ENVRIONMENTAL SOUND MANAGEMENT OF WASTEWATER

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Summary

China is a developing country short of water resources and facing serious water pollution. With the rapid development of economy and urban construction, water pollution is becoming a constraining factor for sustainable development, and is affecting people' health. The Chinese Government has made a great effort to control water

pollution and some positive results have been achieved. A complete environmental legislative system for pollution control has already been established.

Although water pollution problems are serious, improvements have been made in a numbers of areas. For example the water quality in Huai river and Tai lake have clearly improved as a result of the intensive activities for controlling water pollution. But the problems facing China are still very serious. There are still a lot of things to be done in industrial wastewater control, municipal wastewater treatment and regional water pollution control. It is believed that the sustainable management of water resources, including large-scale wastewater treatment, will be possible through hard effort.

1. Wastewater discharge and its management in China

1.1 Definition of Wastewater

Wastewater is water used and discharged from homes, commercial establishments, industries, pollution control devices, and farms. The term wastewater is now more commonly used than sewage, although, for the most part, the terms are synonymous. Domestic or sanitary wastewater refers to waters used during the course of residential life or those discharged from restrooms. Industrial wastewaters refer to those generated by an industry. Municipal wastewaters are waters used by a municipality, so they would usually include both sanitary and industrial wastewaters. Combined wastewater refers to a mixture of sanitary or municipal wastewaters and storm waters created by rainfall.

1.2. Industrial and Municipal Wastewater

1.2.1. Municipal and Industrial Wastewater Discharge

Figure 1 shows the wastewater discharge between 1991 and 2003 in China. It can be seen that the total wastewater discharge from monitored sources almost kept stable between 1991 and 1998, some increase after 1998, but the trends were not consistent for industrial and domestic wastewaters. Industrial wastewater discharges appear to have fallen slightly from 1995 to 1998 and kept almost stable after 1998, though the data do not capture unmonitored townships and village enterprises and industries. Despite limited data, small-scale township and village enterprises and industries are known to be significant contributors to water pollution problems in adjacent surface waters and groundwater. Domestic wastewater discharge amounts show a growing trend. It exceeded the amount from industrial sources in 1998. Discharges from households without sewerage are not included and presumably increased by similar amounts during the same period.

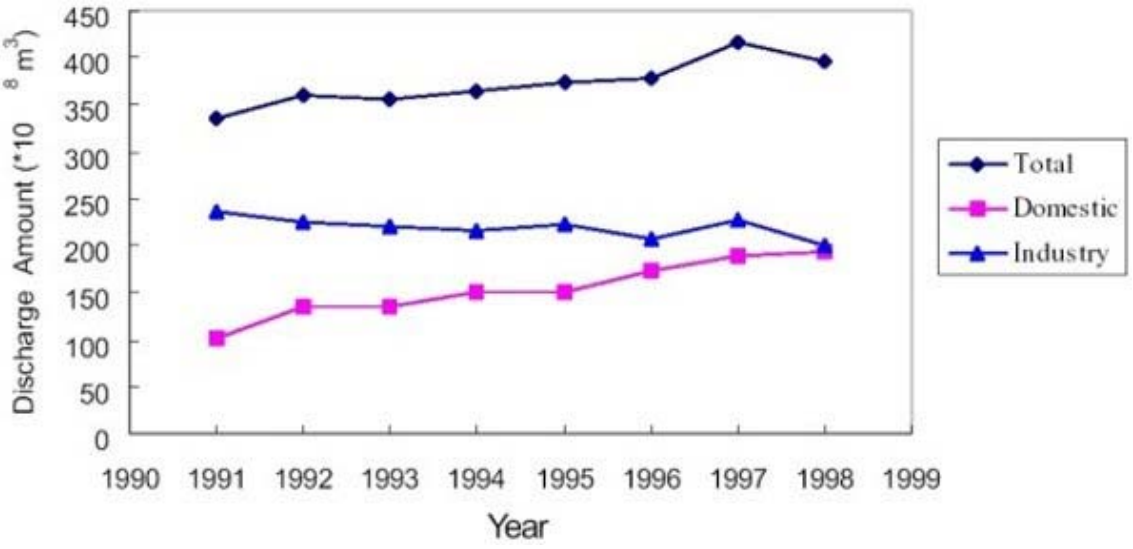

Figure 1. Wastewater discharge between 1991 and 2003 in China

Based upon the data in the "China Environmental Statistical Year Book, 1998", the total wastewater discharge amount was 39.53 billion tons in 1998, of which 20.05 billion tons of industrial wastewater represented 50.7% of the total, an increase of 3% over that of 1997. There was 19.48 billion tons of domestic wastewater, comprising 49.3% of the total, a decrease of 11.5% from 1997. The COD contribution of industrial wasterwater, 800.6 x 10^4 t, occupied 53.5% of the total and domestic wastewater was 695 x 10^4 t, 46.5% of the total. The wastewater treatment rate was 87.4%, an increase of 8.5% from 1997. However, it should be pointed out that only 65.3% of the treated industrial wasteweater meets the discharge standard. The domestic wastewater treatment rate was only 15%.

