

**The investigation on wastewater treatment technology,  
equipment and market over Hunan province**

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## **Foreword: about Hunan**

With the population being over 65,000,000, Hunan is located in middle-east of China and between longitude of 108°47' to 114°15' and attitude of 24°39' to 30° 08', and covered about  $21.18 \times 10^4$  km<sup>2</sup>. There are 13 provincial level cities, 1 autonomous prefecture, and 16 cities of the county level, 106 counties and 1023 towns as well in the province. Hunan is a beautiful place with plenty of resource and products, and also a birthplace of many giants. The comprehensive technical power of the province now ranks in sixth in China, and the industrial foundation is almost completed to some extent. After several years' hard work, the basic conditions will be primarily prepared for economic development, and the international economic and trade cooperation will have been strengthened. The achievement of all kinds of public construction has already provided a good social and economic environment for the developing of environmental protection industry.

The industry in Hunan, mainly distributed along the bank of XiangJiang River and around the bank of DongTing Lake, covers more than 40 industrial categories, among which the heavy industry is dominated, and takes up about 59% of the total gross industrial output value. The industry with the output value more than ¥10 billion RMB per year include nonmetal mine industry, raw chemical material industry and equipment manufacture industry, while the petroleum processing industry, tobacco processing industry, weaving industry, ferrous metal industry and electrical power industry etc. are all over ¥8 billion RMB. In recent years, the total industrial output value is increased by about ¥130,950 million each year. The main problems now existing for the development of economy are the lower efficient management mechanism, slowly upgrading speed of products, and weak market competing capacity as well. There are also some general problems such as wearing equipments, aging products, high-energy consumption, poor economic benefit, too much land-consumption and serious industrial pollution.

With about 20,310,000 citizens and about 289 L/d per capita water consumption in average, the city area of Hunan province takes up about 12,716 km<sup>2</sup>. The tap water popularization rate now reached about 97.85%, but the wastewater treatment rate is only 27%. It was reported that Hunan was speeding up the urbanization process by strengthening the finance support on city infrastructure and by promoting the construction of small towns in 2001. By now, the number of small town has increased to 1086, in which 31 are new cities, and the urbanization level achieved 30.8%.

Hunan is also a place with rich water resource and plenty of rainwater. There are 5341 rivers that are longer than 5 km in the whole province. Because of the high elevation on East, West and South, and low U-shaped basin in the Middle-North, almost all rivers run into DongTing Lake through Xiang, Zi, Yuan, Li four rivers, which almost

make up of a whole centripetal water system. The valley area of the four rivers is nearly 180,000 km<sup>2</sup>, which is about 85% of the whole province area. XiangJiang River, the longest one in Hunan province, comes from HaiYang Mountain, GuangXi autonomous region and goes through the Hunan province from the south to the north, and finally pours into DongTing Lake.

The valley area of XiangJiang River is about 85,300 km<sup>2</sup> in Hunan province (the total is about 94,600km<sup>2</sup>), which is nearly 40 percent of the whole province area. The trunk stream of XiangJiang River is as long as 856km, of which the length of 670km is in Hunan province. There are 2157 branches running into this river, the number of which belonging to grade A is 124. The average annual runoff volume on a long period of time is 67.8 billion m<sup>3</sup>, which is just 1.51 times of that of Yellow River. Since the digging of Lin canal in Qing dynasty, XiangJiang River has become a water channel joining the South and the North. XiangJiang River is known as the mother river of Hunan because that both industry and the agriculture are highly developed with the valley, and the river is crucial factor to the economic development of the whole province.

Dongting Lake is the second largest freshwater lake with the water area of about 2740km<sup>2</sup> now. In the north of , the lake links with the ChangJiang River at 3 places, while in the south, there are Four Rivers flowing into the lake. Each year, the flood season of the Four Rivers is from May to July when a great deal of floodwater runs into the lake. From July to August the floodwater from Jin River of the ChangJiang River pours into the lake too, which drains into ChangJiang River through Chenglingji, YueYang city. The whole water system has a good effect on the water quantity adjustment. In Hunan province, river water mostly comes from rainwater, so the river water quantity is greatly influenced by the rainfall, and the runoff of the Four Rivers varies greatly.

For example, the average annual runoff of XiangJiang River ( XiangTan ) is around 2107m<sup>3</sup>/s, the maximum of the average daily flow is 12700 m<sup>3</sup>/s, and the maximum of the runoff value is 19800 m<sup>3</sup>/s, while the minimum of the average daily flow is 251 m<sup>3</sup>/s, and the minimum of the runoff value is 102 m<sup>3</sup>/s. These varieties can affect the water circumstance capacity and water circumstance protection greatly, so that the water shortages sometimes still happen due to the poor water quantity now and then in this valley though the water resource is quite rich.

Environmental protection made a notable progress in Hunan. According to the statistics, about 129 environmental monitoring stations were set up in 2001 with 2107 persons working there. Furthermore, 331 pollution-controlling projects have been accomplished with the total investment of ¥ 271,000,000, which is 14.0 percent more than that of last year. 157 smoke-and-dust-controlling regions and 126 noise-standard-reaching ones have been built, which is 25.6% and 61.5% more than

that of last year, respectively. By the end of last year, 68 natural conservative regions have been built, among which 8 ones belong to national grade and 26 ones provincial grade. The total of natural conservative area is 803,400 hectares, which is 4.3% more than that of last year. The area of smoke-dust-controlling regions and noise-standard-reaching regions is 495.2 km<sup>2</sup> and 266.7km<sup>2</sup>, respectively. The centralized treatment ratio for municipal wastewater, de-harmful disposal ratio for municipal waste solids, as well as reused ratio for industrial water are 27.3%, 52.1%, 54.0%, which are 9.2%, 1.6%, 1.9% more than that of last year, respectively. At the same time, the comprehensive treatment for DongTing Lake has made great progress, and the environment has been improved gradually. After 3 years' discharging flood by destroying the dam, the lake area will be enlarged, and the ability of storing floodwater can be boosted up. It should be pointed out that there are still some regions, where the environmental pollution and ecological damage have not been well controlled.

# 1. Water environmental status and the policy of pollution control in Hunan

## 1.1 water environmental status in Hunan

### Summarization of the water environment status

The environment-monitoring-department in all levels in Hunan province has set up 75 controlling sections with 26 monitoring items altogether for the Four River and DongTing Lake. According to the Quality Standard of Surface Water Environment (GHZB1-1999), the total circumstance of surface water is as following: the amount of the sections that meet the water quality standard I, II, III, IV, V are 3, 13, 17, 27, 15, with the proportion of 4.00%, 17.33%, 22.67%, 36.0%, 20.0% for each standard. Of all the 75 sections, 42 ones cannot meet the water quality standard grade III, which indicates that over half of the monitored sections have been polluted to different extent. And the related parameters are listed out in table 1-2.

Table 1-1 surface water quality of Hunan provincial monitored sections (2001)

Total (the number of the sections)	Class I	Class II	Class III	Class IV	Class V
75	3	13	17	27	15

Table 1-2 the main parameters relevant to the five Classes

		Class I	Class II	Class III	Class IV	Class V
pH		6.5-8.5				6-9
Sulfate (calculated by the concentration of SO <sub>4</sub> <sup>-</sup> )	≤	Less than 250	250	250	250	250
Solvable iron	≤	Less than 0.3	0.3	0.5	0.5	1.0
Total manganese	≤	Less than 0.1	0.1	0.1	0.5	1.0
Nitrate (calculated as N)	≤	Less than 10	10	20	20	25
Nitrite (calculated as N)	≤	0.06	0.1	0.15	1.0	1.0
TKN	≤	0.5	0.5 (0.05 for fishing)	1 (0.05 for fishing)	2	3
Total phosphorus	≤	0.02	0.1	0.1	0.2	0.2
DO	≤	90% of the saturation ratio	6	5	3	2
COD <sub>Cr</sub>	≤	Less than 15	15	20	30	40
BOD <sub>5</sub>	≤	Less than 3	3	4	6	10
Total As	≤	0.05	0.05	0.05	0.1	0.1
Total Hg	≤	0.00005	0.00005	0.0001	0.001	0.001
Total Pb	≤	0.01	0.05	0.05	0.05	0.1
Total cyanide	≤	0.005	0.05 (0.005 for fishing)	0.2 (0.005 for fishing)	0.2	0.2

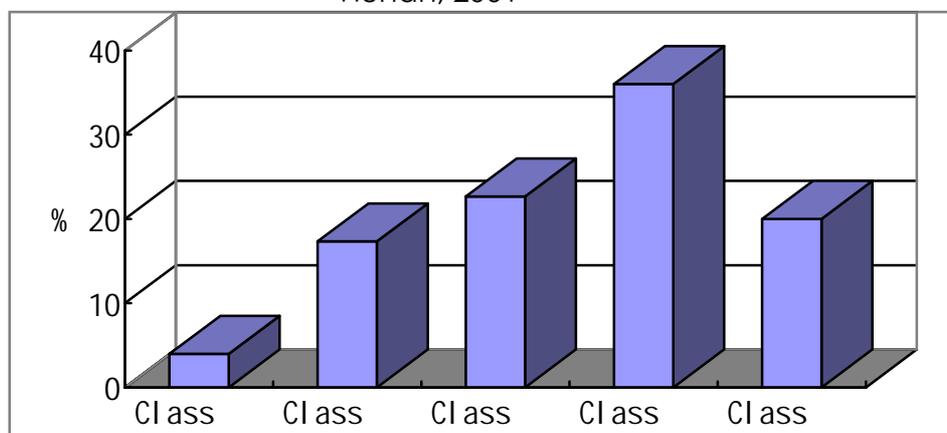
### 1.1.2 the main pollutants

Through comparing of the different index of the 21 monitoring items, the annual average over limit multiple, over limit rate, maximum value over limit multiple, contamination index as well as pollution loading, the conclusion can be given as following (refer to table 1-2 and figure 1-2):

table 1-2 the main inspected items of surface water in Hunan province, 2001

Inspected items	the annual average value		the maximum value	
	the annual average rang mg/L	average comprehensive index	the maximum of the sample mg/L	the maximum over limit multiple
Petroleum	0-0.17	0.955	22.66	36.6
Phosphorus	0.01-0.25	0.755	4.0	39.0
NH <sub>3</sub> -N	0.005-3.6567	0.706	11.33	21.66
Hg	0.00001-0.0009	0.652	0.00446	43.60
Index of MnO <sub>4</sub> <sup>-</sup>	0.92-5.85	0.349	8.68	0.08
Evaporable phenol	0.001-0.013	0.388	0.045	8
Lead	0.001-0.019	0.108	0.06	0.2
Suspended solid	2.08-320.22	0.399	947.5	5.32
COD	0.28-5.27	0.301	9.58	1.4
DO	3.94-9.58	0.229	1.37	1.07
NO <sub>2</sub> <sup>-</sup> N	0.003-0.479	0.312	2.08	12.87
As	0.001-0.138	0.192	2.172	42.44

figure 1-1 the water quality of controlling head faces in Hunan, 2001



( $\mu\text{S}/\text{cm}$ ) electrical conductivity	58.3-400.3	0.197	620	
Cd	0.00001-0.0196	0.272	0.0439	7.78
Cr	0.001-0.027	0.071	0.054	0.08
Zn	0.0024-0.5056	0.039	2.86	1.86
$\text{NO}_3^- \text{N}$	0.024-4.145	0.043	8.016	
Cyanide	0.001-0.009	0.009	0.02	
Cu	0.001-0.025	0.008	0.085	
PH	6.93-8.27		9.12	0.07

The pollution of Hunan surface water was mainly caused by petroleum, phosphorus,  $\text{NH}_3\text{-N}$ , Hg, evaporable phenol,  $\text{MnO}_4^-$  and COD, among which 5 items was used for the representative of organic pollution and 2 ones for nutrimental material, total phosphorus and  $\text{NH}_3\text{-N}$ , and Hg was selected as the representative of heavy metal.

### 1.1.3 Water pollution characteristic in Hunan

1.1.3.1 The region suffered from surface water pollution is quite wide. Most of surface water circumstance was contaminated to different extent (most water area show the light and middling pollution), while the serious water pollution was found in some partial water area. Except that the water quality of Li River water system can meet the Water Quality III, almost half of the inspected sections of other water systems only meet the Water Quality IV or V.

It can be said that in Hunan province, nearly half of the rivers are suffering from middle or even more serious pollution, and more than 1/3 reaches cannot reach the usage function.

1.1.3.2 the quality of trunk streams is better than the branches', and the water of the branches is polluted in general.

1.1.3.3 The water pollution of the reach near the cities has become a ubiquitous problem, and the contamination characteristic of domestic wastewater has been more and more obvious.

1.1.3.4 the surface water is mainly suffered from organic pollution, and also from various pollution caused by domestic wastewater, agriculture broad source and heavy metal contamination.

### 1.1.4 the main reason of surface water pollution in Hunan

1.1.4.1 the direct reason of surface water pollution was caused by the huge discharge

of industrial wastewater with complicated components, and the un-well treated industrial wastewater discharge.

Chemical, metallurgy, light industry, mechanism and steel industry, etc. are the essential industries in Hunan, and unfortunately, serious water pollution was just aroused by these industries. The following are some typical companies: ZhuZhou metal production plant, ZhuZhou chemical plant, ShuiKou mountain mineral department, XiangTan steel corporation, XiangJiang nitrogenous fertilizer plant, LianYuan steel corporation, ZiJiang nitrogenous fertilizer plant, YueYang paper and pulp plant and Hunan 311 plant, which are all near the bank of the trunk streams of the main water systems. Because of the huge discharge amount of these plants, it has great effect on the water quality of the reaches near the cities in XiangJiang and ZiShui system.

Moreover, due to some different reasons, many large and middle-scaled state-own ship enterprises have their problems such as unreasonable distribution, non-advanced technology, old equipment, low efficiency of the resource utilization and huge wastewater discharge etc. On the other hand, due to some enterprises' managers lacking of the idea about environmental protection, pollution management falls far behind. Furthermore, it is often happened that the effluent from the treatment projects could meet the discharge standard only when the inspection was carried, the environmental process cannot be run regularly. It was estimated that only about 1/3 of all the wastewater treatment equipments can reach the discharge standard regularly. Some treatment equipments can hardly realize the high standard and all aspects-permitted discharge. These are also the main reasons of water environmental pollution in Hunan.

#### **1.1.4.2 the quick development of township industry caused wastewater discharge random, which leads to the serious pollution of many branches.**

The township industry have made great progress in recent ten years, and the gross industrial output value of township businesses, which covered nearly all areas, almost takes 50% of the total gross industrial output in Hunan province. And now the township industrial system is composed of 40 industries, among which, building material, chemical industry, excavate, food and mechanism are the main industries.

As far as the industrial structure, the output value of heavy industry takes up about 2/3 of the gross industrial output in the township business. The industries engaged in source excavation and source rough process, and with heavy consumption of source and raw materials, as well as with huge discharge of wastes have a big proportion. Moreover, the traditional industries are much more than the sunrise industries. This kind of industrial structure caused a high pressure on the environment.

Concerning about the condition of the enterprises, many township industries not only suffered from the staled-out equipments, simple management, low level of administration, but also paid only attention to the economic interests, and hardly installed some equipments for environment improvement, which leads to a serious environmental pollution. Some enterprises transfer the staled-out installations from both domestic and abroad enterprises, which also lead to some pollution problems.

In 2000, the wastewater discharge from the township industrial is over 300,000,000 m<sup>3</sup>, about 20% of that of all the industries in the province, and the rate of the wastewater disposal is only 15%, and even this, the treatment measures was mostly in primary level and caused a poor treatment effect. As the results, the discharge amount of COD and SS by township industry takes up about 40% of that of all the industries in the province, which has great effect on the water body accepting wastes. In Hunan, several serious pollution accidents caused by township business have occurred, which once leads to a condition of no water for drinking and agriculture.

#### **1 ·1 ·4 ·3 The low disposal rate of municipal wastewater is the main reason of the organic pollution for city river**

The sewage discharge in Hunan province is about 1.005 billion m<sup>3</sup> per year, among which only 91.57 million m<sup>3</sup> wastewater were treated by only 4 ready municipal wastewater treatment plants in all in the province at present. The disposal ratio is less than 8%, and the nitrogen and phosphorus removal are seldom considered.

