrepreneurs will be willing to pay a realistic excise duty. Secondly, capacity utilization will increase. Thirdly, with the developing countries withdrawing from the manufacture of dyestuffs, it is certainly possible for India to substantially increase its share in the international market. With a small
gesture from the Government by way of bringing down excise duty on dyestuffs to a reasonable level of 10%, the dyestuff industry of India can become one of the largest in the world. It is then certainly possible for India to increase its production of dyestuffs from the present 100,000 tpa to at least 2,00,000 tpa. Even if only 40% of the production is sold in the domestic market, the exchequer can expect to collect at least Rs. 150 crore from excise duty on dyestuffs. Lastly the collection from sales tax and income tax will increase.

As a custodian of the national economy, the dyestuff industry looks upon the ministry of finance to alleviate the excessive burden of excise duty and resuscitate the moribund state of the industry.

3.12 FINANCIAL PERFORMANCE:
With the demand from user industries such as textiles, paints, leather, paper and plastics picking up, dyestuffs industry in India is poised for further growth. Apart from the local demand, the industry has the potential of becoming a major exporter. Now that the Gulf war has come to an end, the shipping lines will be able to operate without hindrance. Further, in view of the declining output of the dyes, pigments and intermediates in America, Europe and Japan which had dominated the world market, India chipped in with its contribution.

During the year ended March 31, 1993, the sales of the
dyestuff manufacturing companies in the private sector
namely Arlabs was Rs.35.97 crore, Atul Products Ltd was
Rs.220.82 crore, Atic industries was Rs.110 crore,
Colourchem was Rs.185.49 crore, Indian dyestuff was
Rs.336.73 crore, Serene duestuff industries was Rs. 30.11
crore, Vinavil was Rs. 23.51 crore and Shurdashan
Chemicals was Rs.151.03 crore.

The transport strike of 1993 and the unscheduled shut
down of certain units for urgent repair contributed for the
poor preformance of IDI in the first half of 1993. The
sales achieved by them in 1994-95 was Rs. 356 crore.
Atul products Ltd, the highest net forex earner in the dye
industry achieved sales of Rs. 225 crore in the year 1994-95. Net sales income of these companies recorded an
annualised increase of 14.3%. Colour Chem would have
comeout with still brighter hues but for the loss of raw
materials and finished goods during the floods. The
company’s sales of reactive dyes showed a marked
improvement in the domestic market though the sales of
disperse dyes were adversely affected by heavy imports.
The company, however, was able to increase its net sales
by 11 %. Operating profit(before interest and depreciation)
of the seven companies for the year ended March 31 1995
rose by 25.4% on an annualised bases. Operating profit
over the period of three years, however spuited by 47%.

3.13 ENVIRONMENTAL AND SAFETY ASPECTS:
The dyestuff industry in our country is older than many
other branches of chemical industry and the popular conception is that it is not a very hazardous industry. But the impression is changing. In fact it is as hazardous as any other branch of chemical industry and more so with respect to certain toxic chemicals. The chief characteristics of the Indian dyestuff industry are (1) a large number of small and medium scale units, (2) a wide variety of chemicals and other ingredient being used, some of which are toxic, even carcinogenic, flammable and corrosive, (3) different type machinery, involving high speed pressure and temperature being employed and (4) compared, to other industries, this is more labour intensive.

The hazards in the dyestuff industry are greater and require attention not only because there are a large number of medium and small-scale units which do not have a formal setup, but also because of the wide variety of chemicals and ingredients used, some of which are toxic, even carcinogenic, flammable and corrosive. There are different types of machinery involving high speed, high pressure and high temperature because the dyes belong to so many varieties of organic compounds that there are various types of technologies and, therefore, there are very complex type of hazards. Moreover, compared to other industries, it is more labour intensive. Workmen in the industry to-date do manual operations and, therefore, there is much more of a possibility of accidents. As far as the statutory aspect is concerned, the safety is mainly governed by the Factory Act, and the 1948 version of the Factory Act was amended in 1987 considerably enlarging the responsibility of the
management. The onus of the responsibility has shifted from the factory managers to the occupiers. The occupier is now responsible for ensuring safety of the employees, for the safety of the plant and machinery, and for the safety of the community and the public in the neighbourhood.

The sources of pollution from the dyestuff industry are three in numbers viz gaseous emission, waste water and solid waste. Pollution from these three sources is abatable with the technology presently available. In spite of this, pollution still prevails due to Inadequate attention, lack of modernization of obsolete technology, unsafe practices/poor house-keeping, improper approach to treatment, risk assessment techniques/technical service under utilized inadequate infrastructural facilities, no common effluent treatment plants/incineration facilities and lack of properly designed landfalls. There is continuing pollution also because the risk assessment techniques and technical services in this area are under-utilized. This assessment is very easy to do, it is available in India. People think pollution control is expensive but it is not really so.

Another reason is inadequate infrastructural facilities and the absence of common effluent treatment plants. This is possible provided there is a little selectivity. Otherwise waste water and the solid waste can prove to be a great problem.
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