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22785

xpl/020/01/005  
C2001/077

**UNIDO Research Project:  
Assessing the Uptake of ESTs in China**

**Final Report**

**July 1, 2002**

**China National Cleaner Production Center  
Chinese Research Academy of Environmental Sciences**

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## **1. Policy Environment and Institutional Framework**

Pulp and paper industry is one of the most important industrial sectors in China. Under the “opening and reforming” policy over the last decades, Paper industry has made rapid progress in several areas. In 1999, the paper total volume was 2.9 MM ton which was listed in the 3<sup>rd</sup> worldwide. And the standard of enterprises, the level of technology, and the quality of products all have been improved notably.

### **1.1 Macro Economic Environment**

During the last ten years, the national economy experienced steady, rapid and sound development, and the overall national strength continued to grow. In the 8<sup>th</sup> five-year plan period, China's GDP increased 12 percent on an annual basis and 8.3 percent in 9<sup>th</sup>. Economic restructuring was extensively carried out. The traditional planning economy is rapidly replaced by a market economy. Significant advances were made in the reform oriented toward the establishment of a modern corporate structure in the large and medium-sized State-owned enterprises (SOEs). Marked progress was made in endeavors to reduce losses and increase profits in enterprises. The system of finance and taxation continued to improve. Banking reform was accelerated.

The government adopted strict measures in restricting the issue of currency and limiting credit to keep the inflation rate down to single digits. Although there had been economic over-warming in early 1990s and Asian financial crisis in later 1990s, China has experienced a relative steady economic development.

The overall economic power of China was greatly enhanced in the last ten years. Its GDP was 1854.79 billion RMB in 1990 and reached 8,940.4 billion RMB in 2000. The national foreign currency reserve reached a new high of 212 billion USD in 2001. 47 billion USD directly from foreign investors arrived and was used by Chinese economy. China exported 72 billion USD of goods and services in 1991 and 266 billion USD in 2001. In the same period its imported goods and services increased from 64 billion USD to 244 billion USD.

### **1.2 Policy Environment**

### **1.2.1 Macro Policies**

#### **Domestic Industrial Regime**

The fast development of economy in China is benefited from the nation's economy reform. In the past ten years China sped up its reform. Its opening policy and industrial regime reforming were accelerated in all parts of China and in all the aspects.

Privatization of state-owned industries was officially issued by the central government as one of its important reforming policies. At the end of 90s state-owned capitals were required to gradually retreat from competitive industries to give way to private capitals. Early this century the central government adopted further measures to introduce competition mechanism among non-competition industries such as telecommunication industry. A wide range of industry is open to private investors and foreign investors. Almost all the previous restrictions on private investors and foreign investors were removed. With entering to WTO foreign investors are allowed to invest in insurance industry and bank industry. More than one circular from the central government emphasized that private investors and foreign investors should enjoy the same preferential policies ranging from financial supports from local government, different banks to simplifying project approval procedures.

Contribution in different forms like management skill, property rights, patents, inventions and so on are allowed and encouraged to be counted as stock of companies. Special importance is attached to protection of intellectual property rights. China amended its Patent Law in 1992 and 2000 to enhanced legislation and enforcement for protection of intellectual property rights. China joined international conventions on patent protection. Its quality of protection of intellectual property rights meets international standards. In the 9<sup>th</sup> five year planning period application for patents in China increased by 81% compared with the 8<sup>th</sup> five-year planning period.

Local governments at all levels are required by the central government to change their role from traditional controlling everything of industry to serve the industries. Industries are allowed to purchase their raw materials, goods and services from any where the industry management think suitable. Many large-scale pulp and paper industry are now buying technologies, consulting and wood pulp from foreign countries.

The reform is however not welcome by everyone. As protectionism from local governments and different industrial sectors became apparent the central government used strict measures and policies to strike these behaviors.

### **Investment Policies**

Lots of preferential policies are issued by the central government to attract investments from all kinds of sources. Particularly investments for ESTs and investments from foreigners are encouraged.

The central government published “Directory for Industries for Foreign Investors ” and “Directory of Industries, Products and Technologies that Are Encouraged by the Nation”. Foreigners are exempted from customs duty and value-added tax for the equipment to be used by the foreigners themselves, if they invest in industries listed in the first directory as encouraged industries or B Category of the restricted industries. Foreign investors enjoy the same benefits if their investments consist of the second directory.

