

## The ways to prevent pollution of the pulp and paper industry in China

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**Abstract** — Water pollution from the pulp and paper industry is one of the most serious environment problems in China. In order to prevent and treat pollution of the pulp and paper industry, the following works have been done in recent years: 1. Making necessary policies, measures and regulations; 2. Making overall planning and rational layout; 3. Relying mainly on internal treatment developing external treatment as supplement; 4. Improving the technology of treating wastewater of the pulp and paper industry.

**Keywords:** water pollution; pulp industry; paper industry.

The pulp and paper industry is an industry which consumes a lot of raw materials and energy. It causes serious pollution to the environment as well. According to statistics, in 1989, the production of paper and paper-board in China was up to 13.33 million tons. Investigating and calculating revealed that the annual discharge of wastewater of the pulp and paper industry was 4600 million tons, accounting for 18.2% of the total amount of industrial wastewater all over the country. The discharge of organic pollutants (in BOD<sub>5</sub>) was 1.96 million tons. So the pulp and paper industry is one of the main pollution sources in China. The heavy metals in water bodies has decreased obviously in China recently, however, the organic pollutants are still increasing. This has draw the attention of all levels of government in China.

In order to strengthen environmental management for the pulp and paper industry, some investigations have been made on the pollution caused by the industry. The result showed at following characteristics:

(1) Account for to much of the non-wood fiber raw materials consumed in the pulp and paper industry

China is a developing country lack of forests resources. It has been using non-wood raw materials to produce pulp and paper for many years. Now, more than 70% of the raw materials consumed in the pulp and paper industry is non-wood fibre materials, including wheat and rice straw, bagasse, reeds, bamboo, sorghum stalk, maize stalk and helm stalk.

(2) There are too many small-scale pulp and paper mills. Obsolete technology and the lower level of management make higher raw materials and energy consumption than normal

level, and making more wastewater and pollutant discharge in unit product and lower economic benefit. Fig. 1 gives the quantities of BOD<sub>5</sub> per ton of pulp produced by different scale of paper mills, accordingly, the smaller the scale of the mill is, the more the BOD<sub>5</sub> per ton of pulp will be generated. Fig. 2 illustrates the economic benefit of different scale of mills, consequently, the larger the scale of the mill is, the better the economic benefit will have.

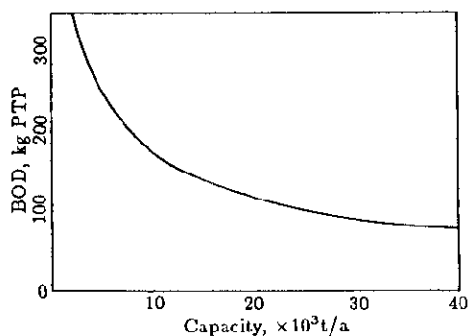


Fig. 1 Quantities of BOD<sub>5</sub> per ton of pulp produced by different scale of mills

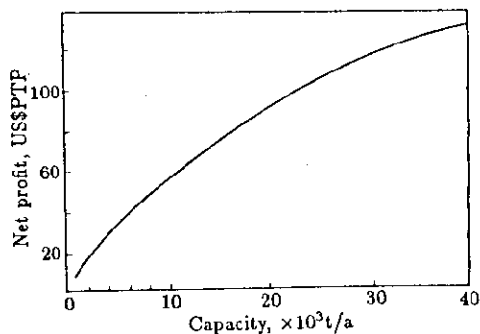


Fig. 2 The net profit of different scale of mills

(3) The pulp and paper mills spread all over the country and make pollution widely. There are about 10 thousands of pulp and paper mills in China now, only about 200 of them has the capacity of producing 10 thousands tons of paper per year, most of them are small ones with their annual capacity below 10 thousands tons. These small-scale mills spread over the country and pollute widely and seriously.

(4) There are not enough necessary wastewater treatment facilities in the pulp and paper industry. Most of the small-scale paper mills have no alkali recovery apparatus and overall reclamation system. The waste from screening and bleaching are not treated. Only few of them have white water reclaimed system. In some paper mills, wastewater is disposed after being treated with oxidation ponds or settling tanks, but in most of the paper mills wastewater is discharged without any treatment.

