Chemical Industry-In the Indian Context

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ABSTRACT

Asia is emerging as a key player in the development of global chemical industry in the world and India is being considered one of the most promising countries within this region. Chemical industry is one of the oldest industries in India and contributes significantly towards industrial and economic growth of the nation. India is the third-largest producer of chemicals in Asia, after China and Japan. However, when it comes to overall contribution to global chemicals, it contributes only 3 per cent of the overall GDP. The Government of India has already highlighted the importance of this sector and prepared a plan to develop the industry to its maximum capabilities. Subgroups including Petrochemicals and Organic Chemicals, Chlor-Alkali & Inorganic Chemicals, Speciality Chemicals including Dyestuffs and Dye intermediates, Pesticides and Agrochemicals, Pharmaceuticals Intermediates, etc. will all play a vital role in the overall enlargement of the industry. Further, Indian government has set ambitious plans to set up Petroleum, Chemicals & Petrochemicals Investment Regions (PCPIR) in Gujarat, Andhra Pradesh, West Bengal and Odisha to accelerate the country's industrial growth. This study is attempted to know the contribution of chemical industry in economic development of India and to examine the safety measures implemented by chemical industries in India and the paper also visualise the production performance of developing and developed regions.

Key words: chemical Industry, Chemical Industry Output, International Trade, Indian Chemical Council, India Chem.

INTRODUCTION

Chemical industry is one of the oldest industries in India. It is the 6th largest in world and 3rd largest in Asia which contributes around 7 percent of the Indian GDP. The exact number of chemicals on the global market is not known but under the pre-registration requirement of the European Union's chemicals regulation, REACH, 143,835 chemical substances have been pre-registered.

The chemical industry is a multiproduct and multi-faceted one. The firms in this industry produce intermediate products such as industrial gases, organic and inorganic acids bases, dyes and pigments intermediaries, salts, metals, compounds and other minerals that are needed as inputs in other

industries including Leathers, Textiles, Paper , Plastics, Rubber, Pharmaceuticals, Food processing and Chemical itself. The chemical industry is among the fastest growing ones in India. The bulk of chemicals produced in India comprise either upstream products or intermediates.

CHEMICAL INDUSTRY AT A GLANCE

Growing at an average rate of 12.5 percent, the Indian chemical industry offers a wide spectrum of opportunities for the investors both from India and the world. The significant market potential, coupled with the existing pool of human resources, and the comprehensive variety of resources in the country make its profitable destination in the new millennium. In the world production of chemicals, Indian industry stands at 12th position. The Indian Chemical Industry has come out of its protected market since liberalization. Although the maximum customs duty is 7.5 percent as a result of number of Free Trade Agreements (FTAs) signed recently the actual duty protection to the chemical industry is significantly lower.

The Indian Chemical industry comprises both small scale and large scale units. Currently, Indian Chemical Industry is the midst of a phase of major restructuring and consolidation. With the shift in emphasis on product innovation, brand building and environmental friendliness, this industry is increasingly moving towards greater custom orientation.

According to National Industrial Classification (NIC) 2004, chemical and chemical products are covered under the industry group 24. The description of product groups under this group is given Table 1

Table 1 - Description of Product Groups

Class	Description
2411	Manufacture of basic chemicals except fertilizers and nitrogen compounds
2412	Manufacture of fertilizers and nitrogen compounds
2413	Manufacture of plastics in primary forms and of synthetic rubber
2421	Manufacture of pesticides and other agrochemical products
2422	Manufacture of paints, varnishes and similar coatings, printing ink and mastics.
2423	Manufacture of pharmaceuticals, medicinal chemicals, and botanical products
2424	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations
2429	Manufacture of other chemical products not elsewhere classified
2430	Manufacture of man-made fibres (this class includes manufacture of artificial or synthetic filament and non-filament fibres.