From the statistics, in China the present average tariff rate for the paper products is 23.35%. As China’s having joined the WTO, the tariff rate is sure to be reduced at a suitable level.

China encourages foreign investors invest in pulp and paper industry. Particularly the following fields are encouraged:

- Large-scale pulp and paper mill together with raw material base
- High-tech chemicals technologies for pulp and paper making
- Manufacturing of new pulp and paper making machinery
- Resource reuse projects of pulp and paper making
- Pollution control projects for pulp and paper mills
- Paper and paper board projects

### **Price Policies**

In order to increase competitiveness of China’s industries government removed control on price of more and more raw material, technologies and equipment.

Price of electricity keeps rising rapidly in China. Electricity was sold at 0.01 USD per kilowatt-hour in 1985. It went up to 0.04 USD in 1996. The price of electricity was controlled by the central government until recently. In 2002 a competition mechanism is established in the power industry. The reform has two important components: separation of power generating stations from power networks, and all the power generating stations are allowed to sell their electricity to the power network and the latter buys the cheapest electricity.

Although reform of electricity price is under way it will take several years for the market mechanism to be fully established. Today in many cities the local government is still in control of the electricity price. But on the other hand industries, particularly the large users of electricity, are working very hard to get the market mechanism for electricity established properly.

Price of water was traditionally too low compared with its real value. Reform of water price has been listed as one of the important tasks of China's the 10<sup>th</sup> five year period. Reform of water price is now a hot topic in China in recent years since China is a water-shortage- country. The first stage of water price reform has been carried in large cities like Beijing and Shanghai. In these large cities water price has been increased from 0.08 USD per M<sup>3</sup> to some 0.25 USD per M<sup>3</sup>. In many other cities water price are increased to the same level for domestic consumption. For the industrial and commercial consumption water price is increased to 0.35 USD per M<sup>3</sup>. in the summer of 2001 many cities put severe punishment on domestic, industrial and commercial users if they use more water than their quotation, including increasing their water price by ten times for the water volume exceeding their quotation.

The central government is now working in a pilot city where, the water price will be increased by 48% initially and then by 32% every two years in 6 years.

### **International Trade Policies**

The international trade policies have undergone fundamental changes. Today China does not pursue the policy of 100% made in China. Instead priorities of the international trade policies are focused on directly participating in the international job division. Based on this policy China works on making its technology-intensive industries and products become an important part of the international industrial network.

Since the middle of 90s China has implementing a policy that provides preferential measures to the high-tech content of the imported technologies. According to the high-tech content of the imported technologies measures of reduction or exemption of customs duty are determined and practiced. Preferential policies are also provided to industries that are identified as China's mainstream industries such as machinery making and electricity-related technologies, and chemical industries.

In an effort to promote development of ESTs the central government decided to take off customs duty and value-added tax for imported goods for the high-tech and equipment that China can not make presently.

### **1.2.2 Environment Policies**

#### **Main Development**

In China environmental legislations consist of four levels. The first level is environmental laws. The environmental laws are formulated by the national People's Congress and issued by the Chairman of the People's Republic of China. A typical law is the "Water Pollution Control Law of the People's Republic of China". The second level is governmental directives in environmental field. They are normally prepared by the State Environmental Protection Agency (SEPA), approved by the State Council and issued by SEPA. A typical environmental directive is " Specifications for Implementing the Water Pollution Control Law of the People's Republic of China ". The third level is environmental regulations which are formulated and issued by SEPA. A typical environmental regulation is " Regulations on Control of Water Pollution from Paper Industry". The fourth level is environmental standards. The environmental standards are prepared and issued by SEPA.

China attaches more and more importance to establishment and improvement of legislation system. An incomplete statistics shows six environmental laws, twenty three environmental directives and fifty three environmental regulations were issued or reissued after amendment in the past ten years or so.

Previous environmental legislations emphasized the end-of-pipe controls. Cleaner production started entering the environmental legislations in the last seven years. Cleaner production is explicitly put down in the "Environmental Law for Solid Waste Pollution Control of the People's Republic of China", the amended "Water Pollution



Control Law of the People's Republic of China" and the "Air Pollution Control Law of the People's Republic of China". In June 2002 the "Law for Promotion of Cleaner Production" was issued by the national People's Congress. The "Regulations on Environmental Protection for Management of Construction Projects" definitely required cleaner production should be part of the environmental impact assessment procedures.