In Hunan province, on average each 16 million people is provided with one municipal wastewater treatment plant, and those plants now only existed in a few cities such as Changsha, Zhuzhou and Changde. Wastewater from the most other cities is directly discharged into water bodies without any disposal. Along with the urbanization expediting, the municipal wastewater now takes up more than more than 50 percent of the total wastewater produced in the whole province. On account of the municipal sewer system and treatment engineering drops far behind the municipal construction, the pollution of the surface water is becoming more and more serious, which makes the organic contaminant load of the water area in the whole province increased continuously, the ammonia nitrogen and the coliform group contaminant gone beyond the criterion generally, and COD, BOD, total phosphorus raised gradually

#### **1 ·1 ·4 ·4 The pollution caused by agricultural area source is not in control, and even becoming more and more serious**

### **1 · 2 The investigation on water pollution control policy in Hunan**

The general target of environmental protection in Hunan province is:

Till 2005, new mechanism and administration system for environmental protection

will have been established, which should be led by government, advanced by market, standardized by legal system, participated by public. The status of environmental pollution will be improved gradually, and the ecological protection and construction will make great progress, and the whole environmental quality will advance steadily, and the environmental quality of some important cities and areas will be also improved.

### **1 · 2 · 1 The concrete target of water environmental quality control in Hunan province**

Till 2005, more than 96 percents of the water from the centralized water sources in whole province will meet the National Water Quality Standard(GHZB1-1999), and more than 75 percents of the national-control cross sections and provincial-control cross sections in main water area will reach the national water environmental quality standard III, 25 percent of which will reach the national water environmental quality standard II. The intersections between cities and the cross sections of four rivers' entrances to Dongting Lake will strictly meet the standard according to the water function.

### **1 · 2 · 2 The concrete index for water environmental quality control in Hunan province (2000-2005)**

#### **1 · 2 · 2 · 1 The total amounts of the main contaminants control index**

——The discharge amount of COD should be controlled under 628,000 tons, and about 710,000 tons are discharged in 2001.

——The discharge amount of ammonia nitrogen should be controlled under 133,500 tons, and 129,000 tons are discharged in 2001.

#### **1 · 2 · 2 · 2 Industrial pollution control index**

——55 percents of industrial water is reused, in 2001 the reuse ratio is 49.24%

——The discharge amount of COD be controlled under 355,000 tons, in 2001, 296,000 tons COD are discharged

——The discharge amount of ammonia nitrogen should be controlled under 65,000 tons, in 2001, 95,000 tons of ammonia nitrogen are discharged.

——The discharge amount of cadmium be controlled under 16.66 tons, in 2001, 23.24 tons are discharged.

——The discharge amount of Hg be controlled under 1.23 tons, and about 2.32 tons are discharged in 2001

——The discharge amount of Lead be controlled under 111.55 tons, in 2001, about 157.27 tons.

### **1 · 2 · 2 · 3 The urban environmental protection index**

——40 percents of municipal wastewater be treated, in 2001 the disposal ratio is 8%

### **1 · 2 · 2 · 4 The countryside environmental protection index**

——The water quality of the centralized drinking water sources should reach the Class III of the Environmental Quality Standard (GHZB1-1999) basically

——60 percents of the wastewater from the large-scale stock farms and the poultry farms meet the standard.

## **1 · 2 · 3 Environmental protection index in the key regions**

### **1 · 2 · 3 · 1 Environmental protection key cities**

——including Changsha, Zhuzhou, Xiangtan, Changde, Yueyang, Zhangjiajie

——Wastewater treatment rate be more than or equal to 50 percents, in 2001 the treatment ratio is 33%

——The discharge of all the contaminants from industrial pollution sources meet the national discharge standard.

### **1 · 2 · 3 · 2 Environmental protection key industrial region**

——Including the Qingshuitang industrial region in Zhuzhou city, Yuetang industrial region in Xiangtan city and Shuikoushan industrial region in Hengyang city.

——The discharge of all the contaminants from industrial pollution sources meet the national discharge standard.

——The discharge of cadmium be reduced 8

——The discharge of hydrargyrum be reduced 1.23 ton

——The discharge of Lead be reduced 43.07 ton

### **1 · 2 · 3 · 3 Environmental protection key rivers and lakes**

——Including the trunk of XiangJiang River and the Dongting Lake

——The water quality of urban segments of XiangJiang River meet the national standards according to their function, and the water quality of the intercity cross sections meet the national surface water environmental quality standard III (GHZB1-1999).

——The disposal rate of wastewater from all the cities and some important towns along the trunk of XiangJiang River be more than or equal to 50 percents

——65 percents of the sewage from the large-scale stock farm and the poultry farm meet the standards.

——The ecological function of Dongting Lake swamp be recovered, the biological diversity be protected, and the eutrophication of the border water area be alleviated

## **1 · 2 · 4 Water pollution controlling strategy in Hunan province from 2000 to 2005**

### **1 · 2 · 4 · 1 Reinforcing the strength of executing the law for water environment**

The main laws and regulations carried out for water pollution control in Hunan province at present are as following: water law of People's Republic of china, water pollution control law of People's Republic of china and water pollution control ordinance of Xiangjiang Valley. The corresponding departments of the provincial government, in near future, will change their emphasis from treatment for the region water pollution to treatment for the valley, and turn the terminal treatment to whole process control. Besides, punishment for violating the environmental law will be strengthened, and some small-scale enterprises with serious water pollution will be closed up. (the relevant laws and the standards can be found in the appendix)

### **1 · 2 · 4 · 2 Improving the synthetical decision-making mechanism for environment and development**

The environment and the economic development are interdependent and restrict each other, which should meet the requirements for sustainable development. According to the demand of national environmental protection, the impact of the important economic policies, long-term development planning and area exploitation as well as construction projects in whole province on the water environment must be assessed firstly and then the corresponding strategy should be brought forward for considering the impact on water environment in different periods and different conditions.

#### **1.2.4.3 Adjusting the industrial structure, and to promote the implementation of total amount discharge control for the t of the water contaminant**

Unreasonable industrial structure is a historical problem for economic development and environmental protection in Hunan province. Along with the globalization of world economy and China's entrance to WTO, the optimization and upgrade of industrial structure will be the inevitable trend of economic development and be the important factor for environmental protection.

The idea from the corresponding departments of provincial government is: to promote clean production, to utilize comprehensively the resource, to realize the strategic change for industrial pollution control and to solve the pollution problem caused by the unreasonable industrial structure. For the valley and the areas where the discharges have met the standards but not met the requirements for water environment quality control, the total discharge amount should be controlled, and the discharge license system for wastewater should also be implemented.

#### **1.2.4.4 To protect the drinking water resource, and to treat the water bodies connected closely with the living environment firstly.**

To protect the drinking water resources that relate with the people's life closely  
To mark off the protection region for drinking water resources according to the law.  
To adjust the discharge location or change the discharge way of the effluent that may influence the water quality much according to the specific situation.  
To strengthen control for the petrolic, organic and bacteria index pollution.  
To make a good water and soil conservation,  
To take positive measures for the treatment of small valley.

#### **1.2.4.5 To emphasis on that water saving is the most effective way to prevent water pollution**

The corresponding departments of government should regard the problems of water resource protection, utilization and recycling as a problem closely connected with the sustainable development in whole province, and enhance the management of water resource, increase the water-recycling rate, decrease the water consumption and discharge amount.

At the same time, something should be done for water saving education and management. From the end of 2002, 0.2Yuan/m<sup>3</sup> surcharge for wastewater treatment will be collected, and this may helpful to improve the public water-saving awareness. And the way using tap water for aquiculture and agricultural irrigation should be forbidden. The new building must take use water-saving facilities, which should be devised, constructed and used at the same time, and the water-saving control agency will check the devices. The water-saving facilities should be taken for car washing and for bathing, and the water-recycling system must be set if permission.

#### **1 · 2 · 4 · 6 To enhance the rate of municipal wastewater treatment**

Municipal wastewater treatment, reclaim and recycle is a key step related to the relationship between the urban development and the urban construction in Hunan, and is also a important problem related to the daily life of each citizen. Until 2005 the wastewater disposal rate of the cities with the population more than 0.5 million should reach 60%. The wastewater treatment technologies with high efficiency and low-cost should be encouraged to take in use.

Government should also promote the supervision and management on the constructed wastewater treatment facilities. Those not running normally should be renovating in limited time.

### **1 · 2 · 4 · 7 Enhance the control of area source pollution**

There is no law that concerned with the country area source pollution at present, and not mention the effective disposal technologies and managing meanings. Along with the standard-meeting discharge of industrial pollution source and municipal wastewater treatment being advanced step by step, the pollution of country area source become more and more serious, and in some regions even become the main surface water pollution source. As a result, the corresponding departments in near future should organize an investigation for area source pollution, and make clear the fundamental data related to area source pollution, and formulate a practical contamination control plan. For example, to guide the adjustment of agricultural structure, to reinforce the environmental management, to adapt advanced technology for poultry and cattle breeding, to promote the scientific applied technology and method for fertilizing, using of pesticide and agricultural film, to utilize and dispose the agricultural wastewater and agricultural solid waste reasonably, to advocate ecological agriculture and ecological country etc.

### **1 · 3 The general analysis on wastewater treatment market in Hunan province**

#### **1 · 3 · 1 Contrast between the target and the status**

As we mentioned above, the status of surface water environment quality in Hunan province is: More than 60% of the surface water (the cross sections monitored) are seriously polluted. Almost half rivers are at above the medium pollution level. According to the demand of the tenth five-year plan of environmental protection in Hunan province, to ensure the security of drinking water and the quality of industrial water as well as the agricultural water, the cross sections monitored of the surface water that meet the national water environmental quality standard III should be more than 75% ( nowadays 39.24 %), and the cross sections that meet the national water environmental quality standard II should reached 25% (nowadays 15.19%), almost all the main industrial pollution sources should be controlled to meet the demand of discharge standard (nowadays 74.9%). The disposal rate of municipal wastewater should reach 40% (nowadays 22%), of which all the cities and important towns along the trunk of XiangJiang River reached 50%. From above, it is obvious that a lot of things need to be done in the field of wastewater treatment in the province in near future.

#### **1 · 3 · 2 The primary analysis on wastewater treatment market**

In order to realize the target of the water environmental protection in whole province, industrial wastewater treatment projects in whole province should constructed or rebuilt to eliminate 81,200 ton COD discharge per year and municipal wastewater treatment plants should be constructed to dispose 2.92 million ton wastewater per day and to eliminate 0.16 million ton COD discharge per year.

According to an analysis report made by the environmental protection administration,

in order to accomplish the environmental protection mission planed in the tenth five-year plan in Hunan province, about 24.7 billion Yuan taking up about 1.05% of GDP of Hunan province should be invested in the field of environmental protection in whole province, of which more than 10 billion Yuan be used for water pollution control.

## **2 · Investigation on wastewater treatment technology and equipment in Hunan province**

### **2 · 1 General introduction**

The industry of environmental protection in Hunan province started from last 60s', with the equipment products mainly for coal-fired boilers dedusting and de-sulphate. And it was not until the early of the last 90s'did the production of water treating-equipment start. According to the uncompleted statistics, more than 100 factories or companies with about 7000 employees manufactured environmental protecting-equipment all over Hunan province, products produced include treating-equipments for water pollution, treating-equipments for air pollution, treating-equipments for solid discards, controlling equipment for voice and vibration, coagulant and material of environmental protection, and the instrument for environment monitoring, etc.

With more than 13% average yearly increase, the total output value reached about 400 million Yuan, and the profit about 57 million Yuan, the profit rate 14%. Among them are 50 factories or companies engaged in the field of wastewater treatment equipments (professional or unprofessional), with total output value about 130 million Yuan, profit about 18 million Yuan, and profit rate near to 14%.

As far as the environmental protection research and development, Hunan has shown her strong ability. There are many national level research organization, universities, and some other academic research institutes, which are the main force, at the same time, some provincial-level professional environmental protecting organizations and enterprises could be the supplement. There are totally more than 60 enterprises engaged in environmental protection research and development, who engaged in the technology for water pollution, air pollution, voice and vibration controlling, and environmental monitoring, etc. The average annul income is near 50 million Yuan, profit rate more than 20%.

### **2 · 2 Investigation on wastewater treatment technology and equipment in Hunan province**

#### **2 · 2 · 1 General introduction of the investigation**

According to the mentioned above, there are more than 50 enterprises engaged in the field wastewater treatment, among them, 20 enterprises, who can be the representative, were selected for this investigation. And the investigation covered different wastewater treatment equipments and technologies including: physical treatment, chemical treatment, physical chemical treatment, biological treatment, combinatorial treating-equipment, kit equipments (such as fan, and water pump etc.), wastewater

treatment chemicals and materials, water pollution monitor instrument, etc.

The general investigation-data-table are listed from table2-01 to 2-20, the basic status of each business enterprises are as follows:

- Changsha Tongda (group enterprise) limited company (table2-01), a large-scale state-own ship company derived from Changsha Water Pump Factory is the biggest water-pump-producing-enterprise in Hunan, and also is one of the main enterprises providing pump for environmental protection engineering. The corporation changed the systems to establish the limited company in 1998, and made kit equipments for wastewater treatment engineering as its main product, and now is managed to get government financial support. The traditional product, sewage pump, is now lacking of competition in the market, and the kit equipments for wastewater treatment has yet not come to a large scale.
- Changsha fan limited company (table2-20): a national key enterprise producing Roots blower, the newly developed fan with low voice has been well applied in some small-scale wastewater treatment engineering. However, its main product is seldom used for wastewater treatment project. Since energy-saving centrifugal fan are more and more popularized in modern municipal wastewater treatment plant, and Roots fans market has become smaller and smaller.
- Hunan Wuling group enterprise (table2-03): a state-own ship enterprise that produces light industry machine for porcelain and ceramic, its pressed filter was originally and primarily used for dehydration of light industry and chemical industry material. Because there are few enterprises that produce pressed filter in Hunan, pressed filter used in environmental protecting engineering were from professional factory in Zhejiang, Shanghai...etc. The company just turned the vision to the environmental protecting industry in the last few years, and its products have some application in the market of wastewater treatment in Hunan.
- Shaoyang Youhua water-clean material limited company (table2-04), established in 1997, is a private enterprise and a professional PAF water treatment material producing factory based on it's own patent technique. The main product is polymerized ferric sulphate. The designed yield is 1,000 ton/a, which is never reached for many reason.
- Chenzhou Yongxing water-cleaning chemical company, one of the environmental protecting enterprises with longer history in Hunan province, is an intensive-labor industry with low technique, and has not made big development in the last few years.
- Changsha Xinshunchang water-cleaning equipment limited company (table2-06), a private enterprise, is mainly engaged in drinking water purification, and also manufactures some simple equipment for wastewater physical treatment.
- Changsha Huilong environmental protection engineering service limited company (table2-07), a private enterprise set up by people who once were the clerks from local environmental protecting bureau, with the main business related to small-scale environmental protecting projects from Changsha area.

- Huaihua environmental protecting equipment factory (table2-08), a small scaled enterprise, with the product mainly for hospital wastewater disinfections.
- Hunan Hongda environmental protecting equipment limited company (table2-09), developed from a small-scale private enterprise, the main business of the company was limited in some small-scaled wastewater treatment project at very beginning in local area. And now, their business expands to central drinking water machine used for small area or hotel and ambulating multi-functional car used for flood control and other task, and originally possessed equipments also get further improved. The company now began to be involved in some larger-scale wastewater treatment project.
- Hygienic engineering institute of Hunan province (table2-10): It is the only professional environmental protecting company of hygienic system, primarily be engaged in the treatment of polluted water from hospital and in the treatment of medical garbage. Sodium chlorite generators used in most of the hospital throughout Hunan province are almost produced by the institute, and it was estimated that the device developed recently for chlorine dioxide generation is nearly take up about 70% of the market in whole province. And the company also got some progress in drinking water deep treatment. The company now transfers into a share company.
- Changsha Aobang environmental protection limited company (table 2-11), a private-own ship share company invested by three peoples persons engaged in the environmental protecting engineering design for several years in an state-own ship institute, is one of companies that run well in Hunan. The company is mainly engaged in the design and construction for industrial wastewater treatment, and in the device manufacturing for the project. The company, without their own factory, normally provides only some technical service. The construction and the manufacturing were usually assigned to some other companies. It can be said that the company runs in a way similar to design institute.
- Hunan Universe environmental protecting engineering limited company (table2-12), a private enterprise invested by a Taiwanese with technical support from universities and design institute. The technique developed for oil-containing wastewater and its kit equipments were applied successfully in western China oil field, and the contract order once reached nearly 100 million Yuan. Since the company adopts the familial management mode, the development of the enterprise was limited.
- Changsha water treatment equipment factory (table2-13), a collective enterprise, mainly engaged in producing industrial water-cleaning equipments. Because of lacking of technical support, some national-standard equipment for water treatment only be manufactured by the company now.
- The eighth design institute of mechanical industry ministry (table2-14), a design institute being engaged in the design of industrial and municipal wastewater treatment early in Hunan province, with strong capability of doing research and design works, from which some of technicians established their own companies

related to environmental protection. Besides the design work, it also has its own small-scaled equipment manufactory, which can provides kit equipments out of standard for its undertaken environmental protecting engineering.