In accordance with the characteristics mentioned above, we have done the following works in recent years:

#### 1. Making necessary policies, measures and regulations

Considering the present economic conditions of our country, two steps should be taken to abate the serious pollution caused by the pulp and paper industry. The first step is to improve internal treatment of the wastewater, for reducing the load of pollution as the production capacity is increased. The second step is to construct external treatment system, making the wastewater discharged to environment qualified. Consequently,

**Table 1 Wastewater disposal standards of the pulp and paper industry**

Category	Nature of enterprise		Maximum allowable discharge, m <sup>3</sup> /t pulp	Maximum allowable concentration of pollutant, mg / L						
				BOD <sub>5</sub> Class		COD <sub>Cr</sub> Class		SS Class		
				I	II	I	II	I	II	
Wood	Nature	New	150							
	Colour	extended			150		350			200
	Bleached	re-build	240							
Pulp	Nature		190							
	Colour	Existing	220	150	180	350	400	200	250	
	Bleached		280, 320							
Non-wood	Nature	New	190							
	Colour	extended			150		350			200
	Bleached	re-build	290							
Pulp	Nature		230							
	Colour	Existing	270	150	200	350	450	200	250	
	Bleached		330, 370							

Note: (1) Class I refers to the water bodies that should be protected specially such as 2nd class protection region of potable water resource, fresher region and important scenery spots; (2) Class II refers to the general protected water bodies, such as the water bodies for industry water supply, some scenery and agriculture region.

the total pollution load generated by the pulp and paper industry will be abated step by step and the quality of the involving aquatic bodies would be improved gradually. In order to get this target, The Environmental Protection Commission of State Council of China, The Ministry of Light Industry, The Ministry of Agriculture and The Ministry of Finance jointly promulgated "Regulations for Protecting of Water Pollution Caused by the Pulp and Industry" in Dec. 20, 1988, including 32 entries all. The regulations, based on reality and putting the near period first, are proper to protect the pollution of the pulp and paper industry on all the aspects of construction, management, technology, economy.

With respect to the disposal standards, the new Integrated Wastewater Discharge Standard, promulgated after being revised in Jun. 1988, provides the standards for the discharge of wastewater of the pulp and paper industry (Table 1):

① Making overall planning and rational layout

The pulp and paper industry of China has been developing for recent 40 years, as showed in Fig. 3. Forecast has been made that there will be great development before 2000. For the purpose of assuring the healthy development of the pulp and paper industry and controlling water pollution caused by it, a good overall planning should be made and the desorded layout of the aimless development of the pulp and paper industry should be changed. The sites of the planned pulp and paper mill should be selected based on the character of the drainage areas. A new paper mill should be located at downstream far away from the sources of water supply, urban area and habitation, with enough water resources, energy and raw materials. Because the larger paper mills will have, the lower product coast and lower treatment cost of per cubic meter wastewater, it is suggested to develop more large-scale pulp and paper industry (Fig. 4-6).

3. Relying mainly on internal treatment developing external treatment as supplement

Internal treatment refers to all the measures adopted to wastewater generated in manufacturing process, including chemicals and fibre recovery, multipurpose utilization and water recycles and reclamation within paper mills. External treatment aims at meeting the discharge standards with the advanced treatment for the effluent of internal treatment and other wastewater which are not treated by internal treatment. The purpose of implementing external treatment including physical, chemical, biological methods and other methods are to reduce suspended solids, organic pollutants, toxic substances and color of the wastewater. In result, to reduce environmental pollution when the wastewater is discharged to water bodies.

Investigations showed that it is beneficial to construct chemical recovery system in large paper mills. A well-working recovery system can recovery all its investment in 4 years, making benefit of both economy and environment. But at present, the technology of chemical

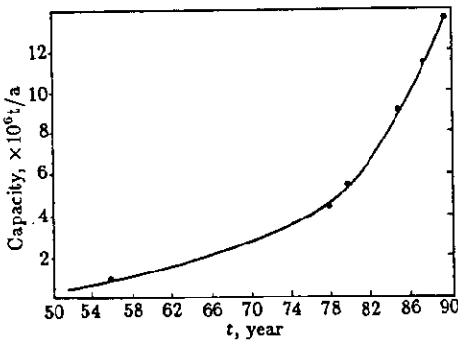


Fig. 3 The annual output of paper and paper-board in China

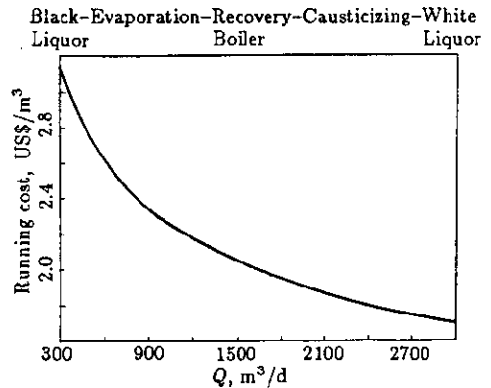


Fig. 4 Running cost vs. the amount of treating black liquor per day

recovery of small-scale mills in China is expensive and not very good.