SEGMENTS OF THE INDIAN CHEMICAL INDUSTRY

The Indian chemical industry has three major segments and many smaller segments. It is clear from the pie diagram and chart drawn below;

Figure 1:

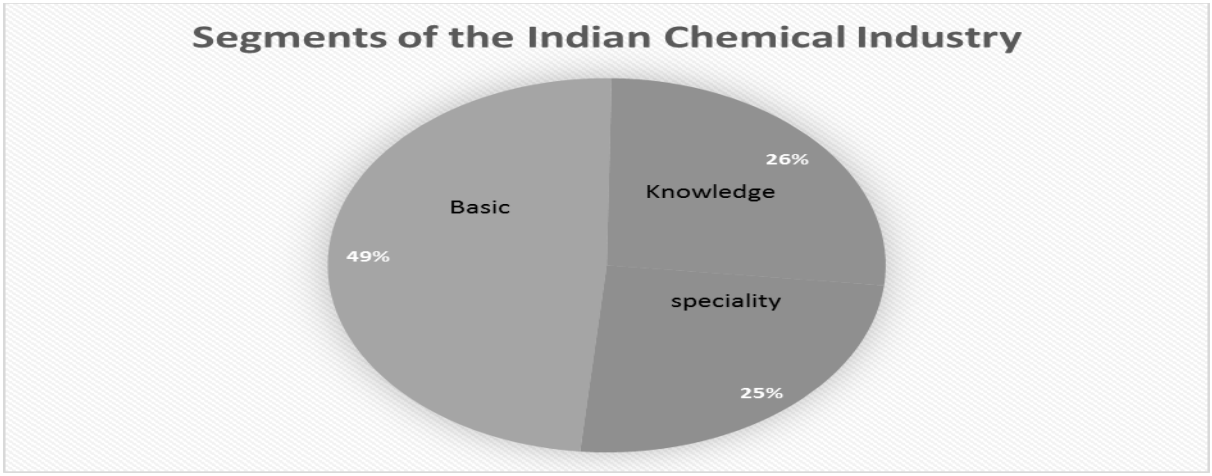
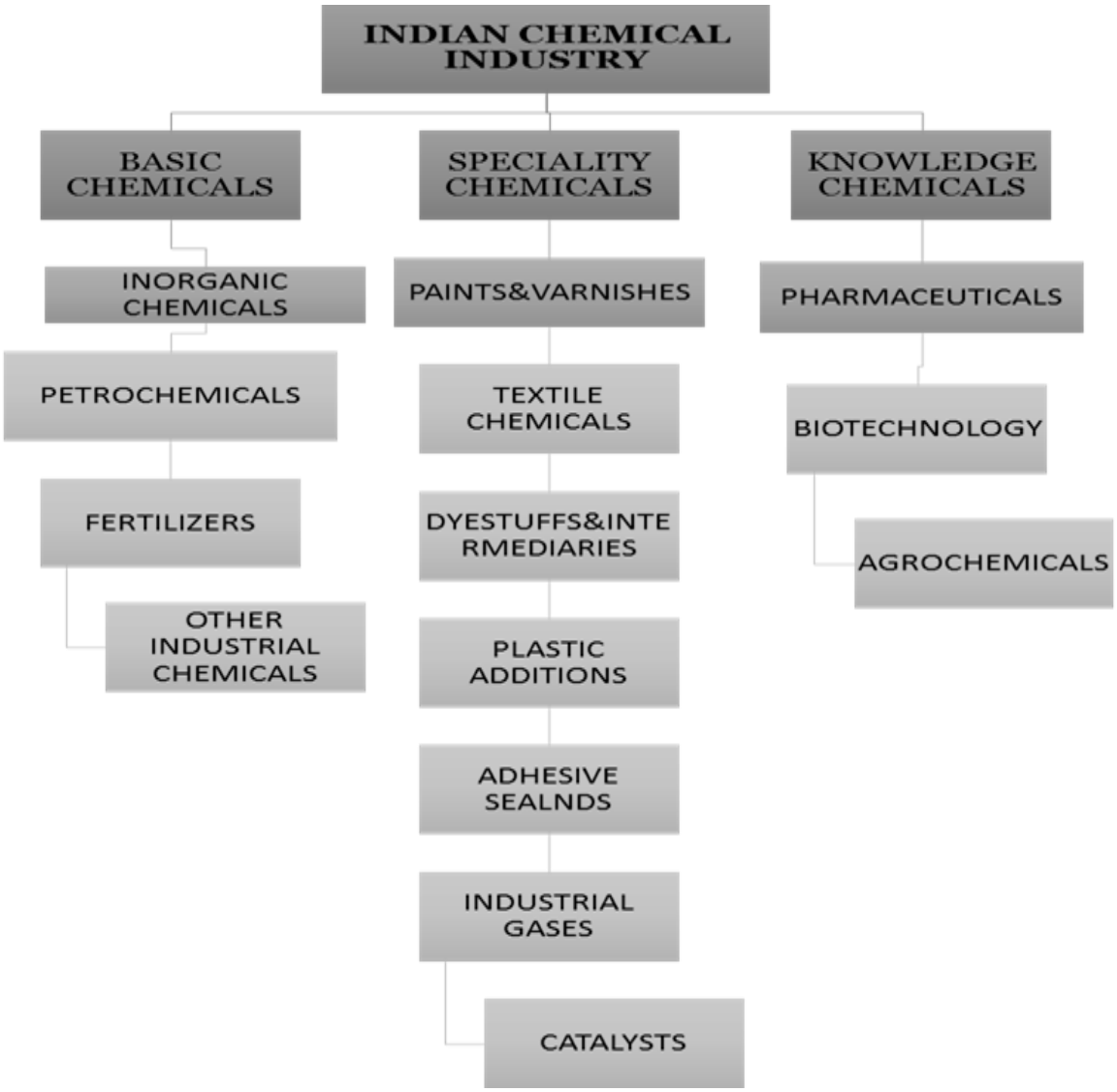