- Hunan Henghui environmental protection industrial limited company (table2-15), a Sino-Netherlands joint venture, producing inorganic membranes with the European materials and technology, which filled up the blank of applying inorganic membranes into the industrial wastewater treatment in Hunan. And its products have shown their strong advantages in the treatment of high strength organic wastewater, such as decontamination and recovery of discarded grease in grease industry, concentration and incineration of high concentration organic wastewater that is difficult to treat, etc. The company has also applied membrane-separating technique into drinking water purification.
- Yongxing wastewater treatment limited company (table2-16), a state-own ship enterprise, specific for the running and managing of municipal wastewater treatment plant. Some plants under its management are still in constructing now, meanwhile, the company also produced some equipments mainly used for the kit equipments for its own project.
- Zhuzhou JieYuan new technique environmental protection limited company (table2-17), a private-own ship enterprise, mainly producing a kind of water treatment chemicals with technique transferred from Guangxi autonomous region, which can be used for tanning industrial wastewater treatment. The company also manufactures some kit equipments for small-scaled wastewater treatment as well.
- Liling Environmental protecting equipments factory (table2-18): Originally a small factory of a waterproof material. From the early of last 90s', the head of factory had foreseen the development in the environmental protecting industry, and began to look for cooperation opportunity with some high-level design institute in the province. The company invited the technicians to design blueprint for wastewater treatment and then directly provided it to assigned manufacturer. After mastering the manufacturing technique, the company would be managed to generalize it. The main technicians are now some retirees from design institutes or some part-time job persons.
- Changsha ChaoYuan ozone generator limited company (table2-19): A small-scaled private-own ship enterprise that produces ozone disinfected equipments.
- Hunan Yideji water purifying equipments limited company (table2-20), a private enterprise that produce small-scaled ozone generator used as kit equipments for drinking water purifying and hospital wastewater disinfections.

## **2 · 2 · 2 Summarize and analyze**

### **2 · 2 · 2 · 1 The status of water treatment technique and production in Hunan**

The beginning of water polluting control is not too late in Hunan, and the ability of research and development in the field of environmental protection is also strong. The

organizations engaged in the environmental protection research and design in Hunan include: Hunan University, Changsha nonferrous metal designing institute, the eighth design institute of mechanical industrial ministry, Hunan environmental protection science institute, Hunan hygienic engineering institute, etc. most of which are involved in wastewater treatment research and development, design and equipment manufacture. With long years continuously research and development, basic demands for industrial and municipal wastewater treatment can be met. The investigation has shown that equipment manufacturing for wastewater treatment in Hunan started late with low technology and was hardly known by public, so most of the equipment used for wastewater treatment in Hunan were selected from some Jiangsu and Zhejiang enterprises recommended by the designing institute. These years, with the rise of some professional units for wastewater treatment, things are improved a little. Those enterprises' technicians are mostly come from some research and design institute or universities. To deal with an environmental project, the enterprise generally began its work from providing the technique service, and followed by providing treatment proposal, feasibility assessment, equipment selecting and design, and then providing related equipments and getting the total engineering contract, and finally training the operators and start-up and test the whole process. The treated water quality should meet the national standard and be supervised by environmental protection administration. The obvious differences between these enterprises and some old enterprises are: most of the employees of these enterprises are from state-own ship institute or from environmental administration, they have done sufficient preparation at the technique, personnel, funds, business and social relationship before they started the company, so once the company established, there are some deals. A large amount of the village or street-own ship enterprises (Generally engaged in simple dust catcher producing or noise elimination and soundproof business), which originally have no technical support, and some research and design institutes (Because of the system reason, the technicians always could not be sufficiently used, and the loss of talented people is serious) are not the rivals of this enterprises. The big wastewater treatment enterprises outside Hunan usually attract the elitists by high payments and some other liberal terms, when they enter the Hunan market.

The investigation has also shown that most of the enterprises in Hunan engaged in wastewater treatment are in small-scale, and with not only a simple product category, but also the low technology. It is difficult to meet the demand of wastewater treatment market in the province.

## **2 · 2 · 2 · 2 Evaluation on the technique**

Wastewater treatment equipments produced in Hunan mainly covered different kinds of separating devices used for physical, chemical or physical-chemical treatment, and kit equipments composed of several unit equipments or/and buildings designed to treat a certain wastewater. Most of them are the separating equipments adopted the

normal technique, such as sedimentation, clarifying, floatation, filtration, centrifugal separation, pressed filter etc. Separating equipments with membrane technology are less to see. Oxidizing equipments can only be used for general chemical oxidization, not for strong oxidization; and the biological treatment equipments primarily include some of biological membranes and activated sludge devices. The new type of anaerobic technique and some high-tech biological technique is just at the beginning.

As far as the heavy metal-containing inorganic wastewater, such as electroplating wastewater, tanning wastewater, and nonferrous metal industry wastewater etc, physical and chemical methods were primarily taken in use. And the treatment projects were used to be done by a few research and design institutes Changsha. Now, some enterprise engaged in wastewater treatment can also provide the whole technique service and the related equipments production, but the main methods are still a combination of traditional techniques.

In the aspect of organic wastewater treatment, aerobic biological treatment to general organic wastewater was mainly used, among which activated sludge technology, biological film, and biological fluidic bed, SBR method etc are widely used. In these years, part of the wastewater treatment projects was done by (such as Hunan Henghui environmental protecting limited company) combining physical and chemical treatment together with biological treatment organically, such as taking floatation process, membranes separating as pre-treatment or further treatment for biological treatment, which made the total investment and running cost increased. Recently, some private-own ship enterprises in Zhuzhou developed a biological membranes reactor based on the membranes technique and materials imported, which could be a new generation product in Hunan water treatment market after lowering the cost.

As to the oil- containing waste water, the environmental protection research institute of the mechanical industry is often a main force in the pass, and generally traditional and mature craft and equipments were taken, such as demulsification, oil removal, oil gathering and filtration. Since 1995, some relevant water treatment experts from Taiwan established Hunan Universe environmental protection engineering limited company, and through oil-containing wastewater treatment machine applied in the oil field, they made a relatively success, and the enterprise has developed to become one of the most important water treatment enterprises in Hunan in recent years.

As to the hazardous material-containing wastewater, high concentration organic wastewater discharged by Organic chemical industry, agrochemical, pharmaceutical manufacturing industry, there are no some mature suitable techniques and equipments in Hunan. Some specific chemicals with good effect have been developed, but have not yet been promoted to application.

The technology for municipal wastewater treatment in Hunan is used to be blank,

these years, several companies received the designs for municipal wastewater treatment plants, but the newly set-up municipal wastewater treatment plant in the province still need to let the design institute from other province to do the design. The equipments, material, and control system for the construction of related municipal wastewater treatment plant are mainly transferred from other province or abroad, no enterprise in the province is capable of providing the complete service.

Equipments dealing with the excess sludge have always been a weakness of Hunan water treatment market, only one or two enterprises can produce pressed filter, and usually can do nothing for bigger project with difficulty dewatering.

## **2 · 3 Inquisition on the key enterprises**

Enterprises in Hunan engaged in wastewater treatment started relatively later, the total technological level is not high, and the product category also comparably simple. Till now, there is no a enterprise with production value over 30 million Yuan, and being able to accomplish large-scale wastewater treatment project design as well as to provide series of services independently. But some enterprises show their good developing trend, and following are two of them.

### **2 · 3 · 1 Hunan Aobang environmental protection limited company**

As it stated before, wastewater treatment project research and design force in Hunan was mainly concentrated in some research and design institute and universities. Before 1995, the big part of wastewater treatment projects design in Hunan were made by these Institute, and the owner takes the blue paper to and hand it over to some company to construct. The equipments were generally specified model number by the designers, some even specified the manufacture. In order to get the contract, the manufactures related to wastewater treatment equipments from Jiangsu and Zhejiang always send their sales representatives to the design institutes, and gave 5% to the designer as “choosing charge”, and let the designer mark clearly recommendation, such as product model number, name of the enterprises. The prices of these equipments are often rather high, which resulted in a high investment, and even affect the engineering quality. Changsha Aobang environmental protection limited company—a private-own ship share enterprise –was invested and established by three professional technicians engaged in the environmental protecting engineering in design institute at this base. The company mainly engaged in the engineering design and construction for industrial wastewater, and in the design along with the produce of kit equipments, like a “design institute and environmental protecting equipments factory”. Because they are familiar with the market, once the company established, it grows fast.

At the beginning, the main business comes from the former customer of the founder.

Most of the work has been done by themselves, such as negotiation and design; the other design works were completed by their original workmates. One year later, they earned their first pay from finished engineering, then rent a floor of write floor, employed some designer and business personnel, improved the working condition, and gradually set up the company's reputation.

Now, the company has more than 40 employees, and the business range also have expanded to the cities around Hunan. The company also passed ISO9001 quantity attestation and got the professional design certificate of national environmental protection engineering, so they have made a solid foundation for the company's development. It is estimated that the company's total business deal could reach 10 million Yuan in 2002, and become one of the a few key companies.

### **2 · 3 · 2 Hunan Henghui environmental protecting industry limited company**

Hunan Henghui environmental protection industry limited company, a private own ship company, whose owner has rich experience in international trade, is an international company cooperated with a company from Netherlands in the field of inorganic membranes and materials, which changed the facet that no inorganic membranes applied in the industrial wastewater treatment in Hunan.

At the beginning of the company's foundation, the company invested a lot to construct the "Henghui environmental protection industrial park", this is the first in Hunan environmental protecting industry. The company has established a perfect management system; hired high ranked technicians and managers from universities, design institutes, and large-scale state-own ship enterprises. There are almost no any customers of the inorganic-membrane, because it was not been familiar by the domestic customers at that time, and also because the high price.

In 2000, according to the policy of national environmental protection management, all enterprises produced industrial pollution sources must reach the discharge standard in a limited time. Since normal technology cannot meet the treatment requirements for hazardous wastewater, and high concentration organic wastewater, which provide opportunities for the inorganic membranes technology. And meanwhile, the inorganic-membrane-product has also completed the reform to be made in China, only some key material need to be imported from European, the product with lower price began to be accepted. The product were firstly used in treating grease-containing wastewater from some edible oil producing enterprises in the province, the advantages over other technology shown not only in the competitive investment and running cost, but also in the grease recovering which created considerable economic profits for the factory.

Now, the products have shown the advantages in high concentration organic

wastewater treatment, such as the purification and recovery of the discarded grease in grease wastewater, treatment of high concentration organic wastewater, etc. The company has also applied membrane-separating technique into drinking water purification.

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-01

Name	Changsha Tongda (group enterprise) limited company			
Address	No.99, south Furong road, Changsha			
Type of company	Limited liability company	Time started being engaged in environmental protection	1998	
Employees ( persons )	150	Time engaged in environmental protection	17	
Total production value per year ( 10000Yuan )	2138	Total profits per year ( 10000Yuan )	114	
Fixed assets ( 10000Yuan )	11344	ISO9000 attestation	Passed	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
Series diving electrical pump of type QZ	Set	55	1017	51
Series diving electrical pump of type QW	Set	87	82	4
Never jammed diving vortex pump of type DV	Set	47	59	3
Dredge pump of large size	Set	5	800	35

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-02

Name	Changsha fan Limited liability company			
Address	No.7 ,Shumuling road ,Changsha			
Type of company	Limited liability company	Time started being engaged in environmental protection	1987	
Employees ( persons )	90	Time engaged in environmental protection	5	
Total production value per year ( 10000Yuan )	1120	Total profits per year ( 10000Yuan )	375	
Fixed assets ( 10000Yuan )	1300	ISO9000	Passed	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
JTS Sound proved fan	Set	626	636	177

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-03

Name	Hunan Wuling group enterprise			
Address	Bantangpu, Xiangtan			
Type of company	Station-owned	Time started being engaged in environmental protection	1995	
Employees ( persons )	576 ( with some part-time workers )	Time engaged in environmental protection	2	
Total production value per year ( 10000Yuan )	126	Total profits per year ( 10000Yuan )	2	
Fixed assets ( 10000Yuan )	3726	ISO9000attestation	No	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
filter presser for sludge dehydration	set	7	126	2

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-04

Name	Shaoyang Youhua limited company of clean water material			
Address	Tabei road, Shaoyang			
Type of company	Limited company	Time started being engaged in environmental protection	1997	
Employees ( persons )	72	Time engaged in environmental protection	2	
Total production value per year ( 10000Yuan )	300	Total profits per year ( 10000Yuan )	90	
Fixed assets ( 10000Yuan )	1000	ISO9000attestation	No	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
Polymerized ferric sulphate	Ton	1500	300	90

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-05

Name	Chenzhou Yongxing water-cleaning-coagulant factory			
Address	Xiangyindu, Yongxing			
Type of company	Collective enterprise	Time started being engaged in environmental protection`	1985	
Employees ( persons )	86	Time engaged in environmental protection	4	
Total production value per year ( 10000Yuan )	392	Total profits per year ( 10000Yuan )	20	
Fixed assets ( 10000Yuan )	289	ISO9000attestation	No	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
Polymerized aluminum chloride	Ton	1200	260	8

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-06

Name	Changsha Xinshunchang water-cleaning equipment limited company			
Address	Changsha's high and new technique developing area			
Type of company	Limited liability company	Time started being engaged in environmental protection	1998	
Employees ( persons )	20	Senior technician ( persons )	0	
Total production value per year ( 10000Yuan )	69	Total profits per year ( 10000Yuan )	32.8	
Fixed assets ( 10000Yuan )	36	ISO9000attestation	No	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
Desanding device	Set	16	69	32.8

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-07

Name	Changsha Huilong environmental protection engineering service Ltd. Co.			
Address	JuYuan area ,Changsha			
Type of company	Limited liability company	Time started being engaged in environmental protection	1996	
Employees ( persons )	22	Senior technician ( persons )	2	
Total production value per year ( 10000Yuan )	88	Total profits per year ( 10000Yuan )	14.8	
Fixed assets ( 10000Yuan )	50	ISO9000attestation	No	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
Underground equipment for water treatment	Set	1	18	1.8

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-08

Name	Huaihua environmental protecting equipment factory			
Address	Anjiang town , Hongjiang			
Type of company	Collective enterprise	Time started being engaged in environmental protection	1992	
Employees ( persons )	10	Senior technician ( persons )	1	
Total production value per year ( 10000Yuan )	33	Total profits per year ( 10000Yuan )	2.1	
Fixed assets ( 10000Yuan )	6.4	ISO9000attestation	No	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
Treatment equipments for discharged water from hospital	Set	3	9	1.2

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-09

Name	Hunan Hongda environmental protecting equipment limited company			
Address	Chenzhou's economic and technique developing area			
Type of company	Incorporated company	Time started being engaged in environmental protection	1993	
Employees ( persons )	65	Senior technician ( persons )	9	
Total production value per year ( 10000Yuan )	671	Total profits per year ( 10000Yuan )	179.4	
Fixed assets ( 10000Yuan )	184.3	ISO9000attestation	No	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
Wholly water treatment equipment	Set	23	345	92.2
water treatment equipment supply	Set	8	96	26.7
Assembled water treatment car	Set	10	230	61.5

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-10

Name	Hygiene engineering graduate school of Hunan province			
Address	Yuhuating, Changsha			
Type of company	State-owned enterprise	Time started being engaged in environmental protection	1980	
Employees ( persons )	30	Senior technician ( persons )	10	
Total production value per year ( 10000Yuan )	1168	Total profits per year ( 10000Yuan )	110.1	
Fixed assets ( 10000Yuan )	800	ISO9000attestation	No	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
Electrolyzing sodium hypo chlorite producer	Set	50	250	24
Electronic chlorine dioxide producer	Set	30	300	36.4
Chemical chlorine dioxide producer	Set	100	500	41.8
Quartz sand filter	Set	50	40	1.8
Self controlled system for water treatment	Set	20	8	1

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-11-1

Name	Changsha Aobang environmental protecting industry limited company		
Address	Shaoshan road, Changsha		
Type of company	Limited liability company	Time started being engaged in environmental protection	1998
Employees ( persons )	42	Senior technician ( persons )	16
Total production value per year ( 10000Yuan )	394.6	Total profits per year ( 10000Yuan )	39.8
Fixed assets ( 10000Yuan )	180	ISO9000attestation	Passed

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-11-2

Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
Floatation facility	Set	3	24	3.6
Drainer	Set	6	36	6.4
Anaerobic + aerobic treatment system	Set	3	106.8	7.2
ABR anaerobic reactor	Set	3	64	6.4
Self controlled system for water treatment	Set	3	18	3.2
Revolving screen filtration machine	Set	4	24	4

