

EXPORT-IMPORT BANK OF INDIA

OCCASIONAL PAPER NO. 117

**INDIAN CHEMICAL INDUSTRY:
A SECTOR STUDY**

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EXECUTIVE SUMMARY

INTRODUCTION

This study focusses on chemical sub-segments such as:

- ❖ *Basic Chemicals* also known as commodity chemicals, including organic and inorganic chemicals, bulk petrochemicals, other chemical intermediates, plastic resins, synthetic rubber, man-made fibers, dyes and pigments, printing inks;
- ❖ *Specialty chemicals*, also known as performance chemicals, are low-volume but high-value compounds. 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;
- ❖ *Agricultural chemicals* especially crop protection chemicals such as pesticides.

The study excludes drugs and pharmaceuticals, and fertilizers, as they are large in size to have a separate industry status and are appropriately positioned for exclusive studies, individually.

GLOBAL SCENARIO

Global chemical production is growing and the growth is contributed by the chemical industry of developing countries. Growth in demand for chemicals in developing countries is high leading to substantial cross-border investment in the chemical sector. Global sales of chemicals in the year 2005 were estimated to be around US\$ 1.75 trillion. USA is the single largest country with a share of 22% (US\$ 380 billion) in world chemical sales, followed by Japan (10% - US\$ 194 billion), China (9% - US\$ 163 billion), Germany (7% - US\$ 122 billion) and France (5% - US\$ 90 billion). In terms of regions, Asia-Pacific tops the list with a share of 35% in global sales followed by Europe (34%), NAFTA (25%) and Latin America (4%).

World export of chemicals is estimated to be US\$ 832 billion in

2005. The share of chemicals in world merchandise trade and global trade of manufactures is estimated to be 11% and 15% respectively, in 2005. The growth in world chemicals trade has averaged out to around 12% during the period 2000-2005. Leading chemical exporters are Germany (11% - US\$ 95 billion), USA (11% - US\$ 94 billion), France (6% - US\$ 51 billion), Japan (6% - US\$ 49 billion), and China (4% - US\$ 32 billion).

The joint framework agreement for tariff harmonization in the Uruguay Round (Chemical Tariff Harmonisation Agreement), has led to a substantial reduction in tariffs in the signatory countries. However, in many countries reduction in tariff has been substituted by increase in non-tariff barriers. Dumping of chemicals and anti-dumping actions by countries have become part of the game plan of many firms / countries.

Globalisation of chemical industry has led to national markets being supplied from an increasing number of locations, while individual companies have increased the geographic scope of their operations. Chemical companies in the world are now merging their business processes, including their supply chain, to reduce risks and to create sustainable competitive advantage.

The global chemical industry is continuously working towards reduction of environmental impact

of its activities. The industry is committed to contribute to the sustainable development of the society as a whole, through its 'Responsible Care Initiative', and has developed systems for improving the health, safety and environmental performance of its products and processes.

CHEMICAL INDUSTRY IN INDIA

Chemical industry is one of the oldest industries in India. It is estimated that the size of Indian chemical industry is around US\$ 30 billion. Volume of production in chemical industry positions India as third largest producer in Asia (next to China and Japan), and twelfth largest in the world. The industry, comprising both small-scale and large units (including MNCs) produces several thousands of products and bi-products, ranging from plastics and petro-chemicals to cosmetics and toiletries. A significant share (around one-third) of production by chemical industry is consumed by itself. The chemical industry accounts for about 13% share in the manufacturing output and around 5% in total exports of the country. The chemical industry contributes around 20% of national revenue by way of various taxes and levies.

The chemical industry produced around 8 million metric tonnes each of basic chemicals and basic petrochemicals, and around

10 million metric tonnes of petrochemical intermediaries in 2005-06.

Gujarat is the major contributor to the basic chemical as well as petrochemical production with 54% and 59% share in all India production, respectively. Other major states producing basic chemicals include Maharashtra (9%), Tamil Nadu and Uttar Pradesh (6% each). Other major states producing petrochemicals include Maharashtra (18%), West Bengal (12%), Uttar Pradesh (4%), and Tamil Nadu (3%).

India's export of basic chemicals amounted to over US\$ 7 billion in 2005-06. India exported US\$ 4.85 billion worth of organic chemicals, US\$ 775 million worth of inorganic chemicals, US\$ 847 million worth of tanning and colouring materials, and US\$ 649 million worth of pesticides, in the year 2005-06. In addition, India exported petrochemicals valued nearly US\$ 4 billion. India is also an importer of basic chemicals and the import value amounted to over US\$ 8 billion in 2005-06. The composition of India's chemical imports includes organic chemicals (63%), inorganic chemicals (28%), dyes (6%) and pesticides (3%). China, USA and Saudi Arabia are the leading source countries for India's chemical imports. In addition, India imported petrochemicals valued over US\$ 2 billion.

The Indian chemical industry has been receiving significant investment intentions, including foreign direct investment (FDI). Since August 1991, and till November 2006, chemical industry has received investment proposals worth Rs.274486 crores, a share of 11.3% in total investment proposals received during this period. FDI, which is very essential for modern manufacturing of chemicals, has also been flowing into the chemical sector significantly. During the period August 1991 to October 2006, FDI inflows into the chemicals sector amounted to US\$ 2.2 billion, a share of around 6% in total FDI inflows into the country.

ANALYSIS OF CHEMICAL IMPORTS BY MAJOR COUNTRIES AND INDIA'S EXPORTS

Analysis has been carried out to identify highly traded chemicals, based on the import data of world chemicals at SITC classification 4-digit level. The analysis revealed that in the year 2005, major chemicals traded in the world include Cyclical hydrocarbons (SITC Code 5112), Polyethylene (5711), Polycarbonates (5743), Propylene polymers (5751), Monocarboxylic acids and derivatives (5137), Acrylic hydrocarbons (5111), Acrylic monohydric alcohol (5121), Polycarboxylic acids (5138), Albuminoidal substances (5922),

and Ether and alcohol peroxide (5161). Analyses have been carried out in these product groups to know about the major importers of each product groups, their source countries for imports, as also India's exports and major export markets.

The analyses revealed that EU, USA and Japan are the leading importing regions / countries for these analysed product groups. These countries have been mostly sourcing their import requirements within the region. Since many countries in the EU are shifting their production base to other developing countries, India may endeavor to attract such manufacturing opportunities and explore possibilities of increasing its exports to European countries. The analyses further revealed that in some product groups, India has been one of the major suppliers to the world. These include insecticides (second major supplier with 13% share), hydrocarbons derivatives (ranked second with 13% share), cyclic alcohol derivatives (ranked third with 12% share), synthetic organic dyestuffs (ranked fourth with 6% share), synthetic brighteners (ranked fifth with 6% share), cyclic hydrocarbons, and fluorides (both ranked ninth with 3% and 2% share, respectively). India may leverage the advancement in manufacturing technologies in these product groups to replicate in the production of other products, and become a global player, across the segments.

CHALLENGES

Indian chemical sector has grown a long way since its early days of independence. The sector has grown from a small-scale sector to multi-dimensional sector, which is taking on the challenges of globalization. Now, Indian chemical industry holds a recognized position in the global map; however, there are few factors, which hinders the growth of the industry. These include:

High prices of basic feed stock

Basic raw materials constitute major portion of cost of production (30% to 60%) in the chemical industry. Indian chemical industry either uses natural gas or crude oil as feedstock for manufacturing process. The fluctuations in oil prices therefore affect the growth projections of the firms.

SSI reservation / Fragmented nature of industry

The Indian chemical industry is having a fragmented structure with more number of units in small-scale sectors spread in various parts of the country. The installed capacities in most of the small-scale units are smaller as compared to global scales. The limitation in capacity in the SSI sector put them in disadvantageous position while tapping export opportunities with large volume.

Low R&D levels

The level of R&D investments in the Indian chemical sector is low at around 0.3% of total sales. The areas for strengthening of R&D in chemical industry include improvements in manufacturing process for reduction in cost of production, application development to diversify demand, and new product development.

Low Level of ICT interface

The usage of information technology in Indian chemical industry is relatively lower, as most of the units are in the small-scale sector. Application of information technology in the chemical sector is required for equipment design, chemical engineering, and process simulation that have helped in reducing product and process development time. Information technology should also be increasingly used in the area of R&D, especially in collaborative research.

Low Level of Brand Development

Indian chemical producers, excepting a few large producers, generally sell their products as generic products without brand development. There is also low level of interest amongst small-scale producers for brand development, product development as also market development.

Low Level of Common Infrastructure

In general, due to its very nature, the chemical / petrochemical industry requires certain basic infrastructure facilities, both in the process chain as also in the supply chain. At present, each unit has to create specialized facilities on its own which leads to duplication of efforts and investment. If chemical units are clustered in close proximity, the required infrastructure could be vertically integrated resulting in cost reduction.

Environmental Regulations

As with other industries, the chemical industry needs to comply with regulations such as Occupational Safety and Health and Process Safety Management regulations. Environmental safety, occupational safety and process management safety can easily be met if a firm is manufacturing large volume of single chemical. But it may not be relatively feasible for the firms who manufacture low volume and large number of chemicals in a single plant.

Dumping / Import Competition

Chemical industry is the second largest industry that has attracted large number of anti-dumping actions in the world. In India, chemicals and petrochemicals industry is the largest segment that

has initiated anti-dumping investigations during the period 1992-2005. 82 anti-dumping cases (out of 188 cases) initiated by India fall under the category of chemicals and petro-chemicals, during this period.

STRATEGIES

Focus on Core Competence

Chemical products trade is increasingly getting specialised all over the world. Innovation is increasingly becoming an important factor to focus on core competence and to become a leading player in specialty products. In the above context, it is important for the Indian chemical manufacturers to focus on select business segments where competitive advantage exists.

Strengthening Technological Competence

Indian chemical industry should strive for continually improving its production processes and products by investing resources in technology development. Technological development may be achieved by the chemical industry at two levels. In the bulk products segment, the chemical industry should undertake process innovation with the objective of reduction in cost of production. In addition, the industry needs to invest in technological resources

that would lead to specialized product development.

Improving Basic Management Capabilities

Indian chemical industry has a good record of management expertise. This could be further leveraged with techniques such as Good Manufacturing Practices, Good Laboratory Practices, Total Quality Management, Total Production Management and Risk Management.

Adhering to Environmental Norms

Since chemical substances are used in manufacture of consumer items such as paint, glue, insect spray, cosmetics and household cleaners, chemical producers have the responsibility in promoting safe management of substances – starting from design in production to end-use, and their final disposal (hazardous waste). Further, in order to garner a greater share in world chemicals market, Indian chemical industry needs to address various developmental issues such as sustainable chemistry, adherence to safety and health and risk management.

Focus on R&D

Indian chemical industry needs to focus on R&D in one or multiple areas. While R&D remains an universal imperative, its purpose

and nature varies across segments. The basic chemical sector should focus on process innovation and product development and strengthen their competitiveness through improvements based on performance and quality of products. Firms in knowledge based chemical sector should focus on R&D with the objective of achieving product leadership and process innovations. The petrochemical sector should focus on application R&D, as new applications have to be identified to increase use and application of polymers.

Collaboration

The chemical industry needs to enhance their collaborative efforts in order to improve competitiveness. Collaboration amongst players in the chemical industry could happen both at cluster level (for sharing of common infrastructure) as also at firm level (for sharing of knowledge and technology). Collaboration with firms across borders for technology and investment would also give a boost to the industry. In addition, the players should also achieve greater level of industry-institutional partnership for knowledge development and sharing.

Increasing ICT interface

Chemical firms in India can gain a lot by making their manufacturing

process IT-enabled. Information Technology (IT) can bring a good change in entire process cycle from technology, engineering and procurement to manufacturing by integrating them with business processes in all these areas. This will eventually result in higher efficiency for the industry. Increasing use of IT to transact business will also help the sector, as most of the products in the chemical sector are commoditised.

Consolidation

The new trend in chemical industry is competing through consolidation. Chemical firms, through mergers and alliances are now achieving economies of scale all over the world. Consolidation helps the chemical industry in reduction of cost in their procurement and production. Such consolidation exercises also provide for reduction in overheads, marketing expenses, increased efficiencies in supply chain management and enhanced presence in various regions. It is important for Indian chemical industry to consolidate their operations and emerge as global winners.

Industry - Academia Linkages

For transforming ideas into new products, partnership between industry and academia is a must. Thus, Indian chemical industry should leverage the potential of educational and research institutions

to source intellectual as well as human capital. Such linkages may be effectively used for setting up of in-house R&D facility or for outsourcing R&D activities.

Marketing and Promotion

Indian chemical industry should increasingly focus on marketing and promotion to achieve greater share in global chemical trade. The industry may endeavour to concentrate more on issues such as brand building, export promotion and market development.

Setting up of Chemical Parks or Mega Chemical Estates

In order to address the issue of creation of common infrastructure, the chemical industry, in association with the Government may establish exclusive Chemical Parks – a concept similar to the Software / Hardware Technology Park. It is also important to consider establishment of exclusive Chemical Zones on the lines of Special Economic Zones to give a fillip to the industry. In such Parks / Zones, the industry may be encouraged to set up mega chemical plants that could contribute to increased production as well as employment generation. The Government has already initiated policies for setting up of integrated Petroleum, Chemicals and Petrochemicals Investment Regions (PCPIR).

De-reservation of Select Chemical Production

Many chemical products (eg. Potassium Permanganate, Sodium Ferrocyanide, Calcium Carbide, Citric Acid, Sodium Cyanide) are still reserved for production under small-scale sector. However, cost-competitiveness as well as technological compliance cannot be achieved without operating under scale economies. Most of the firms operating at the global level are big ones and enjoy economies of scale. De-reservation of chemical products reserved for production under small-scale sector can be a good measure to support the globalisation efforts of the industry.

Creation of Modernization Fund

A modernization fund on the lines of technology upgradation fund established for the textile sector may be created to strengthen the technological competence of the industry.

Increasing Consumption Levels of Chemicals

Per capita chemical consumption in India is low as compared to world standards (estimated to be one-tenth of world average). Increasing consumption level in the domestic market would ignite the prevailing latent demand. This could be achieved through

increasing applications through R&D and enhancing the knowledge of end consumers.

OUTLOOK

Indian chemical industry has come a long way. Today, India has significant presence in production of basic organic and inorganic chemicals, pesticides, paints, dyestuffs and intermediates, petrochemicals, fine and specialty chemicals, cosmetic and toiletry product segments. Thus, by virtue of its diversity, the chemical industry bears a close correlation not only with the quantum of overall economic growth but also with the contents and quality of growth.

The performance and outlook of the chemical industry, particularly in the context of India's development process, depends upon and determines the trends in the overall economy, as also the linkages with the rest of the world in terms of international trade, investment flows and technology transfers. On the domestic front, with the reduction in tariffs, Indian chemical companies with strong systems and organized operations are likely to be benefited further. Companies with competitive advantages, like having competence in the areas of high value added chemicals, conforming to international quality standards, could

translate their capabilities and establish a dominant presence in both international and domestic markets.

In the years to come, various new avenues are likely to arise in the Indian chemical industry like structural shifts, strategic marketing alliances for domestic sales and exports, strategic marketing alliance with multinationals and trading companies, stricter enforcement of good manufacturing practices, opportunity for value addition using contract manufacturing or contract research.

Use of advanced technology, strong research capabilities, backward and forward linkages and development of domestic capacity to reduce dependence on imported raw materials are key success factors for Indian chemical industry. In addition, safety, health and environment protection issues are becoming important challenges for the Indian chemical industry. Indian manufacturers are addressing such challenges in an organized way.

The International Council of Chemical Associations (ICCA), an association representing 80% of the world manufacturers of chemicals has reiterated its support for a new round of multilateral trade negotiations in the World Trade Organization. ICCA's priorities

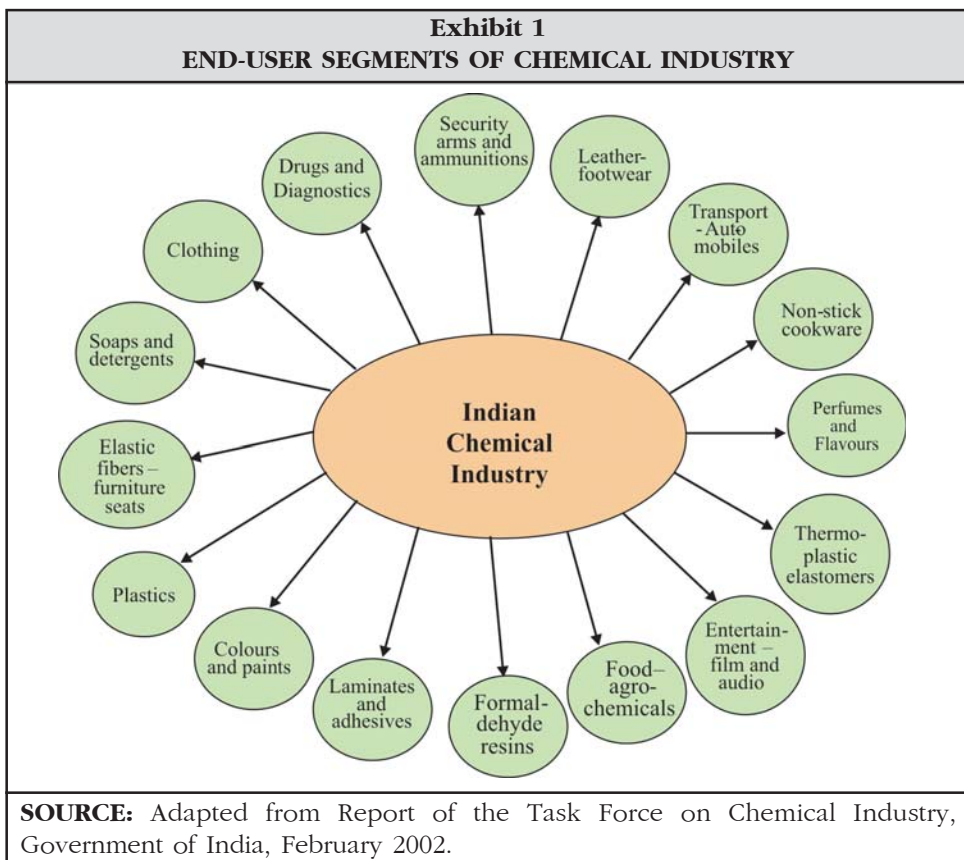
include elimination of chemical tariffs by the year 2010, harmonization of anti-dumping practices, simplification of customs procedures and full implementation of TRIPs agreement.

