CHINA'S DYESTUFF INDUSTRY PRESENT TRENDS AND FUTURE PROSPECTS

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People's Republic of China : An Emerging World Leader

People's Republic of China is the most populous country in the world and the 3rd largest in area. It is made up of 21 provinces, 5 autonomous regions, 3 municipalities - Beijing, Shanghai and Tientsin. It occupies most of the habitable mainland in east Asia. One of the ancient countries in the world, China became a republic in 1911. The People's Republic of China was proclaimed in Beijing on October 1, 1949 under Mao Tse-Tung.

China's economy is one of the fastest growing economies in the world. Chinese economy expanded by 57% between 1991 and 1995 and GDP totalled 3318 Billion US $ during the 1st-half of 1997, up by 9.5% over the same period in the preceding year. China's is basically an agrarian economy. Among the principal industries are cotton, woolen mills, iron, leather and electrical equipments. China has vast reserves of mineral wealth - coal manganese, iron, gold, copper, lead, silver and tungsten to mention a few.

With constant acceleration of the reforms in science and technology management in China, a number of few and high technology industries development zones have been started. These zones are the nuclei for the development of new and advanced technology in China. Presently, the number of new and high technology enterprises in China in these zones number about 2500 with a turnover 7 billion Yuan (RMB) 1990.

History and Present Status of Dyestuff Industry

China's dyestuff industry is one of its oldest industries and can be traced back to the year 1919. In that period, there were hardly any noteworthy development. A few sulfur dyes numbering 4-5 were produced with a capacity of about 5000 tons. The situation prevailed without any further development till the formation of the People's Republic of China in 1949. With the establishment of a new political system, the dyestuff industry got a big boost. Since, then, over 300 dyes plants have been set-up in China spreading over 19 provinces and cities such as Shanghai, Tianjin, Beiging, Shandong, Jiangsu, Dailian, Jilin and Chongquing. The establishment of dyestuff industries led to simultaneous growth intermediates and auxiliary agents industry.

Today, China is one of the leading dyestuff producing countries in the world and probably the 2nd or 3rd. The production figures for the early years of 1990 are as follows :

1990	144155	MT
1991	136331	MT
1992	141256	MT

In the past 3 to 4 years, the annual production is around 150 thousand tons. The annual growth rate is around 7%. About 450 different products are produced and the Chinese production of dyestuff accounts only for 10% of the world production. This is in comparison with 2 % share of India. The domestic production of dyestuff is able to cater to the local demand for the textile processing industry. However, a sizeable quantity of dyes are also imported to meet the need of certain categories of the processing industry.

Location - wise Production of Dyestuffs

The dyestuff industry has been distributed all over the country although the concentration is maximum in the eastern and northern part of China. The distribution of the industry in various regions is as follows :

	Region		% of total Production
1.	Northern China	-----	24
2.	North-East	-----	14
3.	East of China	-----	48
4.	Central China and	-----	11

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	Guangdong Province		
5.	South-West	-----	1
6.	North-West	-----	2

Break-up of Individual Class of Dyes on Total Production

1.	Sulfer Dyes	-------	36%
2.	Direct Dyes	-------	5%
3.	Acid Dyes	-------	5%
4.	Basic Dyes	-------	3%
5.	Vat Dyes	-------	6.5%
6.	Ice Dyes	-------	5%
7.	Disperse Dyes	-------	19%
8.	Neutral Dyes	-------	0.5%
9.	Cationic Dyes	-------	2%
10.	Reactive Dyes	-------	8%
11.	Other Dyes (Solvent dyes, etc.)	-------	10%

Besides dyes, China has made significant progress in the pigment field. Benzimidazole pigments are product of recent development and are characterised by excellent application properties. They are frequently referred to as, **"Pigments of the 21st Century"** and find extensive application in power coating, high-grade printing-inks and plastic master-batches. These new pigments and their intermediates have been developed in **Wujiang Skyhigh Chemicals Co. Ltd.** and commercial production is expected to start this year. New kinds of organic pigments including pigment Red 57:1 and Red 48 : 2 have been specially developed for printing-ink in Changzou factory. These pigments are claimed to have many outstanding properties and higher colour-strength than the conventional ones. Apart from developing production technology for commercialisation within the country, China's pigment intermediate technology has been exported to South Korea. According to China Chemical Industry Newspaper, Shen Yang Chemical Institute has exported to Korean SUMSANG, the manufacturing technology for diketene, acetoaceti ester and anilides derived from it. The technology-transfer covers basic design and process. Multi-national companies such as **Hoechst, BASF, Clariant** and **Dainippon Ink** have also set-up joint-venture facilities in China for the production of pigments. Hoechst has set-up a new pigment plant with **Tianjin No. 8, Dyestuff Chemical factory** with an investment of 16 million US $ and has gone on commercial production. **Tianjin Toyo Ink** has also started production of printing-inks and pigments. **Dainippon's** new joint-venture is in Zhongshan city for the production of pigmented printing-paste and master-batches.