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-12

Name	Hunan Universe environmental protecting engineering limited company			
Address	Weijiapo , Changsha			
Type of company	Cooperation enterprise	Time started being engaged in environmental protection	1996	
Employees ( persons )	54	Senior technician ( persons )	7	
Total production value per year ( 10000Yuan )	329.6	Total profits per year ( 10000Yuan )	4.1	
Fixed assets ( 10000Yuan )	155	ISO9000attestation	No	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
YYF Oil-containing discharged water treating set	Set	5	329.6	4.1

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-13

Name	Changsha water treatment equipment factory			
Address	Jingkui road, Changsha			
Type of company	Collective enterprise	Time started being engaged in environmental protection	1999	
Employees ( persons )	80	Senior technician ( persons )	0	
Total production value per year ( 10000Yuan )	49.8	Total profits per year ( 10000Yuan )	0	
Fixed assets ( 10000Yuan )	260	ISO9000attestation	No	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
Quartz sand filter	Set	5	10.8	1.0

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-14

Name	The eighth design institute of machine industry department			
Address	Dongtang, Changsha			
Type of company	State-owned enterprise	Time started being engaged in environmental protection	1975	
Employees ( persons )	40	Senior technician ( persons )	13	
Total production value per year ( 10000Yuan )	130	Total profits per year ( 10000Yuan )	38.7	
Fixed assets ( 10000Yuan )		ISO9000 attestation	No	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
Efficient clarifier	Set	4	65	15
Equipment of floatation process	Set	1	12	4
Double speed sand colander	Set	2	18	7.2
Efficient hydraulic reactor	Set	2	10	3.5

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-15

Name	Hunan Henghui environmental protecting industry limited company			
Address	The economic technique developing area of Shaoshan,Xiangtan			
Type of company	Home and abroad cooperating enterprise	Time started being engaged in environmental protection	1998	
Employees ( persons )	92	Senior technician ( persons )	8	
Total production value per year ( 10000Yuan )	293	Total profits per year ( 10000Yuan )	58.5	
Fixed assets ( 10000Yuan )	707.8	ISO9000attestation	Passed	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
Membrane separating equipment	Set	4	176	7
Drinking water clarifier	Set	4	32	1.3
Drainer	Set	11	55	2.2
Depilating and desmutting machine	Set	3	8	0.3
Beater	Set	8	20	0.8

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-16

Name	Yongxing waste water treatment limited liability company			
Address	Middle Xiaoxiang road, Yongzhou			
Type of company	Limited liability company	Time started being engaged in environmental protection	1997	
Employees ( unit )	160	Senior technician ( unit )	20	
Total production value per year ( 10000Yuan )	1250	Total profits per year ( 10000Yuan )	530	
Fixed assets ( 10000Yuan )	6918	ISO9000attestation	No	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
Aerating turnplate	Set	15	1250	115

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-17

Name	Zhuzhou JieYuan new technique Ltd. Co. for environmental protection			
Address	Zhuzhou's economic and technique developing area			
Type of company	Limited liability company	Time started being engaged in environmental protection	1998	
Employees ( persons )	28	Senior technician ( persons )	3	
Total production value per year ( 10000Yuan )	380	Total profits per year ( 10000Yuan )	170	
Fixed assets ( 10000Yuan )	450	ISO9000attestation	No	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
Equipment set for water treatment	Set	10	80	40
Kit coagulant for water treatment	Ton	600	300	130

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-18

Name	Liling Environmental protecting equipments factory			
Address	Dongfu road, Liling			
Type of company	Private enterprise	Time started being engaged in environmental protection	1990	
Employees ( persons )	50	Senior technician ( persons )	5	
Total production value per year ( 10000Yuan )	97	Total profits per year ( 10000Yuan )	24	
Fixed assets ( 10000Yuan )	120	ISO9000attestation	No	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
Up flowing precipitate device	Set	5	20	5
Gas floating devices	Set	4	32	8
Filter device with many layers	Set	3	21	6
Pipe chute	m <sup>3</sup>	300	24	5

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-19

Name	Changsha ChaoYuan limited company of ozone equipments			
Address	Middle Jinasha road, Liuyang			
Type of company	Limited liability company	Time started being engaged in environmental protection	1997	
Employees ( persons )	98	Senior technician ( persons )	6	
Total production value per year ( 10000Yuan )	502	Total profits per year ( 10000Yuan )	3.6	
Fixed assets ( 10000Yuan )	18	ISO9000attestation	No	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
Ozone disinfecting machine with many functions	Set	2010	502	3.6

The investigating table of enterprises producing water treatment equipments in Hunan Table 2-20

Name	Hunan Yideji purifying equipments limited company			
Address	Chanbsha's high and new technique industry developing area			
Type of company	Limited liability company	Time started being engaged in environmental protection	1998	
Employees ( persons )	20	Senior technician ( persons )	6	
Total production value per year ( 10000Yuan )	62.3	Total profits per year ( 10000Yuan )	18.8	
Fixed assets ( 10000Yuan )	19.8	ISO9000attestation	No	
Basic status of the main water treatment products				
Name	Producing quantity		Production value ( 10000Yuan )	Profits ( 10000Yuan )
	Unit	Quantity		
Ozone producer	Set	40	62.3	18.8

### **3 · Investigation on typical wastewater treatment projects in Hunan**

#### **3 · 1 Investigation on municipal wastewater treatment projects**

##### **3 · 1 · 1 Present discharge and treatment status of the municipal wastewater in the whole province**

The total population of Hunan province is 6.592 million  $m^3$  now, among which 1.377 million  $m^3$  population are citizens; the total municipal wastewater discharging quantity is about 1 billion  $m^3/a$ , the average about 200 L/day per capita; total COD contained in the municipal wastewater of the province is about 400,000 ton, about 80g per capita per day; total ammonia-nitrogen is about 350 thousand tons, about 7g per person per day; most of the municipal wastewater is discharged into Xianjiang river, Zijiang river, Yuanjiang river, Li river and Dongting lake.

There are now only 4 municipal wastewater treatment plants operating in Hunan, with the treatment capability 362 thousand  $m^3$  per day, treating more than 90 million  $m^3$  of municipal wastewater per year (including treatment of more than 6 million tons of industrial wastewater). About 8.47% of the municipal wastewater were treated in Hunan , among which about 10 million  $m^3$  treated wastewater was recycled. The 4 municipal water treatment plants dispose nearly 10 thousand tons of COD, 1 thousand tons of ammonia per year, with 1.8 thousand of excess sludge created, in which 1,5 thousand ton of sludge was disposed. The running cost is 3.35 million Yuan, about 0.38 Yuan per  $m^3$  wastewater.

##### **3 · 1 · 2 The investigation on municipal water treatment plants in Hunan**

###### **3 · 1 · 2 · 1 The first municipal water treatment plant of Changsha**

The No. 1 municipal water treatment plant of Changsha, located in Wujialing, north suburb of Changsha and occupied about 45,000  $m^2$ , was constructed in 1979 and finished in 1981, with the design capacity of primary treatment 60 thousand  $m^3$  per day, among which 30 thousand  $m^3$  was treated by secondary stage and discharged. The total engineering investment 6 million Yuan, about 100 Yuan per  $m^3$  per day, is all from government. There are 60 people now in the plant, running cost about 0.4 Yuan per  $m^3$ , including electricity charge 0.12 Yuan per  $m^3$ . The excess sludge was only digested at the beginning, and it was not until 2000 that a strap pressed filter was installed. Since 2001, the plant began to expand, the treatment capacity increased to 200 thousand tons per day, and the expansion project is now in constructing.

Craft process :

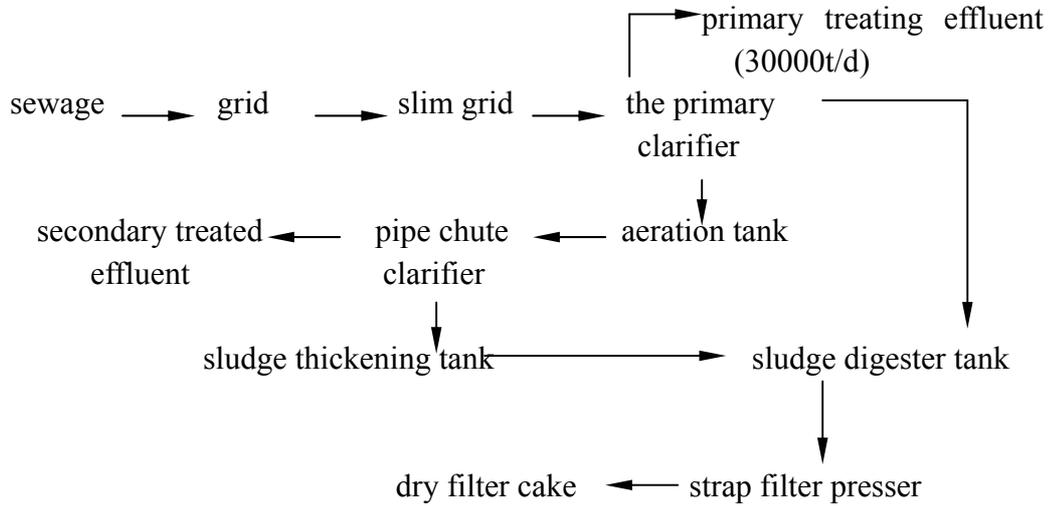


Chart3-1 The craft process chart of water treatment

Treatment result :

COD<sub>Cr</sub> : influent 120—160mg/L , after treatment, the effluent≤60mg/L

BOD<sub>5</sub> : influent 80—100 mg/L , after treatment, the effluent≤15mg/L

SS : influent 60—120 mg/L , after treatment, the effluent≤30mg/L

Main equipments :

Table 3-1 Main equipments

Name	Specification and model number	Amount (set)	Unit price (10000Yuan)	Producing factory
Surface accelerate aerator	50kgO <sub>2</sub> /h	8	3.00	Anhui Spinning and weaving machine factory
Mechanic slim grid	1400mm	1	8.00	Yixing omnipotence machine factory
Train belt sludge scraper		8	10.00	Wuhan valve factory
mixed flow pump	16HB-40	6	0.10	Wuxi water pump factory

Strap filter presser	2000mm	1	25.00	
Electricity system			40.00	

### 3 · 1 · 2 · 2 The No. 2 municipal water treatment plant of Changsha

The No. 2 municipal water treatment plant of Changsha, located in Xianghu fishing ground, east of Changsha, north to the Changsha railway station and occupied nearly 30,000 m<sup>2</sup>, was constructed in 1992 and finished in June 1994. With the municipal wastewater treatment capacity of 140 thousand m<sup>3</sup> per day, the total engineering investment is 4.98 million Yuan, about 356 Yuan per m<sup>3</sup> per day. It is a national demonstrating project for environmental protection during the “Eighth five” period, and was titled as “national choiceness Engineering for environmental protection” by the national construction ministry. There are 94 people in the plant, with running cost about 0.3 Yuan per m<sup>3</sup>, including electricity charge 0.25 Yuan per m<sup>3</sup>.

Main characteristics :

——Advanced technique. An improved oxidation ditch technology was taken, in which hydraulic retention time was shortened from traditional 8—12 hours to 3.7 hours. This led to not only reduction of the occupied area and civil engineering cost, but also reduction of the energy cost and equipments cost, as well as running cost and maintenance cost.

——Advanced technology. For traditional clarifier, the inlet water comes into the center, and the outlet water at periphery. In this plant, inlet water and outlet water are all at periphery, which improved the sediment efficiency and made the clarifier reduced from original 8 to 4. This not only reduced the area occupied, but also saved more than 9 million Yuan of civil engineering and equipment cost.

——Advanced equipments. The No. 2 municipal water treatment plant of Changsha developed a machine that can suck while scraping sludge during the project constructing, saved foreign exchanges 400,000 dollars. At the same time, the electricity charge of the machine is lower than conventional one, which is helpful to reduce the running cost.

——Less occupied area, less investment. Conventional secondary stage treatment occupies about 6,670—10,000 m<sup>2</sup> while 10,000 m<sup>3</sup>/day of wastewater was treated, but this plant only occupies 2130 m<sup>2</sup> while 10,000 m<sup>3</sup>/day of wastewater was treated; and for conventional wastewater treatment plant, the constructing cost is above 10 million Yuan per 10,000 m<sup>3</sup>, but this one just cost about 3 million Yuan. The occupied area and cost are one third of the conventional wastewater treatment plant.

——high efficiency. The stability and credibility of the improved oxidation ditch technology has been proved enough through years of running that, and the new

technology also shown its simple process, and convenience to operate etc. The treated water can stably reach the national discharge standard.

——Low running cost. The electricity charge for No 2 municipal water treatment plant of Changsha is 0.25 Kilowatt per hour while 1,000m<sup>3</sup> wastewater is treated. The treatment cost is 0.3 Yuan per m<sup>3</sup>, which is much lower than that of the same type plant in other cities.

Craft process :

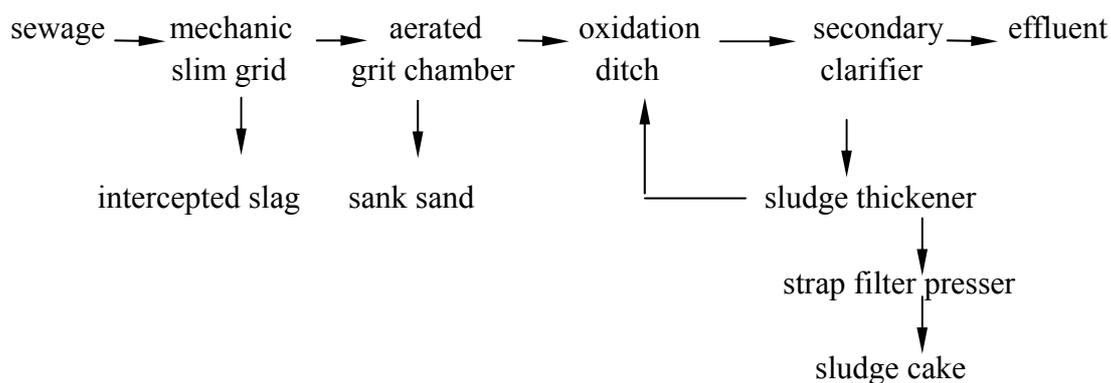


Chart 3-2 the craft process chart of water treatment

Treatment result :

Table 3-2 Main indexes of water treatment ( mg/L )

Items	COD <sub>Cr</sub>	BOD <sub>5</sub>	SS	TN	TP
Designed value	250	150	250		
Influent	150-220	60-100	60-180	20-30	2-5
Effluent	20-30	10-20	5-10	10-20	0.25-0.54
Removing rate(%)	83-89	80-90	85-95	40-60	80-92

The results are actual results collected in the operation of municipal sewage plant.

Main equipments : Table 3-3 Main equipments

Name	Specification model number	number (set)	Unit price (10000Yuan)	Producing factory
Surface accelerate aerator	325	10	9.02	Anhui Spinning and weaving machine factory
Diving sludge pump	QW220	4	8.5	Nanjing Jinling pump company
Diving sludge pump	QW220	4	6.8	Shanghai Kaiquan pump company

Slim grid	B2000	2	28.8	Yixing environ. protection equipment factory
Suck while scrape machine	40m	4	23	Luoyan mining machine factory
sludge pump	21/2PW	4	1.2	Shijiazhuang pump factory
Strap filter presser	500kg/h	2	23	Tianjin civics company
Sludge concentrator	12m	2	16	Jiangdu environ. protection equipments factory
Electricity & control			46	
Automatic control system			100	

### 3 · 1 · 2 · 3 Dongjiadian wastewater treatment plant of Zhuzhou

Dongjiadian wastewater treatment plant of Zhuzhou is a small-scaled municipal wastewater treatment plant designed and constructed by Wuhan municipal design institute with the form of engineering gross contract , mainly engaged in the treatment of wastewater from south motive motorcycle factory. The capacity is 12,000 m<sup>3</sup> per day ,occupied area 8,400m<sup>2</sup> ,total investment about 8 million Yuan. The construction was completed in December1995. There are 22 people, and treatment cost is 0.42—0.45 Yuan per m<sup>3</sup>wastewater, one third of which is electricity charge.