### **Environmental Impact of Pulp and Paper Industry**

In 1999 pulp and paper industry in China discharged 3 billion tons of waste water accounting for 15.6% of the national total. The industry is the third biggest polluter in the country only after chemical industry and the iron and steel industry. Only 1.12 billion ton or 37.3% of the waste water discharged by the pulp and paper industry met environmental standards. The industry discharged 3 million ton of COD which was 43.5% of the nation total from industries.

### **Environmental Enforcement**

Although many industries are still paying their levy based on agreement with local EPBs and not based on standards environmental enforcement has been greatly enhanced since the middle of 90s. Environmental Enforcement Centers are established at provincial level, city level and county level. Particularly in recent two or three years Environmental Protection Bureau (EPB) at all levels strengthened monitoring and enforcement on the industries discharging pollution secretarily during nights or through hidden outlets. Local governmental officials were removed from their positions and received other punishments who protected those industries for their illegal pollution discharge. Quality and quantity of imposing pollution levy are getting better.

In 1996 the State Council issued its" State Council's Decisions on Enhancing Environmental Protection for Several Issues " which required all the pulp and paper mills with an annual capacity less than 5,000 ton be closed. Before December of 1996 4,081 small pulp and paper mills were closed. The State Environmental Protection Agency, environmental protection bureaus at different provinces, cities and counties played an important role in the enforcement of the State Council's decision.

Shandong Province has the most straw-based pulp and paper industry in terms of number of mills and production volume allover China. And therefore Shandong EPB

took the most restrict measures. While straw-based pulp and paper mills whose capacity is less than 15,000 ton per year are still operating in other parts in China Shandong EPB closed pulp and paper mills whose capacity was less than 25,000 ton per year. This year Shandong EPS is closing pulp and paper mills whose capacity was less than 30,000 ton per year.

In China environmental policies and economic policies are coherent. Closing the small pulp and paper mills is a requirement from both environmental administration department and economic development department. Both require industries to integrate pollution control with high tech development and industry mix restructuring.

### **Environmental Regulations Applicable to Pulp and Paper Industry**

Control and regulation on pollution from pulp and paper industry are becoming more and more strict. Before 1983 China did not have a separate environmental standard for water pollutants from pulp and paper industry. The first environmental standard for water pollutants from pulp and paper industry was issued in 1983 and since then, it was modified twice with each modification becoming stricter. The first modification was made in 1992. The last modification made in 2001 increased requirements on BOD<sub>5</sub> and SS. This can be seen in Table 1

Table 1

Items		WW dis. quantity	BOD5		CODer		SS		AOX		P H
			Kg/t*	Mg/L	Kg/t*	Mg/L	Kg/t*	Mg/L	Kg/t*	Mg/L	
Category	Items	M3/t*	Kg/t*	Mg/L	Kg/t*	Mg/L	Kg/t*	Mg/L	Kg/t*	Mg/L	P H
		Pulp	Wood	150	10.	70	52.5	350	15	100	
	5										6-9
Non wood	220		15.	70	88	400	22	100	2.64	12	
			4								6-9
Paper	Normal conditions Paper and paper board	300	30	100	135	450	30	100	27	9	
		60	3.6	60	6	100	6	100			6-9

## **1.3 Institutional Framework**

### **Technical Infrastructure**

Although private manufacturing industries are growing fast in China like other sectors technical infrastructure for pulp and paper industry is dominated by state capitals.

- **Design Institutes**

There are 50 design institutes in China working for pulp and paper industry. Among them the most famous ones include “China National Pulp and Paper Research Institute” and “China Light Industry Shanghai Design Institute”.

- **R&D Organizations and Information Providers**

R&D organizations and information providers are mostly research institutes and universities. These organizations most of the time apply research projects from governmental scientific funds. Some of them are getting more and more practical projects from pulp and paper mills and this is in line with the governmental policy to put the R&D organizations on a market place.

The South China Technology University established a national key laboratory for pulp and paper making. The lab is active in exploring non or low chlorine bleaching technologies.