While the harmonization of anti-dumping practices would benefit developing countries like India, the tariff-free world would pose stiff competition.

1. INTRODUCTION

Chemical industry is one of the key industries in contribution to the world economic output and employment. The industry has contributed around US\$ 1.75 trillion in global value of sales in 2005. 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. Thus, the business cycles of end user segments significantly affect the chemical industry.



The chemical industry uses raw materials such as gas, oil, coal, water and minerals to produce a vast array of products. Chemical industry is also major demand driver for other sectors such as energy, information technology, environmental technology.

The industry is heterogeneous in nature with many sectors such as organic, inorganic, dyes, paints, pesticides and specialty chemicals. Specialty chemicals are produced in select countries, which has advanced technology and production skills. The chemical industry is energy-intensive in its manufacturing process as also in terms of usage of raw materials. While using natural gas, natural gas liquids, oil, coal and electricity as energy, the industry also draws up its raw materials from such energy sources as primary ingredient in production. The industry is one of the largest employers (employs over 10 million persons worldwide) and contributes to the welfare and employment on a global scale. The role of Research & Development (R&D) is crucial in the chemical industry due to the constant need for innovation.

The chemical industry is generally categorised 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.
- ❖ *Agricultural chemicals*, especially crop protection chemicals such as pesticides.

2. GLOBAL SCENARIO

PRODUCTION

Global sales of chemicals in the year 2005 were estimated to be around US\$ 1.75 trillion. USA is the single largest country with a share of 22% (US\$ 380 billion) in world chemical sales, followed by Japan – 10% (US\$ 194 billion), China - 9% (US\$ 163 billion), Germany -7% (US\$ 122 billion) and France - 5% (US\$ 90 billion).

In terms of regions, Asia-Pacific tops the list with a share of 35% in global sales (US\$ 615 billion),

followed by Europe (34% - US\$ 609 billion) and NAFTA (25% - US\$ 450 billion). Latin American countries accounted for US\$ 73 billion (4%) of global sales in 2005.

EXPORTS

According to World Trade Organisation's data, world export of chemicals is estimated to be US\$ 832 billion in 2005. The share of chemicals in global merchandise trade and global trade of manufactures is estimated to be 11% and 15%, respectively in 2005.

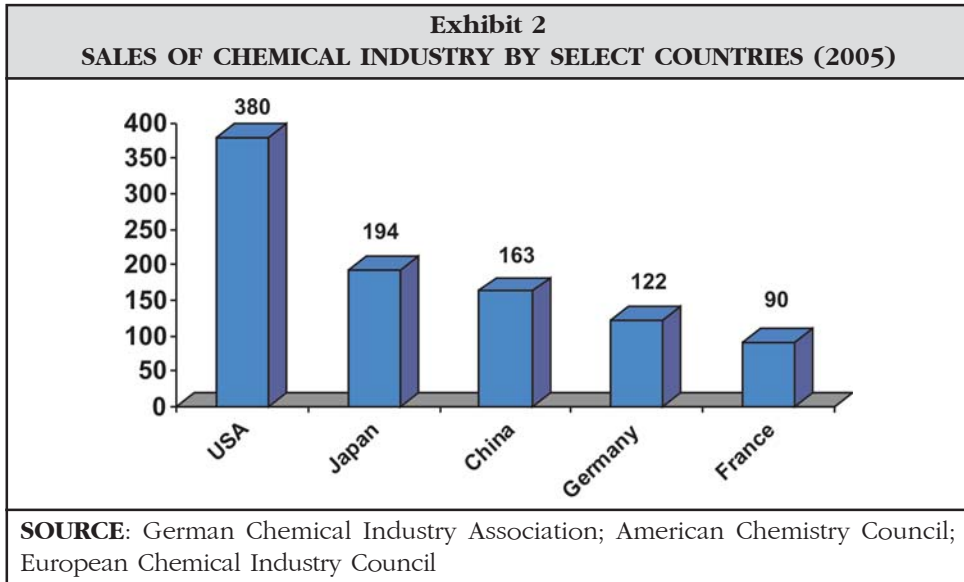
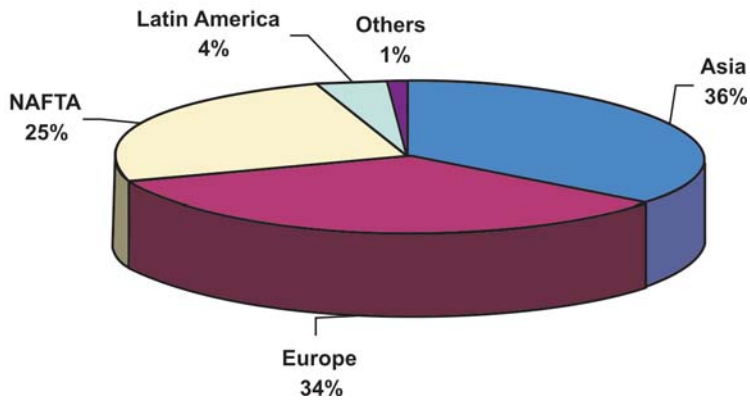
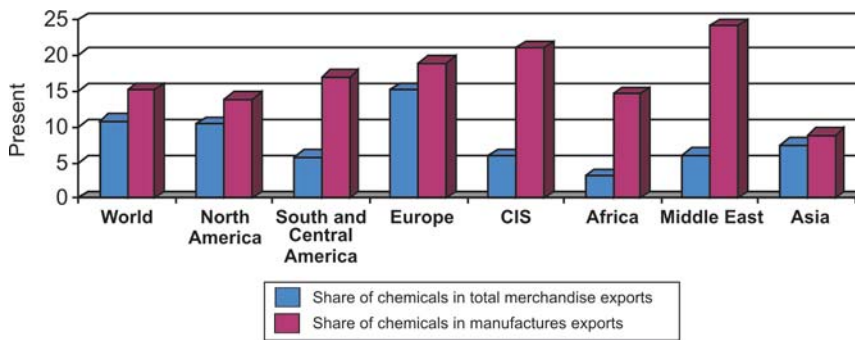


Exhibit 3
SALES OF CHEMICAL INDUSTRY BY REGIONS (2005)



SOURCE: German Chemical Industry Association; American Chemistry Council; European Chemical Industry Council

Exhibit 4
SHARE OF CHEMICALS IN TOTAL MERCHANDISE EXPORTS AND MANUFACTURES EXPORTS IN THE WORLD (2005)



SOURCE: World Trade Organisation

Export of chemicals by European region has highest share (15.2%) in total merchandise exports, while that of Africa was the lowest at 3.1% in 2005. Export of chemicals by CIS region has highest share (21%) in total export of manufactures, while

that of Asia was the lowest at 8.9% in 2005.

The growth in world chemicals trade has averaged out to around 12% during the period 2000-2005. In terms of individual countries, leading exporters in the order of

their share in world exports include Germany (11% - US\$ 95 billion), USA (11% - US\$ 94 billion), France (6% - US\$ 51 billion), Japan (6% - US\$ 49 billion), and China (4% - US\$ 32 billion). Leading importers are USA (11.% - US\$ 92 billion), China (9% - US\$ 75 billion), Germany (8% - US\$ 67 billion), France (5% - US\$ 46 billion), UK (4.5% - 39 billion), Italy (4% - 36 billion) and Japan (3% - US\$ 30 billion)

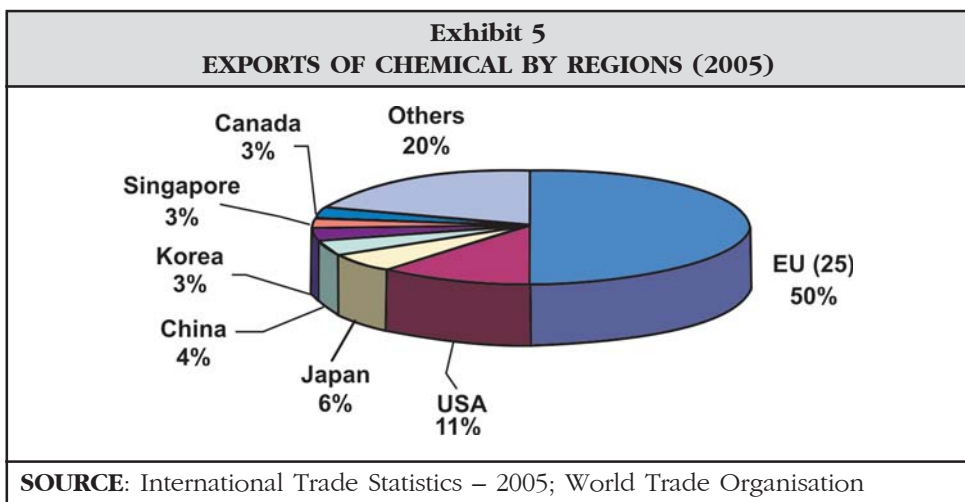
According to World Trade Organisation, the share of intra-regional trade by Europe, North America and Asia have been significant. The share of intra-regional trade by Europe was 72%, while that of North America and Asia have been 40% and 65% respectively.

TRENDS IN GLOBAL CHEMICAL INDUSTRY

World chemical production is growing and the growth is

contributed by the chemical industry in developing countries. Growth in chemicals demand in developing countries is also high, leading to substantial cross-border investment in the chemical sector. 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.

The joint framework agreement for tariff harmonization in the Uruguay Round, (Chemical Tariff Harmonization Agreement or CTHA), has led to a substantial reduction in tariffs in the signatory countries. However, in many countries, reduction in tariff has been substituted by increase in non-tariff barriers. The tariffs in countries not participating in the CTHA are also remaining high. Many CTHA



members are seeking for inclusion of more chemical producing countries under CTHA or other such mechanisms that might bring same tariff harmonization results.

Globalisation of chemical industry has led to national markets being supplied from an increasing number of locations, while individual companies have increased the geographic scope of their operations. Dumping of chemicals and anti-dumping actions by countries have become part of the game plan of many firms / countries. According to data collated by World Trade Organisation, during the period 1995 to June 2006, 578 anti-dumping cases have been initiated in the chemical sector, second largest sector, next only to metals / metal processing sector. During the same

period, in 381 cases the member countries have taken anti-dumping measures, second largest sector with a share of 20%.

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.

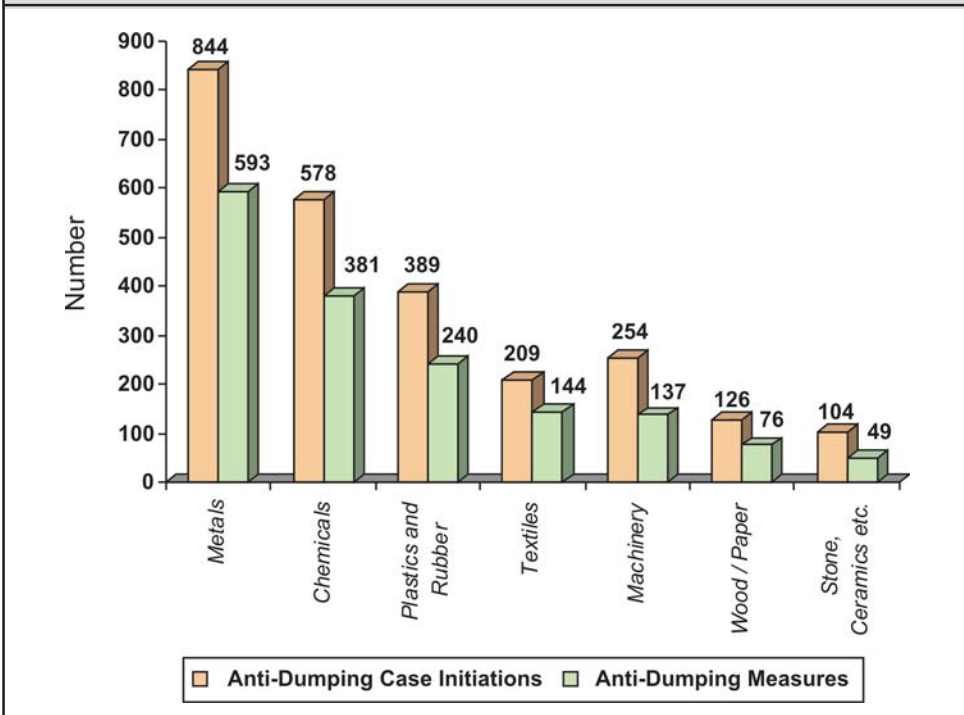
Box 1

CHEMICAL TARIFF HARMONISATION AGREEMENT

In the Uruguay Round, select WTO Members have agreed to harmonize tariffs on a broad range of chemical goods to promote liberalization in this sector and to develop a more predictable and transparent global tariff structure for this industry. The result was the Chemical Tariff Harmonization Agreement (CTHA), which led to a substantial reduction and harmonization of chemical tariffs in HS Chapters 28-39. Current discussions involve the expansion of both product coverage and participation in that Agreement, although the focus continues to be on participation. At present, CTHA members include: Australia, Bulgaria, Canada, the Czech Republic, Ecuador, Estonia, the European Union, Hong Kong, Japan, Jordan, the Republic of Korea, Mongolia, New Zealand, Norway, Panama, People's Republic of China, Qatar, Singapore, Slovakia, Switzerland, Taiwan, the United Arab Emirates and the United States of America.

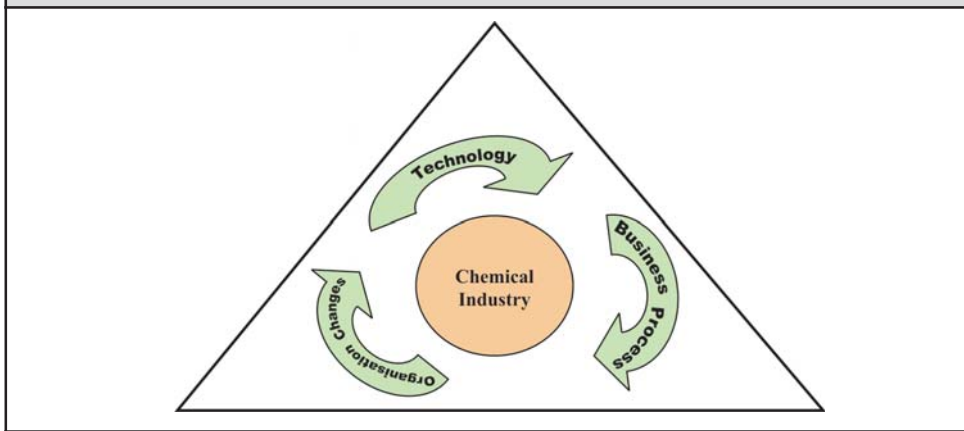
SOURCE: World Trade Organisation, CEFIC

Exhibit 6
SECTORWISE BREAK-UP OF ANTI-DUMPING CASES – INITIATIONS AND MEASURES IN THE WORLD (1995 – JUNE 2006)



SOURCE: World Trade Organisation

Exhibit 7
SURVIVAL TRIANGLE OF WORLD CHEMICAL INDUSTRY



SOURCE: Exim Bank Research

The chemical industry is riding on the big wave of automation, integration and collaboration. Technology is becoming a key enabler in the world chemical industry with the wake of increasing complexity. It is expected that the demand for automation would flow across organizational boundaries within the enterprise.

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.

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.

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, which

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;
- ❖ 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 re-use or recycling of used substances and products

The chemical industry is an energy intensive industry; on an average, about 9% of total production costs are being incurred by the industry due to energy use. For

manufacture of some chemicals, this ratio can raise upto 60%. Thus, competitive access to energy is necessary to the chemical industry. Since the reservoir of energy resources is finite, their proper management is a crucial pillar of sustainable development. The global chemical industry is continuously working towards reduction of environmental impact of its activities. Perhaps, the innovation in the world chemical industry is enabling other industries to use resources more

efficiently with less environmental impact.

The global chemical industry has committed to continuously improving the health, safety and environmental performance of its products and processes, and thereby contributes to the sustainable development of the society as a whole, through its 'Responsible Care' initiative. The Responsible Care initiative is currently implemented in over 50 nations with chemical manufacturing operations,

Box 2

MERGERS AND ACQUISITIONS IN GLOBAL CHEMICAL INDUSTRY

A study by PriceWaterHouseCoopers has estimated that over 2000 deals were in the chemicals sector during the period January 2003 to December 2005, with a cumulative deal value of over US \$ 130 billion. These include 35 mega deals, with a value of US \$ 1 billion and more, with an aggregate value of US \$ 82.1 billion.

In the year 2005 alone, number of deals witnessed by this sector was 95 with a cumulative deal value of US \$ 55 billion. There were 15 deals with the deal value of US \$ 1 billion or more, cumulatively accounting for 63% (US \$ 32 billion) of total deals concluded in this year.

The global trends in mergers and acquisitions have indicated that most of the chemical companies were interested in improving their market position in Europe and North America, but prefer to expand in Asia by means of investments in capacity expansion. In the year 2005, Asia Pacific region witnessed 263 deals, of which China alone accounted for 112 deals, followed by Japan 63, and India 24.

Majority of the deals in 2005 were in the basic chemical sector (55%), followed by specialty and fine chemicals (20%), polymers (16%) and diversified chemicals (9%). Strategic investors played a major role in many of the deals in the year 2005. Strategic investors have collectively invested nearly US \$ 38 billion (about 68% of the total value of deals).

SOURCE: PriceWaterHouseCoopers, Mergers and Acquisitions Activity in the Global Chemicals Industry 2003-2005.

