The word *chemical* is a substance which has some definite composition made of chemical element. Through molecular composition, identity as organic, inorganic or metallic is established. Elements of chemical or compositions are naturally occurring in raw form. Subsequent processes enable these naturally occurring compounds/elements into usable chemicals by use of chemical process steps (www.wikipedia.com). The chemicals industries came into existence since the time of industrial revolution. The industrial chemicals like sulfur and sodium carbonate are as old as mid 18th century. Chemical industries play a major role in adding value to raw materials by converting them into the various utility driven products.

2.1 Overview of Chemical Industry

Chemical industry is one of the key industries in contribution to the world economic output and employment. The industry has contributed around US$ 3.0 trillion in global value of sales in 2008. (Lohokare, 2010) employing over 20 million people over globe are connected to this industry (Sherwood, 1981) and ranks 12th in global production rating. Through a rough estimate over two million chemicals and compounds that exist in modern chemical industry as known products. Out of these estimated 80,000 chemicals contribute to a large portion of industry business. Chemical industry is 'the central industry of modern civilization' tending because of its control over materials due to its deep penetration in socio-economic structure. (Illigen, 1983) The industry provides products and services that improve the quality life of customers and communities. Product-lines of the chemical industry are used in every area of life such as food, clothing, housing, communication, transport as well as entertainment. (Exhibit-1) Thus, the business cycles of end user segments have significant effect on the chemical industry.
Chemical industry has important ways for its distinct industry position, (Ilegen; 1983)
(1) Product diversity (2) Concentration of industry (3) Infrastructure (4) Competition
(5) Low political visibility. Chemical industry is also identified as 'Industries Industry'
due to its positioning as major supplier to textiles, Dyes & chemicals,( bleaching
agents, synthetic fibers) , agriculture & food Fertilizers,( pesticides, food additives),
construction (Paints and resins), automobiles (Synthetic rubber, coatings, engineering
plastics) and health care (Pharmaceuticals). Chemical industry for serving these
sectors goes through rapid technological changes and innovation to support any of
these service industries.(Ilegen;1983)

2.2 Chemical Industry Segments
The chemical industry is generally categorized into the following three broad
segments.

Basic chemicals, also known as commodity chemicals, include organic and inorganic
chemicals, bulk petrochemicals, other chemical intermediates, plastic resins, synthetic rubber, man-made fibers, dyes and pigments, printing inks.

Specialty chemicals are low-volume but high-value compounds, and are also known as performance chemicals. These chemicals are derived from basic chemicals and are sold on the basis of their function. For example, paint, adhesives, electronic chemicals, water management chemicals, oilfield chemicals, flavors and fragrances, rubber processing additives, paper additives, industrial cleaners and fine chemicals. Sealants, coatings, catalysts also come under this category.

Knowledge Chemicals, low volume high value added chemicals include specialty agro-chemicals, drugs and pharmaceuticals, bio-chemicals especially derivatives based on services and application appropriateness.

The three segments of chemical industry highlight a distinct cost characteristic. Basic chemicals have high feedstock and other raw material costs, whereas Specialty chemicals have high sales value and product development costs. Knowledge chemicals segment, on the other hand is characterized by large spends on advertising and R&D. A basic chemical is the most mature segment with the marginal profitability, while Knowledge chemicals have the highest profitability and growth projections.

2.3 Trends in Global Chemical Industry
The chemical industry is a key contributor to the world economy. It is a knowledge-based industry with significant investments in R&D. In terms of consumption, the chemical industry is its own largest customer and accounts for approximately 33 per cent of the consumption. In most cases, Basic chemicals undergo several processing stages to be converted into downstream chemicals. These in turn are used for industrial applications, agriculture, or directly for consumer markets. Industrial and agricultural uses of chemicals include auxiliary materials such as adhesives, unprocessed plastics, dyes and fertilizers, while uses within the consumer sector include pharmaceuticals, cosmetics, household products, paints, etc.

Growth in revenues within the chemical industry depends largely on the overall
growth of the economy and industrial production, and is often measured as a multiple of GDP growth. Three key segments share in Chemical Industry is, (Exhibit-2)

**Global Chemical Industry Classification**

- Basic Chemicals, 47%
- Specialty Chemicals, 25%
- Knowledge Segment, 28%

Globally, the Basic segment has major share for about 47% followed by 28% for Knowledge chemicals growing fastest (six times faster than basic chemicals) and Specialty chemicals at 25%. Specialty chemicals have a growth rate faster than Basic chemicals, but lags behind the growth rate of Knowledge Chemical.