The facilities of all kinds of multipurpose utilization can change waste into useful materials. If well managed, they could run normally and make benefit of both economy and environment. For instances, the fibre recovery system of Kunming Pulp and Paper Mill, the chemical recovery system of Xinhua Paper Mill in Shanghai, the fermentation system producing alcohol, the system producing adhesive and the system producing vanillin of Guangzhou Paper Mill, the recovery system of alcohol and liginosulfonate of Kaishantun Chemical Cellulose Pulp Mill, have all made good economic benefit.

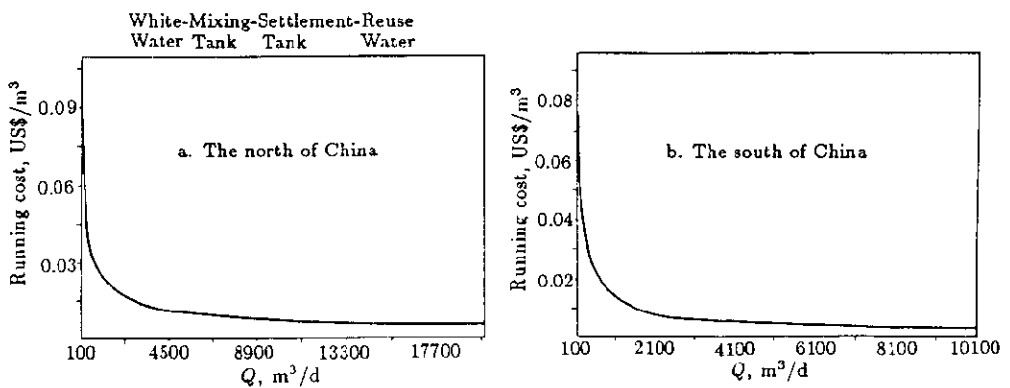


Fig. 5 Running cost vs. the amount of treating white water per day

But the facilities of multipurpose utilization need a lot of investment at one time and its products could not be sold unless a lot of work of opening up market has been done. But the white water treatment facilities, making some economical benefit with reclamation of its effluent and recovery of fibre, need fewer investment and it can be recovered them within 1 to 3 years.

Oxidation pond has the advantages of steady operation and maintained easily, it costs little money for construction, but needs big land area.

#### 4. Improving the technology of treating wastewater of the pulp and paper industry

First, the investigation on wastewater pollution caused by the pulp and paper industry, especially by the small-scale mills, should be stressed further, the research work on the practical technology of preventing pollution should be carried on.

Second, the design for treating wastewater of paper industry should be improved continuously, and the management on the design should be strengthened.

Third, the level of manufacturing of facilities and the technology of construction should be improved.

Fourth, the management of the wastewater treatment facilities should also be strength-

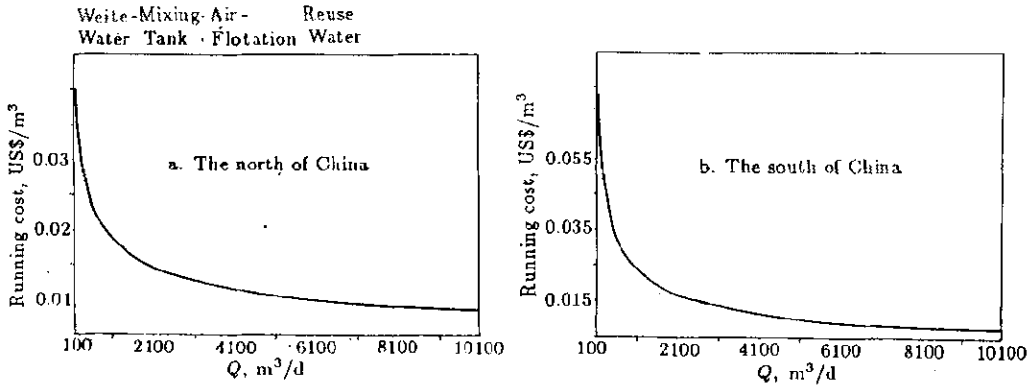


Fig. 6 Running cost vs. the amount of treating white water per day

ened, rules and regulations should be established thoroughly. The work of supervising and recording must be done, too.

Overall, we have done our best though some problems still exist. Fortunately, the pollution of the pulp and paper industry has deeply drawn the attention of all the people at home and abroad. Experts of many states and areas have begun the work of preventing pollution of non-wood pulp and paper industry and has got some useful experiences, although a lot of difficulties exist on this aspect.

We believe that the ways to prevent pollution of small-scale non-wood pulp and paper industry can surely be found so long as we work hard.

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