Box 3
THE RESPONSIBLE CARE INITIATIVE

The Responsible Care initiative:

- ◆ promotes mutual support between companies and associations through experience sharing and peer pressure to identify and implement best practices;
- ◆ encourages companies and associations to inform their public about what they make and do, including the reporting of performance data and the products they make;
- ◆ supports education and research on the health, safety and environmental issues on chemical processes and products;
- ◆ helps the industry to engage and work in partnership with stakeholders at the local, national and international levels to listen to and address their concerns and aspirations;
- ◆ promotes cooperation with governments and organizations in the development and implementation of effective regulations and standards; and enhances accountability through its requirement to develop credible processes to verify that member companies are meeting Responsible Care goals and expectations.

SOURCE: Status Report on Responsible Care Initiative, International Chemical Councils Association

accounting for 90% of global chemical production..

**PROFILE OF LEADING
CHEMICAL PRODUCING
COUNTRIES**

USA

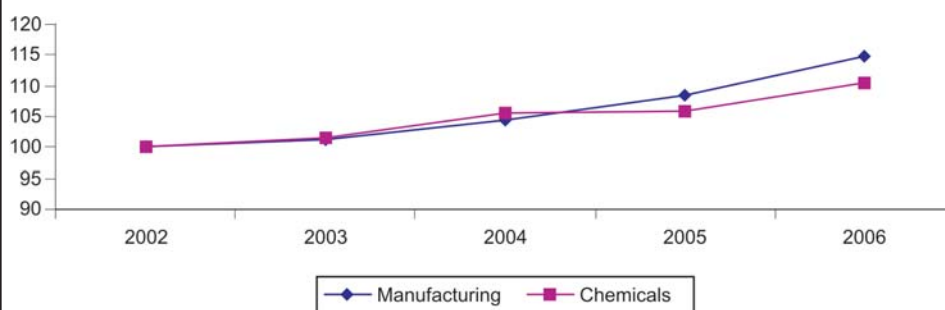
The chemical industry in USA has over 15000 units and employs around 0.9 million workers directly. The industry accounts for 6.2% of total employment generated by the manufacturing sector. In addition, it is estimated that around 5 million indirect employment is created by the chemical industry. With a sales turnover of US\$ 380 billion and export turnover of US\$ 94 billion,

the export orientation of the chemical industry in USA works out to 25% in 2005. The industry ranks second in terms of productivity – the per employee value added in the US chemical industry is estimated to be US\$ 200 per annum – second amongst all manufacturing sectors.

Japan

Chemical industry in Japan is the second largest in the world (next only to USA) with a turnover of US\$ 194 billion in 2005. The chemical industry in Japan consists of over 4000 units, employing over 250,000 persons. The value added in the Japanese chemical industry accounted for 11% of total value

Exhibit 8
INDEX OF CHEMICAL INDUSTRY PRODUCTION (2002=100) IN USA



SOURCE: Chemical and Engineering News

Table 1
CHEMICAL TRADE BY PRODUCTS IN USA (2006)

(US\$ Million)

| Type of Chemicals | Exports | Imports | Trade Balance |
|---------------------|---------|---------|---------------|
| Organic Chemicals | 29470 | 42676 | - 13206 |
| Inorganic Chemicals | 8980 | 10960 | - 1980 |
| Plastics | 32482 | 19183 | 13299 |
| Dyes and Colourants | 5367 | 3100 | 2267 |
| Others | 17865 | 9546 | 8319 |
| Total | 94164 | 85465 | 8699 |

SOURCE: Chemical and Engineering News

added in the manufacturing sector. With an export value of US\$ 49 billion in 2005, export orientation of Japanese chemical industry was 25%. R&D expenditure by chemical industry in Japan accounted for 16% of total business R&D; the R&D expenditure as a percentage of sales accounted for 5%.

China

With a sales turnover of US\$ 163 billion in 2005, the Chinese chemical industry is third largest in the world,

and second largest in Asia (next to Japan). The growth in the value of output in Chinese chemical industry is quite high and increasing every year. In the last one decade, China has displaced France and Germany to move to the third slot in the world chemical production. The Chinese chemical industry exported goods valued US\$ 32 billion in 2005; thus, the export orientation is estimated to be 20%. Chemical majors in China are mainly public sector firms. However, the Chinese Government

| Table 2 | | | |
|---------------------------------------------------|--------------|--------------|----------------|
| CHEMICAL TRADE BY PRODUCTS IN CHINA (2006) | | | |
| <i>(US\$ Million)</i> | | | |
| Type of Chemicals | Exports | Imports | Trade Balance |
| Organic Chemicals | 15222 | 29127 | - 13905 |
| Inorganic Chemicals | 7371 | 6157 | 1214 |
| Dyes and Pigments | 2954 | 3462 | - 508 |
| Other Chemicals | 8719 | 11470 | - 2751 |
| Total including others | 34266 | 50216 | - 15950 |
| SOURCE: Chemical and Engineering News | | | |

continues to actively steer market entry for foreign companies. There are over 10,000 chemical units in China, majority of which are set up as joint ventures.

Germany

The German chemical industry consists of over 2000 firms; some of them are well-known household names across the globe. However, over 90 percent of German chemical firms are small and medium enterprises with less than 500 employees. The chemical industry in Germany employs around 450,000 persons directly and another 600,000 jobs indirectly. The sales turnover of German chemical industry is estimated to be US\$ 122 billion. With an export turnover of US\$ 95 billion, the German chemical industry has an export orientation of 77%, one of the largest in the world. German chemical industry is estimated to be having 10% share in total manufacturing output. The industry invests around US\$ 10 billion in

Research and Development (R&D). The R&D intensity of German chemical industry is estimated to be around 6%.

France

With a sales turnover of US\$ 90 billion, the French chemical industry is the fifth largest in the world and second largest in Europe. The chemical industry in France is second largest manufacturing sector, next to Automobiles, and exports around 60% of its turnover. The industry has around 1000 units providing employment to around 200,000 persons. With an export turnover of US\$ 51 billion, the chemical industry in France is the largest exporting sector. Exports accounted for one-sixth of total exports of the manufacturing sector in France. The R&D intensity of the French chemical industry was over 3% of sales, while the R&D budget represented over 20% of the total value of investment into industrial R&D in France.

Table 3
PRODUCTION OF SELECT CHEMICAL PRODUCTS IN JAPAN
(2005 AND 2006) *(000 Tonnes)*

| Chemicals | 2005 | 2006 | Growth (%) |
|----------------------------|-------|-------|------------|
| Inorganic Chemicals | | | |
| Ammonia | 1318 | 1316 | - 0.2 |
| Ammonium Sulphate | 1458 | 1457 | - 0.1 |
| Carbon Black | 805 | 825 | 2.5 |
| Chlorine Liquid | 601 | 579 | - 3.7 |
| Hydrochloric Acid | 2276 | 2281 | 0.2 |
| Hydrogen Peroxide | 197 | 211 | 7.1 |
| Nitrogen | 11435 | 11890 | 4.0 |
| Oxygen | 11371 | 11708 | 3.0 |
| Sodium Hydroxide | 4552 | 4399 | - 3.4 |
| Sodium Silicate | 546 | 517 | - 5.3 |
| Sulfuric Acid | 6546 | 6984 | 6.7 |
| Titanium Dioxide | 259 | 244 | - 5.8 |
| Organic Chemicals | | | |
| Acetic Acid | 599 | 585 | - 2.3 |
| Acetone | 546 | 516 | - 5.5 |
| Acryl nitrite | 742 | 653 | - 12.0 |
| Benzene | 4980 | 4726 | - 5.1 |
| Butadiene | 1040 | 981 | - 5.7 |
| Butanol | 513 | 499 | - 2.7 |
| Captrolactum | 458 | 485 | 5.9 |
| Cyclohexane | 723 | 746 | 3.2 |
| Ethylene | 7618 | 7406 | - 2.8 |
| Ethylene Dichloride | 3689 | 3517 | - 4.7 |
| Ethylene Glycol | 841 | 766 | - 8.9 |
| Ethylene Oxide | 1005 | 976 | - 3.2 |
| Octanol | 279 | 265 | - 5.0 |
| Phenol | 938 | 823 | - 12.3 |
| Phthalate Plasticizers | 315 | 281 | - 10.8 |
| Phthalic Anhydride | 239 | 174 | - 27.2 |
| Polypropylene Glycol | 339 | 336 | - 0.9 |
| Propylene | 6030 | 5936 | - 1.1 |
| Purified Terephthalic Acid | 1472 | 1491 | 1.3 |
| Styrene | 3392 | 3318 | - 2.2 |
| Toluene | 1676 | 1614 | - 3.7 |
| Toluene disocyanate | 216 | 219 | 1.4 |
| Xylene | 5570 | 5598 | 0.5 |
| P-Xylene | 3358 | 3384 | 0.8 |

SOURCE: Chemical and Engineering News

Italy

Chemical industry in Italy is the third largest in Europe, after Germany and France. In the year 2005, the production of Italian chemical industry was valued at US\$ 60 billion. The industry employs around 130,000 persons. The industry is well represented by small and medium enterprises (42% of total units), Italian large enterprises (23%), and foreign multinationals (35%). Export turnover of Italian chemical industry was US\$ 26 billion in 2005; the export orientation of the Italian chemical industry thus works out to 43% in 2005. Exports to turnover have grown from 15% to 43% in 15 years, the best performance among European countries. Not only large firms, but also SMEs in Italy are strongly oriented to international markets. According to a survey by Federation of Italian Chemical Associations (FEDERCHIMICA), over 70% of Italian chemical enterprises are engaged in R&D activities.

UK

Chemical industry is one the largest manufacturing sectors and top ranking export sector in UK. In 2005,

the UK chemical industry produced goods worth US\$ 50 billion, and accounted for around 2% of national GDP and over 10% of gross value added in the manufacturing sector. Exports of chemicals by UK was estimated to be US\$ 38 billion in 2005. The export intensity of the UK chemical industry thus works out to 76%. The UK chemical industry provides direct employment to around 200,000 persons and helps in creation of indirect employment to equal number of persons. In 2005, the chemical industry in UK made a capital investment of around US\$ 2 billion, which is over 10% of capital investment in manufacturing sector. R&D intensity of UK chemical industry is estimated to be 3% in 2004.

Canada

The Canadian chemical industry witnessed a turnover of US\$ 26 billion in 2005. Exports by the chemical industry in Canada amounted to US\$ 22 billion in 2005. The export intensity thus worked out to 85%. The industry employed around 80000 persons and provides indirect employment to another 200,000 persons.

| Table 4 PRODUCTION OF SELECT CHEMICAL PRODUCTS IN CANADA (2005 and 2006) | | | |
|-----------------------------------------------------------------------------------------------------|-------------|-------------|---------------------|
| | | | <i>(000 Tonnes)</i> |
| Chemical Items | 2005 | 2006 | Growth (%) |
| Ammonia | 4607 | 4444 | - 3.5 |
| Ammonium Nitrate | 1206 | 1120 | - 7.2 |
| Benzene | 798 | 724 | - 9.3 |
| Butadiene | 245 | 251 | 2.6 |
| Chlorine | 1004 | 988 | - 1.6 |
| Hydrochloric Acid | 141 | 162 | 14.6 |
| Nitric Acid | 1147 | 1121 | - 2.2 |
| Polyethylene | 3366 | 3613 | 7.3 |
| Polystyrene | 198 | 194 | - 2.0 |
| Propylene | 737 | 755 | 2.5 |
| Sodium Chlorate | 1169 | 1125 | - 3.8 |
| Sodium Hydroxide | 1117 | 1071 | - 4.2 |
| Sulfuric Acid | 3755 | 3828 | 1.9 |

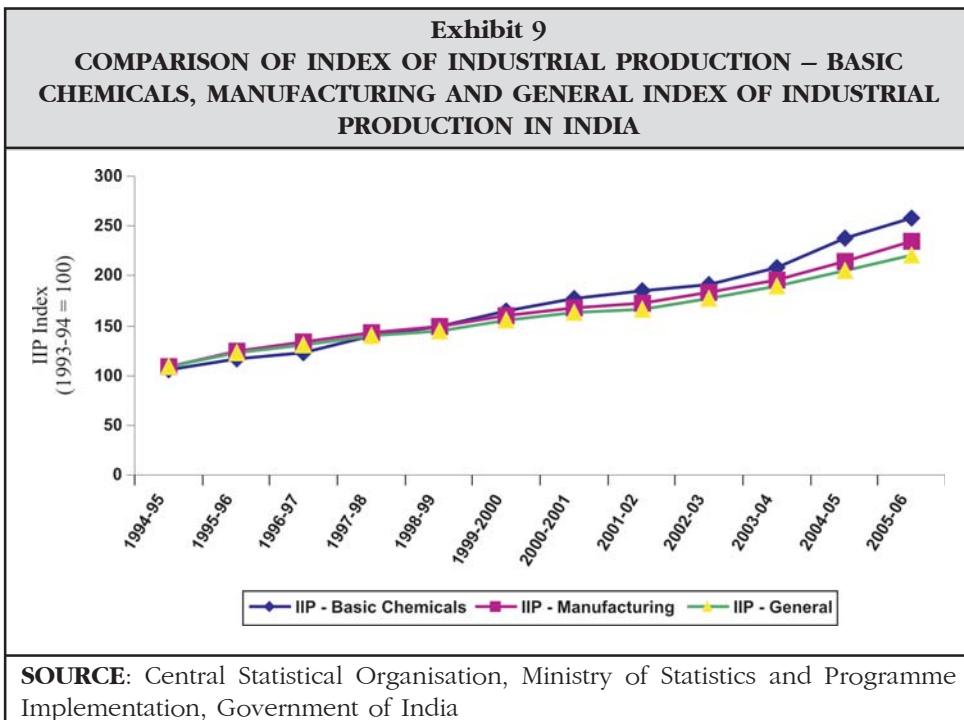
SOURCE: Chemical and Engineering News

3. CHEMICAL INDUSTRY IN INDIA

OVERVIEW

Chemical industry is one of the oldest industries that has contributed significantly to the industrial and economic growth of India. It is estimated that the size of the Indian chemical industry is around US\$ 30 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. The industry, comprising both small scale and large units (including MNCs), produces several thousands of products and bi-products, ranging from plastics and petrochemicals to cosmetics and toiletries. A significant share (around one-third) of production by chemical industry is consumed by itself.



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 Organisation 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.

The chemical industry accounts for about 13% share in the manufacturing output and around 10% in total exports of the country. India is also an importer of chemicals; however, the chemical

trade balance is positive. The industry contributes around 20% of national revenue by way of various taxes and levies.

CAPACITY AND PRODUCTION OF MAJOR CHEMICAL SUB-SEGMENTS

The volume of major basic chemicals produced in India amounted to around 8 million metric tonnes (MTs) in 2005-06. This works out to a capacity utilization level of over 80%. Alkalis (such as soda ash, caustic soda and liquid chlorine) are the largest sub-segment in production of chemicals amounting to around 70% share in volume terms.

| Table 5 INSTALLED CAPACITY AND PRODUCTION OF MAJOR BASIC CHEMICALS IN INDIA | | | | | | |
|-------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|------------------------|----------------|----------------|----------------|--------------------|
| Major basic chemical segments | Installed Capacity as of March 2006 | Production (MT) | | | | |
| | | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 (P) |
| Alkali | 6602680 | 4342305 | 4792345 | 5070374 | 5271675 | 5474614 |
| Inorganic | 742015 | 374132 | 403827 | 440608 | 508157 | 543965 |
| Organic | 1791858 | 1140405 | 1319967 | 1444510 | 1472819 | 1509546 |
| Pesticides | 148551 | 81803 | 69565 | 85118 | 93966 | 82240 |
| Dyes and Dyestuff | 52043 | 24789 | 26196 | 25940 | 28498 | 29541 |
| Total Above | 9337147 | 5963434 | 6611900 | 7066550 | 7375115 | 7639906 |
| SOURCE: Chemical and Petrochemical Statistics at a Glance, Ministry of Chemicals and Fertilizers, Government of India. | | | | | | |
| P – Provisional | | | | | | |

Box 4

MAJOR CHEMICAL GROUPS AND SUB-SEGMENTS PRODUCED IN INDIA

| | |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Alkali</i> | – Such as Soda ash, Caustic soda, and Liquid chlorine |
| <i>Inorganic chemicals</i> | – Such as Aluminum fluoride, Calcium carbide, Carbon black, Potassium chlorate, Sodium chlorate, Titanium dioxide and Red phosphorous. |
| <i>Organic chemicals</i> | – Such as Acetic acid, Acetic anhydride, Acetone, Phenol, Methanol, Formaldehyde, Nitrobenzene, Citric acid, Maleic Anhydride, Penta-Erithritol, Aniline, Chloro methanes, ONCB, PNCB, MEK, Acetaldehyde, Ethanolamines, Ethyl acetate and Ortho nitro toluene. |
| <i>Pesticides</i> | – Pesticides and insecticides registered under the Insecticide Act of 1968. |
| <i>Dyes and dyestuff</i> | – Such as Azo dyes, Acid direct dyes, Basic dyes, Fast colour bases, Ingrain dyes, Oil soluble (solvent dyes), Optical whitening agents, Organic pigment colours, Pigment emulsion, Reactive dyes, Sulphur dyes, Vat dyes, Food colours and Naphthols. |
| <i>Petrochemicals</i> | – Such as Synthetic fibres, Fibre intermediates, Polymer, Elastomers, Surfactants and Performance plastics. |

The volume of major basic petrochemicals produced in India amounted to around 8 million MTs in 2005-06. This works out to a capacity utilization level of over 90%. Polymers (such as Low / High Density Polyethylene, Polypropylene and Polystyrene) are the largest sub-segment in production of petrochemicals amounting to around 63% share in volume terms.

The volume of major petrochemical intermediates produced in India amounted to around 10 million MTs in 2005-06. This works out to a capacity utilization level of over 98%. Olefins (such as Ethylene, Propylene and Butadiene) are the largest sub-segment in production of petrochemicals amounting to around 46% share in volume terms.