Figure 2



INDIAN CHEMICAL INDUSTRY - SEGMENT WISE CHARACTERISTICS

Table 2

Segments	Characteristics	Constituent industries
Basic	High volume, low value added Limited product differentiation across manufacturers High entry barriers on account of high capital requirements and stringent regulations	Petrochemicals Fertilizers Inorganic chemicals Other industrial chemicals
Speciality	High product differentiation and value addition Typically smaller production units with more flexibility Low capital investment levels	Adhesive sealants Catalysts Industrial gases
Knowledge	Differentiated chemical and biological substances used to induce specific outcomes in humans, animals, plants and other life forms High investment in R&D and marketing	Plastic additives Agrochemicals Pharmaceuticals Biotechnology

QUALITY ASSURANCE AGENCY

Indian Chemical Council (earlier as Indian Chemical Manufacturers Association- ICMA) started in the year 1938 to promote the interests of the nascent chemical industry. ICC became the representative body of the Rs. 500 billion / US $ 16 billion chemical industry in India. Its members include both Indian companies with a global presence as well as subsidiaries of multinationals. **INDIAN CHEMICAL COUNCIL (ICC)** is the apex national body representing all branches of the Chemical Industry in India such as Organic & Inorganic Chemicals, Plastics & Petrochemicals & Petroleum Refineries, Dyestuffs & Dye-intermediates, Fertilizers & Pesticides, Specialty Chemicals, and Paints etc. The Indian Chemical Council is dedicated to the growth of the Indian Chemical Industry. ICC has over the years grown its functions and offerings to cater to the varying needs of the Indian Chemical Industry.

In order to promote the growth of the Indian Chemical Industry, ICC has the following objectives:

• To anticipate and respond to government policy

• To provide better service to members in effective dissemination of information, safety, health and environment issues and monitoring the national and international chemical industry scenario.

• To extend and maintain international liaison

• To promote chemicals exports vigorously. To work towards effective representation of all sectors of the chemical industry

• To help ensure availability of trained manpower, and to foster R&D culture, quality standards and technology absorption

• To promote and maintain good relations between members of the Association and the Government authorities, other segments of the economy and the public and improve the image of the industry