On the global scale Asia-pacific and Europe have the largest chemicals market contributing (Exhibit-3) to total of 69.34% with 34.84% and 34.50% consecutively. NAFTA countries (North American Free Trade Agreement) have 25.50% market size.
World chemical production growth is currently contributed by the chemical industry in developing countries. Growth in chemicals demand in developing countries is high, state laws are less stringent and skilled manpower for working in chemical industry is easily available. This has lead to substantial cross-border investment in the chemical sector and shift of sensitive chemical plants to Far East regions. Transnational corporations through cross border investment and production cater to the demand growth in developing countries. Trade between developing countries is also on the rise due to the increased production capacity in developing countries. A rapid shift of chemical industry is observed in favor of Asia and Latin America, largely due to availability of feedstock/raw materials, lower prices, availability of labor at marginal cost and importantly environment regulations are favorable for setting up of Chemical industry. (Chemical Industry Digest, 2005)

The economic transformation in the world in the last two decades has altered the landscape of the traditional chemical supply chain. Such alterations have also changed organizational boundaries of multinational firms and have pushed the frontier of information technology as a key enabler to this business process transformation. Chemical companies in the world are now merging their business processes, including their supply chain, with information technology to better manage unexpected events to reduce risks and to create a sustainable competitive advantage.
The planning process in the world chemical industry is becoming more and more interactive and demand-driven with additional information flowing into the planning systems directly from the customers, suppliers and service providers. Technology has been performing as key enabler in transforming the chemical companies to become more responsive and competitive without sacrificing costs.

Successful chemical firms are deploying an adaptive business network that gives them the ability to quickly sense and respond to changes in the extended supply chain. Chemical firms now require viable supply chain, with analytical capabilities to integrate across the enterprise and to close the loop between planning and execution. Some of the advantages of globalization, specific to segments, have been outlined below.

Basic chemicals: Globalization allows the Basic chemicals segment to hedge the impact of business cycles cost variables. Since cost structure widely varies across countries or regions.

Specialty chemicals: Globalization has also been driven by the increasing commoditization of Specialty chemicals, with customers focusing on reducing costs of Specialty chemicals that are used in large quantities. This has provided opportunities to companies in low cost locations like China, India, Brazil and South Korea to set-up global scale plants and to market these chemicals at lower costs globally.

Knowledge chemicals: Companies in this segment are setting up global scale plants to manufacture generics that can benefit from economies of scale to supply to global markets. There is also an increasing trend of migrating R&D centers to China, India to access low cost skilled manpower and cut down overall product development costs.

2.4 Global Initiatives
The concept of sustainable development is receiving a growing recognition in the chemical industry. In order to implement sustainable development, environmental and safety standards have been set for the chemical industry. The standards addresses the problems of users (both intermediate and end users), as also the production related
issues (consumption of energy and energy resources as raw materials). Some of the parameters that are being addressed by the chemical industry include:

- Use of scientific environment monitoring systems.
- Development of waste minimization (be it energy or energy resources as raw materials) systems in a consistent manner, with the objective of integrating environmental protection considerations into products and processes, as early as possible.
- Enhancing systems for plant and product safety and improving the efficiency of waste disposal systems. Supporting education and research on the health, safety and environmental issues on chemical processes and products.
- Creating a policy for usage of economically and environmentally optimized materials and energy use with a thrust on sound attitude towards usage of scarce resources.
- Appropriate provision for reuse or recycling of used substances and products.
- Since the reservoir of energy resources is finite, their proper management is a crucial pillar of sustainable development.
- Promote co-operation with governments and organizations in the development and implementation of effective regulations and standards.

2.5 Trends in Indian Chemical Industry

Indian Chemical industry (ICI) is one of the oldest industries that contributes significantly to the industrial and economic growth of India. It is estimated that the size of the Indian chemical industry is around US$ 60 billion. Volume of production by chemical industry positions India as third largest producer in Asia (next to China and Japan) and twelfth largest in the world. Chemical industry contributes to 7 per cent of India’s GDP and 12.5 per cent of Indian Industrial production. The characteristics of Indian Chemical Industry are given below.

- The industry segments are highly heterogeneous in their characteristics. They are Fragment and widely dispersed in nature.
- Western India contributes to 49% of ICI production
- ICI is also having sizable presence of multinational organizations.
- High domestic demand and potential for market development
- Low per capita consumption levels as compared to global standards.
• High degree of fragmentation and small scale of operations
• Limited emphasis on exports due to domestic market focus and smaller scale operations
• Low cost competitiveness as compared to other countries due to high cost of feedstock
• High cost of Power, taxation structure and cost of capital influences ICI
• Low focus on R&D as compared to global technological developments

Indian Chemical Industry segments and their market shares are given below.