Table 6
INSTALLED CAPACITY AND PRODUCTION OF MAJOR BASIC
PETROCHEMICALS IN INDIA

| Basic petro-chemical segments | Installed Capacity as of March 2006 | Production (MT) | | | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------|----------------|----------------|----------------|----------------|
| | | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 (P) |
| Synthetic fibre yarn | 2416500 | 1668553 | 1754556 | 1867746 | 1875420 | 1906193 |
| Polymers | 4727750 | 3974170 | 4175085 | 4499167 | 4775745 | 4768085 |
| Elastomers | 147580 | 79372 | 81506 | 87394 | 96775 | 110212 |
| Synthetic detergent intermediates | 577500 | 424760 | 447426 | 453379 | 487895 | 555474 |
| Performance Plastics | 136580 | 89883 | 94656 | 99257 | 112834 | 126681 |
| Total Above | 8005910 | 6236738 | 6553229 | 7006943 | 7348669 | 7466665 |
| SOURCE: Chemical and Petrochemical Statistics at a Glance, Ministry of Chemicals and Fertilizers, Government of India. P – Provisional | | | | | | |

Table 7
INSTALLED CAPACITY AND PRODUCTION OF MAJOR PETROCHEMICAL
INTERMEDIATES IN INDIA

| Basic petro-chemical inter-mediate | Installed Capacity as of March 2006 | Production (MT) | | | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------|----------------|----------------|----------------|-----------------|
| | | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 (P) |
| Fibre Inter-mediate | 2847200 | 2417331 | 2648473 | 2691098 | 2851365 | 2963039 |
| Olefins | 4374800 | 3696808 | 3961673 | 4281669 | 4667885 | 4679743 |
| Aromatics | 3142400 | 2242549 | 2426258 | 2424962 | 2451310 | 2536549 |
| Total Above | 10364400 | 8356688 | 9036404 | 9397729 | 9970560 | 10179331 |
| SOURCE: Chemical and Petrochemical Statistics at a Glance, Ministry of Chemicals and Fertilizers, Government of India. P – Provisional | | | | | | |

| Table 8 | |
|------------------------------------------------------------------------------------------|----------------------------------------|
| CAGR OF PRODUCTION BY VARIOUS CHEMICAL SECTORS IN INDIA DURING 2001-02 TO 2005-06 | |
| Sector / Sub sector | CAGR % (2001-02 to 2005-06) |
| Basic Chemicals | 6.39 |
| Alkali | 5.96 |
| Inorganic | 9.77 |
| Organic | 7.26 |
| Pesticides | 0.12 |
| Dyes and Dyestuff | 4.54 |
| Basic Petrochemicals | 4.60 |
| Synthetic Fibre Yarn | 3.39 |
| Polymers | 4.66 |
| Elastomers | 8.63 |
| Synthetic Detergent Intermediates | 6.90 |
| Performance Plastics | 8.99 |
| Petrochemical Intermediates | 5.05 |
| Fibre Intermediates | 5.22 |
| Olefins | 6.08 |
| Aromatics | 3.13 |
| SOURCE: Compiled from Chemical and Petrochemical Statistics at a Glance 2005-06. | |

| Table 9 | |
|---------------------------------------------------------------------|-------------------------------------|
| ESTIMATED SIZE (IN VALUE) OF THE CHEMICAL INDUSTRY (2005-06) | |
| <i>(Rs. Crores)</i> | |
| Item | Estimated Turnover (2005-06) |
| Organic chemicals | 10200 |
| Pesticides | 5200 |
| Dyes and Pigments | 4800 |
| Alkalies | 3000 |
| Inorganic chemicals | 2200 |
| Other chemicals | 7000 |
| Total (above) | 32400 |
| SOURCE: CMIE, Exim Research. | |

In value terms the size of the basic chemical industry in India is estimated to be around US\$ 7.5 billion in 2005-06.

In terms of consumption, Indian chemical industry itself is its largest consumer; as the basic chemicals undergo several processing to manufacture downstream chemicals. The industry accounts for approximately one-third of the total consumption.

With over 40000 units, the industry is widespread and has presence in both small and large-scale sector. The advantages of SSI reservations and the fiscal concessions extended to this sector facilitated establishment of large number of units in the Small Scale Industry (SSI) sector. Gujarat is the major contributor to the basic chemical as well as petrochemical production with 54% and 59% share, in all India production, respectively.

Other major states producing basic chemicals include Maharashtra (9%), Tamilnadu and Uttar Pradesh (6% each). Other major states producing petrochemicals include Maharashtra (18%), West Bengal (12%), Uttar Pradesh (4%) and Tamil Nadu (3%).

EXPORTS

Since the formation of World Trade Organisation, structural changes have happened in chemicals trade. There has been reduction in tariff for chemical imports in developed countries. However, non-tariff barriers associated with environmental issues are influencing the chemical imports by developed countries.

India has been increasing its export of chemical products in the recent years. The trend analysis of India's exports of major chemical products in the last four years is given in Exhibit - 11.

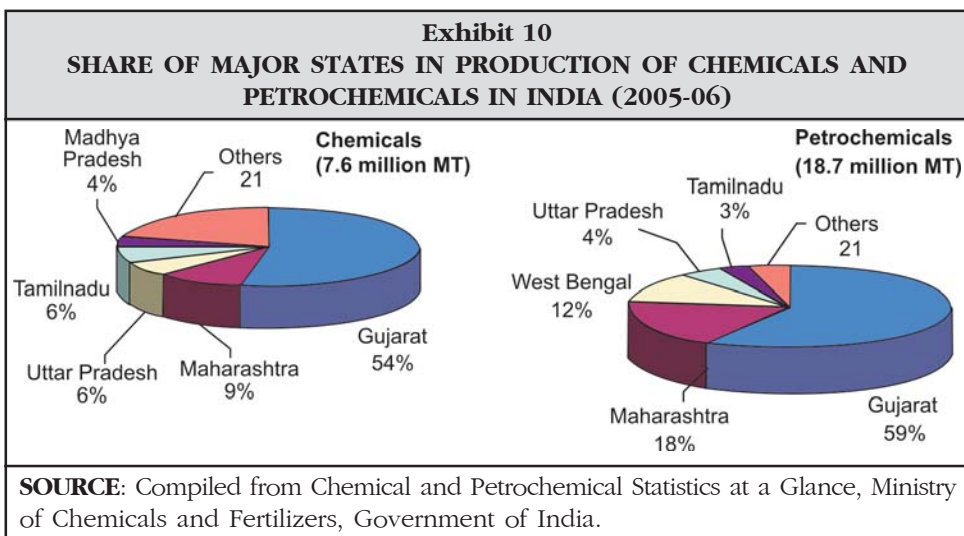
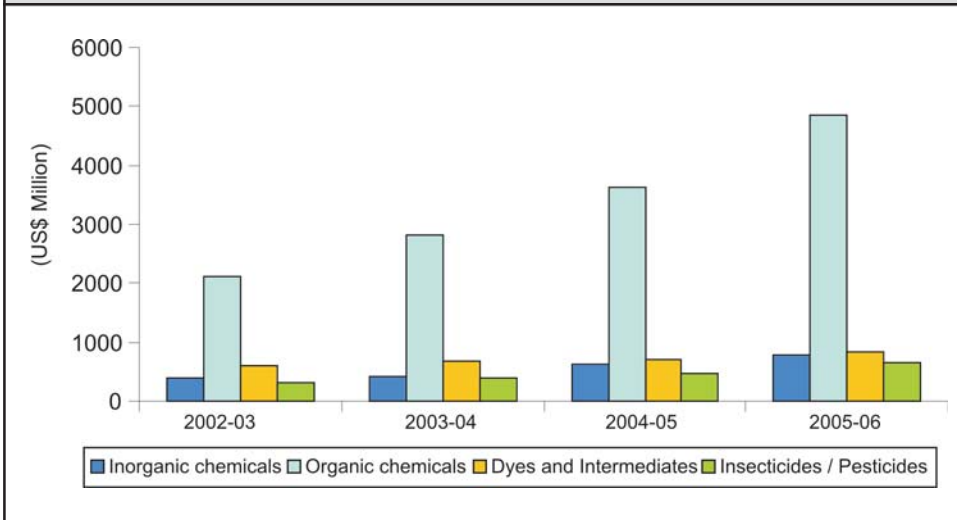


Exhibit 11
TRENDS IN INDIA'S EXPORT OF SELECT BASIC CHEMICAL PRODUCTS



SOURCE: Directorate General of Commercial Intelligence and Statistics, Ministry of Commerce and Industry, Government of India.

Analysis of production and export performance of major chemical segments are given in the following sections:

Organic chemicals

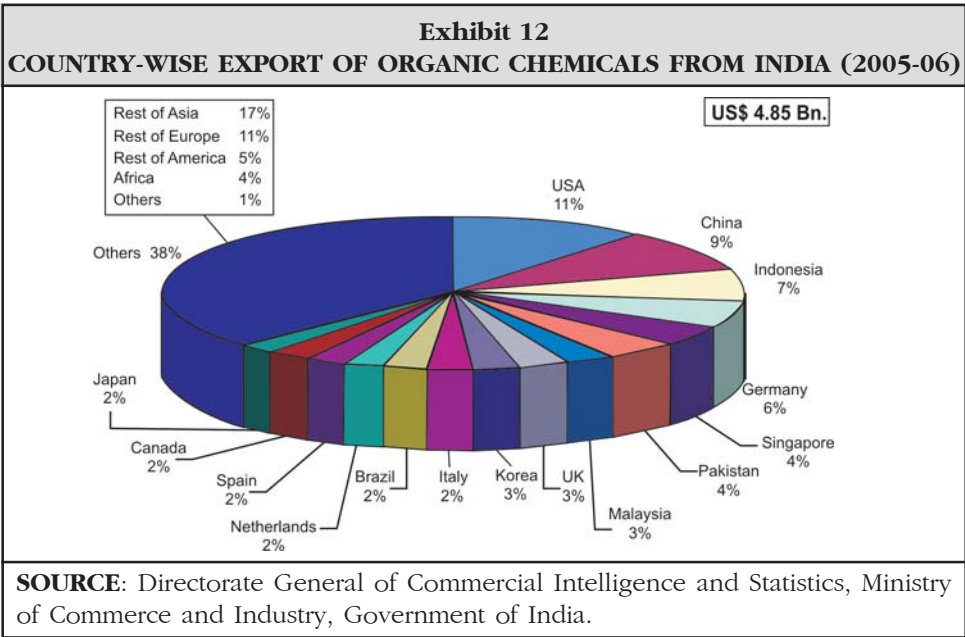
Most of the chemical compounds that contain carbon atoms are called organic chemicals. Organic chemicals are used in many household products like paints, varnishes and products of cleaning and disinfecting. In the year 2005-06, India is expected to have produced 1.5 million MTs of organic chemicals. Major products produced include methanol, acetic acid, formaldehyde and acetaldehyde. India's export of organic chemicals in the year 2005-06 was valued at US\$ 4.85 billion. The exports during the first quarter

(April – June) of 2006-07 were valued at US\$ 1.32 billion.

Major markets for Indian organic chemicals include USA, China, Indonesia and Germany. The share of USA market in India's exports was around 11%.

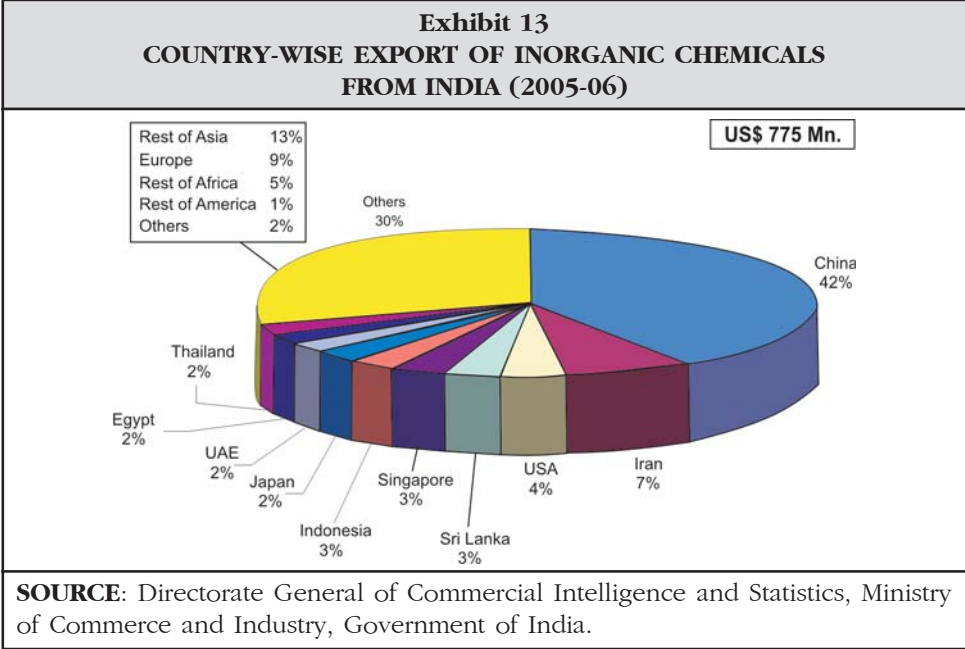
Inorganic chemicals

Inorganic chemicals are substances of mineral origin, but not of basically carbon structure. These include nitrate, fluoride and metals. Inorganic chemicals are mostly used in detergents, soaps, and fertilizers. Major products produced in India are carbon black, titanium dioxide and calcium carbide. In the year 2005-06, India is estimated to have produced 544,000 MTs of inorganic chemicals. In addition, alkalis,



which are commonly used to manufacture products like bleach, ammonia, detergent powder, drain cleaners, hair color preparations, depilatories, alkaline disk batteries are also produced in India.

India has built up capacity of alkali chemicals viz., soda ash, caustic soda and liquid chlorine. The estimated total production of these items in the year 2005-06 was 5.47 million MTs.



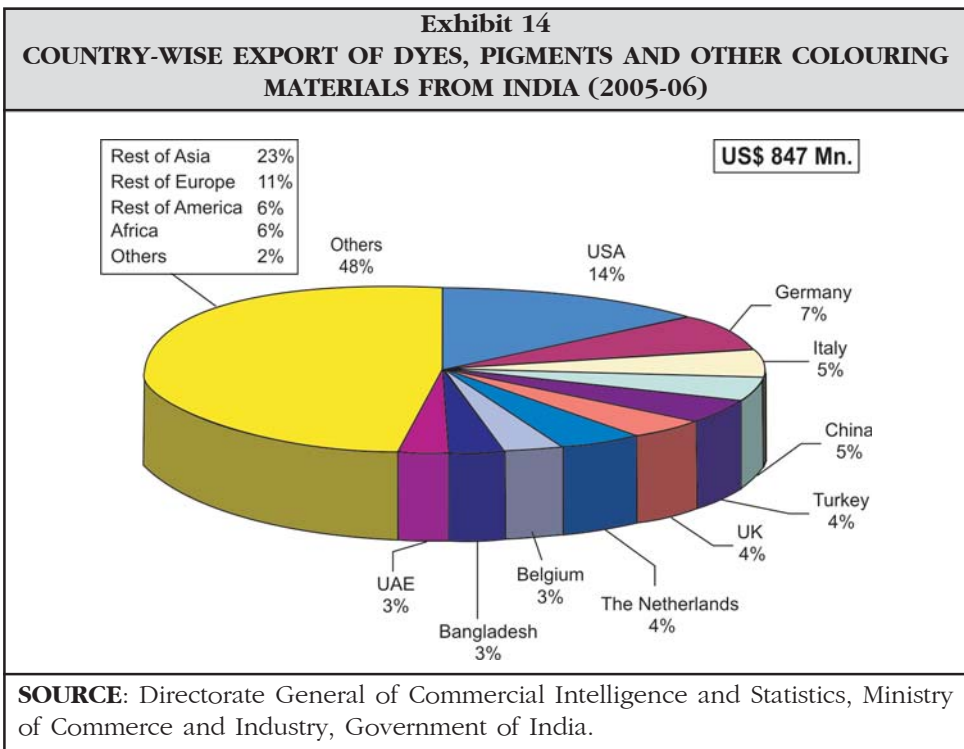
India exported inorganic chemicals valued US\$ 775 million in 2005-06. In the first quarter of 2006-07 (April – June), India has achieved an export level of US\$ 228 million. Major markets for India’s inorganic chemicals include China, Iran, USA, Sri Lanka, Singapore and Indonesia. China alone accounted for about 42% of India’s exports in 2005-06.

Inks and foodstuffs. Indian dyestuff sector has emerged as a leading player in the world market with a share of over 6%. In the year 2005-06, the production of dyes and dyestuffs in India was estimated to be 29,541 MTs. Major dyestuffs produced in India are organic pigment colours, azo dyes, sulphur dyes, reactive dyes and pigment emulsion.

Dyes and Pigments

Indian dyestuff sector is one of the important segments of Indian chemical industry. The dyestuffs find usage either as raw material or for direct application in a number of manufacturing sectors like textiles, leather, paper, printing

India exported tanning and colouring materials (including paints) worth US\$ 847 million in 2005-06. Exports during the first three months (April-June) of 2006-07 were US\$ 231 million. Major destinations of Indian dyestuff materials are USA, Germany, Italy, China, Turkey, UK, The Netherlands and Belgium.



Pesticides

India, at present, indigenously produces over 60 technical grade pesticides. The industry comprises of both large and SME manufacturers, numbering over 100 units. Besides, India also has the presence of leading multinational firms. In the year 2005-06, the industry is estimated to have produced 82,240 MTs of pesticides, (including fungicides, herbicides, weedicides, rodenticides and fumigants).

India's exports of pesticides amounted to US\$ 649 million in 2005-06. In the current year (April-June 2006-07), exports were valued at US\$ 152 million. Major markets for Indian pesticides include USA, The Netherlands, France, Argentina, Brazil and Belgium. Major component of India's exports of

pesticides is insecticides, which has a share of over three-fourth of total exports of pesticides.