Craft process :

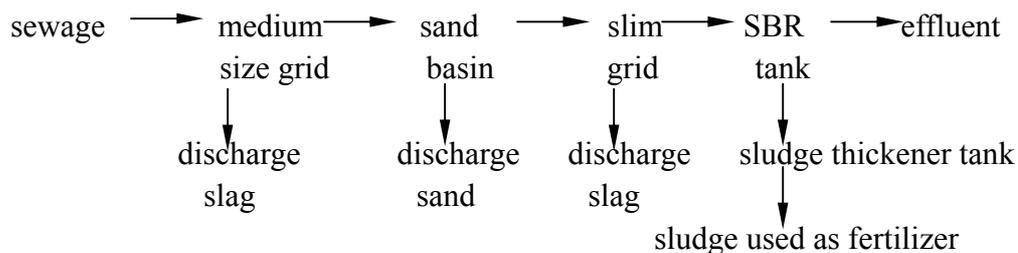


Chart 3-3 The craft process chart of water treatment

Treatment result :

COD : influent 100—250mg/L , effluent 60 ≤mg/L

BOD : influent 50—100mg/L , effluent 20 ≤mg/L

SS : influent 100mg/L , effluent 30 ≤mg/L

Main equipments :

Table 3-4 Main equipments

Name	Specification & model number	NO. (set)	Unit price (10000Yuan)	Producing factory
Medium-sized grid	TS-10	1	18	Tianjin civics company
Slim grid	B1000	1	8	Factory of Shenzhen environmental protecting equipments
sewage pump	4PW , 2PW	2/2		Anhui Hexian pump factory
Circulation pump	IS200-150 -250B	11	1	Xiangtan water pump factory
sludge pump	2PN	2		Fujian Changting environmental protecting equipments factory
ejector		40		Wuhan civics design institute

### 3 · 1 · 2 · 4 Water decontamination center of Changde

Water decontamination center of Changde, located beside of Willow leaf lake in the east-north of Changde ,occupied area more than 350 mou (about 40000 m<sup>2</sup>) ,is mainly engaged in the treatment of municipal wastewater from the north city of Changde. As one of the key environmental protection projects in Hunan, the center was set up by the planning commission of Hunan in1992, and started to construct from 1998, finished in 2001. Total investment of the project is about 150,100,000 Yuan, which including ground cost about 10,000,000 Yuan, civil engineering cost about 90,000,000 Yuan, electric machine and controlling equipments cost about 20,000,000 Yuan, craft piping expenses about 8,000,000 Yuan. The investment were composed of the national special-purpose funds 55,000,000 Yuan , Japanese international cooperation funds loan 570,000,000 yen , National development bank loan 22 million Yuan, the local government 36.82 million Yuan. Engineering is design to treat 150,000 m<sup>3</sup>/day of municipal wastewater.

The effluent quality can meet the national standard after treatment, and the pollutants removal rate can reach 85—90%, sludge produced in wastewater treatment process can be used as fertilizer or land-fill after concentration and dehydration. The project can help to solve the pollution problem of the city zone and surroundings water body, when the project being built and put into production, and the function for aquatic products farming can also be guaranteed, which greatly lower the downstream water pollution.

Craft process :

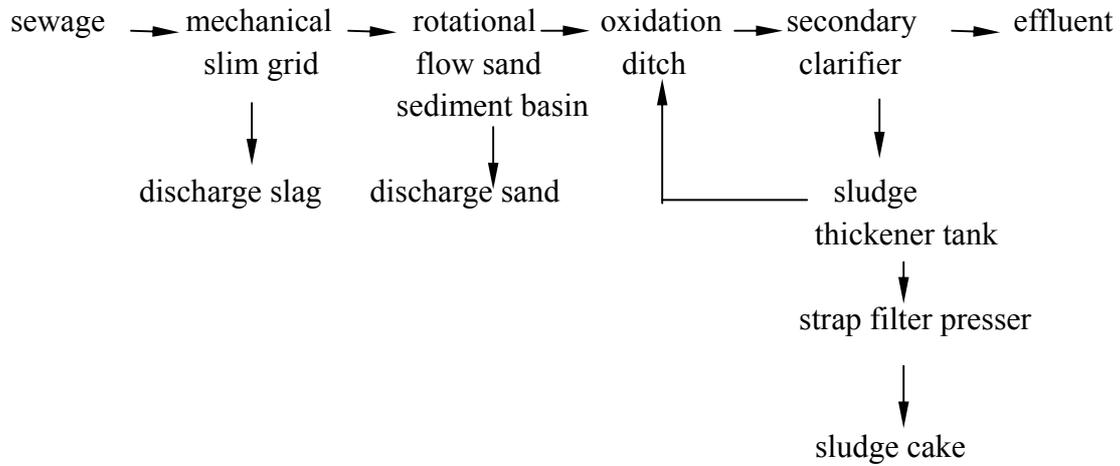


Chart 3-4 The craft process chart of water treatment

Main equipments :

Table 3-5 Main equipments

No.	Place	Name	Specificat ion	NO. (set)	price (10000 Yuan)	factory
1	Grid room	Revolving solid liquid separating machine	XGC-1800	2	182.0	Jiangsu Yihuan group
2		Spiral transport machine	XLS-320-6000	1	6.0	Jiangsu Yihuan group
3		Spiral squeezer	XLY-200X	1	5.5	Jiangsu Yihuan group
4	Promoting pump house	Upright sewage pump	WL1625-13.5-75	6	9.0	Jiangsu taifeng group
5	Sand basin	Arc-shaped grid separating machine	GH	2	7.5	Jiangsu Yihuan group
6		spiral sand-water separating machine	XLH-320	2	6.8	Jiangsu Yihuan group

7		no stalk Spiral transport machine	XLS-320	1	10.5	Jiangsu Yihuan group
8	Grid room	Spiral squeezer	XLY-200	1	5.5	Jiangsu Yihuan group
9		rotational flow sand sinking machine	XCS-5.5	2	21.4	Jiangsu Yihuan group
10		sand pump	QW100 5020	2		Jiangsu Yihuan group
11	Reflux pump house	diving pump	WQ-1100 -5-30	5		Jiangsu taifeng group
12	oxidation ditch	Revolving spiral aerator	YBP-1400	24	15.1	Yixing water industry device factory
13		reduction drive	K168K4 -T200L4W	24		Gallo Fland company
14	Secondary clarifier	center driving Suck while scrape machine	42m 40m	3 1		Yangzhou Tianyu group

Continuous Table 3-5 Main equipments

No.	Place	Name	Specification	NO. (set)	price (10000 Yuan)	factory
15	thickener tank	center driving Suck while scrape machine	18m	2		Yangzhou Tianyu group
16		Diving sludge pump	WQ100 -16-11	2	1.8	Jiangsu taifeng group
17	Tail pump house	axial pump	ZLB-500	4	10.2	Jiangsu taifeng group
18	sludge dehydrate car	Strap filter presser	VY2000-N	2	1.8	Wuxi omnipotence machine factory
19		hydraulics		3		Wuxi omnipotence machine factory
20		coagulant adding device	DYE/F	3		Wuxi omnipotence machine factory
21		sludge pump	G50-1	3		Wuxi omnipotence machine factory

22		clear water pump	LS05-40 -200	3		Wuxi omnipotence machine factory
23		coagulating blend bottle		3		Wuxi omnipotence machine factory
24		Mud mixer	YS-1200	3		Yangzhou Tianyu group
25		no stalk Spiral transport machine	LS420	3		Wuxi omnipotence machine factory
26	Chlorin ation	Chlorination Machine	JLF6	1	3.2	
27	room	traveling crane	LX-2T	1	9.1	Changsha derrick factory

### **3 · 2 Investigation on industrial wastewater treatment in Hunan**

#### **3 · 2 · 1 Current status of industrial wastewater discharging and treating**

According to the environmental protecting investigation statistics on nearly 3000 industrial enterprises in Hunan, the total industrial output value of these enterprises is nearly 130 billion Yuan, with more than 4000 employees professionally engaged in environmental protection, and the total water consumption 5 billion m<sup>3</sup> including 2.6 billion m<sup>3</sup> of fresh water and 2.4 m<sup>3</sup> of recycled water, recycling rate is 48%. These enterprises have a total discharge quantity of more than 1 billion m<sup>3</sup>, almost each enterprise has its own wastewater treatment station, which totally treat more than 8 million m<sup>3</sup> per day, but less than 80% can meet the discharge standard. It was estimated that only about 50% of other enterprises not covered in this statistics have their treated wastewater met the discharge standard, most of which are small-scaled and township or private-own ship enterprises.

#### **3 · 2 · 2 Investigation of industrial wastewater treatment projects in Hunan**

##### **3.2.2.1 The sulfuric acid wastewater treatment project of Zhuzhou Chemical Engineering Group**

The sulfuric acid wastewater treatment project of Zhuzhou Chemical Engineering Group was constructed and put to use in April,1986, with the total investment 4 million Yuan. During 1996 — 2000, about 7.7 million Yuan was invested to make the project over. The project, occupied area of more than 7000 m<sup>2</sup>, can treat 550 m<sup>3</sup> wastewater per hour, and the running cost is 1,12 Yuan per m<sup>3</sup>. There have had being some problems in the sludge treatment, and now, the discharged watery sludge from first, secondary clarifier precipitate in the sludge concentration tank and then be grasped to sludge drying field by traveling crane grab bucket, and finally transport out with sulphate iron to be used as fertilizer. According to the on-spot investigation, part of the facilities cannot meet the requirements, especially, some devices can't operate normally in the raining season.

Craft process :

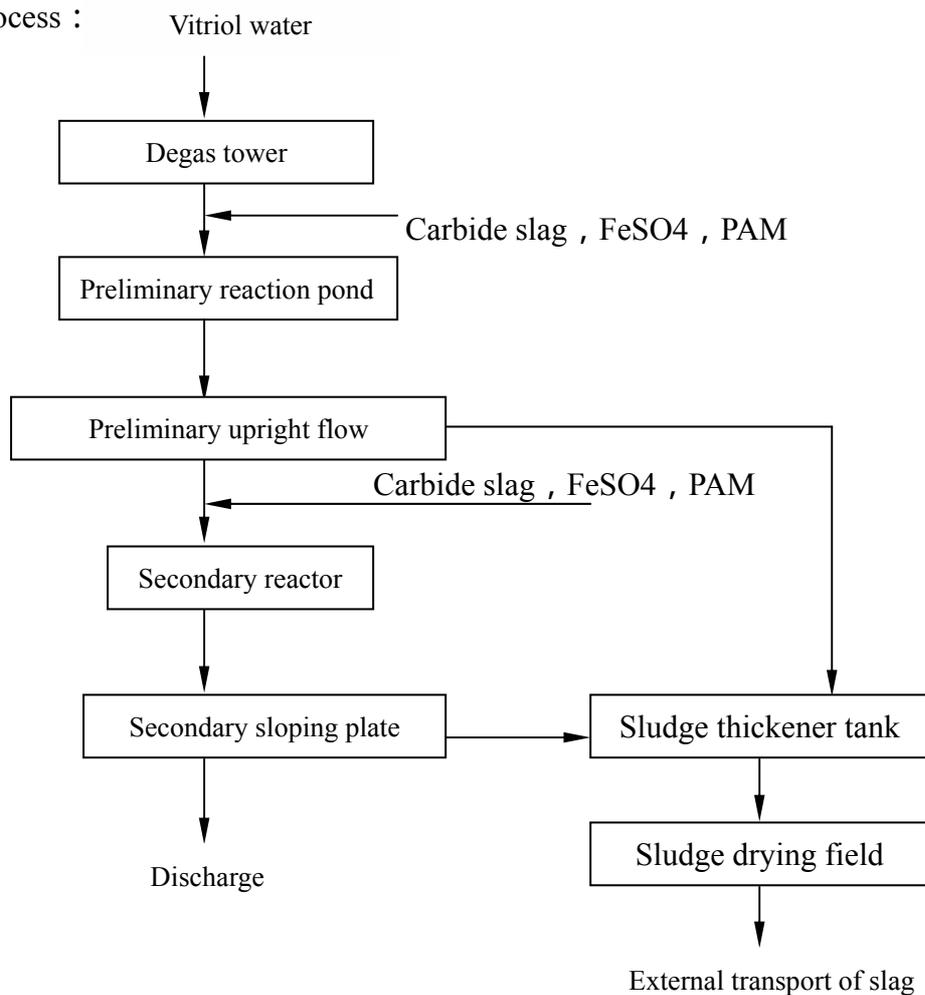


Chart 3-5 The craft process chart of vitriol water treatment

Treatment results :

PH : influent 1.2—3.8, effluent 6—9, COD : influent 356—1001mg/L, effluent 100--149 mg/L, SS : influent 1180—3550mg/L, effluent 34--1259 mg/L, As : influent 0.12—5.59mg/L, effluent 0.017—0.059 mg/L, F : influent 24—52.6mg/L, effluent 5.6—7.2 mg/L

Main equipments :

Table 3-6 Main equipments

Name	Specification and model number	Amount (set)	Unit price (10000Yuan)	Producing factory
Sewage promoting pump	HTBZK150/25	3	2,4	Yixing porcelain and ceramics equipment factory

PAM pump	IS50-32-125	1	0.5	
submerged pump	150YW130-32-2	2	1.57	
carbide slag pump	3PNL	2	2.6	
carbide slag pump	2PN	1	1.8	
sludge pump	3PN	2	2.8	
Concentrating sludge pump	HZJ100-80	2	3.2	
carbide slag Mixer	BLD4	2	1.5	
Roots blower	D36 35-20	5	4.8	Changsha fans factory
Crane	W=3t	2	26	
slag wagon	W=3t	2	8.4	
Civil engineering			300	
Antisepsis engineering			89	

### 3 · 2 · 2 · 2 Wastewater treatment project of Changsha red star slaughterhouse market

Red star slaughterhouse market occupies area of 16000 m<sup>2</sup> , is a newly established enterprise, with the scale of slaughter 500 pigs, 200 sheep, 600 chicken, 500 ducks. Half mechanic slaughter was adopted. Sewage is discharged in batch, and the water quantity with huge fluctuated is about 500 m<sup>3</sup> per day. The total investment of the project is about 1.5 million Yuan, including equipments valued about 700 thousand Yuan. The slaughter wastewater, domestic wastewater as well as rainwater are discharged and treated, respectively, and all the wastewater discharged into Guitang river can reach the national standard.

Treatment results :COD :before treatment :4350mg/m<sup>3</sup> ,after treatment74 mg/m<sup>3</sup>

Craft process :

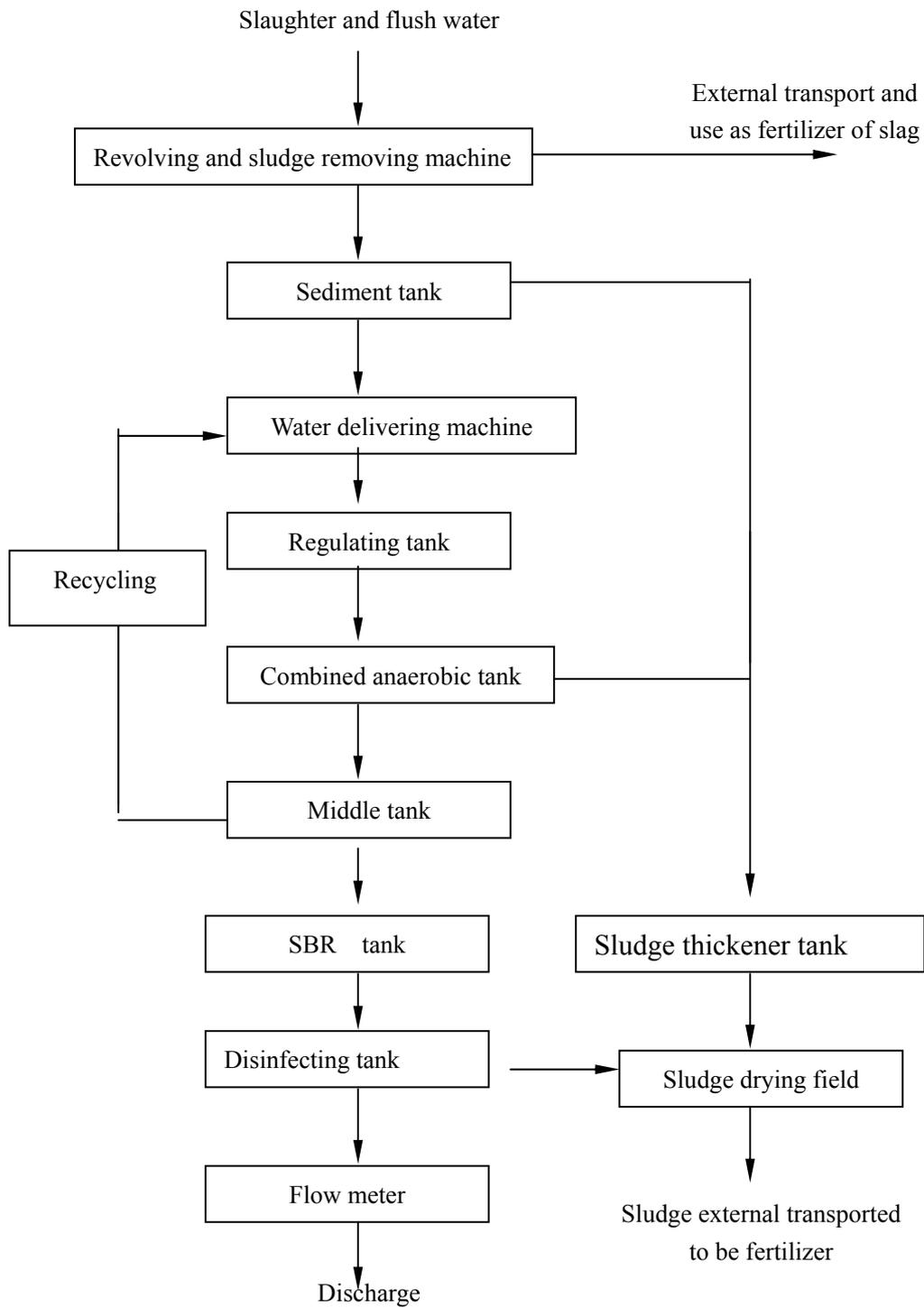


Chart 3-6 The craft process chart of slaughter water treatment

Main equipments :

Table 3-7 Main equipments

Name	Specification and model number	Amount (set)	Unit price (10000Yuan)	Producing factory
Revolving sieve filter	ABXC	1	5.8	The engineering's technique and equipments are mainly provided by Changsha Aobang environmental protecting industry limited company , and gross engineering is contracted to the company except for civil engineering. Worth about 7.01 million Yuan.
compound leaf plug flow aerator		2	3.8	
sludge propeller	ABYT	1	2.3	
water manifold		1	1.5	
ultrasonic flow meter		1	1.5	
Drainer	ABBS	2	3.8	
air compressor		1	0.15	
elastic filler		220	0.03	
liquid chlorine adding machine	SOX	1	4.6	
electricity and automatic control			8.8	
Pumps and pipes			10.8	

### 3 · 2 · 2 · 3 Jiansimao Food Company wastewater treatment project

Jiansimao Food Company produces about 100,000 m<sup>3</sup> of organic wastewater per day during its producing process of cooked food, with its original material soaked and rinse.