China's New Technology Developments on Pigments

China claims to have successfully developed a new kind of red and yellow pigment by combination of organic and inorganic pigments. The technology involves using an inorganic pigment as the base material which is further over-coated with red and yellow organic pigments. The new pigments have been successfully tested by China's Chemical Industry Institutes of these pigments are their very low cost of production with excellent tinting properties. The new pigments have been approved by China's Chemical Industry Ministry and are projected as the key areas of development in China's **"8th FIVE YEAR PLAN".**

China's largest production facility of Pigment Violet 23 has started commercial production in 1998. The factory in Yangzhou city in Jiangsu province has a capacity of 80 mt/year.

Development of Paint and Coating Industry

There has been a significant increase in both demand and supply for the paint and coating industry. According to published data, production quantity of coating was around 1.00 million metric tons in 1998 and is expected to touch 2.0 million metric tons by 2000. Out of this, 0.75 million tons will be industrial coating, 0.95 million tons construction coating and 0.3 million tons road and other coating.

Non-toxic paints have also been developed in the country. Shishan Chemical factory at Guangdong has produced lead-free paints which are fast-drying with excellent covering properties. These new paints have been approved by the quality inspection centre of Railway Ministry Scientific Institution.

Lanzhou 404 Factory, a subsidiary of China Nuclear Industry Corporation has set-up a plant for the production of titanium dioxide (Rutile Type) with imported technology and equipment with a capacity of 10 thousand metric tons per year.

Development of Organic Intermediates Industry

China has turned its attention to the development and production of a vast range of intermediates required for the dyestuff and pigment

industry. Presently there are about 100 plants producing raw materials and intermediates. Among them, **Jalin Chemical Complex, Nanjing Chemical Plant, Henan Chemical Plant, Sichuan Dyes Plant** and **Dalian Dyes Plant** are notable with large capacities. The intermediates derived from benzene toluene, naphthalene, anthraquinone and heterocyclic compounds also cater to pharmaceutical and agrochemical industries.

Zhuhai Dumen XIEDA Chemical Product Co. Ltd. has successfully started production of high - purity ortho-dichlorobenzene (99.98%). Among the organic intermediates, Beta-Naphthol continues to be a high volume governed by China. The world production capacity of this item is estimated at 100 thousand tons/per year. China, India, Japan and Italy and some of the east European countries are the major producers. Japan has 3 plats producing 10 thousand tons while India with 7 plant produces 10 thousand tons. Italy has one plant with a capacity of 20 thousand tons. In former Russia, the production was around 14 thousand tons. In China the production capacity has reached a staggering 40 thousand tons. In the past, Germany and US have capacities of 12 thousand and 18 thousand tons, respectively. Presently, the world production of Beta-Naphthol is pegged at 809 thousand tons. Germany and the US have virtually stopped the production due to environmental reasons. This leaves China and India as the major players. The yearwise production figures for Beta-Naphthol in China are summarised below :

1986	----	15778 MT
1991	----	20863 MT
1992	----	25760 MT
1993	----	27892 MT
1994	----	32312 MT
1995	----	33000 MT

It is pertinent to note that the quality of β–Naphthol produced in India is far superior to that of China.

In recent, times, China has made good progress in the manufacture of anthraquinone and its derivatives. China's anthraquinone is presently the cheapest in the world and is extensively consumed in the dyestuff industry as well as paper industry (Redox system during pulping process). **Fei Da Chemical factory** is the largest producer of 1-amino anthraquinone and the production in the 1st quarter of 1999 reached 260 metric tons 50% of which was exported. The Technology appears to be based on direct nitration of anthraquinone and subsequent reduction. The advantage of this process is absence of any contamination with mercuric during the sulfonation of anthraquinone.