Petrochemicals

The petrochemical industry is relatively a new entrant in the Indian chemical industry, but has registered rapid growth since 1980's. The petrochemical industry mainly comprises of synthetic fibres, polymers, elastomers, synthetic detergents intermediates and performance plastics. Today petrochemical products permeate the entire spectrum of daily use items and almost cover entire sphere of life. In the year 2005-06, Indian petrochemical industry is estimated to have produced over 18 million MTs of products. In value terms, in the year 2004-05, export of petrochemicals amounted to nearly Rs.16,800 crores.

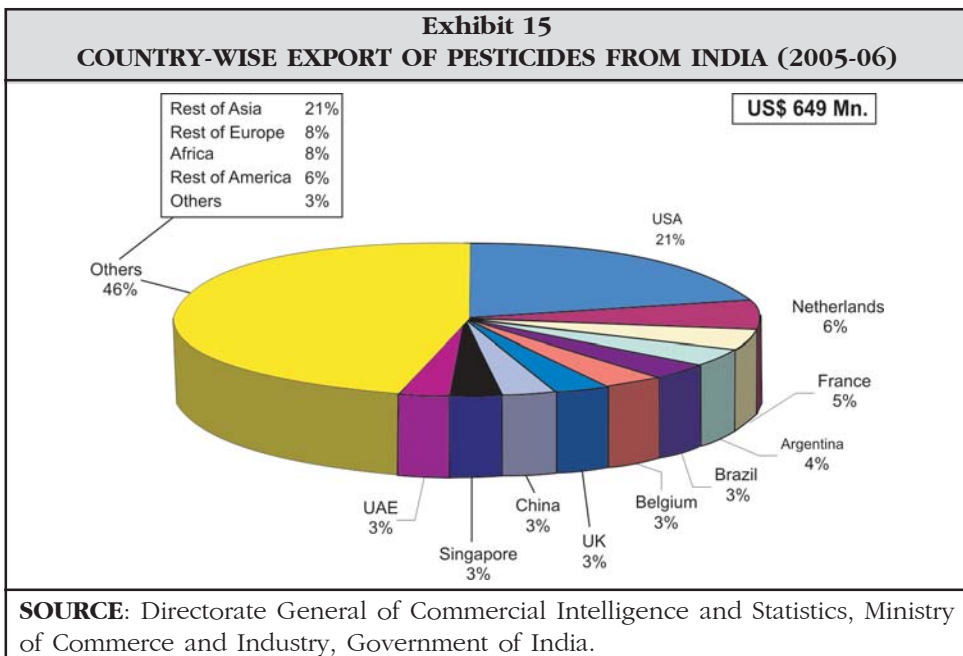
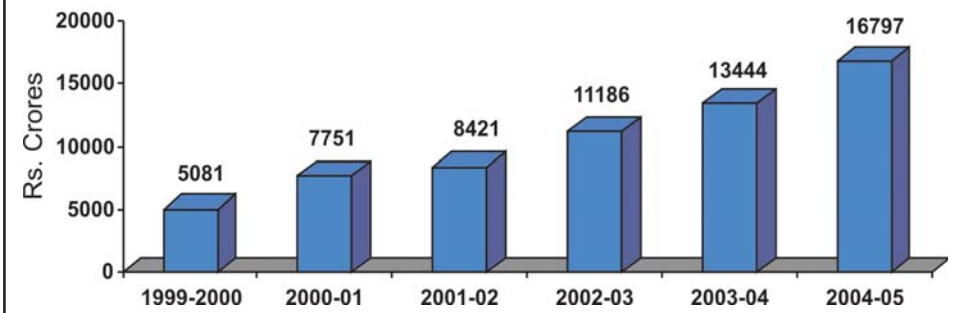
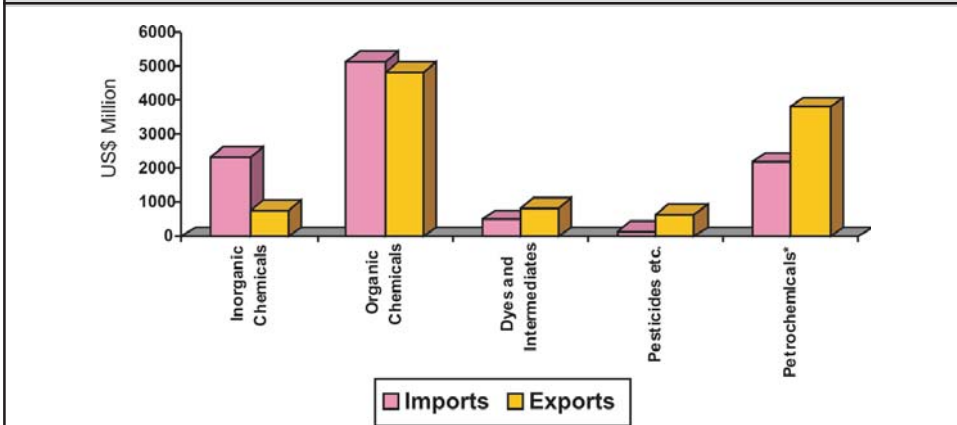


Exhibit 16
TRENDS IN EXPORT OF PETROCHEMICALS FROM INDIA



SOURCE: Annual Report – 2005-06, Ministry of Chemicals and Fertilizers, Government of India

Exhibit 17
TERMS OF TRADE IN SELECT CHEMICAL SECTORS IN INDIA (2005-06)



SOURCE: DGCIS, Ministry of Chemicals and Fertilizers, Government of India.

* Petrochemical data represents the year 2004-05.

IMPORTS

India is also an importer of chemical products; India's chemical imports are either for the purpose of further processing in the chemical industry or for usage as intermediates in other manufacturing sector. Overall the

terms of trade have been negative in inorganic and organic chemical sectors, the two major product groups traded by India. However, the terms of trade have been positive for dyes and intermediates, pesticides and petrochemicals segments. Thus, it may be

Box 5

EXIM BANK'S SUPPORT TO INDIAN CHEMICAL INDUSTRY

Exim Bank has been closely associated with the export efforts of Indian chemical industry. Exim Bank's loan exposure to chemicals sector, including dyes, amounted to over Rs. 1000 crores as of December 31, 2006. This works out to a share of 5% in the Bank's total loan exposure during this period.

The Bank has been helping the chemical manufacturing and exporting units to modernise and upgrade their production facilities, install pollution control and environmental safety systems of internationally acceptable standards and develop export market for value added products through various products and services.

The Bank has helped a few chemical companies to invest in overseas ventures for manufacturing and marketing, under its Overseas Investment Finance Programmes. In addition, the Bank through its refinance programmes, supported a number of small chemical units through commercial bank network.

The Bank, in association with the Centre for Promotion of Imports from Developing Countries, The Netherlands facilitated Participation of Indian fine and speciality chemical firms in the Export Promotion Programme (EPP) in Europe. EPP has provided combination of elements such as assistance on adhering to regulations and standards, marketing, organisation of production and operational management, training in export marketing.

concluded that overall, import of chemicals has been lower than exports.

The trend analysis of India's imports of major basic chemical products in the last four years is given in Exhibit - 18.

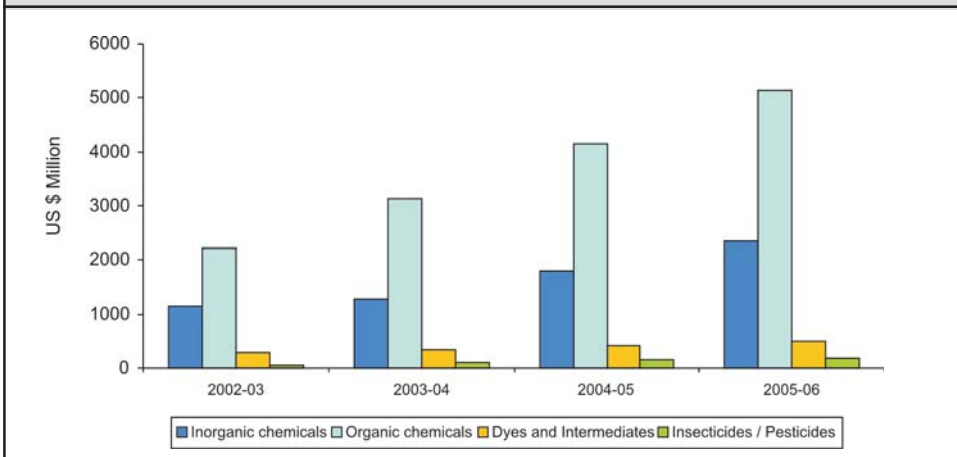
Basic chemical imports by India amounted to over US\$ 8 billion in 2005-06. Organic chemicals accounted for around 63% of India's chemical imports followed by inorganic chemicals (28%), dyes (6%)

and pesticides (3%). India has been sourcing its imports mainly from China (20% of India's total chemical imports), followed by USA (8%), Saudi Arabia (6%), Singapore, Morocco and Germany (5% each).

INVESTMENT PROPOSALS INCLUDING FOREIGN DIRECT INVESTMENT IN INDIAN CHEMICAL INDUSTRY

Increasing investments in any sector will have significant effect on growth, development productivity

Exhibit 18
TRENDS IN INDIA'S IMPORT OF SELECT BASIC CHEMICAL PRODUCTS

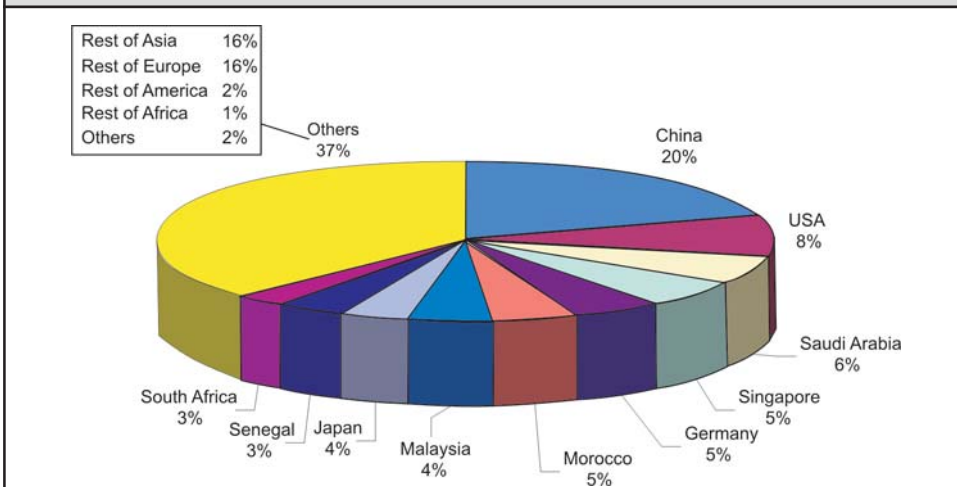


SOURCE: Directorate General of Commercial Intelligence and Statistics, Ministry of Commerce and Industry, Government of India.

and competitiveness. The Indian chemical industry has been receiving significant investment intentions, including Foreign Direct Investment (FDI). Since August 1991 and till November 2006, chemical industry

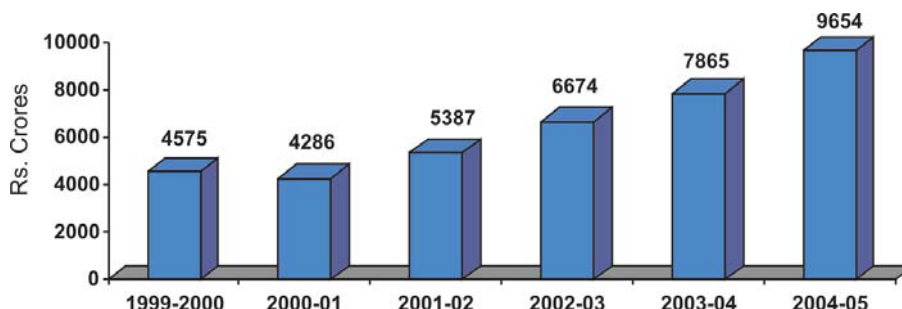
has received investment proposals worth Rs. 274486 crores, a share of 11.28% in total investment proposals received during this period. The investment proposals include over 8500 industrial entrepreneurs

Exhibit 19
SOURCE COUNTRIES FOR INDIA'S BASIC CHEMICAL IMPORTS



SOURCE: Directorate General of Commercial Intelligence and Statistics, Ministry of Commerce and Industry, Government of India.

Exhibit 20
TRENDS IN IMPORT OF PETROCHEMICALS IN INDIA



SOURCE: Annual Report – 2005-06, Ministry of Chemicals and Fertilizers, Government of India

memoranda and over 500 letters of intent / direct industrial licenses filed for production of chemicals, with an estimated employment generation for over 1 million persons.

FDI, which is very essential for modern manufacturing of chemicals, has also been flowing into this sector significantly. During the period

August 1991 to October 2006, FDI inflows into chemicals sector amounted to US\$ 2.2 billion, a share of around 6% in total FDI inflows into the country. Chemicals sector was ranked at sixth position following electrical equipments, services sector, telecommunication, transportation and fuels.

Table 10
INVESTMENT PROPOSALS IN INDIAN CHEMICAL INDUSTRY

| Sl. No | Sector | Investment Proposals (Rs. Crores) | Share in Total Investment Proposals |
|-----------------------------------|-----------------------------------------------------------|-----------------------------------|-------------------------------------|
| 1 | Metallurgical Industries | 512652 | 21.07 |
| 2 | Electrical Equipments | 313883 | 12.90 |
| 3 | Chemicals (Other than Pharmaceuticals and fertilizers) | 274486 | 11.28 |
| Total Investment Proposals | | 2432713 | 100.00 |

SOURCE: SIA Statistics, December 2006, Secretariat for Industrial Approvals, Department of Industrial Policy and Promotion, Government of India.

Table 11
FDI IN INDIAN CHEMICAL INDUSTRY

| Sl. No | Sector | FDI Inflows (US\$ Million) | Share in Total FDI Inflows |
|---------------|---------------------------------------------------------------------------|---------------------------------------|---------------------------------------|
| 1 | Electrical equipments (including computer software and electronics) | 6712.26 | 17.49 |
| 2 | Services Sector | 5235.43 | 13.64 |
| 3 | Telecommunications | 3797.54 | 9.89 |
| 4 | Transportation | 3460.31 | 9.01 |
| 5 | Fuels (Power & Oil refinery) | 2731.65 | 7.11 |
| 6 | Chemicals (Other than Pharmaceuticals and fertilizers) | 2238.84 | 5.83 |
| | Total FDI (excluding acquisition of shares and stock swaps) | 38382.82 | 100.00 |

SOURCE: SIA Newsletter, November 2006, Secretariat for Industrial Approvals, Department of Industrial Policy and Promotion, Government of India.

GOVERNMENT INITIATIVES AND POLICIES

The Government has been announcing a number of measures to improve the competitiveness of the Indian chemical industry. These include: 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 upgradation 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. PCPIR would reap the benefits of co-siting, networking and greater efficiency through use of common infrastructure and support services. Such an industrial complex would boost manufacturing activities, augment exports and generate employment.

Government is a signatory to Chemicals Weapons Convention, which is an universal, non-

discriminatory, multilateral Disarmament Treaty that bans the development, production, acquisition, transfer, use and stockpile of all chemical weapons. India has passed the Chemical Weapons Convention Act, 2000, which has

come into force in 2005. Necessary rules, to facilitate the implementation of the Act have also been notified. The Government is taking steps to create awareness in the industry about its obligations, under the Chemical Weapons Convention, by

Table 12
LIST OF CHEMICAL ITEMS RESERVED FOR SSI SECTOR

| Sl. No | Item |
|--------|------------------------------------------------------------------------------------------------------|
| 1. | Water soluble wood preservative based on copper chrome arsenic boric compounds |
| 2. | Dyestuff – Basic dyes |
| 3. | Azo dyes |
| 4. | Naphthols |
| 5. | Phthalocyanine Blue (except for captive consumption for manufacture of Phthele Cyanine green) |
| 6. | Reactive dyes |
| 7. | Fast colour bases |
| 8. | Pyrasolones |
| 9. | Potassium citrate – industrial grade |
| 10. | Diethyl phthalate |
| 11. | Diocetyl phthalate |
| 12. | Niacinamide |
| 13. | Paint dryers-Napthhenates octoates linolcates etc., of lead, cobalt, manganese, zinc, calcium, etc., |
| 14. | Chlorinated paraffin wax (upto 60% of chlorine content) |
| 15. | Lanolin anhydrous |
| 16. | Turpentine by steam/hydro-distillation process |
| 17. | PVC compounds |
| 18. | Alkyd resins (except for captive consumption) |
| 19. | Potassium nitrate produced from salt petre |
| 20. | Barium carbonate |
| 21. | Copper sulphate - other than manufactured as primary producer as a by-product |
| 22. | Zinc sulphate-other than manufactured as primary producer as a by-product. |
| 23. | Magnesium sulphate |
| 24. | Sodium silicate |
| 25. | Calcium silicate |

SOURCE: Ministry of Small Scale Industries, Agro and Rural Industries, Government of India.

Box 6

INDIA: A SIGNATORY TO CHEMICAL WEAPONS CONVENTION

The Chemical Weapons Convention is a universal, non-discriminatory, multilateral Disarmament Treaty, which bans the development, production, acquisition, transfer, use and stockpile of all chemical weapons. The convention is being implemented by the Organization for the Prohibition of Chemical Weapons (OPCW) located in The Hague. The Convention permits commercial production of those chemicals, which are used for non-prohibited purposes. The Convention identifies toxic chemicals on three schedules:

1. Schedule – 1 lists chemicals that are produced and stockpiled as chemical weapons;
2. Schedule – 2 contains such precursors, which pose significant risk to the objective and purpose of the Convention, since these chemicals are capable of generating Schedule 1 chemicals.
3. Schedule – 3 lists dual-purpose chemicals that have a large number of legitimate civilian, commercial applications and which could also be used for purposes of developing chemical weapons.