Treatment results : COD : before treatment 24768mg/m<sup>3</sup> , after treatment 68 mg/m<sup>3</sup>

SS : before treatment 19510 mg/m<sup>3</sup> , after treatment 70 mg/m<sup>3</sup>

grease : before treatment 117 mg/m<sup>3</sup> , after treatment 11 mg/m<sup>3</sup>

Craft process :

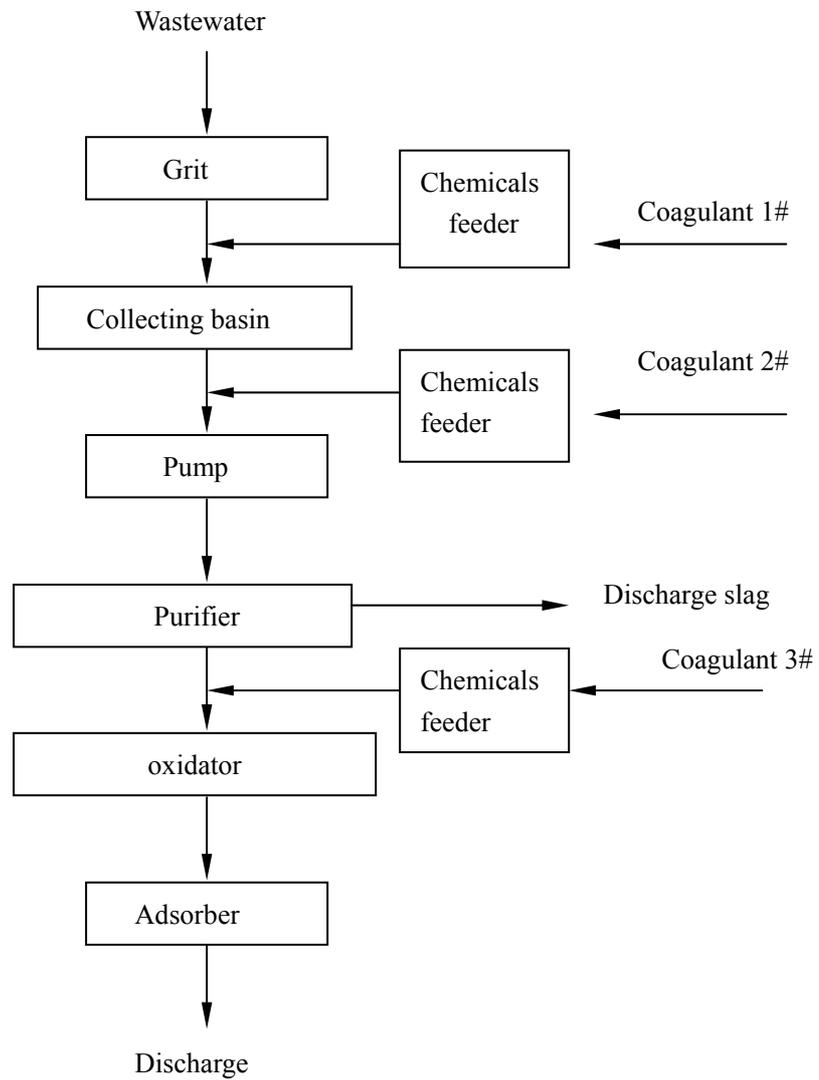


Chart 3-7 The craft process chart of food wastewater treatment

Main equipments :

Table 3-8 Main equipments

Name	Specification	Amount(set)	price (10000Yuan)	Producing factory
Decontaminat ion processor		1	3.8	Provided by equipments manufactory of Hunan University air condition environmental protecting technique Development Company
dose		3	2.7	
oxidator	SCDL-100	1	2.0	
absorber `	500	1	1.2	
Pump		1	0.24	

### 3 · 2 · 2 · 4 The medical wastewater treatment project of people's hospital of Chaning

The people's hospital of Chaning, a polyclinic of country class, now has 300 sickbeds , with wastewater discharging about 300 m<sup>3</sup> per day. It once owned a set of sodium chlorite disinfecting equipment , which can't be used for years no repairing. It was rebuilt in 2001, with total investment 140 thousand Yuan, and the treated wastewater can reach the national first class discharging standard.

Treatment results :

COD : <60mg/L

BOD : <20mg/L

coliform : 0—200 个

Craft process :

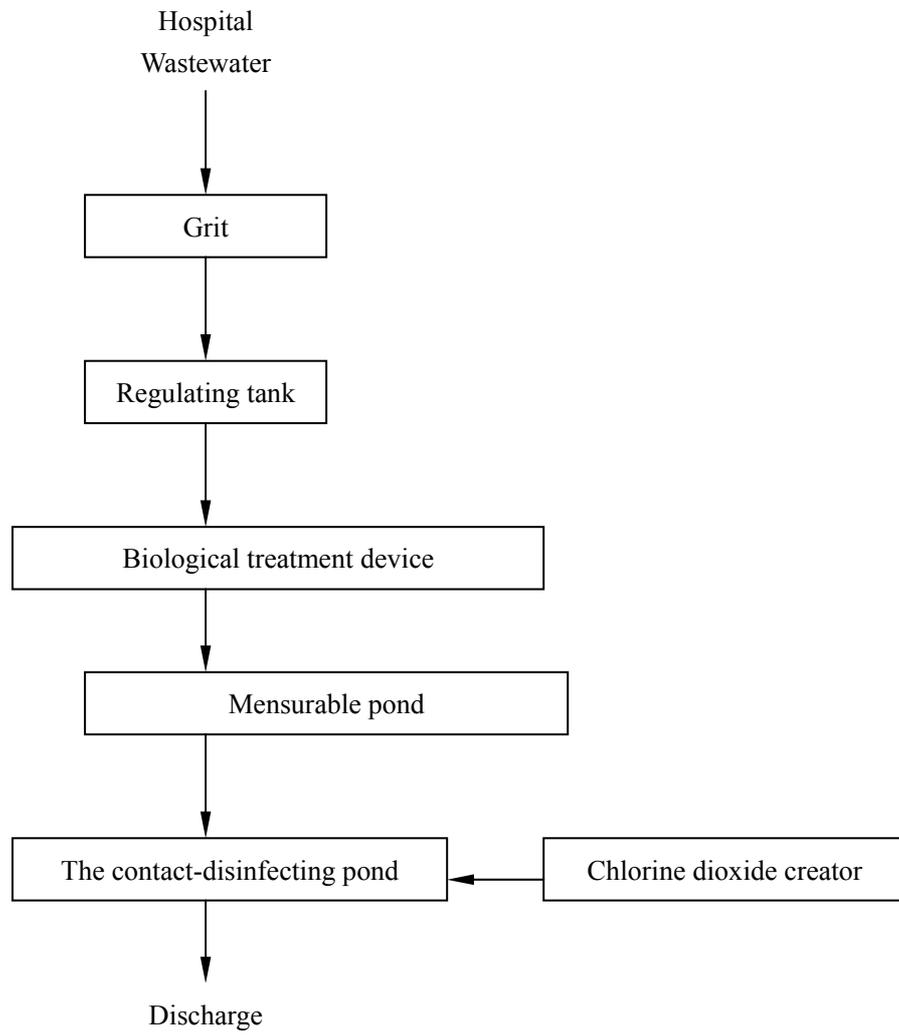


Chart 3-8 The craft process chart of hospital wastewater treatment

Main equipments :

Table 3-9 Main equipments

Name	Specification	Amount (set)	price (10000Yuan)	Producing factory
chlorine dioxide producer	BL-A	1	6.5	The equipments and the total engineering are contracted to Hunan Hunan hygiene engineering department , total investment is about 1.41 million Yuan.
Integral biological treatment device	B-15	1	7.5	
Diving sludge pump	WQ-15	1	0.45	
Ejector	S-20	1	0.65	

### 3 · 2 · 2 · 5 The soap wastewater treatment of Hunan Lichen industrial limited company

Hunan Lichen industrial limited company is a medium scaled state-own ship enterprise , with washing powder, washing liquor, toothpaste, and laundry soap etc as their main products. Soap wastewater produced during the process of laundry soap producing is a kind of high concentration alkalinity wastewater, produced about 800 m<sup>3</sup> each day. After chemical pretreatment, the wastewater was formerly used for boiler smoke desulfurizing, dedusting and was recycled. The discharged water is about 100 m<sup>3</sup> per day in fact. But because of the block of the equipment, it can't be used. The project was finished and sent to use at the end of 2000. The total investment is about 800 thousand Yuan (not including inherent buildings), mainly is equipments cost.

Treatment results :

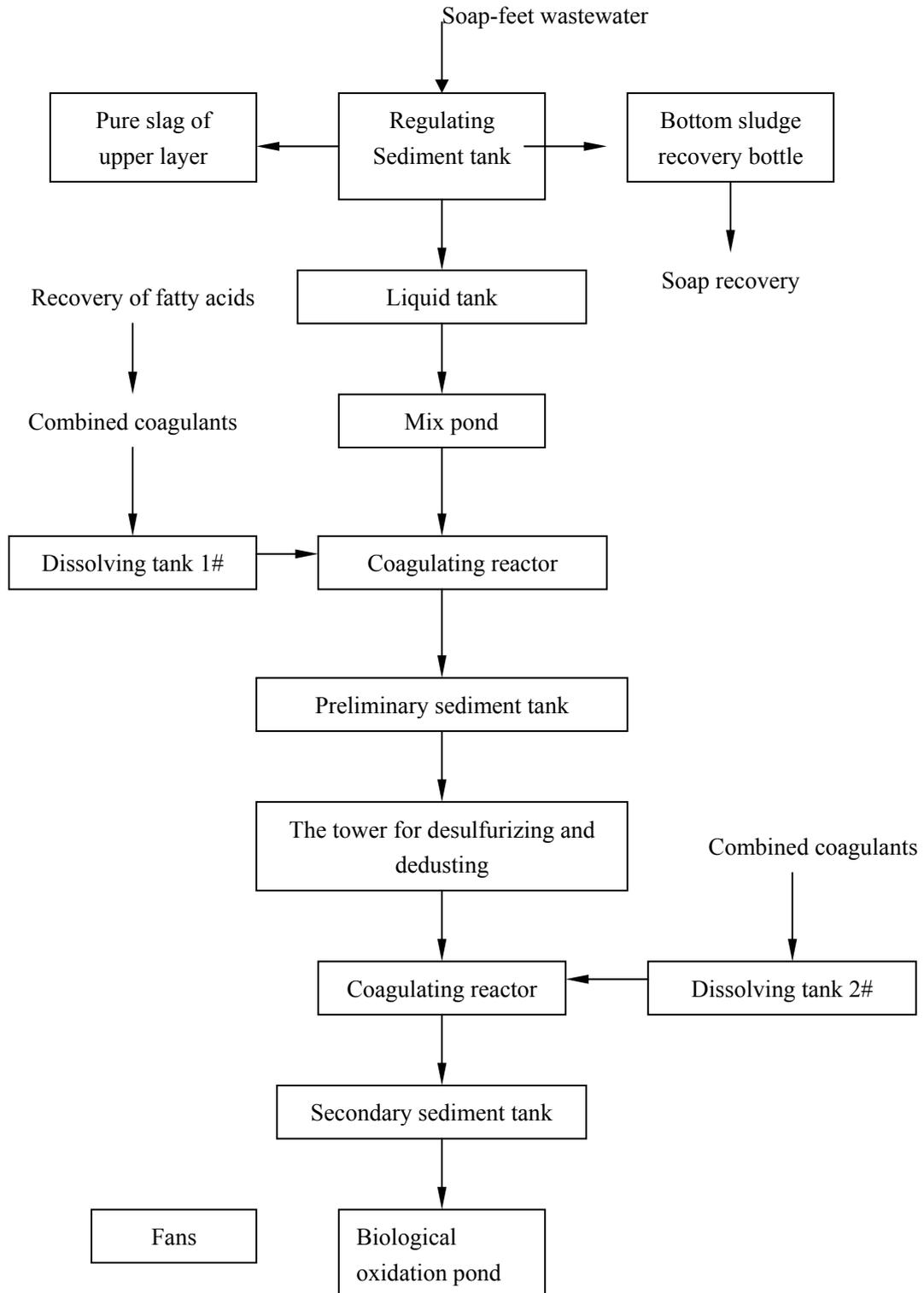
PH : before treatment 12-14 , after treatment 6-9

COD : before treatment 20000-160000mg/L , after treatment <150 mg/L

BOD : before treatment 1000-70000 mg/L , after treatment <60 mg/L

SS : before treatment 97-223000 mg/L , after treatment <200 mg/L

Craft process :



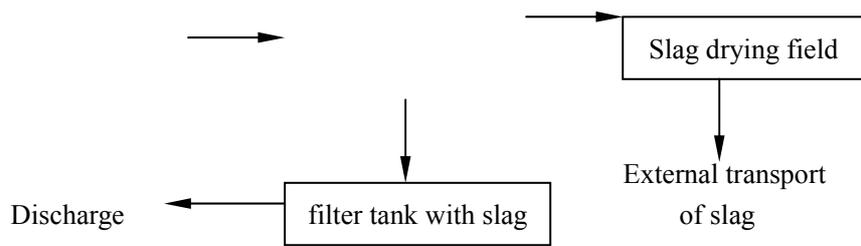


Chart 3-9 The craft process chart of soap-feet sewage treatment

Main equipments :

Table 3-10 Main equipments

Name	Specification and model number	Amount (set)	Unit price (10000Yuan)	Producing factory
Calculating dose	WY-3	2	0.52	The equipments and the total engineering are contracted to Hunan environmental protecting science research , total investment is about 8.01 million Yuan.
flow meter		1	0.47	
whirlpool reactor	1400	2	0.86	
fan	R14	4	0.78	
Pump	WQ10	6	0.86	
pump	WQ30	4	1.68	
liquid meter		1	0.58	
Biological treatment equipment		2	3.7	

### 3 · 2 · 2 · 6 Electroplating wastewater treatment of X Factory

Military industrial enterprise X consumes about 670 m<sup>3</sup> water each day, and discharges acid-alkali wastewater 300 m<sup>3</sup>, cyanogens-containing wastewater 100 m<sup>3</sup>, chromium-containing wastewater 140 m<sup>3</sup>, cadmium-containing wastewater 50 m<sup>3</sup>. The factory originally possessed a series of water treatment structures, Matching with reconstruction of the electroplating car in 2000, the water treatment facilities also reformed, and discharged water reach the standard after treatment.