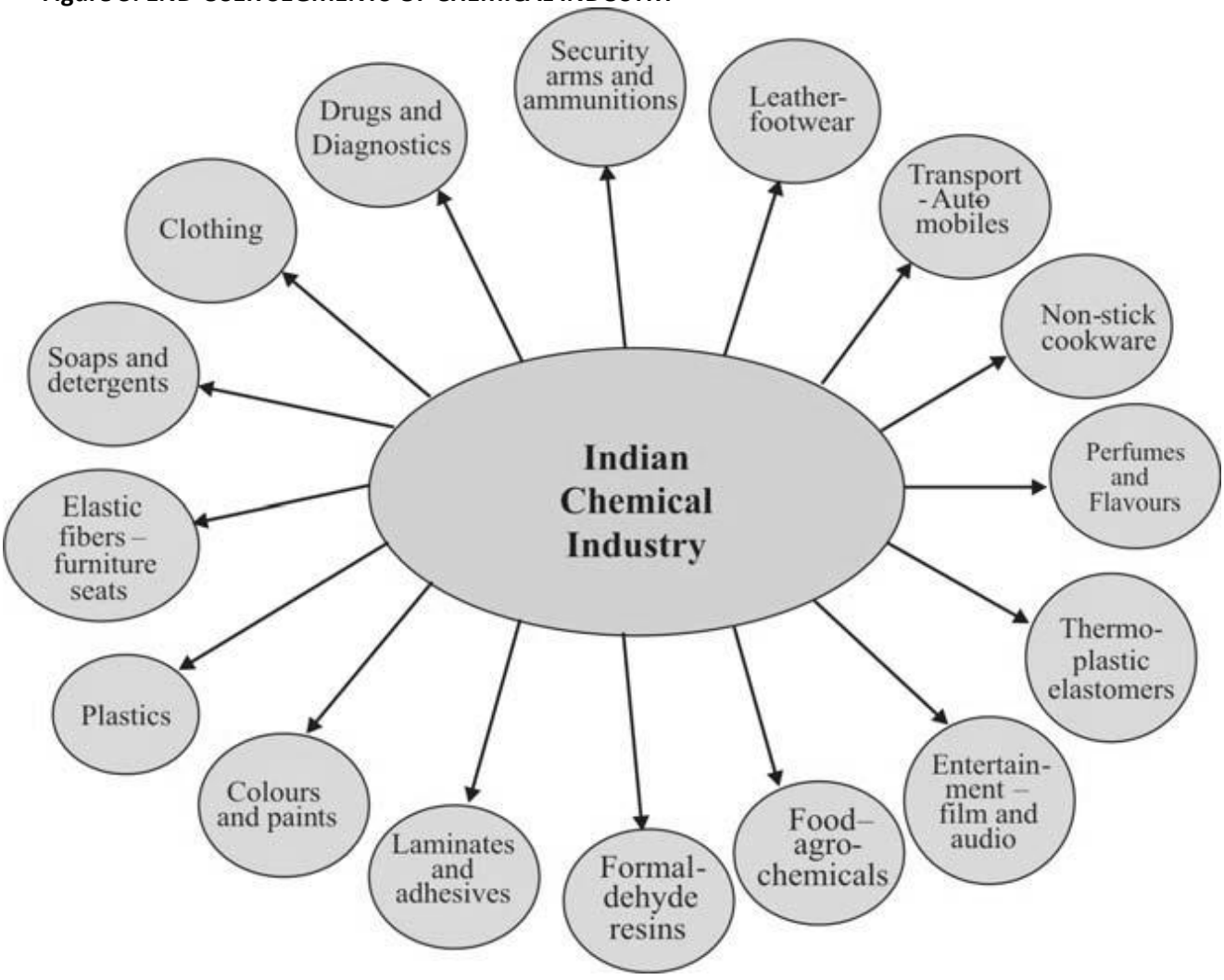
• To encourage work studies, research, investigations & experiments with the aim of improving the manufacture of chemical products, cost reduction & enhanced productivity

• To organize trade delegations to foreign countries, disseminate trade & commercial information about various countries amongst its members and generally facilitate trade & exchange of know-how in chemicals & petrochemicals

• To promote energy conservation measures in the industry

• To promote Responsible Care initiative under the structured approach to self-regulations

Figure 3: END-USER SEGMENTS OF CHEMICAL INDUSTRY



SIGNIFICANCE OF THE INDUSTRY

The chemical and petrochemical sector in India presently constitutes 14 percent of the domestic industrial activity. The growth of petrochemicals and chemicals is projected at 12.6 percent and 8% respectively in 11th Five Year Plan. According to the United Nations Industrial Development Organization (UNIDO), in terms of value added at constant 2000 prices, the Indian chemical Industry was the 6th largest in the world and 3rd largest in Asia in the year 2012. As per the latest available Information from industry associations, the size of the Indian Chemical Industry in the year 2010 was US$ 108.4 Billion.