India is a signatory to this convention. To be able to discharge the obligations under the Convention, each country is required to have a domestic legislation, which makes the mandatory filing of correct information about various activities in scheduled chemicals. India has passed the Chemical Weapons Convention Act, 2000, which has come into force in 2005. Necessary rules, to facilitate the implementation of the Act have also been notified.

Declarations and verifications are the two important aspects for implementation of the Convention. Each nation is required to make annual declarations of the production, import and export of the scheduled chemicals and their production facilities. Declarations in respect of relatively large number of plant sites producing other Discrete Organic Chemicals are also required to be made. India has been making declarations within the prescribed time frame.

Inspections are routinely conducted by the OPCW to ensure that the activities in schedule chemicals are in accordance with the provisions of the Convention. Ministry of Chemicals and Fertilisers is taking steps to create awareness in the industry about its obligations, under the Chemical Weapons Convention, by organizing a number of awareness programmes all over the country.

SOURCE: Department of Chemicals and Petrochemicals, Ministry of Chemicals and Fertilizers, Government of India

organizing a number of awareness programmes all over the country.

INDUSTRY INITIATIVES

Indian Chemical Council (ICC - also known as Indian Chemical Manufacturers Association) is the nodal point / signatory representing India under the Responsible Care Initiative. ICC has prepared codes, guidance notes for implementation of process safety, employee health and safety, pollution prevention, emergency response and product safety. ICC is continuously interacting with regulatory bodies on various issues like emergency preparedness, and safe transportation of hazardous chemicals. Member companies of ICC are encouraged to dialogue with local communities and groups such as students, teachers, fire / police personnel. Nearly 100 member firms of ICC have signed up indicating their commitment to the Responsible Care Initiative. Self-assessment reports are being obtained from Responsible Care companies. However, external auditing has not been introduced, although many firms are interested in getting external audit.

FIRM LEVEL INITIATIVES

At firm level too, several initiatives are being taken to strategically position in the global market place. Indian chemical firms have strived to increase their market share

through global presence. One of the leading firms in the agro-chemical sector has acquired several manufacturing facilities in both developed and developing country markets. Through such acquisitions, strategic alliances and establishment of subsidiaries, the firm has built a network across the globe and strategically positioned for continuous expansion, backward / forward integration, brand development, product registration and aggressive marketing.

Indian chemical firms have in place technical agreements with multinational firms to keep abreast of the technological development in the global chemical industry, and to explore possibilities of adapting the technology to meet the specific requirements of the Indian market. Such a strategy helped the firms to have continuous upgradation in technology, resulting in a wide and superior product portfolio.

Managing supply chain in international marketing is another strategy adopted by Indian chemical firms. A firm manufacturing oleo chemicals has adopted various supply chain management strategies, such as having bulk storage tanks with leading ship-lines, custom built rail/road tankers exclusively for its bulk products and warehousing facilities for packaged goods in various places, supported by vast distributor network, to manage the supply chain in international markets.

Strategies have also been adopted by Indian chemical firms to cut down cost of production through leveraged buy-out for sourcing cost efficient raw materials and solutions for energy efficiency. A leading soda ash manufacturing firm bought a manufacturing facility in Romania to tap the natural resources available in east and central European countries and to become low cost producer of soda ash. The firm through innovative use of coke briquettes made from coke fines (rather than using the expensive metallurgical coke) in its kilns has also brought down the cost of energy. Another leading manufacturer of acetyls is using molasses based production process, in which molasses is used as feedstock. Such innovation in manufacturing process has helped the firm in overcoming the cost cycles that affects the chemical industry worldwide.

Some Indian chemical firms are engaged in continuous research and development activities to innovate new applications to increase end user segments. A leading firm engaged in manufacture of performance polymers works closely with customers to innovate new products to suit the end users.

Several manufacturers of bulk chemicals have started focussing on moving up in the value chain to manufacture specialty chemicals. While some of them have started

separate entities for manufacture of specialty chemicals, a leading specialty chemical manufacturing firm has changed its name with the vision of re-branding from a commodity chemical manufacturer to specialty chemical manufacturer and to move up in the value chain.

Consolidation through buy-outs of brands and business is another strategy adopted by Indian chemical firms. An Indian firm manufacturing building chemicals has adopted this strategy to consolidate the market position and to enhance the range of products. The firm has also bought leading retail brands of drawing brushes and colours to enhance the market presence in retail segment.

Indian chemical firms are leveraging their manufacturing expertise and enter into contract manufacturing with multinational firms. These include custom manufacturing and private labeling. A leading chemical firm, leveraging its expertise in handling hazardous chemicals and distillation and crystallization operations, is undertaking customized synthesis of organic chemical products. The firm, equipped with advanced process equipments and analytical instruments, also undertakes research and development in areas such as agrochemicals and specialty chemicals.

The chemical manufacturers are also addressing the environmental

issues through technological solutions. Many Chlor Alkali manufacturers have moved away from Mercury Cell Technology to Membrane Cell Technology in order to be energy efficient and

environment friendly. A leading manufacturer of organic acids and pigments has established modern biological effluent treatment plant to ensure zero pollution from the entire complex.

4. ANALYSIS OF CHEMICAL IMPORTS BY MAJOR COUNTRIES AND INDIA'S EXPORT MARKETS

Analysis has been carried out to identify highly traded chemicals, based on the import data of world chemicals at SITC classification 4-digit level. The analysis revealed that in the year 2005, major chemicals traded in the world include Cyclical hydrocarbons (SITC Code 5112), Polyethylene (5711), Polycarbonates (5743), Propylene polymers (5751), Monocarboxylic acids and derivatives (5137), Acrylic hydrocarbons (5111), Acrylic monohydric alcohol (5121),

Polycarboxylic acids (5138)), Albuminoidal substances (5922), and Ether and alcohol peroxide (5161). Analyses have been carried out in these product groups to know about the major importers of each product groups, their source countries for imports, as also India's exports and major export markets.

World imports of **cyclical hydrocarbons** are estimated to be US\$ 30 billion in 2005. Major

Exhibit 21
MAJOR IMPORTERS OF CYCLICAL HYDROCARBONS (SITC CODE 5112) AND THEIR SOURCE COUNTRIES

| Major Importers | Imports (US\$ Mn) in 2005 | Major Source Countries | | | | | | | | | | | |
|-----------------|---------------------------|------------------------|-------|-----|--------------|-----------|-------------|---------|----|--------|--------|-----------|-------|
| | | Korea | Japan | USA | Saudi Arabia | Singapore | Netherlands | Germany | UK | Canada | Brazil | Argentina | China |
| World | 29987 | | | | | | | | | | | | |
| China | 5595 | | | | | | | | | | | | |
| Taiwan | 3189 | | | | | | | | | | | | |
| Belgium | 2712 | | | | | | | | | | | | |
| USA | 2321 | | | | | | | | | | | | |
| Korea | 2072 | | | | | | | | | | | | |

SOURCE: COMTRADE, International Trade Centre, Geneva.

importers are China, Taiwan, Belgium, and USA. China and Taiwan have mainly sourced from Japan and South Korea. While Belgium has sourced from other EU countries such as Netherlands, Germany and UK; USA has sourced from Canada and Korea. India's exports of cyclical hydrocarbons in 2005 amounted to US\$ 815 million. India's share in global trade of cyclical hydrocarbons was around 2.7% in 2005. India has exported cyclical hydrocarbons mainly to Indonesia, Pakistan and Singapore. India may explore possibilities of increasing its exports to EU and USA.

Polyethylene imports by the world in 2005 are estimated to be US\$ 28 billion. Major importers of

polyethylene are China, Germany and USA. China has sourced its import requirements mainly from Asian countries such as Korea, Saudi Arabia and Malaysia; while Germany has sourced from EU partners, USA has primarily sourced from Canada. India exported US\$ 267 million worth of polyethylene in 2005. With such a level of exports, India accounted for around 1% of global imports of polyethylene. Major market for India's exports is China, which accounted for about 56% of India's total exports of polyethylene. However, India's share in total imports of polyethylene by China amounted to only 4%. India may explore possibilities of increasing its exports to Germany and USA.

Exhibit 22
MAJOR IMPORTERS OF POLYETHYLENE (SITC CODE 5711) AND THEIR SOURCE COUNTRIES

| Major Importers | Imports (US\$ Mn) in 2005 | Major Source Countries | | | | | | | | | | | | | | | |
|-----------------|---------------------------|------------------------|--------------|----------|--------|-----------|-------------|---------|--------|--------|---------|--------|----------|---------|--------|-------|----|
| | | Korea | Saudi Arabia | Malaysia | Taiwan | Singapore | Netherlands | Belgium | France | Sweden | Austria | Canada | Thailand | Germany | Brazil | Japan | UK |
| World | 28211 | | | | | | | | | | | | | | | | |
| China | 3717 | | | | | | | | | | | | | | | | |
| Germany | 2035 | | | | | | | | | | | | | | | | |
| USA | 2011 | | | | | | | | | | | | | | | | |
| Italy | 1817 | | | | | | | | | | | | | | | | |
| Belgium | 1645 | | | | | | | | | | | | | | | | |

SOURCE: COMTRADE, International Trade Centre, Geneva.

Exhibit 23
MAJOR IMPORTERS OF POLYCARBONATES (SITC CODE 5743) AND THEIR SOURCE COUNTRIES

| Major Importers | Imports (US\$ Mn) in 2005 | Major Source Countries | | | | | | | | | | | | | | | |
|-----------------|---------------------------|------------------------|-------|----------|-------|-----|--------|--------|-----------|-------------|---------|-------|-------|--------|---------|----|-------|
| | | Taiwan | Japan | Thailand | Korea | USA | Canada | Mexico | Indonesia | Netherlands | Belgium | Italy | Spain | France | Germany | UK | China |
| World | 22183 | | | | | | | | | | | | | | | | |
| China | 3068 | | | | | | | | | | | | | | | | |
| USA | 1695 | | | | | | | | | | | | | | | | |
| Germany | 1243 | | | | | | | | | | | | | | | | |
| France | 1161 | | | | | | | | | | | | | | | | |
| Italy | 1149 | | | | | | | | | | | | | | | | |

SOURCE: COMTRADE, International Trade Centre, Geneva.

Global import of **polycarbonates** is valued at over US\$ 22 billion. Major importers include China, USA and Germany. China has principally sourced its imports from Asian countries such as Taiwan, Japan and Thailand. While USA has sourced from Canada, the source countries for Germany are principally EU countries such as Netherlands, Belgium and Italy. India exported polycarbonates worth US\$ 370 million in 2005. India accounted for around 2% of global imports of polycarbonates. Major markets for India's polycarbonates are USA, UAE, Saudi Arabia and Israel. USA alone accounted for one-fourth of India's total exports. India may explore possibilities of tapping markets such as China and Germany.

World import of **propylene polymers** is valued at US\$ 21 billion in 2005. Major importers of propylene polymers are China, Germany and Italy. China's major sourcing partners are Korea, Taiwan and Singapore. Germany and Italy have mainly sourced from EU countries such as Belgium, Netherlands and France. In 2005, India's exports of propylene polymers amounted to US\$ 241 million - a share of around 1% in global imports. India's major markets for propylene polymers are China, Pakistan and Vietnam. China alone accounted for around 20% of India's total exports of propylene polymers. However, India's exports of propylene polymers accounted for around 1% of China's total imports of propylene polymers. India may

explore possibilities of increasing its export of propylene polymers to China and EU countries such as Germany and Italy.

World imports of **monocarboxylic acids and derivatives** amounted to US\$ 15 billion in 2005. Belgium, China and USA are the major importers accounting for a cumulative share of around 30% in world imports. India's exports amounted to US\$ 126 million in 2005, a share of little less than 1% in global imports. Belgium has mainly imported from UK, Germany and USA; while China has imported mainly from Asian countries such as Singapore, Japan and Taiwan. USA has principally sourced from China, Japan and UK. India's major export markets are USA, China and UK.

However, India's market share was negligible in these markets. India may explore possibilities of increasing its export of monocarboxylic acids and derivatives to these markets.

World import of **acrylic hydrocarbons** is valued at US\$ 14 billion in 2005. Major importers are Belgium, Germany and USA. These three countries cumulatively accounted for over 40% of world imports in 2005. Major source countries for Belgium and Germany are European countries such as Netherlands and UK. Major source country for USA is Canada, accounting for over 70% of market share. India, in the year 2005, exported acrylic hydrocarbons valued at US\$ 98 million. Major

Exhibit 24
MAJOR IMPORTERS OF PROPYLENE POLYMERS (SITC CODE 5751) AND THEIR SOURCE COUNTRIES

| Major Importers | Imports (US\$ Mn) in 2005 | Major Source Countries | | | | | | | | | | | | |
|-----------------|---------------------------|------------------------|--------|-----------|-------|-----|---------|-------------|--------|---------|----|---------|-------|-------|
| | | Korea | Taiwan | Singapore | Japan | USA | Belgium | Netherlands | France | Austria | UK | Germany | Spain | Italy |
| World | 20758 | | | | | | | | | | | | | |
| China | 3523 | | | | | | | | | | | | | |
| Germany | 1657 | | | | | | | | | | | | | |
| Italy | 1572 | | | | | | | | | | | | | |
| Belgium | 1292 | | | | | | | | | | | | | |
| France | 1059 | | | | | | | | | | | | | |

SOURCE: COMTRADE, International Trade Centre, Geneva.

Exhibit 25
MAJOR IMPORTERS OF MONOCARBOXYLIC ACIDS AND DERIVATIVES
(SITC CODE 5137) AND THEIR SOURCE COUNTRIES

| Major Importers | Imports (US\$ Mn) in 2005 | Major Source Countries | | | | | | | | | | | | | |
|-----------------|---------------------------|------------------------|---------|-----|--------|-------------|-----------|-------|--------|----------|-------|-------|---------|--------|---------|
| | | UK | Germany | USA | France | Netherlands | Singapore | Japan | Taiwan | Malaysia | Korea | China | Germany | Mexico | Belgium |
| World | 15145 | | | | | | | | | | | | | | |
| Belgium | 1658 | | | | | | | | | | | | | | |
| China | 1413 | | | | | | | | | | | | | | |
| USA | 1181 | | | | | | | | | | | | | | |
| Germany | 1074 | | | | | | | | | | | | | | |
| Netherlands | 722 | | | | | | | | | | | | | | |

SOURCE: COMTRADE, International Trade Centre, Geneva.

markets for India's export of acrylic hydrocarbons are Taiwan, Malaysia and China, cumulatively accounting for two-third of India's exports. India

may explore possibilities of increasing its export of acrylic hydrocarbons to EU countries such as Belgium and Germany and USA.

Exhibit 26
MAJOR IMPORTERS OF ACRYLIC HYDROCARBONS (SITC CODE 5111)
AND THEIR SOURCE COUNTRIES

| Major Importers | Imports (US\$ Mn) in 2005 | Major Source Countries | | | | | | | | | | | | | | | | |
|-----------------|---------------------------|------------------------|----|---------|--------|-----|---------|--------|-------|--------|--------------|--------|--------|-------|-------|-------|--------------|----------|
| | | Netherlands | UK | Germany | France | USA | Belgium | Brazil | Czech | Canada | South Africa | Norway | Russia | Spain | Korea | Japan | Saudi Arabia | Thailand |
| World | 13919 | | | | | | | | | | | | | | | | | |
| Belgium | 3389 | | | | | | | | | | | | | | | | | |
| Germany | 1460 | | | | | | | | | | | | | | | | | |
| USA | 1162 | | | | | | | | | | | | | | | | | |
| Netherlands | 1055 | | | | | | | | | | | | | | | | | |
| Taiwan | 990 | | | | | | | | | | | | | | | | | |

SOURCE: COMTRADE, International Trade Centre, Geneva.

In 2005, global import of **monohydric alcohol** was estimated to be around US\$ 14 billion in 2005. Major importing countries are USA, China, Japan and Germany. These four countries cumulatively account for around 40% of global imports. USA has principally sourced from America region, from countries such as Trinidad and Tobago, Venezuela and Canada. China has sourced from Malaysia and Singapore, while Japan has sourced from Saudi Arabia, Brazil and Malaysia. India's export value of US\$ 125 million in 2005 accounted for around 1% of global imports of monohydric alcohol. India's exports are principally oriented towards Netherlands, USA and China. India may explore possibilities of

increasing its export of monohydric alcohol to EU countries such as Germany, and Asian countries such as Japan.

World import of **polycarboxylic acids** is estimated to be US\$ 14 billion in 2005. Major importers include China, Germany and Italy. China alone accounts for over 40% of global imports of polycarboxylic acids in 2005. China has imported mainly from Asian countries such as Korea, Taiwan and Japan. While Germany has sourced from EU countries such as UK, Italy and Netherlands; Italy has sourced from other EU countries such as Belgium, Spain and France. India's export of polycarboxylic acids in 2005 was US\$ 85 million. Major

Exhibit 27
MAJOR IMPORTERS OF ACRYLIC MONOHYDRIC ALCOHOL
(SITC CODE 5121) AND THEIR SOURCE COUNTRIES

| Major Importers | Imports (US\$ Mn) in 2005 | Major Source Countries | | | | | | | | | | | | | | | | | | |
|-----------------|---------------------------|------------------------|-----------|--------|-------------------|-------|----------|-----------|--------|--------------|-------|-----------|--------|-------------|-------------|--------|---------|--------|----|-----|
| | | Trinidad and Tobago | Venezuela | Canada | Equatorial Guinea | Chile | Malaysia | Singapore | Russia | Saudi Arabia | Japan | Indonesia | Brazil | New Zealand | Netherlands | France | Belgium | Norway | UK | USA |
| World | 13860 | | | | | | | | | | | | | | | | | | | |
| USA | 2413 | | | | | | | | | | | | | | | | | | | |
| China | 1524 | | | | | | | | | | | | | | | | | | | |
| Japan | 1058 | | | | | | | | | | | | | | | | | | | |
| Germany | 727 | | | | | | | | | | | | | | | | | | | |
| Korea | 680 | | | | | | | | | | | | | | | | | | | |

SOURCE: COMTRADE, International Trade Centre, Geneva.

markets for India's export of polycarboxylic acids are Saudi Arabia, UAE and China. India may explore possibilities of increasing its export of polycarboxylic acids to EU countries such as Germany and Italy.