Treatment results :

PH : 6-9

COD : <100 mg/L

SS : <200 mg/L  
 Total cadmium : <0.1 mg/L  
 Total chromium: <1.5 mg/L  
 Total cyanogens: <0.5 mg/L

Craft process:

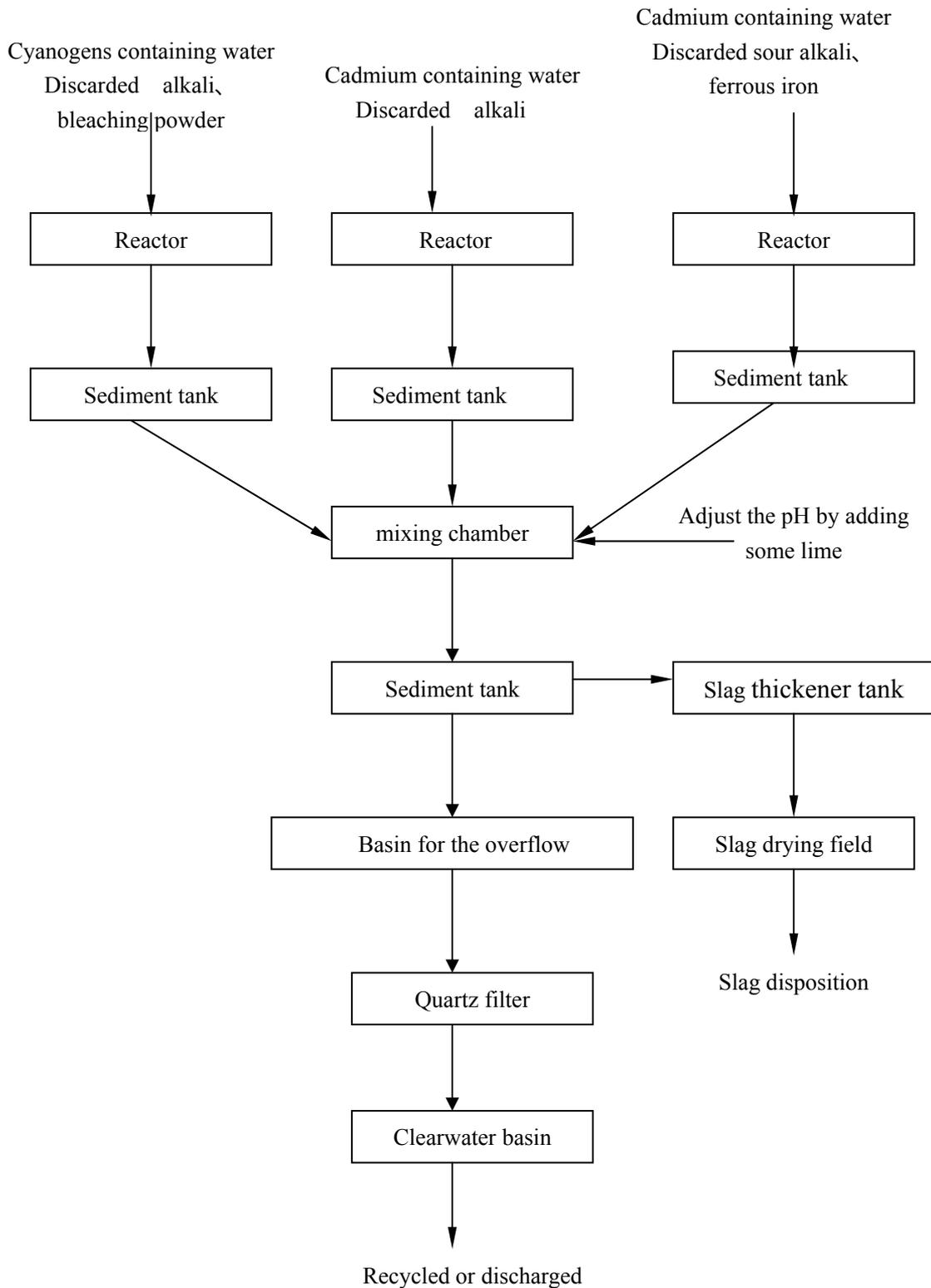


Chart 3-10 The craft process chart of electroplating wastewater treatment

Main equipments : Table 3-11 Main equipments

Name	Specification	Amount (set)	price (10000Yuan)	Producing factory
Calculating dose	WY-10	5	0.32	Hunan Sanding company provides this engineering equipments, total engineering is contracted to the company except for original buildings. total investment is about 3010000 Yuan.
flow meter		5	0.17	
Water inhaling machine	800	4	0.86	
Liquor tank	1000	3	0.80	
Pump`	IH	5	1.86	
liquid meter		1	0.58	

### 3.2.2.7 Wastewater treatment project of Zhenxing aluminum material Ltd. Co. in Hunan province

Hunan Zhenxing aluminum material limited company, a relatively large-scale aluminum material machining enterprise in Hunan, discharged about 50 m<sup>3</sup> per hour wastewater including acid, alkaline, and aluminum containing wastewater produced from the process of acid washing, caustic washing, and electroplating. The project was constructed in two-phase, and the first one was finished in 1999.

Treatment results : PH: 6-9, COD: <100 mg/L, SS: <200 mg/L

Craft process :

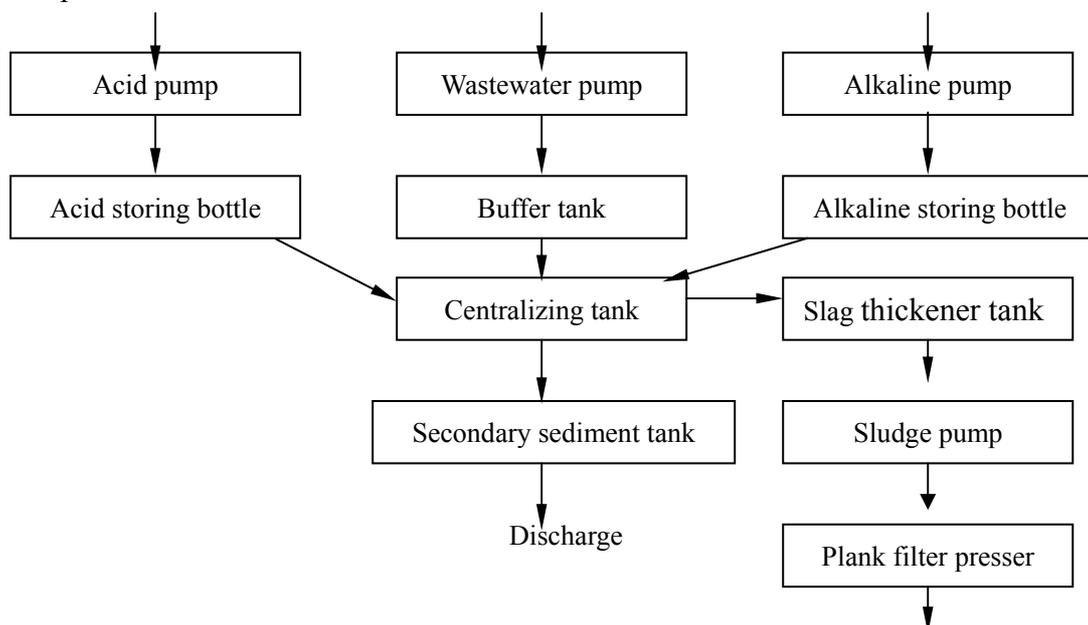


Chart 3-11 The treatment craft process chart of aluminum material machining

Main equipments :

Table 3-12 Main equipments

Name	Specification and model number	Amount (set)	Unit price (10000Yuan)	Producing factory
Acid bottle	1000	2	0.5	The equipments and installation of the engineering is contracted to Changsha Huilong environmental service limited company , about 20.01 million Yuan.
Alkaline bottle	1000	2	0.5	
buffer tank	2400	2	3.0	
Coagulant tank	800	2	0.5	
stirrer		4	2.5	
Plank filter presser	35m <sup>2</sup>	6	4.1	
air compressor		2	1.1	

### 3.2.2.8 Wastewater treatment project of Yiyang Hansheng biological pharmaceutical limited company

Yiyang Hansheng biological pharmaceutical limited company, a Chinese patent coagulant producing enterprise, discharged 240 m<sup>3</sup> of organic wastewater each day. And the wastewater was treated by a combining physical and biological technology.

Treatment results :

pH : before treatment 5-6 , after treatment 6-9

COD : before treatment 1500 mg/L , after treatment <100 mg/L

BOD : before treatment 400 mg/L , after treatment <60 mg/L

SS : before treatment 200 mg/L , after treatment <50 mg/L

Craft process :

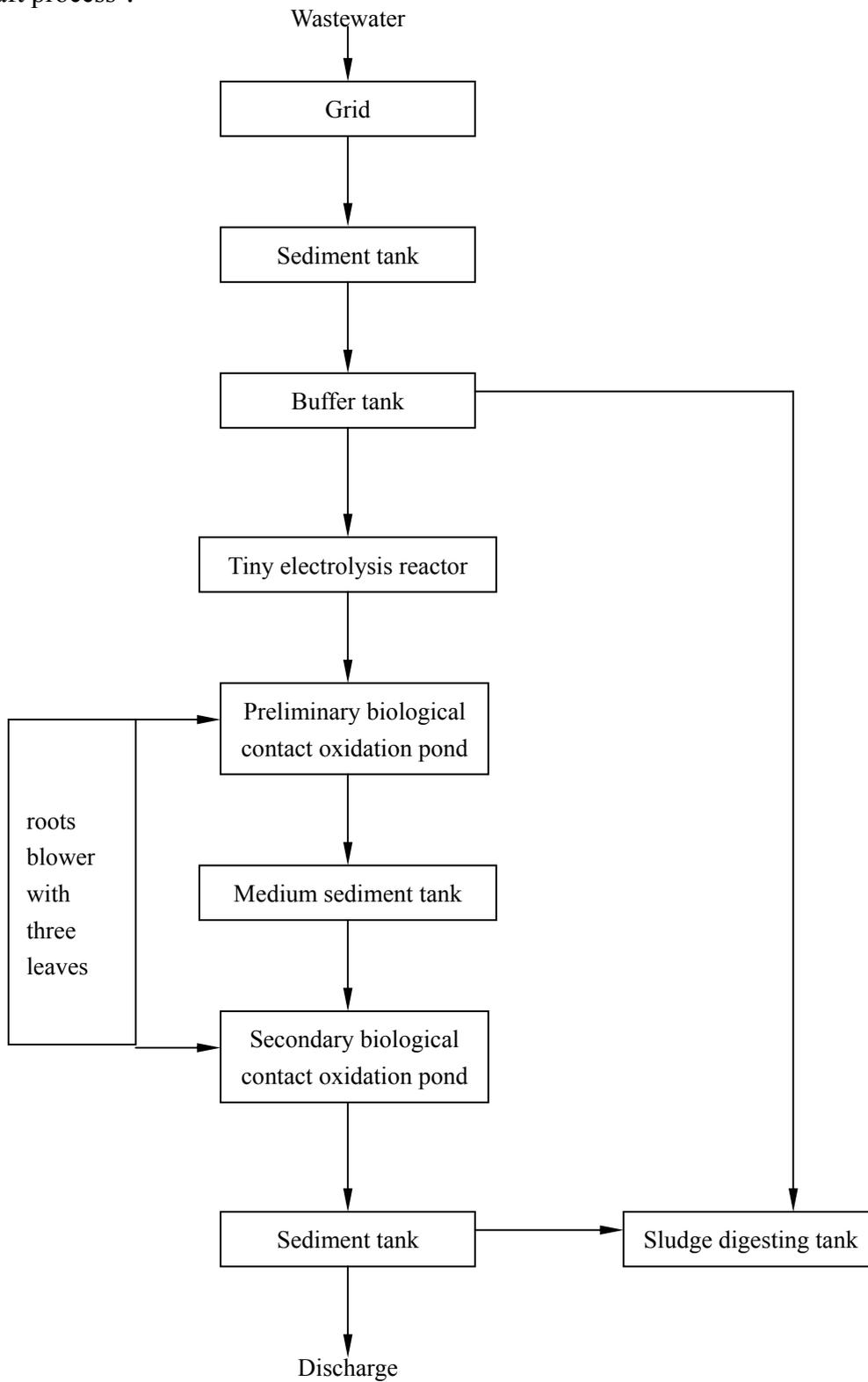


Chart 3-12 The craft process chart of pharmacy water treatment

Main equipments :

Table 3-13 Main equipments

Name	Specification and model number	Amount (set)	Unit price (10000Yuan)	Producing factory
Tiny electrolysis reactor		2	5.8	Changsha Aobang company
Low voice three leaves roots blower		2	2.7	Changsha Aobang company

### 3 · 2 · 2 · 9 Wastewater treatment project of Xiangxiang tanning factory

Xiangxiang tanning factory, a private own ship enterprise , treated about 300 thousand pieces of pigskin per year ,and totally discharged wastewater 150,000 m<sup>3</sup> per year . The main pollutants are from the process of antiseptis, denuding, packing ash work segment, de-oiling, degreasing work segment, de-alkalization work the segment, tanning work segment and dying work segment, including: Vaporizing phenol, sulfide, animal grease, ammonia, chrome salt, suspended material and dyestuff etc. the different wastewater were firstly treated separately to recover the part of some useful materials, and then were treated together.

Treatment results :

PH : before treatment 11 , after treatment 6-8

COD : before treatment 17750mg/L , after treatment 100mg/L

NH3-N : before treatment 417 mg/L , after treatment 15mg/L

SS : before treatment 35410 mg/L , after treatment 5mg/L

Bivalent sulfur : before treatment 2775 mg/L , after treatment 0.5mg/L

Chrome : before treatment 2500times , after treatment 5times

Craft process:

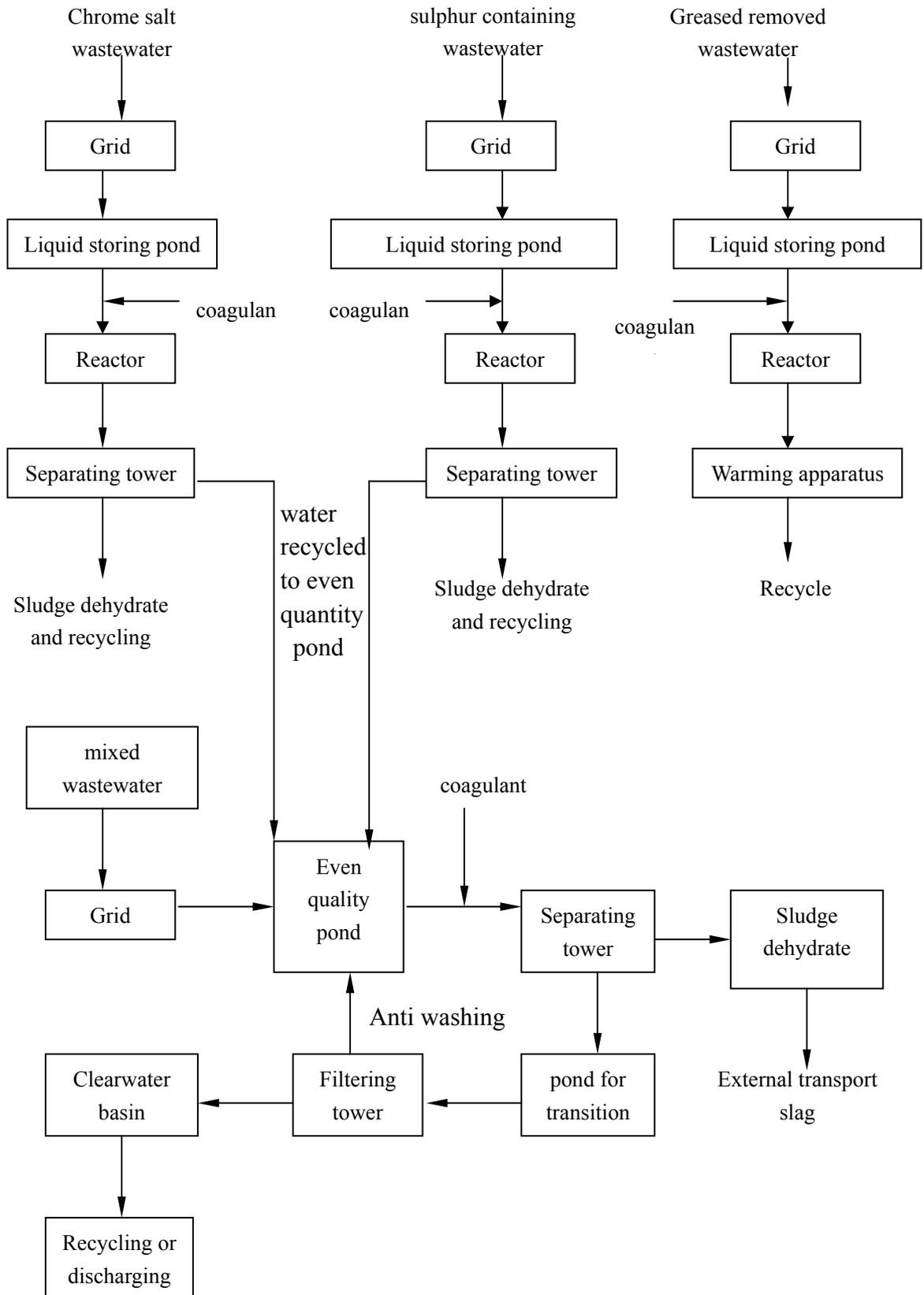


Chart 3-13 The craft process chart of tanning water treatment

Main equipments :

The treatment project is constructed by Hunan Universe environmental protection limited company, and has not provided any technical parameter and price of unit equipment, the total investment of the project is 1.5 million Yuan.