“China Technical Association of Paper Industry” and “China Paper Association” are famous organizations in this field for the services they are providing.

- **Testing Centers for Pulp and Paper Industry**

13 testing centers are actively working on measuring, testing and analysis for technologies, processes and products of pulp and paper industry.

### **Education and Training Institutions**

Universities play an important role not only in providing education but also providing training. There is one light industry university in almost all the provinces. There is a department of pulp and paper making in almost all the universities.

## **Efficiency and Quality of Technology Infrastructures and Universities**

With China entering the market economy the technology infrastructures and universities now often proactively go to the pulp and paper mills trying to help them and get projects from them. Communication between the technology infrastructures and universities and the pulp and paper mills is becoming better and better. Mills are willing to pay for technologies and information that bring them profits and market competitive power.

Many of the Chinese technology infrastructures and universities understand the technologies that fit Chinese mills needs the most. Some of them know the good technologies their foreign colleagues are developing. But since many factors affect the development of ESTs in the pulp and paper industry China at present can not make the best technologies for pulp and paper mills. Hence more and more large pulp and paper mills in China are purchasing technologies from developed countries.

## **2. Pulp and Paper Industry in China**

### **2.1 Sector Development**

China's production volume of paper and paper board accounts for the third place in the world (after the USA and Japan). China produced 26 million paper and paper boards in 1996, an increase of 485% compared with 5.4 million in 1980. The annual growth rate was 10.4%. It produced 30 million ton paper and paper board in 2000 which was an 25% increase compared with the 24 million in 1995. There were 6,500 mills nationwide in 1996 with 1.3 million employees.

The nation increased investment in the ESTs for the pulp and paper mills at the last five years in the last century. National loans were provided to 51 technology innovation projects. The nation also exempted all the interests for the loans provided to the 51 pulp and paper making projects. The overall loans were estimated at 2.44 billion USD and it is expected to build a new capacity of 3.55 million ton of paper and paper board.

In the same period more and more foreign investment was used in the pulp and paper industry. The foreign investment like the state investment was largely used by ESTs related projects. In 1999 32% of the investment in pulp and paper industry was foreign investment.

On the average China's paper mills consume 100 ton of water to produce 1 ton of paper compared with 10-20 ton of water per ton of paper in developed countries. For China's pulp and paper mills their water consumption is averaged at 300 ton compared with 35-50 ton in the developed countries.

The pulp and paper mills in China usually use 1.55 – 1.7 ton of standard coal while in the developed countries it is 0.85 – 1.2 ton.

Ownership structure of the pulp and paper mills in China changed significantly in the past ten years. In 1999 state-owned mills accounted for 29.8% in the total, joint ventures accounted for 27.7% and the rest 42.5% were owned private and collectively (most of the collectively-owned mills became private today).

China has been a big importer of paper and pulp. It imported 6.5 million ton of paper and paper board in 1999, which was 12.88% increase compared with 5.8 million ton of importation in 1998. China imported 2.2 million ton of pulp in 1998 and 3.1 million ton of pulp in 1999, an increase of 40.86%. The following table summarizes the volume of pulp imported by China in recent years.

Table 2 Pulp imported by China in recent years

	1995	1996	1997	1998	1999
Imported pulp	80	150	150+	212	310
Increase rate	--	88%	0%	41 %	46%

In 1995 mills that were with a capacity of less than 5,000 ton per year accounted for 83% of the national total. In the efforts of capacity restructuring number of large-scale mills increased. In 2000 44 mills reached capacity more than 100,000 ton per year while in 1995 the number was 15. The largest annual capacity of a single mill in China in 1995 was 240,000 ton and it became 700,000 ton in 2000.

## 2.2 Technology Development

From 1995 to 2000 consumption of wood pulp in the pulp and paper industry increased from 12.5% to 17.9%, and pulp made of used paper increased from 37.2%

to 40.9%. In the same period consumption of non-wood pulp dropped from 50.3% to 41.2%.

In China's process of product restructure paper products became more and more user-needs oriented. Priority shifted from quantity to quality. Low level products are phased out. New and high quality products are developed. Quality of paper products increased fast. Products of middle and high levels increased from 30% to 40% from 1995 to 2000.