The chemical industry is a key contributor to the world economy. The industry supplies to all the sectors of the economy and produces more than 80,000 products. India's key strengths lie in a quality manufacturing processes, availability of technical manpower, raw material and moreover safety measures or precautions implemented by the industry. Currently, per capita consumption of products of chemical industry in India is about 1/10th of the world average.

The wide and diverse range of products can be broken down into several categories, which include inorganic, and organic (commodity) chemicals, plastics and petrochemicals, drugs and pharmaceuticals, dyes and pigments, pesticides and agrochemicals, fine and specialty chemicals, and fertilizers. With primary focus on modernization, the Govt. of India has taken an active role in promoting the growth and development of Indian domestic chemical industry. The Department of Chemicals & Petro-Chemicals that has been part of the Ministry of Chemicals and Fertilizers since 1991 is responsible for making policy making, planning, development, and regulation of the industry. In the private sector, several organizations, including the Indian Chemical Council, the Chemicals and Petrochemicals Manufacturers Association, and the Pesticides Manufacturers and Formulators Association of India, all work with the prime objective of promoting the growth of industry and the export of Indian chemicals. For example, the Indian Chemical Manufacturers Association represents a large number of Indian companies, which produce and export a variety of chemicals, which have legitimate commercial applications, but also can be used as precursors and intermediates for production of chemical weapons.

SCOPE OF THE STUDY

Chemicals are an integral part of daily life in today's world. There is hardly any industry where chemicals are not used and there is no single economic sector where chemicals do not play an important role. Millions of people throughout the world lead richer, more productive and more comfortable lives because of the thousands of chemicals on the market today. These chemicals are used in a wide variety of products and processes and while they are major contributors to national and world economies, their sound management throughout their lifecycle is essential in order to

avoid significant and increasingly complex risks to human health and ecosystems and substantial costs to national economies.

In our everyday life, we use a lot of industrial products related to chemical industry. The chemical industry, which includes basic chemicals and its products, petrochemicals, fertilizers, paints & varnishes, gases, soaps, perfumes &toiletries and pharmaceuticals is one of the most diversified of all industrial sectors covering thousands of commercial products. It plays an important role in the overall development of the Indian economy.

OBJECTIVES OF THE STUDY

1 To study the contribution of chemical industry in economic development of India.

2 To examine the safety measures implemented by chemical industries in India.

CONTRIBUTIONS OF CHEMICAL INDUSTRY

A decade of economic reforms has resulted in major changes in the way the Indian chemical manufacturers work and operate. Individual enterprises have realized their strengths and weaknesses and are gearing up to face the new challenges. Success stories in dyes and agrochemicals have boosted the confidence of Indian manufacturers to take on global competition squarely. Chemical industry is among the fastest growing ones in India, can contribute to economic development of the country. Some of the major contributions of chemical industries are,

- Chemical industries supply the farmers' pesticides and fertilizers which are essential for crop growing. In this way chemical industries contribute to agriculture and food self-sufficiency of every country.
- Due to its low cost infrastructure, the country has huge export potential. According to a recent report, India's chemical exports have the potential to raise US$ 300 billion by 2015. This defines an investment of US$ 50 billion in chemical industry alone.
- The country has the capacity for high value addition being close to Middle East. This is a cheap and ample source for petrochemical feedstock.
- In some categories of chemicals, India does have the advantage for exports (dyes, pharmaceuticals and agrochemicals) by establishing strategic alliances with countries like Russia. With the expertise and know-how available in the country, there is a tremendous export potential in dyestuff and agrochemical market.
- Availability and abundance of raw materials for titanium dioxide and agro-based products, such as castor oil provide an opportunity to yield significant value addition. This, however, would require substituting their exports in raw form by producing high value derivatives.

- The chemical and petrochemical sector in India presently constitutes 14 percent of the domestic industrial activity. The growth of petrochemicals and chemicals is projected at 12.6 percent and 8 percent respectively in 11th Five Year Plan.
- The chemical industry, which includes basic chemicals and its products, petrochemicals, fertilizers, paints & varnishes, gases, soaps, perfumes & toiletries and pharmaceuticals is one of the most diversified of all industrial sectors covering thousands of commercial products. It plays an important role in the overall development of the Indian economy. It contributes about 3 percent in the GDP of the country.
- India also produces a large number of fine and specialty chemicals, which have very specific uses and find wide usage as food additives, pigments, polymer additives, anti-oxidants in the rubber industry, etc.