Diaminostilbene disulfonic acid (DSD acid) is an important intermediate for optical brightening-agents used in detergents, paper production and also for textile dyes. In 1993, there were 20 factories in China with a production capacity of 4000 metric tons per year. In 1998, the number increased to 50 with a production capacity of over 16,000 tons, Actual production in 1998 was around 7100-7300 tons. In 1999, nearly 16 factories stopped the production of DSD acid due to lower demand and over-supply.

Production of Textile Auxiliary

With the development of the dye industry, the requirement of various textile auxiliaries also increased. At present about 100 plants in China produce different kinds of auxiliaries to meet the demands of textile processing mills. The main items of production are, pretreatment and the post treatment agents, dispersing agents based on phenol, naphthalene and lignosulfonates, scoring agents, fabric softeners, antistatic agents, optical-brighteners and flame-retarding agents and various types of levelling agents. However, the quality and performances of many of these auxiliaries need upgradation. Besides, China does not have a wide variety unlike the US and European manufacturers. This deficiency has already been taken note of an attempts are being made to redress it.

Domestic Demand and Export

The Domestic consumption of dyes in China by the textile industry is 70,000 metric tons. 60% of the domestic need is catered by local production and the rest through imports. In the past decade, import and export have shown significant increase. Export was 35-40% of the total production. In 1992, the export was 57,657 metric tons valued at US$ 227.06 million while import stood at 16,851 metric tons valued at US$ 107.97 million thus striking a favorable trade balance. The main items of import are acid, disperse and solubilised at from Japan, the US, Switzerland UK and Hongkong. Export consists mainly of sulfur dyes, vats, disperse and basic dyes to Hongkong, the US, Thailand, Pakistan and former USSR.

Status of Technical Education, Research and Development Work and Production Technology

Presently many universities in China offer specialised courses in dyestuff chemistry and technology. Notable among them are Tianjin University, Dalian Polytechnic University and Haudong Chemical Institute. Roughly 150-160 fresh

graduates are inducted into various dyestuff factories annually. China claims to have around 6000 specialist technical staff members in the dyestuff industry which accounts for 4% of the total staff. In addition to the universities, there are 3 reputed institutes-Shenyang Chemical Research Institute, Shanghai Dyes Research Institute and Tianjin Dyes and Research Institute which are engaged in fundamental research on dye stuff chemistry. Most of the big manufacturing plants have their own in-house R and D centres staffed with highly experienced and qualified personnel. These laboratories are equipped with the most modern facilities including testing and application equipments with good reference libraries. China Research Centre was set-up with an investment of 50 million Yuan. The institute carries out research and development work on dyes and optimises production conditions through pilot-plant trials for commercial production.

The results of these encouragements and investments have already started showing. Today. China is able to compete in the world market to some axtent in quality and largely in quantity and price. Most of the technological developments that have taken place in the dyestuff area have been successfully adapted and commercially exploited by China. For example, the production of specialised liquid-formulation with long shelf-life, granulated spray-dried products which are non-dusting, high-strength disperse and reactive dyes are some of the achievements of recent times.

Production technology in the intermediate sector also has undergone upgradation. The conventional reduction of nitro compounds, with sodium sulfide and/or iron-acid has been replaced by catalytic reduction with hydrogen. Continuous sulfonation using sulfurtrioxide is widely followed in many industry. Also purification technology using vacuum sublimation and distillation and through molecular-sieve have widespread uses. Finally, dye-testing, in-process control tests, modern facilities such as HPLC HP-TCL and computers.

Fabrication Technology of Equipment and Machinery

In the early stages of development, China paid little attention to equipment technology, since process and product development attracted major attraction. This led to serious problems in quantity of products both intermediates and the finished products. To overcome this deficiency, the authorities decided to import highly sophisticated equipment from Japan, U.S. and Europe. They include flash-dryers paddle dryers, high energy homogenisers and sand mills especially the horizontal types such as Dyno-Mills. The engineers studied the drawing, carefully and started fabricating them in China with future modification to suit the local conditions. This gave encouragements to the fabrication industry which started producing these equipments for domestic industries and also for export. Today, China produces sophisticated equipment such as pressure-filters, spray-dryers which can deliver granules, mixers of different types and automatic packing machines. A noteworthy example is the large-scale production of glass-lined vessels the prices of which are atleast 30-40% less as compared to the well-known brands. It is significant to note that low price of glass-lined equipment form China is due to widespread usage of glass-lined vessels. Besides, price of a stainless-steel equipment is relatively high in China due to inflated cost of stainless-steel.