According to EST developmental trait of China paper industry, the development is divided into four stages. Before 1985, in the great and middle scale of state-owned corporations, pollution control route with apparent planning economy trait. 1985~1992, because of the reforming and opening up policy, some small, privately owned and collective paper mills grew very fast, and developed many applicable EST technologies. 1992~1997, for helping the country manage pollution of the three rivers and the three lakes, all pulp mills with yearly yield of less 5000 tons were closed in 1996. Afterwards, a series of EST technologies were developed as the key technologies of great wheat straw pulp alkali recovery and end treatment to meet drainage standard. 1998~2000, with market economy further opened, customs duty decreased and enforcement of pollution gross control, EST showed the main trait of introducing capital and improving technology. During the 20 years, SEPA issued wastewater drainage standard in paper industry three times respectively in 1983, 1990 and 2000, which all apparently had age trait.

- EST in China early paper industry before 1985

Because of the lack of wood resource and recognizing that wheat straw should be long-term and big proportion of pulping raw material in China, it was decided that straw and wood should be the main material and should be used rationally, and long fiber material should be gradually increased in pulping material. The idea was also embodied in "GB 3544-83" about wastewater drainage standard in China paper industry published in 1983.

According to the principle and basis of technique route of the established standard, the basic idea up to now was correct. It is emphasized raw material utilization, waste liquor recovery and water close circulation were consistent with EST. But in some sense, it had some trace of early reform all of things made way for developing economy, middle-small individual and collective enterprises. For example, the standard was suitably loosen for small scale enterprises, and it proposed that design

department should be permitted to design and check by adopting testing technique for some processes being set and lacking of mature pollution control technique. The idea also affected some policy linked to environmental protection, and brought about the formation of thousands of small mills in the next 10 years in China.

- Applicable EST technologies from 1985 to 1992

During the years, many EST were carried out and developed for small mills.

- Alkali recovery in small soda straw pulp mill
- Comprehensive utilization of cooking waste liquor in small chemical straw pulp mills.
- Many ammonium sulfite pulp mills were developed.
- Anaerobic digestion of semichemical pulp and high yield straw pulp waste liquor
- Project breakthrough of great wheat straw pulp alkali recovery from 1993 to 1997.

After much discuss about paper pollution control technique, policy, law and science research, governments, professional administration managers and corporation managers agreed on the follows:

- Too small scale of pulp mill was the greatest obstacle for EST technique implementation: Value of some raw material was not fit to the cost of pollution treatment, such as rice straw alkali pulping.
- The basic mold of pollution control and meeting standard drainage in paper industry was decided: Alkali recovery + biochemical treatment.
- Theory of products life cycle was introduced and cleaner production technique and process were extensively implemented, for saving energy, decreasing consumption, saving water and reducing pollution.
- To meet the market, industry branch periodically issued reliable lists of the mature whole set technology, and the needed technologies, some of which need fund helping.

Until this time, the upsurge of blindly extending production and blindly developing pollution control projects from 1985 was ended eventually. The change was indirectly obtained not only from chance of harnessing the three rivers(Huai river、 Hai river and Liao river),and the three lakes(Tai lake、 Chao lake and Dian pool), but also from accumulation of experience and lessons of those who had pursued industrial development and environmental protection.

- 1998~2000,the important period of adjusting framework.

Under the great pressure of environmental protection and furious market competition, the keystone of pulp and paper industry was deepening system reform, adjusting products and raw material framework, improving products quality and



further implementing EST.

Today, we may say that pulp and paper industry has already changed deeply extensively in system, framework and conception, which has a deep effect on sustainable development in pulp and paper industry. The effect will be shown in the near future years.

### 3. Methodology and Sample Profile

#### Sample Selection of Pulp and Paper Mills

Sampling principle was based on pollution volume. Most of the water pollution from pulp and paper mills are generated from non-wood raw material mills hence priority was focused on the non-wood raw material mills.

Among the non-wood raw material mills Shandong Province has the largest ones and it has the most non-wood raw material mills in numbers. Shandong Province is one of the four provinces located in the Huaihe Basin. The Huaihe Basin is famous for its pollution disaster which is the largest environmental crisis in China so far. Huge number of pulp and paper mills in Shandong is largely responsible for the Huaihe Basin pollution disaster. For this reason most of the pulp and paper mills were selected from Shandong Province.