The above data show that the wastewater treatment rate has been growing in China. But there are still big challenges. The ratio of treated industrial wastewater that can meet the standards is not very high and the domestic wastewater treatment rate is very low. There are still problems with the treatment of refractory organic pollutants and some toxic materials. The wastewater collection systems are far from adequate and effective.There is a long way to go to the bright future when wastewater discharges are well controlled and natural waters are of high quality.

Table 1 shows the results of the predicted wastewater amount for the coming years, from consideration of national economic development, the life standard improvement, implementation of the water pollution control strategy, and using experience from western countries as a guide. It can be seen that wastewater discharges from domestic sources will keep growing because of the increasing urbanization of the country and the elevation of the people's living standards. The amount of industrial wastewater discharge can be controlled at a stable level by adopting a variety of measures.

Year	Municipal (*10^8 m^3/d)	Domestic (*10^8 m^3/d)	Industry (*10^8 m^3/d)	Uncollected by Sewage (*10^8 m^3/d)(%)	
1990	294.0	157.7	248.7	112.4	27.66

2000	369.0	241.2	220.0	92.24	20.0
2010	440.0	310.0	220.0	90.10	17.0
2020	396.0	396.0	220.0	80.0	10.0

Source: Zhang, ZX, Qian, Y. Sustainable Development of City and Water Pollution Control Strategy", China Architecture Industrial Press, 1998

Table 1. Predicted wastewater discharge from cities in China

In the last thirty years, the Chinese Government has attached great importance to sustainable management of water resources and wastewater treatment. Many measures including policies, regulations, law and its enforcement and supervision system, and advanced treatment technology development and application,. have been taken to improve wastewater control. Great achievements have been made and a lot of experience gained. More scientific oriented measures have been investigated and gradually established. Through years of hard work, sustainable management of water resource and wastewater control will certainly be realized.

1.2.2. Characteristics of the Domestic and Industrial Wastewater

The composition of domestic wastewater and municipal wastewater varies significantly both in terms of place and time. The variations of the characteristics of domestic wastewater depend mainly on the living customs and standards. The change of municipal wastewater is more complex. The characteristics of typical domestic wastewater are shown in Table 2. Table 3 shows the data from a large municipal wastewater treatment plant in Beijing.

Parameters	**TSS**	**BOD_5**	**CODcr**	**TN**	**TP**	**Cl^-**	**Oil**
Values(mg/l)	180-300	160-280	550-700	40-50	10-15	50-60	90-110

Table 2. Characteristics of domestic wastewater

Parameters	**TSS**	**BOD_5**	**CODcr**	**NH_4-N**	**TP**	**Cl^-**
Values(mg/l)*	329	109	234	23	29	345

*one year average in1998

Table 3. Characteristics of municipal wastewater

Industrial processes generate a wide variety of wastewater pollutants. The characteristics and levels of pollutants vary significantly from industry to industry. It is not possible to give a snapshot view of the characteristics. The pollutants in industrial wastewaters generally can be classified as conventional pollutants such as BOD producing materials, oil, suspended solids, and toxic material such as heavy metals, phenols, and synthetics organic compounds. These latter include: pesticides, polychloride, polyhydrocarbon, etc. Table 4 shows the characteristics of some industrial wastewaters. Table 5 shows some refractory pollutants and their sources.

Industries	**Toxic Chemicals (mg/l)**			**TSS**	**BOD5**	**COD**	**pH**
	phenol	**CN**	**sulfide**	**(mg/l)**	**(mg/l)**	**(mg/l)**	

Oil processing			100-200	50-250	200-250		7-8
Cock-plant	900-2000	1.5-3.0	5.4	46-60	1500-2000	5000-8000	8-9
Tannery				2500	2000	2600	7.3
Dying (fiber)				20-200	300	1200	6-8
Food processing (meat)				600-3000	600-2000		

Table. 4. Characteristics of some industrial wastewaters

Pollutants	**Chemical Formula**	**Industrial Sources**
Petrol products		petrol, petrochemicals, plastics, coke-plant, pharmacy, smelting
Phenol	C_6H_5	coke-plant, chemistry, fertilizer, pesticide
Benzene, Toluene	C_6H_6, $C_6H_4(CH_3)_2$	petrol oil, coke-plant, pesticide, plastic
Aniline	$C_6H_5NH_2$	petrol oil, coke-plant, pesticide,
p-2-phenol	$C_6H_6O_6$	plastic, dye, pharmacy, rubber and resin
Anthracene-quinnone		paper-mill, cock-plant
Chloride - pesticide		pesticide production

Table. 5. Refractory pollutant from industrial sources

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Biographical Sketch

Xianghua Wen is a Professor in the Department of Environmental Science and Engineering at Tsinghua University, Beijing, Peoples' Republic of China. She received her Ph.D degree in Environmental Engineering from Tsinghua University in 1991. She teaches Modern Environmental Biotechnology for graduate students. She carries out research in the State Key Joint Laboratory of Environmental Simulation and Pollution Control. Her major research fields are in water pollution control theory and technology, and environmental chemistry. The on-going projects that she is responsible for, or involved in, include: "membrane bioreactor for industry wastewater treatment"; "effect and reinforced mechanism of modern biotechnology in detoxication of pollutants"; "sustainable development of water resource in Chinese cities"; "screening and testing on white-rot fungi to degrade refractory organics", etc. She is the author or co-author of about 100 technical papers and research reports.