With the development in equipment manufacturing technology and improved producing technology, the working efficiency and quality have undergone major of changes and today China is a significant player in the global market.

Environmental Issues

The most important problem facing the China dyestuff industry has been the problem related to waste-management. The Government of China is taking serious steps to project of the environment. In the past decade, 700 million Yuan has been spent for waste management in Chemical industry which of course is note commensurate with the size of the chemical industry in China. In recent times, the Government has been more active and the discharge norms for the waste have been prepared. The industry has been asked to upgrade the production process and set-up efficient treatment plants in order to lessen the effluent problem. All newly set-up plants must have their own treatment plants and should meet the strict stipulation laid down by the pollution control authorities. For medium and small industries which cannot afford proper treatment of effluent as per industry norms, strict measures are taken to limit their production capacity. However, there is still scope for improvement, in the treatment efficiency.

Azoic Dyes Banned for Use in Textiles

According to China Chemical Industry Newspaper dated May 24, 1996, China's commodity Inspection Bureau (CCIB) is making a new rule to ban azoic dyes for use in textile dyeing. This is due to the fact that many of the Naphthols are derived from suspected carcinogenic amines appearing in the German banned list.

Action Plan for Future Development

While China has achieved significant progress in the manufacturing technology of dyestuff and its intermediates, there is still scope for improved with respect to product quality and development of various types of auxiliaries for finishing or standardisation. Beside, the most important aspect is the need for creating a brand image in the international market which is presently missing. Today, the main consideration for the large-scale acceptance of Chinese dyestuff and organics intermediates in the global market is their unbelievably low price for an average quality. The Chinese Government is aware of this and is working hard to incorporate quality improvement and create a brand-name through international help.

It was precisely for this reason that, **"The Seminar on Dyestuff Manufacturing Technology for Commercialisation"**, was held in Beijing in 1993. It was sponsored jointly by the Economic and Social Commission for Asia and the Pacific (ESCAP) and the Ministry of chemical Industry, the Government of China, with generous financial assistance from Chinese Government.

The ESCAP plan of action of technology development in Asia and the Pacific emphasised the importance of providing assistance for the technological development of very large countries such as China. It pointed out the need for reorienting and using more effectively their existing capacities to achieve higher productivity, better quality reliability as well as international competitiveness in the relevant areas. Dyestuff manufacturing technology for commercialisation was accepted as one such area. China identified the need for improving its indigenous technical capability of dyestuff manufacturing for commercialisation since textile and related industries play an important role in the industrial development. Like China, many countries in Asia and the Pacific such as Republic of Korea, Thailand and India have made serious attempts to strengthen their industrial base and reduce important dependency of the textile industry by establishment of domestic dyestuff industry.

Since the dyestuff manufacturing process involves use of a number of hazardous chemicals that generate toxic effluents, the development, transfer and adaptation of environmentally-sound technologies for the relevant industries are of paramount importance.

The seminar provided opportunities to the participants from selected developing countries of the ESCAP region and other countries, to review and exchange technical information and experience in dyestuff manufacturing technologies and process for commercialisation. Beside it also helped to promote technical co-operation among developing countries and among ESCAP members as well as to explore business co-operation with industrialised countries and developing nations and facilitates transfer of technology.

The Chinese delegates exhibited active participation. I had the opportunity to attend the seminar as an invitee and expert in manufacturing technology from Thailand. Throughout the deliberations of the conference, the Chinese delegates showed keen interest in improving their technology for the finishing and standardisation of disperse and vat dyes and bringing the quality to the international level. They were prepared to discuss in detail with all the foreign experts their manufacturing and finishing problems without inhibition. They were also keen on co-operation in technology-transfer and joint-venture project a true picture of the dyestuff industry as it exists today to the world and in turn receive valuable help from outside in areas which were highly deficient.

In short, China's dyestuff industry looks ahead to the international market with confidence by creating a global brand-name that will remain for aeons to come.