One of the factors in selecting the mills was the samples should cover the diversity of raw materials used by Chinese pulp and paper mills. Therefore mills using wood raw material and sugarcane baggages were also selected. Table 3 gives the profile of the mills selected.

Table 3 Details of Sampled Mills

Name	Product type	Capacity in 2000(t)
Shandong Chenming Paper Group	double pastern paper, besmear paper	226897.60
Shandong Quanlin Paper Group	enameled paper, pastern paper, besmear paper, color printing paper	127000.00
Shandong Bingzhou Huanghe Paper Co. Ltd.	Offset Paper	120000.00
Shandong Sun Paper Group	White board, white card paper	380000.00

Shandong Taishan Paper Mill	enamel paper, stay tape, solvent coated	80000.00
Bohui Pulp and Paper Mill	writing and printing paper	60000.00
Huatai Paper Co. Ltd.	machine made paper	200000.00
Gunagxi Guigang No.1 Paper Co. Ltd.	mechanically made paper	100000.00
Guangxi Guigang No. 2 Paper Co. Ltd.	mechanically made paper	40000.00
Tianhong Paper Co. Ltd.	cultural paper, alkali fpor pulp, vacuum for wash, CEH for bleching	32000.00
Bailu Paper Co. Ltd	Chemical wood pulp, Newsprint, Sanitary	216352.00

### **Sample Selection of Outside Organizations Affecting the Mills to Adopt ESTs**

This part of investigation was divided into three levels, i.e. national, local and enterprises, according to the different bodies to formulate the polices and different bodies to be regulated by the polices.

The visits paid at the national level focused on all of the already existing laws, regulations, policies and standards that might have an influence on the uptake of EST and their background and goals. Visits were also paid to NGOs and sector association.

At local level the visits were aimed at the local governmental bodies, such as industrial administration and environmental protection departments. Purpose of the visits was to collect necessary information among various regions at different economic development stages, including the attitude of local government towards the uptake of EST, policy environment created for the uptake of EST, specific local regulations and policies, and the real effects of national and local policies.

At enterprise level, on-site visits were undertaken to get to know the influence of various national and local regulations and policies on its production and daily operation, to know the major reasons for enterprises to adopt EST (on the aspects of the capacity of survival and competition, economic returns, barriers to getting loans, and enterprise image, etc.), the source of influence on the investment decision making for applying EST, and the channels for capitals to be used for purchasing EST.

Table 4 The selected outside organization

No.	Name
1	State Environmental Protection Administration
2	Center for Environmental Sound Technology Transfer (CESTT)
3	Shi He Zi City Government and environment protection Bureau
4	Student Association on Environment and Development, Peking University
5	Women Union of Dawang Town, Doying City, Shandong Province
6	Guigang Environmental Protection Bureau
7	Yanbian City Environmental Protection Bureau
8	The Science and Technology Division of Shandong Environmental Protection Bureau
9	Fujian Light-industrial Machine & Equipment Co., Ltd
10	Sichuan Light-industrial Machinery Plant, ( in Dujiangyan City)
11	Nanjing Forestry University
12	State Economy and Trade Committee (SETC)
13	China National Pulp and Paper Research Institute
14	China Technical Association of Paper Industry
15	China Paper Association

#### 4. Main Findings and Policy Recommendations

##### Main Findings

(1) The ESTs in pulp and paper industry in China developed very fast in terms of their quantity, quality and investment. This enhanced the competitive power of the sector significantly. The fast development of ESTs in China's pulp and paper industry is obviously benefited from the nation's opening policy and its deep and comprehensive reform. Only positive changes occurred in ownership structure from completely state-owned economy to a diversified ownerships, and in economy development model from central planning to market economy, restructure could happen in technologies, products, mill capacities and investment channels in the pulp and paper industry.

(2). Proper governmental guidance is important to speed up adoption of ETS in the pulp and paper industry. In China the government insists on the restructure of raw materials, products, mill capacities, technologies, ownerships and so on in the pulp

and paper industry. These measures greatly accelerate adoption of the ESTs in the sector.

### **Policy Recommendation**

(1) The government should further formulate policies and measures related to the uptake of EST. And the pulp and paper industry should enlarge the coverage of EST information exchange and personnel training. What's more, the mills should put more efforts in training. By exchanging experiences and holding the workshops concerning technology transfer and demonstration, improve the ability to uptake the EST.