<table>
<thead>
<tr>
<th>Segment</th>
<th>Market Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrochemicals</td>
<td>22%</td>
</tr>
<tr>
<td>Agrochemicals</td>
<td>3%</td>
</tr>
<tr>
<td>Pharmaceuticals</td>
<td>15%</td>
</tr>
<tr>
<td>Organic chemicals</td>
<td>15%</td>
</tr>
<tr>
<td>Inorganic chemicals</td>
<td>8%</td>
</tr>
<tr>
<td>Soaps and detergents</td>
<td>11%</td>
</tr>
<tr>
<td>Fertilizers</td>
<td>18%</td>
</tr>
<tr>
<td>Dyes &amp; Paints</td>
<td>5%</td>
</tr>
<tr>
<td>Others</td>
<td>3%</td>
</tr>
</tbody>
</table>

[Table- 2.1: Market Share of Indian Chemical Industry segments]

ICI contributes to 18 per cent of industrial revenue by way of various taxes and levies. The industry, comprising of small scale and large units (including MNCs). The chemical industry by itself is a significant user of (around one-third) its own production. Indian Chemical Industry (ICI) represents to a just 2% of global investment. ICI has 40,000 units widely spread in both, large and small-scale sectors. The Indian chemical industry (ICI) accounts for around 10% in total exports of the country. India is also an importer of chemicals; however, the chemical trade balance is positive. Total exports from India during 2008-09 and 2009-10 were 185.295 billion US$ and 176.575 billion US$ respectively. Export of chemicals and related products were 24.066 billion US $ in 2008 - 09 amounting to 13.63% of the total exports. Total imports during 2008-09 were 303.696 billion US $. Of this, Chemical
sector imports were 28.19 billion USD amounting to 9.28% with a positive chemical trade balance of 4.35%. (Exhibit-4)

[Exhibit-4: Performance of Indian Chemical Industry on Import-Export Trade]

The basic chemicals and chemical products industry has grown greater than the growth in manufacturing sector as also the general industrial production. The data on Index of Industrial Production (IIP) compiled by Central Statistical Organization shows that the IIP (1993-94=100) for basic chemicals and chemical products has increased to 258.5 in 2005-06 as compared to the index of 234.2 for the manufacturing sector and 221.5 for general index, in the same year.

**Statewise Indian Chemical Industry Manufacturing**

[Exhibit-5: Statewise share of Chemicals production in India]
ICI growth is projected to reach 100 million US $ by 2015. Gujarat State shares the largest investment reaching to 49-50% of total industry investment and has emerged as one of favorable hub for investment. (Exhibit-5)

2.6 Government Initiatives and Policies to Support ICI
The Government has been announcing a number of measures to improve the competitiveness of the Indian chemical industry (ICI). These includes, abolition of industrial licensing to most of the chemical sub-sectors, excepting a small list of hazardous chemicals. Approval is being granted for FDI up to 100 percent in the chemical sector. The Government is also continuously reducing the list of reserved chemical items for production in the small scale sector, thereby facilitating greater investment in technology up gradation and modernization. Now, there are only around 25 chemical items reserved for production in small-scale sector.

The Government has initiated policies for setting up of integrated Petroleum, Chemicals and Petrochemicals Investment Regions (PCPIR). Such an initiative is likely to attract major investment, both domestic and foreign, into the regions, which would have enabling infrastructure that would provide conducive and competitive environment for setting up of manufacturing units.

ICI market due to favorable policy and focus shift has recorded 16.7% compounded growth in 2004-2008 as per Deloitte records. (Pg 40, Chemical Industry Digest, 2010) is next to China the fastest growing market.

Drivers for growth are lower cost of raw materials, Quality of working talents, substantial increase of domestic markets, governments for favorable policies, improved infrastructural facilities.

2.7 Strategic Direction of ICI
Drivers for growth are identified as:
- Competitive cost of raw materials
- Quality of working talents and pool of workmen direct/indirect employment of chemical industry
• Substantial increase of domestic markets and sustained demand
• Governments for favorable policies
• Improved infrastructural facilities and IT enabled services
• Convenient geographical location
• Domestic growth of process/product technological development
• Quality accredited product and services in competitive markets

Indian companies have successfully created global presence in terms of size and being part of competitive player in market. This could be achieved through sizable acquisitions, R & D alliances, Technology transfers, and surge in patenting, product and process development efforts. There has been expected accelerated growth in specialty chemicals, pharmaceuticals, paints and specialized coatings, specific need agrochemicals.