- The production, transport, import, export, consumption and disposal of chemicals are important factors in six of the ten central economic sectors - agriculture, water, energy (efficiency and supply), fisheries, waste, and industry. The chemical sector contributes to economic development mainly through the value of products and products containing chemicals (technological contribution) and direct employment.
- The global chemical industry supports some types of regulation and voluntary measures that seek to stabilize markets and set harmonized standards. Global Product Strategy (GPS) (2011) commits global companies to promote the safe use of chemical products and enhance product stewardship throughout the value chain – and is particularly aimed at Small and Medium Sized Enterprises (SMEs) in developing countries.
- Indian exports of agrochemicals have shown an impressive growth over the last five years. The key export destination markets are USA, U.K., France, Netherlands, Belgium, Spain, South Africa, Bangladesh, Malaysia and Singapore. India is one of the most dynamic generic pesticide manufacturers in the world with more than 60 technical grade pesticides being manufactured indigenously by 125 producers consisting of large and medium scale enterprises (including about 10 multinational companies) and more than 500 pesticide formulators spread over the country.

GROWTH OF CHEMICAL INDUSTRY OUTPUT

The OECD's Environmental Outlook to 2050 notes that while annual global chemical sales doubled over the period 2000 to 2009, OECD's share decreased from 77 percent to 63 percent and the share of the BRIICS countries (Brazil, Russia, India, Indonesia, China, and South Africa) increased from 13 percent to 28 percent. Figures 1 and 2 illustrate the growth of chemical industry output over time, broken out by country or region.

Chemical Industry Output: Developed Regions

Table 3

Name of Region	Year &Output (Billions USD)						
	1970	1980	1990	1998	2000	2010	2020
Japan, Korea, Australia		500	900	1100	1300	2200	3000
Western Europe	200	400	700	800	900	1700	2300
North America	100	300	300	400	500	800	1100

Source: Global Chemicals Outlook (UNEP 2012)

Chemical Industry Output: Developing Regions& Countries with Economies in Transition

Table4

Name of Region	Year &Output (Billions USD)						
	1970	1980	1990	1998	2000	2010	2020(EST)
Central &Eastern Europe		400	400	450	400	1900	3400
Africa &Middle East					350	1700	3100
Central &South America	200	300	300	350	300	1500	2700
Other Asia				300	250	1400	2500
India			350	250	250	1000	2100
China	100	100	250	200	150	800	1700

Source: Global Chemicals Outlook (UNEP 2012)

The above tables represent the chemical industry output of developed regions (Japan, Korea, Australia, Western Europe, and North America) and developing regions (Central &Eastern Europe, Africa &Middle East, Central &South America, Other Asia, India and China). The tables, chemical Industry Output, which was compiled by UNEP working with international experts, is designed to inform governments and industry on trends in chemicals production, use and disposal while offering policy advice aimed at meeting the 2020 goal. It focuses particularly on the challenges and opportunities facing developing nations.

The shift in production from developed to developing countries is underscored by China, which today is the largest consumer of textile chemicals with 42 percent of global consumption, and South Africa, where spending on pesticides has grown by close to 60 per cent since the late 1990s.

Developing countries and countries with economies in transition are increasingly significant. Over the last decade, chemical production in the BRICS countries has far exceeded the growth rates of the OECD countries. From 2000 to 2010, chemical production in China and India grew at an average annual rate of 24 percent and 14 percent, respectively, whereas the growth rate in the United States, Japan and Germany was between 5 and 8 percent.

Recent forecasts from the American Chemistry Council (ACC) also predict significant growth in chemical production in developing countries in the period to 2021 and more modest growth in developed countries **(Table 5).**

Chemical Production: Predicted Growth, 2012-2020

Percent change, 2012-2020			
North America		**25%**	
	United States		**25%**
	Canada		**27%**
	Mexico		**28%**
Latin America		**33%**	
	Brazil		**35%**
	Other		**31%**
Western Europe		**24%**	
Emerging Europe		**35%**	
Africa & Middle East		**40%**	
Asia-Pacific		**46%**	
	Japan		**22%**
	China		**66%**
	India		**59%**
	Australia		**23%**
	Korea		**35%**
	Singapore		**35%**
	Other		**44%**

Source: Percentages calculated based on projections for the regions and for selected countries by Swift, Thomas Kevin et al., and (June 2011). "Mid-Year 2011 Situation & Outlook, » American Chemistry Council.