(2) The developed countries and international organizations should put more efforts in funds raising for helping the uptake of EST. For example, by launching the demonstration of uptake of EST and then establish a transferring mechanism for EST uptake is very important.

## 5. Particular cases

### Case Study 1: Guangxi Guitang Co.Ltd

#### (1) Introduction of the corporation

Guangxi Guitang Co.Ltd locates at the west bank of the Yujiang River in southwest Guigang City, Guangxi Province. It has the biggest sugar factory in China and many big integrated enterprises include alcohol, pulp, paper, bump, cement, and so on.

Primary production yielded at present: sugar 120000t/a, paper 85000t/a, alcohol 10000t/a, cement 330000t/a, alkali recycled 8900t.

Guitang No.1 Paper Co. Ltd was founded in 1959 and put into production in 1961. It is the earliest enterprise which used bagasse as the major raw material. After tens of years technology reformation, now it has the capacity to produce 80000t pulp, 65000t culture paper and 20000t life paper per year.

With the development of the enterprise and higher requirement of environmental protection from the government, some old machine that consume large amount water and energy have to be discarded. At the same time, some new technology and EST technologies have put into practice.

#### (2) Major technologies reformed at present.

The technology of CEHMP is adopted to improve the quality of pulp, to cut down the quantity of chlorine by 30-40% in the three-step-bleaching of CEH, and to reduce the pollution load of the wastewater when bleaching.

The gross-reducing project has been brought into effect including the process of alkali recycle of black water in pulp manufacture, midterm disposal of waste water, and recycle of white water.

Using the sugarcane dregs from the sugar refine as raw material so that Guangxi Province can save 4300 km<sup>3</sup> woods each year.

The braising and steaming step in pulp-making system introduces alkali successive steaming. This method consumes less vapor and save more energy. Comparatively, each unit of products can save 40% of energy. Moreover, the decoloration capability of raw pulp is better; the decolourant consumed in bleaching is less; and the contamination of bleaching water is also less.

When vacuum pulp washing machine and squeezing washing machine are used in

concatenation, the power consumption can be decreased by 20%. Besides, water used in lavation is reduced by 50%.

The alkali recycle system applies advanced technologies which has been well-developed. The alkali used in the pulp-producing engineering enforced closedown recurrence, which has an alkali callback quotiety as high as 85%.

In the disposal of white water, the papermaking workshop adopts pulse white water reclamations technologies. According to the specialty of the white water in paper-making, the company put the following technologies into practice: magnetization, circumrotation and flocculation, pulse vibration to produce secondary flocculation, callback of pulp fibre and white water. With such procedure, the white water has also become a closedown circulation. The removing ratio of SS and COD in white water is 99% and 85% respectively. The technologies to process and reclaim the white water is in the highest flight at the present time, compared with the other waste water disposal techniques within China.

As far as manufacturing facilities are concerned, the project applies mature equipment from abroad by and large. Each index and parameter is comparatively advanced in its industry, while the material equipment has set the pace in China.

The investment cost in environmental protection by the corporation is as the following table.

Table Budget of the infrastructure in environmental protection

	Items	Investment (10,000 RMB)
1	Building the waste water treatment station	2147
2	Rebuild the alkali recycling workshop	10,435
3	Recovery the waste gas from the chimney	480
4	Install the black water extracting equipments	3,229
5	Recycle of the white water	200
6	Greening	100
	In total	16,391

### (3) Primary driving mechanism of adopting EST technology

- The government encourages to develop the integrated utilizing technology in light industry, adjust the raw material structure and open up the utilizing technology of bulrush and bagasse. The project that Guangxi Guitang No.1 Co. Ltd make paper from bagasse belongs to the raw material integrated utilizing item which the state and industry encouraged.