World import of **albuminoidal substances** was valued at over US\$ 12 billion in 2005. Major importers are USA, Germany and Japan. These three countries cumulatively accounted for around one-fourth of total world import of albuminoidal substances in 2005. USA has mainly imported from New Zealand, Ireland and Canada. Germany has mainly imported from Netherlands, France and Switzerland. Japan has mainly imported from USA, Thailand and New Zealand. India's export of albuminoidal substances was valued at US\$ 128 million in 2005. Major

markets for India are USA, UAE and Japan. USA alone accounted for around two-third of India's export of albuminoidal substances in 2005. India may explore possibilities of increasing its export of albuminoidal substances to EU countries such as Germany.

World import of **ether and alcohol peroxide** was estimated at around US\$ 12 billion in 2005. Major importers are USA, Netherlands and Belgium. USA's main sourcing partners are Saudi Arabia, UAE and Venezuela. Netherlands has imported from mainly Germany and Saudi Arabia. Major source markets for Belgium include Netherlands, Germany and USA. India exported US\$ 70 million worth ether and alcohol peroxide in 2005. Major export markets for India were China,

Exhibit 28
MAJOR IMPORTERS OF POLYCARBOXYLIC ACIDS (SITC CODE 5138) AND THEIR SOURCE COUNTRIES

| Major Importers | Imports (US\$ Mn) in 2005 | Major Source Countries | | | | | | | | | | | | | | |
|-----------------|---------------------------|------------------------|--------|-------|-----------|----------|----|-------|-------------|---------|--------|---------|-------|--------|-------|--------|
| | | Korea | Taiwan | Japan | Indonesia | Thailand | UK | Italy | Netherlands | Belgium | France | Germany | Spain | Canada | China | Mexico |
| World | 13750 | | | | | | | | | | | | | | | |
| China | 6147 | | | | | | | | | | | | | | | |
| Germany | 875 | | | | | | | | | | | | | | | |
| Italy | 718 | | | | | | | | | | | | | | | |
| USA | 859 | | | | | | | | | | | | | | | |
| France | 435 | | | | | | | | | | | | | | | |

SOURCE: COMTRADE, International Trade Centre, Geneva.

Exhibit 29
MAJOR IMPORTERS OF ALBUMINOIDAL SUBSTANCES (SITC CODE 5922)
AND THEIR SOURCE COUNTRIES

| Major Importers | Imports (US\$ Mn) in 2005 | Major Source Countries | | | | | | | | | | | | | | | |
|-----------------|---------------------------|------------------------|---------|--------|---------|--------|-------------|-------------|-----|----------|-----------|-------|--------|-------|-------|---------|----|
| World | 12244 | New Zealand | Ireland | Canada | Germany | France | Netherlands | Switzerland | USA | Thailand | Australia | Japan | Taiwan | Korea | Italy | Belgium | UK |
| USA | 1290 | | | | | | | | | | | | | | | | |
| Germany | 1180 | | | | | | | | | | | | | | | | |
| Japan | 711 | | | | | | | | | | | | | | | | |
| China | 793 | | | | | | | | | | | | | | | | |
| France | 623 | | | | | | | | | | | | | | | | |

SOURCE: COMTRADE, International Trade Centre, Geneva.

Indonesia and Netherlands. China alone accounted for over one-third of India's exports of ether and alcohol peroxide to the world. India may

explore possibilities of increasing its export of ether and alcohol peroxide to USA and EU countries such as Belgium.

Exhibit 30
MAJOR IMPORTERS OF ETHER AND ALCOHOL PEROXIDE
(SITC CODE 5161) AND THEIR SOURCE COUNTRIES

| Major Importers | Imports (US\$ Mn) in 2005 | Major Source Countries | | | | | | | | | | | | | |
|-----------------|---------------------------|------------------------|-----|-----------|--------|--------|---------|---------|-----|-------|-------------|----|--------|-----------|--------|
| World | 11691 | Saudi Arabia | UAE | Venezuela | Brazil | Canada | Germany | Belgium | USA | Japan | Netherlands | UK | France | Singapore | Taiwan |
| USA | 1375 | | | | | | | | | | | | | | |
| Netherlands | 1045 | | | | | | | | | | | | | | |
| Belgium | 969 | | | | | | | | | | | | | | |
| China | 959 | | | | | | | | | | | | | | |
| Germany | 746 | | | | | | | | | | | | | | |

SOURCE: COMTRADE, International Trade Centre, Geneva.

The product / country analyses show that EU, USA and Japan are the leading importing regions / countries for these analysed product groups. These countries have been mostly sourcing their import requirements within the region. Since many countries in the EU are shifting their production base to other developing countries, India may endeavor to attract such manufacturing opportunities and explore possibilities of increasing its exports to European countries. It may be mentioned that in some product groups, India has been one of the major suppliers to the world. These

include insecticides (second major supplier with 13% share), hydrocarbons derivatives (ranked second with 13% share), cyclic alcohol derivatives (ranked third with 12% share), synthetic organic dyestuffs (ranked fourth with 6% share), synthetic brighteners (ranked fifth with 6% share), cyclic hydrocarbons, and fluorides (both ranked ninth with 3% and 2% share, respectively). India may leverage the advancement in manufacturing technologies in these product groups to other products, to replicate in the production of other products and become a global player across the segments.

5. CHALLENGES AND STRATEGIES

CHALLENGES

Indian chemical sector has grown a long way since its early days of independence. The sector has grown from a small-scale sector to multi-dimensional sector, which is taking on the challenges of globalization. Now, Indian chemical industry holds a recognized position in the global map; however, there are few factors, which hinders the growth of the industry. These include:

High prices of basic feed stock

Basic raw materials constitute major portion of cost of production (30% to 60%) in the chemical industry. Indian chemical industry either uses natural gas or crude oil as feedstock for manufacturing process. The fluctuations in oil prices therefore affect the growth projections of the firms. At times, the manufacturers are unable to pass-on the cost escalation (occurring due to sudden increase in oil prices) to end consumers. Cost optimization is thus critical for the chemical units, as their margins may go under pressure during oil crisis.

SSI reservation / Fragmented nature of industry

The Indian chemical industry is having a fragmented structure with more number of units in small-scale sectors spread in various parts of the country. The installed capacities in most of the small-scale units are smaller as compared to global scales. The limitation in capacity in the SSI sector put them in disadvantageous position while tapping export opportunities with large volume.

Low R&D levels

R&D intensity is assuming greater significance for many of the manufacturing segments. Since, chemical industry is a knowledge-based industry, the competitiveness of the units can be strengthened only through supply of new and innovative products. The areas for R&D in chemical industry include improvements in manufacturing process for reduction in cost of production, application development to diversify demand, and new product development. The level of R&D investments in the

Indian chemical sector is low at around 0.3% of total sales.

Low Level of ICT interface

Globally, information technology is being extensively used in several areas like chemical processing and manufacturing. Application of information technology in the chemical sector is mainly for equipment design, chemical engineering, and process simulation that has helped in reducing product and process development time. Information technology is also increasingly used in the area of R&D, especially in collaborative research. The usage of information technology in Indian chemical industry is relatively lower, as most of the units are in the small-scale sector.

Low Level of Brand Development

Indian chemical producers, excepting a few large producers, generally sell their products as generic products without brand development. There is also low level of interest amongst small-scale producers for brand development, product development as also market development.

Low Level of Common Infrastructure

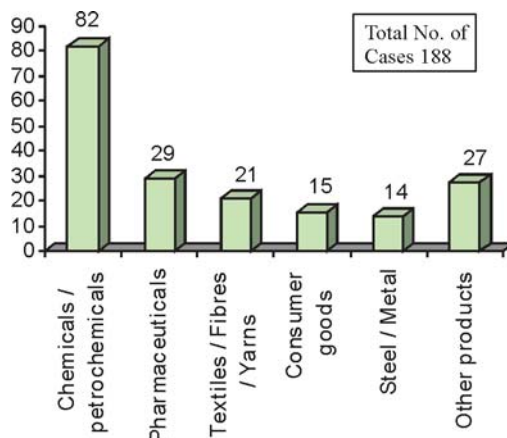
In general, due to its very nature, the chemical / petrochemical industry requires certain basic

infrastructure facilities, both in the process chain as also in the supply chain. In the process chain, the critical infrastructure requirements include a common effluent treatment plant, and an effective green belt segregating the industrial units from human settlements. In the supply chain, the critical infrastructure requirements include a good port, chemical storage terminal, and adequate berthing facilities. In the above context, it is being felt that the production and export earnings of this sector would receive a quantum jump if an industrial estate dedicated to the chemical industry could be set up. At present, each unit has to create specialized facilities on its own which leads to duplication of efforts and investment. If chemical units are clustered in close proximity, the required infrastructure could be vertically integrated resulting in cost reduction.

Environmental Regulations

Safety, health and environment protection issues are becoming important concerns for the Indian chemical industry. As with other industries, the chemical industry needs to comply with regulations such as Occupational Safety and Health and Process Safety Management regulations. Environmental safety, occupational safety and process management safety can easily be met if a firm is manufacturing large volume of single chemical. But it may not be

Exhibit 31
ANTI-DUMPING CASES INITIATED BY INDIA (1992 – 2005)



SOURCE: Ministry of Commerce and Industry, Government of India

relatively feasible for the firms who manufacture low volume and large number of chemicals in a single plant.

Dumping / Import Competition

As mentioned earlier, the chemical industry is the second largest industry that has attracted large number of anti-dumping actions in the world. In India, chemicals and petro-chemicals industry is the largest segment that has initiated anti-dumping investigations during the period 1992-2005. 82 anti-dumping cases (out of 188 cases) initiated by India fall under the category of chemicals and petro-chemicals, during this period.

STRATEGIES

Focus on Core Competence

Chemical products trade is increasingly getting specialised all over the world. Innovation is increasingly becoming an important factor to focus on core competence and to become a leading player in specialty products. In the above context, it is important for the Indian chemical manufacturers to focus on select business segments where competitive advantage exists. Such strategies would help Indian chemical manufacturers to establish relationship with their customers in profitable segments and exit non-competitive segments.

Strengthening Technological Competence

Indian chemical industry should strive for continually improving its production processes and products by investing resources in technology development. Technological development may be achieved by the chemical industry at two levels. In the bulk products segment, the chemical industry should undertake process innovation with the objective of reduction in cost of production. In addition, the industry needs to invest in technological resources that would lead to specialized product development. Liberalization process has already increased the possibility of intra-firm transfer of technology and management practices in the form of consolidation within the economy as also from developed countries through foreign direct investment.

Improving Basic Management Capabilities

Indian chemical industry has a good record of management expertise. This could be further leveraged with techniques such as Good Manufacturing Practices, Good Laboratory Practices, Total Quality Management, Total Production Management and Risk Management. The Principles of Good Laboratory Practices have been developed to promote the quality and validity of test data used for determining the

safety of chemicals and chemical products. Such practices would result in quality improvement and lower cost, thereby improving competitiveness.

Adhering to Environmental Norms

Since chemical substances are used in manufacture of consumer items such as paint, glue, insect spray, cosmetics and household cleaners, chemical producers have the responsibility in promoting safe management of substances – starting from design in production to end-use, and their final disposal (hazardous waste). Many chemical consuming countries are working towards development of inherently safer chemical products (such as less polluting solvents) and processes (such as use of renewable feed-stocks). In fact, environmental regulations were the principal reason for the relocation of manufacturing facilities from developed to developing countries. There are also instances of legislative pronouncements in many countries on the use of chemicals.

To garner a greater share in world chemicals market, Indian chemical industry needs to address various developmental issues such as sustainable chemistry, adherence to safety and health and risk management. It may be mentioned that in addition to the chemical industry, government and

community also have major role (in terms of preparedness for, and response to chemical accidents) to ensure chemical safety in a broadest sense.

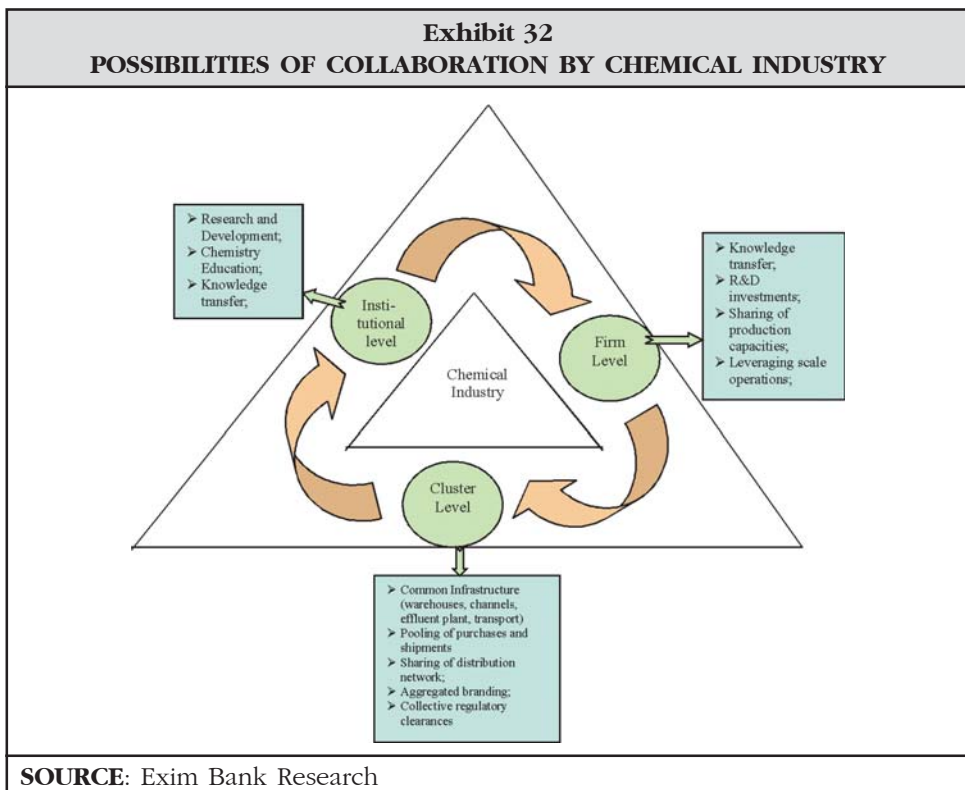
Focus on R&D

Research and Development in the chemical sector may be undertaken in areas such as:

- Product development;
- Process innovation;
- Equipments for production; and
- Research related to application/ safe use of chemicals.

Indian chemical industry needs to focus on R&D in one or multiple

areas. While R&D remains an universal imperative, its purpose and nature varies across segments. The basic chemical sector should focus on process innovation and product development and strengthen their competitiveness through improvements based on performance and quality of products. Firms in knowledge based chemical sector should focus on R&D with the objective of achieving product leadership and process innovations. The petrochemical sector should focus on application R&D, as new applications have to be identified to increase use and application of polymers.



Collaboration

The chemical industry needs to enhance their collaborative efforts in order to improve competitiveness. Collaboration amongst players in the chemical industry could happen both at cluster level (for sharing of common infrastructure) as also at firm level (for sharing of knowledge and technology). Collaboration with firms across borders for technology and investment would also give a boost to the industry. In addition, the players should also achieve greater level of industry-institutional partnership for knowledge development and sharing.

Increasing ICT interface

Chemical firms in India can gain a lot by making their manufacturing process IT-enabled. Information Technology (IT) can bring a good change in entire process cycle from technology, engineering and procurement to manufacturing, by integrating them with business processes in all these areas. This will eventually result in higher efficiency for the industry. Increasing use of IT to transact business will also help the sector, as most of the products in the chemical sector are commoditised.

Consolidation

The new trend in chemical industry is competing through consolidation. Chemical firms, through mergers

and alliances are now achieving economies of scale all over the world. Consolidation helps the chemical industry in reduction of cost in their procurement and production. Such consolidation exercises also provide for reduction in overheads, marketing expenses, increased efficiencies in supply chain management, and enhanced presence in various regions. An analysis of the global chemical industry shows that mergers and acquisitions have helped the combined entities consolidate their position in the market and enhance their revenues. It is important for Indian chemical industry to consolidate their operations and emerge as global winners.

Industry - Academia Linkages

For transforming ideas into new products, partnership between industry and academia is a must. Thus, Indian chemical industry should leverage the potential of educational and research institutions to source intellectual as well as human capital. Such linkages may be effectively used for setting up of in-house R&D facility or for outsourcing R&D activities. The educational institutions could play a greater role for development of Indian chemical industry by offering courses and conducting research proactively. The research and academic institutions may also open local offices within chemical clusters to facilitate greater level of interactions.

Marketing and Promotion

Indian chemical industry should increasingly focus on marketing and promotion to achieve greater share in global chemical trade. The industry may endeavour to concentrate more on issues such as brand building, export promotion and market development. These aspects can be easily tackled through adoption of superior process technologies and adhering to quality and environmental standards.

Setting up of Chemical Parks or Mega Chemical Estates

In order to address the issue of capacity expansion and for creation of common infrastructure, the chemical industry, in association with the Government may establish exclusive Chemical Parks – a concept similar to the Software / Hardware Technology Park. It is also important to consider establishment of exclusive Chemical Zones on the lines of Special Economic Zones to give a fillip to the industry. In such Parks / Zones, the industry may be encouraged to set up mega chemical plants that could contribute to increased production as well as employment generation. The Government has already initiated policies for setting up of integrated Petroleum, Chemicals and Petrochemicals Investment Regions (PCPIR).

De-reservation of Select Chemical Production

Many chemical products are still reserved for production under small-scale sector. However, cost-competitiveness as well as technological compliance cannot be achieved without operating under scale economies. Most of the firms operating at the global level are big ones and enjoy economies of scale. De-reservation of chemical products reserved for production under small-scale sector can be a good measure to support the globalisation efforts of the industry.