PRODUCTION PERFORMANCE OF MAJOR CHEMICALS

The actual production of major chemicals during the years 2006-07 to 2012-13 up to September 2012 is exhibited in Table 6

PRODUCTION PERFORMANCE (From 2006-07 to 2012-13 up to September 2012)

Table 6 **Figures in thousand Metric Tonne (MT)**

Sector		PRODUCTION						
		2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13(up to sep.12
Alkali chemicals	Production	5269	5443	5442	5602	5981	6113	2973
	Growth rate (%)	-3.8	3.3	0	2.9	6.8	2.2	
Inorganic chemicals	Production	602	609	513	518	572	574	267
	Growth rate (%)	10.7	1.1	-158	1	10.5	0.4	
Organic chemicals	Production	1545	1552	1254	1280	1342	1396	656
	Growth rate (%)	0	0.4	-19.2	2	4.9	4	
Pesticides	Production	98	102	105	104	11	120	60
	Growth rate (%)	4.6	4.2	2.6	-1	6.7	8.4	
Dyes &Dyestuffs	Production	90	117	110	149	164	171	86
	Growth rate (%)	29.5	30.5	-6.5	35.8	10.5	4	
Total Major chemicals	Production	7605	7823	7423	7651	8170	8374	4041
	Growth rate (%)	-1.6	2.9	-5.1	3.1	6.8	2.5	

From the Table 6 it may be seen that the production of major chemicals account for more than 70% of the total major chemicals. The production of major chemicals in 2011-12 was 8374 thousand MT, compared to 8170 thousand MT in 2010-11 implying growth of 2.5%.

INTERNATIONAL TRADE

Trends in exports and imports of major chemicals and major petrochemicals during the year 2006-07 to 2012-13 up to September 2012 are exhibited in Table 7.

EXPORT AND IMPORTS -MAJOR CHEMICALS &PETROCHEMICALS

Table 7

(Figures in Rs. Crores)

Items/years	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
A. Total Exports	571779	655864	840755	845534	1142922	1465959
Of which:						
Chemicals	39351	43482	53738	54948	67008	86690
Petrochemicals	21801	22199	24226	29272	36785	48377
Total Chemicals& petrochemicals	61152	65681	77964	84220	103883	135067
Share of total chem. & petro chem in total exports (%)	10.7	10	9.3	10	9.1	9.2
B. Total Imports	840506	1012312	1374436	1363736	1683467	2345463
Of which:						
Chemicals	47914	54422	74857	76682	94154	121887
Petro chemicals	16339	19577	24020	30221	39436	46801
Total Chemicals& petrochemicals	64253	73999	98877	106903	133590	168688
Share of total chem. & petro chem in total imports (%)	7.6	7.3	7.2	7.8	7.9	7.2

Source: Directorate General of Statistics &Commercial Intelligence (DGCIS), Kolkata

The imports of major chemical and petrochemical products contributed 7.2 percent of total imports in 2010-11, compared to 7.8 percent in 2009-10 whereas exports of major chemical and petrochemical products contributed 9.9 percent of total exports 210-11, compared to 10.0 percent in 2009-10.

INDIA CHEM 2012

To promote the Indian Chemical Industry, the Govt. of India Department of Chemicals &Petrochemicals and Federation of Indian Chambers of Commerce & Industry (FICCI) have been jointly organising the "India-Chem" series of events in every alternate year. The events provide a platform to the Indian Chemical Industry to showcase its potential to an international audience. The participation of major international players in the chemical, petrochemical, and pharmaceutical sectors exposes the Indian industry to international developments.

The seventh edition of India-chem International Exhibition & Conference was held on October 04-06 2012 at Mumbai. The theme of the India-Chem International conference was "Emerging India: Sustainable Development of Chemical Sector. The President of India (Shri.Pranab Mukherjee) in his inaugural address stressed the growth of the Indian chemical sector by adopting sustainable measures and green Chemistry, taking in to consideration the essentials for the protection of safety health and environment.