- Based on the demand of gross control that Guigang City Government ordered, the released gross of cyanide, arsenic and heavy metal in industrial liquid waste should be reduced compares with the end of “the Ninth Five-year Program”; the released gross of soot, powder, sulfur dioxide and industrial solid waste should be basic equal to “the Ninth Five-year Program ”. The purpose of all these demands is to get more yield but less pollution. The deterioration of water environment pollution has been controlled. And try to reach a new lever .The development direction of atmosphere pollution and acid rain pollution has been basic controlled. All the industrial solid waste has been innocuity dealt with.
- Considered from the enterprise, for carrying out the spirit of cleaner production and pollution prevention, technology and management reformation of the enterprise are relative easy actions to reduce the pollution gross.
- Now vehement competition exists among Chinese paper production enterprises, and the abroad paper production will enter the competition which make great pressure to the existence and development of Chinese enterprises along with China entering the WTO. Considered from the competition capacity, technology reformation should be carried on to improve the competition capacity.
- Considered from reaction from dwellers nearby, the Chinese consciousness of environmental protection are enhancing greatly. Guangxi Guitang Co.Ltd still release large amount waste to Yujiang River though it has done well in environmental protection. Dwellers nearby and some NGOs appeal the enterprise to strengthen environment protection.

#### (4) Effects

- Through renewing and reconstruct the equipment, the existing low quality, high energy consumption, low yield 1#-7# paper machine will be abolished. A 75t/h boiler has been accomplish and put into use. At the same time, three 25t/h low-pressure boilers have been discarded. Sulfur dioxide and soot contamination can reach the prescriptive release standard.
- Guangxi Guitang Co.Ltd has spent 70 million RMB in dealing with the pollution derived from sugar making, paper production, alcohol making and thermoelectricity station. These works can reduce COD burthen 45848t/year,

which establish the stability foundation to release pollution in standard.

- Though audit to clear production, that the cooling water reused after cooling by spray can direct reduced COD burthen 606t.
- Using the advanced alkali recycle boiler which bought abroad, the paper mill can reclaim active alkali 24000t (callback percent is 85), gain profit worthy of 25 million RMB, reduce the release gross of COD about 70%.

## **Case Study 2 Xinjiang Tianhong Paper Co. Ltd**

### **(1) Corporation introduction**

Xinjiang Tianhong Paper Co. Ltd was set up in 1958, and is one of the big-scale paper-made corporations which integrate paper-made, printing, machine process and material exploitation. Tianhong has a staff of 1072, among which are different special technicians. Its total asset is up to 384 million, net assets 184 million. Annual production of culture-used paper is 32 thousand ton. And is the only corporation which was awarded “National Energy Well-saved Unit” in Xinjiang.

### **(2) Primary technologies renovation at present:**

#### **Improved raw material configuration**

Raw material adopt local special plant- Achnatherum Splends, and the wastewater recycle to irrigate the Achnatherum Splends, so pollutant discharged out into the environment is rare.

#### **Introduction into advanced technologies and equipment**

Improved production layout make technologies more smooth and efficient with reduced pipeline length and transportation distance. Adoption of new type grinding part increase paper’s dry degree when it is in-out drying part; Drying part adopt multi-segment aeration and obturation gas cover in order to save steam and reclaim most of heat energy.

#### **Istallation of new measure equipment**

The data are used to calculate precisely load, heat, water, material equilibrium etc. So equipment in use can match up well with production scale.

Adoption of computer control to increase production efficiency;

Strengthen waste recycle;

Wastewater: this project send extracted black liquid back to be treated with alkali (extracted black liquid 90 percent); Send mid-segment water to Achnatherum Splends base for irrigation; white water are reused through white water reclaiming system, superabundance are sent to pulp-made system to be reused.

Pulp residue is used as raw material of subcompany.



Waste residue is used feed process.

### **Driving mechanism**

Tianhong lies in the westward of China. Under the policy of Big Development, Chinese government offer many favorable policies for the development of westward industries. The same scale as Tianhong in other places of China will have to be closed according to the law of China. But in order to develop the economy of westward, the governments have made many supporting policies.

Market demand is huge, while paper-made material (timber, grass material and so on) in China are lack which have restricted the development of paper-making industry. In order to develop papermaking industry, China has to import a great deal of wood slurry from foreign countries. Furthermore according to national “fifteen” developing plan and long-range layout of 2015, the demand to paper pulp will increase greatly.

The forest resource in Xinjiang Province is invaluable, nation and local government, as well as people, requires developing non-wood slurry for paper-made material. Tianhong adopt the native pasture- *Achnatherum Splends*-as material which not only save a great deal of foreign exchange, but also protect forest resource.

The leaders of the company pay high attention to environment protection and support the introduction and adoption of EST technique.