Creation of Modernization Fund

A modernization fund on the lines of technology upgradation fund established for the textile sector may be created to strengthen the technological competence of the industry.

Increasing Consumption Levels of Chemicals

Per capita chemical consumption in India is low as compared to world standards (estimated to be one-tenth of world average). Increasing consumption level in the domestic market would ignite the prevailing latent demand. This could be achieved through increasing applications through R&D and enhancing the knowledge of end consumers. The industry, thus, has a major role in increasing the per capita consumption level in the domestic market.

6. OUTLOOK

Indian chemical industry has come a long way. Today, India has significant presence in production of basic organic and inorganic chemicals, pesticides, paints, dyestuffs and intermediates, petrochemicals, fine and specialty chemicals, cosmetic and toiletry product segments. Thus, by virtue of its diversity, the chemical industry bears a close correlation not only with the quantum of overall economic growth but also with the contents and quality of growth. On the one hand, the range of products of the industry's constituent segments are used in most productive activities, and on the other, the chemical industry's diversity relates to the pattern of demand to the changing standards of living. Specific to mention is the significant contribution of Indian chemical industry for the growth of India's agriculture and healthcare sectors.

The performance and outlook of the chemical industry, particularly in the context of India's development process, depends upon and determines the trends in the overall economy, as also the linkages with the rest of the world in terms of

international trade, investment flows and technology transfers. On the domestic front, with the reduction in tariffs, Indian chemical companies with strong systems and organized operations are likely to be benefited further. Companies with competitive advantages, like having competence in the areas of high value added chemicals, conforming to international quality standards, could translate their capabilities and establish a dominant presence in both international and domestic markets.

In the years to come, various new avenues are likely to arise in chemical industry like structural transformation, strategic marketing alliances with multinationals and trading companies for domestic sales and exports, stricter enforcement of good manufacturing practices, opportunity for value addition using contract manufacturing or contract research.

Use of advanced technology, strong research capabilities, backward and forward linkages and development of domestic capacity to reduce dependence on imported

raw materials are key success factors for Indian chemical industry. In addition, safety, health and environment protection issues are becoming important challenges for the Indian chemical industry. Indian manufacturers are addressing such challenges in an organized way.

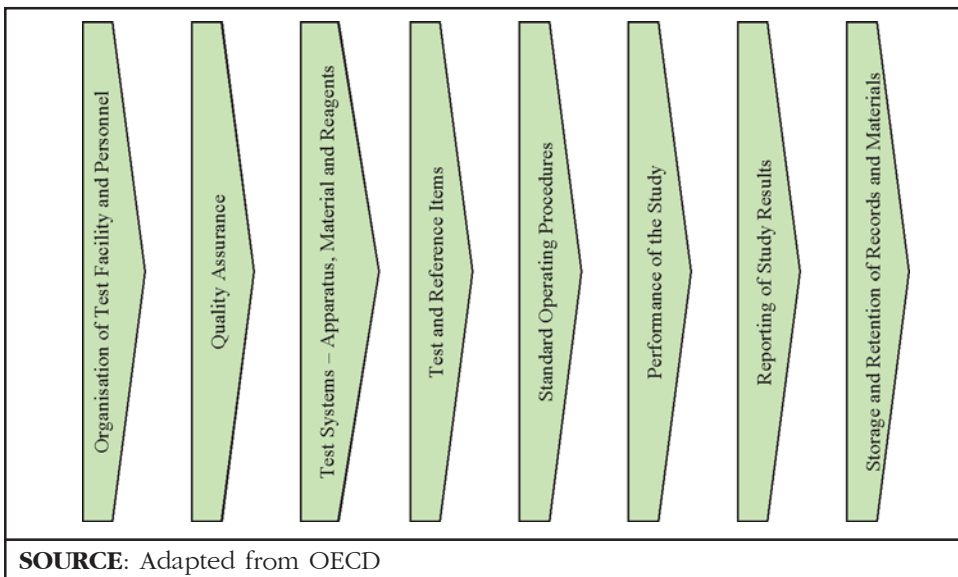
Indian chemical industry has major strengths in basic research facilities available with CSIR laboratories such as National Chemical Laboratory, Indian Institute of Chemical Technology, as also corporate R&D centers. This ensures that development of process know-how, plant process design, detailed engineering design, commissioning assistance and even consultancy for re-engineering are available at low cost.

The need for globalisation has made many Indian chemical companies enter into strategic alliances or merge operations to achieve economies of scale. Foreign collaboration is also bringing solutions for clean technology, process consultancy, feedstock linkages, R&D, waste management,

safe manufacture and environmental protection. In addition, Indian chemical companies are attempting to achieve global standards by improving productivity through various measures such as better raw material utilisation, bi-product reduction and use, energy reduction and conservation, effluent management, water management, upgradation of plant and equipment, skill development.

The International Council of Chemical Associations (ICCA), an association representing 80% of the world manufacturers of chemicals has reiterated its support for a new round of multilateral trade negotiations in the World Trade Organization. ICCA's priorities include elimination of chemical tariffs by the year 2010, harmonization of anti-dumping practices, simplification of customs procedures and full implementation of TRIPs agreement. While the harmonization of anti-dumping practices would benefit developing countries like India, the tariff-free world would pose stiff competition.

ANNEXURE 1: SELECT PRINCIPLES OF GOOD LABORATORY PRACTICES



ANNEXURE 2: ANTI-DUMPING CASES INITIATED BY INDIA AGAINST VARIOUS COUNTRIES IN THE CHEMICAL SECTOR (1992-2005)

| Sl. No | Item | Country |
|--------|-----------------------------------|------------------------------------------------------------------------------------------|
| 1 | PVC Resin | Brail, Korea, Mexico and USA |
| 2 | Potassium Permanganate | China |
| 3 | Trimethoxy Benzaldehyde | China |
| 4 | Acrylonitrile Butadiene Rubber | Japan |
| 5 | Sodium Ferrocyanide | China |
| 6 | Dead Burnt Mangnesite | China |
| 7 | Low Carbon Ferro Chrome | Russia, Kazakhstan, Ukraine |
| 8 | Acrylonitrile Butadiene Rubber | Germany, Korea |
| 9 | Catalysts | Denmark |
| 10 | Purified Terephthalic Acid (PTA) | Korea, Thailand & Indonesia |
| 11 | Polystyrene | Korea, Japan, Taiwan & Malaysia |
| 12 | Calcium Carbide | China, Malaysia and Romania |
| 13 | Para Tert Butyl Catechol (PTBC) | France |
| 14 | Citric Acid | China |
| 15 | Styrene Butadiene Rubber | China, Korea, Turkey, Japan, Taiwan, USA, Germany and France |
| 16 | Low Carbon Ferro Chrome (LCFC) | China, South Africa & Macedonia |
| 17 | Poly Tetra Fluoro Ethylene (PTFE) | Russia |
| 18 | Acrylonitrile Butadiene Rubber | Taiwan |
| 19 | Sodium Cyanide | USA, Germany, Czech, Korea |
| 20 | Polystyrene | China, Hong Kong, Singapore & Thailand |
| 21 | Barium Carbonate | China |
| 22 | Pure Terephthalic Acid (PTA) | Spain |
| 23 | Soda Ash | China |
| 24 | Oxo Alcohols | Poland, South Korea, Russia, Iran, USA, European Union, Indonesia and Saudi Arabia |
| 25 | Aniline | Japan & USA |

(Contd...)

| <i>(Contd...)</i> | | |
|-------------------|----------------------------------------|-------------------------------------------------------|
| Sl. No | Item | Country |
| 26 | Sodium Nitrite | China |
| 27 | Sodium Ferrocyanide | European Union |
| 28 | Caustic Soda | Iran, Saudi Arabia, USA, France & Japan) |
| 29 | Aniline | European Union |
| 30 | Strontium Carbonate | China |
| 31 | Phosphoric Acid | China |
| 32 | Potassium Permanganate | China, Hong Kong and Taiwan |
| 33 | Sodium Hydrosulphite | China |
| 34 | Zinc Oxide | China |
| 35 | Choline Chloride | China and EU |
| 36 | High Styrene Butadiene | Poland and EU |
| 37 | 2-Methyl (5) Nitro Imidazole | China |
| 38 | Hexamine | Saudi Arabia and Russia |
| 39 | Zinc Oxide | Nepal |
| 40 | Flexible Slabstock Polyol | USA, Japan, Singapore & EU |
| 41 | Poly-Iso-Butylene | EU, Brazil, Japan, Korea, Singapore and Thailand |
| 42 | D (-) Para Hydroxy Phenyl Glycine base | China & Singapore |
| 43 | Caustic Soda | Qatar |
| 44 | Sodium Nitrite | EU, Taiwan |
| 45 | Isopropyl Alcohol | Singapore, USA, EU & China |
| 46 | Pentaerythritol | Canada, Taiwan & Japan |
| 47 | Hydrofluoric Acid | China |
| 48 | Acyclic Alcohols (Oxo Alcohol) | Singapore, Brazil, Romania, Malaysia and South Africa |
| 49 | Vinyl Acetate Monomer | Iran and Singapore |
| 50 | Phenol | EU, Singapore and South Africa |
| 51 | Sodium Tripoly Phosphate | China and Taiwan |
| 52 | D (-) Para Hydroxy Phenyl Glycine Base | European Union |
| 53 | Citric Acid | Indonesia & Thailand |
| 54 | Ammonium Nitrate | Russia and Iran |

(Contd...)

(Contd...)

| Sl. No | Item | Country |
|--------|-------------------------------------------------------|---------------------------------------------|
| 55 | Caustic Soda | Taiwan, Indonesia and EU (excluding France) |
| 56 | D (-) Para Hydroxy Phenyl Glycine Methyl Dane Salt | China and Singapore |
| 57 | Hexamine | Iran |
| 58 | Methylene Chloride and Singapore | European Union, South Africa |
| 59 | Isopropyl Alcohol | Singapore, USA, Netherlands |
| 60 | Sodium Hydrosulphite | Germany and Korea |
| 61 | Caustic Soda | China and Korea |
| 62 | Borax Decahydrate | China and Turkey |
| 63 | Potassium Carbonate | EU, China, Korea and Taiwan |
| 64 | Titanium Dioxide | China |
| 65 | Methylene Chloride | Korea |
| 66 | Toluene Di-Isocyanate | Taiwan, EU, Japan, Korea and USA |
| 67 | Melamine | China |
| 68 | 6-Hexanelactam (Caprolactum) | Japan, EU, Nigeria and Thailand. |
| 69 | Flexible Slabstock Polyol | China, Korea, Taiwan and Brazil |
| 70 | Cyclohexanone | Taiwan, EU and USA |
| 71 | Propylene Glycol | USA, Singapore, Korea and EU |
| 72 | Poly Vinyl Chloride (PVC) Paste Resin | Korea, Saudi Arabia, EU |
| 73 | Rubber Chemicals | China |
| 74 | Rubber Chemicals | EU, Taiwan, USA |
| 75 | Acrylonitrile Butadiene Rubber | EU (excluding Germany) Brazil & Mexico |
| 76 | Sodium Cyanide | Taiwan |
| 77 | Citric Acid | China, Ukraine and Korea |
| 78 | Polytetrafluoroethylene (PTFE) | China |
| 79 | Sodium Formaldehyde Sulphoxylate (SFS) | China |
| 80 | Ethylene-Propylene-Non-Conjugated Diene rubber (EPDM) | European Union, USA, China and Brazil |
| 81 | Pentaerythritol | China and Sweden |
| 82 | Para Cresol | China |

SOURCE: Anti-Dumping Cases in India – Product Profiles, Ministry of Commerce and Industry, Government of India

ANNEXURE 3: MFN APPLIED AND BOUND TARIFFS FOR CHEMICALS AND PRODUCTS IN SELECT CTHA* COUNTRIES

| Sl. No | Select CTHA Countries | Average Applied Duty (%) | Average Bound Duty (%) |
|--------------------------------------------------|------------------------------|---------------------------------|-------------------------------|
| 1. | Australia | 1.8 | 9.0 |
| 2. | Bulgaria | 7.3 | 11.6 |
| 3. | Canada | 2.8 | 4.4 |
| 4. | China | 6.8 | 6.7 |
| 5. | Ecuador | 7.5 | 11.1 |
| 6. | EU | 4.5 | 4.6 |
| 7. | Hong Kong | 0.0 | 0.0 |
| 8. | Japan | 2.6 | 24.7 |
| 9. | Jordan | 2.6 | 5.0 |
| 10. | Republic of Korea | 5.8 | 5.8 |
| 11. | Mongolia | 5.0 | 5.8 |
| 12. | New Zealand | 12.9 | 21.7 |
| 13. | Norway | 0.0 | 2.5 |
| 14. | Panama | 4.1 | 6.1 |
| 15. | Qatar | 4.8 | 7.6 |
| 16. | Singapore | 0.0 | 5.1 |
| 17. | Taiwan | 3.3 | 2.8 |
| 18. | UAE | NA | 7.1 |
| 19. | USA | 3.2 | 2.9 |
| * CTHA – Chemical Tariff Harmonisation Agreement | | | |
| SOURCE: World Trade Organisation. | | | |

ANNEXURE 4: LIST OF COUNTRIES THAT HAVE JOINED THE RESPONSIBLE CARE INITIATIVE

America Region

Argentina
Brazil
Canada
Chile
Colombia
Ecuador
Mexico
Peru
Venezuela
Uruguay
USA

Africa Region

Morocco
South Africa

Asia-Pacific

Australia
Hong Kong
India
Indonesia
Japan
Korea
Malaysia
New Zealand
Philippines
Singapore
Taiwan
Thailand

West Asia

Israel
Turkey

European Union

Austria
Belgium
Bulgaria
Czech Republic
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Ireland
Italy
Latvia
Lithuania
Netherlands
Poland
Portugal
Slovakia
Spain
Sweden
UK

Other European Countries

Norway
Switzerland

SOURCE: International Council of Chemical Associations

ANNEXURE 5: MEGA DEALS IN GLOBAL CHEMICAL SECTOR IN 2005

| Target Name | Acquirer | Value of Transaction (US \$ Bn) | Ultimate Seller |
|----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------|----------------------------|
| Innovene | INEOS | 9.00 | BP |
| IMC Global | Access Industries | 5.70 | BASF, Royl |
| | The Chatterjee Group | | Dutch Shell Group |
| Lanxess | Existing shareholders | 3.21 | Bayer |
| Borealis Petrochemicals Group | International Petroleum Investment Company (IPIC) OMV | 2.01 | Statoil |
| UCB (surface specialty business) | Cytec Industries | 1.84 | UCB |
| Dyno Nobel (formerly Dyno Industrier) | Macquarie Bank | 1.70 | Ensign-Bickford Industries |
| Great Lakes Chemical Corporation | Crompton Corporation | 1.55 | Shareholders |
| Thai Petrochemical Industry (61.5%) | PTT (31.5%), Vayupak Fund (10%), Government Pension Fund of Thailand (10%), Government Savings Bank (10%) | 1.41 | Creditors |
| Seminis | Monsanto | 1.40 | Fox Paine |
| Huntsman Corporation | Market Purchase | 1.40 | Huntsman Corporation |
| Chr. Hansen (food ingredients) | PAI Partners | 1.34 | Chr. Hansen |
| British Vita | Texas Pacific Group (UK) | 1.28 | British Vita |
| Wacker-Chemie | Dr. Alexander Wacker Familiengesellschaft mbH | 1.24 | Hoechst |
| Flink Ink Corporation | CVC Capital Partners, XSYS Print Solutions | 1.21 | Family Flint |
| BP Solvay | BP | 1.05 | Solvay |
| SOURCE: PriceWaterHouseCoopers, Mergers and Acquisitions Activity in the Global Chemicals Industry 2003-2005. | | | |

ANNEXURE 6: SELECT FOREIGN ACQUISITIONS BY INDIAN COMPANIES IN THE CHEMICAL SECTOR

| Target Company | Country | Acquirer | Activity | Value (US\$ Million) |
|------------------------------------------------------------------------------------------------------------------|--------------|------------------------------------------------------------|---------------------------|----------------------|
| SCIB Chemicals SAE | Egypt | Asian Paints | Paints | 5.00 |
| 25% stake in midland fumigations | USA | United Phosphorous | Pesticides | NA |
| 50% stake in KAW Valley Corp. | USA | United Phosphorous | Pesticides | NA |
| Dashiqiao Chemical Company | China | AV Birla Group | Carbon Black | 8.51 |
| Oryzalin Herbicide Business of Dow Agrosience | USA | United Phosphorous | Agrochemicals | 21.30 |
| Aciflorfen Compound of BASF | Germany | United Phosphorous | Pesticides | NA |
| Taubmans Paints (Fiji) | Fiji | Asian Paints | Paints and Varnishes | 1.40 |
| Cropserve | South Africa | United Phosphorous | Caustic Soda | NA |
| AG Value Inc | USA | United Phosphorous | Pesticides | 35.75 |
| Basell | USA | Purendu Chatterjee (along with US based Access Industries) | Petrochemicals | NA |
| Trinity Laboratories Inc (64%) | USA | Jubilant Organosys Ltd | Chemicals | 12.25 |
| C6 | Manchester | Dishman Pharmaceuticals and Chemicals | Chemicals | 20.00 |
| Reposo | Argentina | United Phosphorous | Crop Protection chemicals | 11.00 |
| UCC | Dubai | Pidilite Industries | Construction | |
| Chemicals | NA | | | |
| Chemson Asia (75%) | Singapore | Pidilite Industries | Chemicals | NA |
| Brunner Mond Group Ltd. (63.5%) | UK | Tata Chemicals | Chemicals | NA |
| Kansas (Soap Unit) | USA | VVF Ltd | Oleo Chemicals | NA |
| Cerexagri | France | United Phosphorous | Agrochemicals | 135.00 |
| Sintesis Quimica | Argentina | Punjab Chemicals | Chemicals | 10.00 |
| SOURCE: Compiled from Mergers and Acquisitions, March 2007; Centre for Monitoring Indian Economy, Mumbai. | | | | |

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