SAFETY MEASURES IMPLEMENTED BY CHEMICAL INDUSTRY IN INDIA

In the present global scenario, for any industry to be successful, essential to inculcate safety culture consciousness in health and environment aspects in each personnel of an organization. The significance of Safety & Health in chemical industries has been a vital issue in achieving productivity and an edge in the competitive world.

• Only trained, authorized persons allowed in storage area; notices posted at entrance;

• Corrosives to be stored in designated, hazard labeled area (location specified); natural ventilation provided via building design.

• Acidic and alkaline corrosives to be kept in separate zones as per local notices;

• Store man to inspect corrosives storage area daily for signs of damaged, bulging or leaking containers and for poor housekeeping;

• Store man to inspect incoming containers to ensure they are compatible, properly labelled and not damaged;

• Personal Protective Equipment for store man/operatives: Safety footwear, protective clothing, acid-resistant gloves and goggles,

• Emergency eye-wash station and safety shower to be checked daily by store man; record to be maintained in store log;

• Hygiene measures: eating and drinking not permitted.

- Elimination: change the process or activity so that the hazardous substance is not used or is not generated;
- Substitution: replace it with a safer alternative;
- Isolation: separate the hazardous substances from workers;
- Engineering controls: use physical measures to minimize workplace contamination, e.g. extraction at source by LEV (local exhaust ventilation);
- Administrative controls: use of safe work practices and procedures to minimize contamination, e.g. good hygiene procedures;
- Personal Protective Equipment (PPE): provide facemasks, gloves, protective clothing, etc., but only as a last resort or "belt and braces" measure.

• Dispense only at designated location (well ventilated location, spill tray fitted for spill collection, free of fixed ignition sources, earthing and bonding facilities provided, warning notices posted);

• Use of mobile phone or other portable electrical equipment prohibited;

• Dispense from only one container at a time;

• Open containers must not be left unattended;

• Ensure both containers are securely closed when dispensing is complete;

• Mandatory Personal Protective Equipment (PPE) for operative as follows –

a Anti-static safety footwear;

b protective chemical-resistant clothing

c solvent-resistant gloves and

d goggles

Some of the Safety Equipments adopted by the industry are;

1. Gas masks for use in leakage of Gases like Ammonia, Chlorine, etc. are available in all the Plant. Apart from this, breathing apparatus supplied by MSA, (USA) are available in all the control rooms and at Ammonia storage tank area.
2. Air line systems are provided in Urea and Ammonia control rooms for which air is supplied from instrument air header. These can be used by the operators working in control room in case of Ammonia leak.
3. Personnel Protective appliances like safety helmet, safety goggles hand gloves etc., are issued to all the employees. Apart from this Eye wash showers, face shields, PVC suits etc. are installed in all sections of the plant.
4. Gas tight suits, chemical splash suits, Fire proximity suits and other suits are available to handle emergencies like toxic release, fire etc.

The built in Safety has been the prime factor while selecting the equipments, processes etc. Standards codes of practices are being followed seriously during the erection, modification etc. Some Safety relevant components are mentioned below:-

- Use of relief valves, rupture discs explosion vents of adequate sizes with proper testing. Checking of this safety relevant components is done in every annual shut down.
- Automatic control valves, solenoid operated quickly shut off valves is installed to control any sort of emergencies.
- Alarms, sensors, relays, trip systems have been provided.
- Proper training, disclosure of information related to Safety rules / procedures have been given.
- Appropriate operating procedures, manuals etc. are implemented since inception.
- Flare stack for burning of vent gases like Ammonia, Natural Gas and Naphtha Vapors have been provided.
- All the statutory requirements are being fulfilled and followed.

These are the some of the safety measures and equipments implemented by Indian chemical industry for the smooth functioning and security of their employees.

CONCLUSION

The Indian Chemical industry is one of the oldest industries in India and contributes significantly to the industrial and economic growth of India. It is thus an important constituent of Indian economy. Its size is estimated at US $ 35 billion approximately by the Department of Chemicals and Petrochemicals which is a part of the ministry of Chemicals and Fertilizers.

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 quant sum 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.

With investments in R&D, the industry is registering significant growth in the knowledge sector comprising of specialty chemicals, fine chemicals and pharmaceuticals. Over the last decade, the

Indian Chemical industry has evolved from being a basic chemical producer to becoming an innovative industry.

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