### **3 · 2 · 2 · 10 Wastewater treatment project of Hengyang Xidu paper plant**

Hengyang Xidu paper plant, a medium-scaled paper plant with reed as the raw material, produced paper about 20 ,000 tons, and consumed about 40 ,000 tons of reed per year. The plant discharges black liquid about 200 m<sup>3</sup>/d, middle segment wastewater about 16 ,000 m<sup>3</sup>/d .About 50% treated wastewater were recycled, and the running cost nearly 0.9 Yuan per ton paper.

Treatment results :

Black liquor before treatment :

COD : 30000mg/L

BOD : 9000 mg/L

SS : 2000 mg/L

PH : 11~13

Middle segment sewage before treatment :

COD : 600 mg/L

BOD : 300 mg/L

PH : 7~9

After treatment: reach the second discharge standard of the nation(GB8978-1998), the average sickness of COD is 320mg/l.

Craft process :

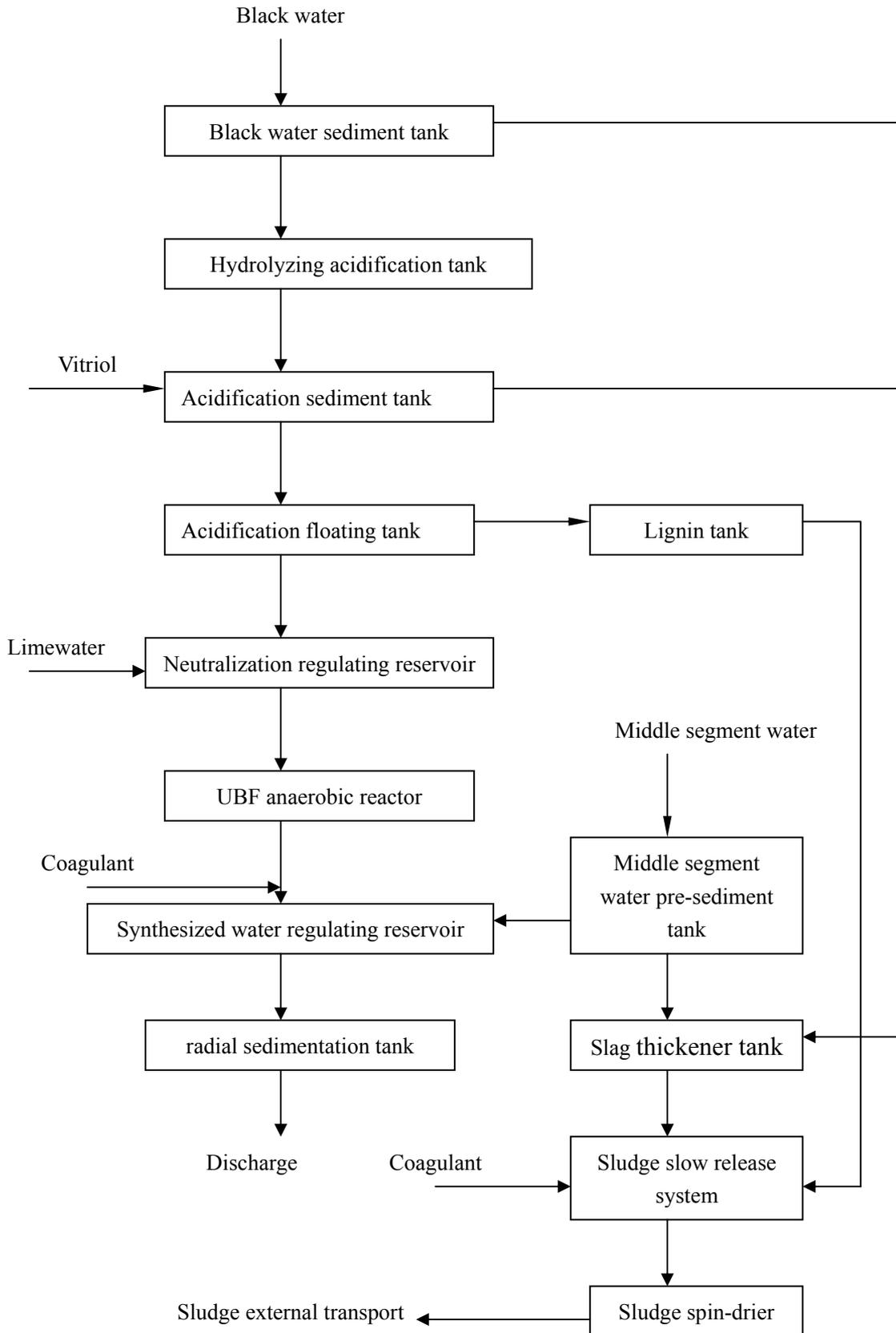


Chart 3-14 The craft process chart of paper plant water treatment

Main equipments :

Table 3-14 Main equipments

Name	Specification and model number	Amount (set)	Unit price (10000Yuan)	Producing factory
UBF anaerobic reactor		2		This engineering is contracted by Fujian new century company, and is provided with technique, equipments by the company. Total investment is about 90.01 million Yuan.
filter presser	XGYZ70-630-61	6		
sewage pump	3000-WL400-15			

## **4. The research on the prospect of wastewater treatment market in Hunan province**

### **4.1 summarize**

Environmental protection is one of the fundamental national policies in China, which is one of the most important components to sustainable development strategy. The next 5 to 10 years will be the important period to develop the national economy, and to accomplish strategy adjustment for economic structure as well as to advance the process of industrialization, agro-industrialization, and urbanization. At the same time, it will be the critical period of eliminating environmental pollution and strengthening ecological construction. The market of environmental protection will maintain the quick development.

In China, the market for environmental protection is induced by the government. When the government makes out a new policy on the aspect of environmental protection, the new market opportunity will come along with it. For example, at the end of the last century, according to the decision of State Council and the policy of economic structure adjustment, the government shut down 1300 minor enterprises engaged in the paper making, coking and smelting, which suffered from the problem of trailed-out technology, wasteful resource and serious pollution. At the same time, some key industrial pollution sources have been ascertained and asked for discharging within the standard.

By the end of 2000, among the 396 main enterprises checked by the national EPB, 372 enterprises had reached the standard. During the period of the Ninth-Five Years plan, the environmental protection investment of Hunan was 11,680,000,000 RMB, which took up 0.75% of the GDP at the same period, and compared with the Eighth-Five Years plan, the investment was 0.35% more than that of the latter. It is planned that about 24,700,000,000 RMB will be invested for environmental protection during the Tenth-Five Years plan, which will be the 1.05% of the GDP at the same period, and 0.30% more than the environmental protection investment of the Ninth of Five Years.

The economic development of Hunan is in the primary period of industrialization metaphase, during the Tenth-Five Years, the government will speed up the process of industrialization, agro-industrialization and urbanization. The task of industrial pollution prevention is quite terrible due to the accumulated pollution problems and the economic construction pollution caused by the industrial economy, which can hardly be completely changed within short time. On the other hand, the increasing of urban population and the three wastes (waste gas, waste water and industrial residue) caused by farm product process also give a greater pressure on environmental protection.

After the China entrance of WTO, the environmental policy and standard should be consistent with the international, the environment market becomes more and more exoteric, and the environmental protection requirements to the enterprises are becoming more rigorous as well.

In a word, the economy and society should not develop at the cost of environmental pollution, and the Chinese government decides to solve the environmental problems. It has become a choice that cannot be changed.

## **4.2 the main task and measures for environmental protection**

### **4.2.1 the main task**

#### **4.2.1.1 the urban environmental protection**

The aim is to improve the living quality of urban people and create favorable inhabited environment. During the course of advancing urbanization, urban environmental comprehensive treatment should be strengthened, and the problem of air pollution, water pollution and waste solids pollution should be solved as an emphasis.

Firstly, we should program reasonably the urban function. The problem of urban functional region being mixed should be solved step by step by following the natural ecological law, ensuring the urban scale and developing direction reasonably, adjusting the industrial structure. According to the general plan and environmental function division, the city group of Changsha, Zhuzhou and Xiangtan should develop in order at the general aim of economical integration. Yueyang and Changde city should be constructed with full plan and step by step as the environmental protection model city, and Zhangjiajie city should be built at the request of a key tour city.

Secondly, the aim of improving the environment quality of city should be reached by adjusting measures to local conditions, and speeding up the environmental infra-construction, such as municipal wastewater plant, waste solids disposal plant and center of heat and gas supply, etc. Thirdly, the municipal management and the environmental comprehensive control should be by strengthened. The security of drinking water should be ensured by protecting the drinking-water source strictly, and improving the structure of energy source by controlling the raw coal as the direct fuel and inhibiting the enterprises with seriously air pollution from being built in the city zone, controlling the exhausted gas by encouraging enterprises and people to manufacture and to drive the automobiles using the fuel which could not cause air pollution, controlling noise pollution by restraining motor vehicles and trains from whistling, strengthening the monitoring of noise coming from the construction site, industrial enterprises and the society.

The problems of the clearing and transporting residues and rubbish produced from the construction work, the repairing of damaged road surface and the recovering of bareness land, etc. should be considered as prominent problems in urban management, and try our best to stop dust pollution.

#### **4.2.1.2 industrial pollution control**

Combining the strategic adjustment of the economic structure, it should be put into practice the whole process control, and strengthen the technological transformation. Moreover, the projects that can reach completely the standard should be put into operation by turning off and washing out the trailed-out enterprises and production facilities. The emphases should be put on the pollution prevention and control of the industries of energy (coal and electric power), metallurgy (non-ferrous metal and ferrous metal), chemical industry, building material and light industry, so as to realize the aim of diminishing the pollution and increasing the benefit.

**Metallurgy:** The ferrous metal industry should be integrated with steel output control and structure adjustment closing down the primary coke oven plants and steel mills, and washing out the staled-out production skills and equipments such as molded casting with small electric cooker and open-train mill, etc., on the other hand, introducing the advance technology such as continuous casting with converter and continuous train mill, etc. In 2005, the comprehensive energy consumption and the fresh water quantity consumption will be decreased to be less than 0.8 ton standard coal and 16m<sup>3</sup> per ton steel in large and medium size enterprises, respectively, and the discharge amount of the main pollutants including smoke dust and sulfur dioxide, etc. should be decreased 10% on the base of the disposal efficiency by now.

The non-ferrous metal industry should continue to shut down the primary metallurgy, wash off the staled-out techniques and enterprises, strengthen the technological reform and realize the structural general optimization and the industrial upgrade. The resource should be utilized comprehensively by promoting the innovation of the skills such as gathering, selection, smelting and processing and controlling the pollution of sulfur dioxide trail gas with low concentration in lead smelting industry, so as to realize economy on energy and decrease on consumption. In 2005, the water reuse rate will increase to 85%, the energy consumption per production will decrease 3-5%, and the sulfur recovery ratio in lead smelt industry will reach 90% as well.

**Energy:** guide the coal industry improve the match of coal category, restrain the exploitation of high sulfur coal, and increase the ratio of high grade coal. Develop the technology of coal washing, coal separation, coal shaping, coal blending with motility, coal-water slurry, coal gasification and liquefaction, and increase the clean utilization standard and efficiency. At the same time, research and develop the technology of coal washing, coal separation and desulfuration, and decrease the ash content and sulfur

content. Moreover, pay attention to the comprehensive utilization of low quality coal, coal slack and fly ash, restrain using raw coal directly and develop the industry of coal blending. Thermoelectric power industry should have the emphasis on decreasing the discharge amount of sulfur dioxide by washing out the small thermoelectric power stations, and closing or replacing the old-fashion assembling sets. The new coal-fired power plant should be introduced to burning manner with low nitrogen, and construct desulfuration equipment simultaneously. In 2005, the discharge amount of sulfur dioxide per electric-power output will decrease prominently comparing with that in 2000, the coal consumption will decrease 15-20 g/kilowatt·h, and the wastewater reuse ratio will reach 60% as well.

**Petroleum chemistry:** put the emphasis on the configuration adjustment and low pollution production. Close the minor chemistry enterprises with serious pollution, wash out the organic phosphorous pesticides such as methamidophos, monocrotophos, parathion, phosphamidon, etc., which have high toxicity and serious pollution, and put down the dye and dope production with out-date techniques, serious pollution and low additional value should, too. Research and develop the fertilizer with high concentration and slow release as well as the pesticide, bactericide and herbicide with high efficiency and low toxicity. And pay more attention to the research and application of biological pesticide. In 2005, the ratio of high concentration fertilizer, low toxicity fertilizer and low pollution dope will reach 65%, 55% and 45%, respectively.

**Building material:** wash out the out-date technology such as machine kiln, lepol system and hollow kiln, prohibit machine kiln、humidification kiln、pint-sized preheater kiln from being built and enlarged,

**Light industry:** wash out staled-out techniques and productivity by closing the minor pulp mills, tanneries and brewing plants with serious pollution, out-dated technology and unfit for the economical scale. The paper and pulp industry will spread the mode of pulp making in centralization and paper-making in decentralization, the enterprises without ability of alkali recovery should stop making pulp, and use merchandise pulp. At the same time, strengthen the construction of base for raw material, and integrate forestry with paper industry or reed industry with paper industry. Realize the unite of forestry-and-paper economic benefit and environmental benefit by building the steady raw material base for wood-pulp and reed-pulp, develop and popularize the non-phosphorus washing product with enthusiasm, prohibit the zinc mercury cell from being yielded and stop the producing and selling of plastic foamed tableware using for one time.

Wash out the ozone consumption material coming from the trades of air-condition on the automobile, tobacco, electric refrigerator and refrigeration for the industry and business use and *HaLong* 1211 , and realize the object that 50% CFC<sub>5</sub> can be

substituted by the end of 2005. Moreover, spread the product attestation of environmental protection, and promote the development of light industrial product with low energy consumption, low noise, non-toxicity and non-pollution.

Improve the rural environmental quality, put an emphasis on controlling area source, domestic animals and birds breeding pollution and preventing and treating the township industrial pollution. Integrating with the adjustment of agriculture structure, develop the organic food, green food and nuisance free food, control the area source pollution caused by using fertilizer and pesticide irrationally. Popularize the technology of manurial comprehensive utilization and disposal in domestic animals and birds breeding, and realize the manurial resourcization. Develop the project of improving water quality in rural area, strengthen the water protection, and ensure the sanitation of concentrative drinking water. Stop cooking the straw-stalk of the crop and make comprehensive use of it. At the course of developing the towns, rationally arrange the distribution and the programming, divide the function region according to the environment, adjust the township industrial structure, promote the township to centralize as industrial village, perfect the construction of the environmental basic equipments, and realize the pollution-centralization control. At the same time, prevent the out-dated industry with great consumption and serious pollution to transfer from the urban to the rural through efficient measure.

#### **4.2.1.3 ecological environment protection**

Directed by the National Ecological Environment Protection outline, the protection emphases are the Dongting Lake, the source of the Four Rivers and the autonomous prefecture of west hunan, the main measures are changing the cultivated land to the forest, changing the cultivated land to the lake, strengthening the inspection, lessening the man-made destroy and restraining the ecological deterioration trend. Firstly, protect the important ecological function regions as an emergency. The emphases are bombing the bam to run the flood, changing the cultivated land to the lake, changing the cultivated land to the forest and planting woods by seal a mountain pass in the source of the Four Rivers, as well as the treatment of soil washed out by the running water, strengthening the protection of the swamp ecological system.

Secondly, protect the main resource exploitation area with compel. The emphases are the mine exploitation area and the basic installation construction area. Increase the strength of law execution and inspection, strengthen the prevention, inspection and resumption of soil quality destroy, the pollution of the waste gas, waste water and industrial residue and the geologic disaster caused by resource exploitation. Prevent the soil from being washed out by the running water and ecological caused by the basic installation construction such as the highway and railway, etc., from being damaged. Thirdly, take an active protection to the good ecological environment area. The emphases are the Zhangjiajie and WulingYuan nature conservation area, lay stress

on the biological variety and the integrality of nature ecological system. In particular, avoid the ecological environment pollution created by the trend of urbanization and commercialization at the cause of tour and exploitation.

#### **4.2.2 the main protection measure**

##### **4.2.2.1 To establish comprehensive decision-making mechanism, and strengthen the work of environmental protection**

To persist in the sustainable development strategy, to establish and perfect the comprehensive decision-making mechanism of integrating economy and environment in all levels of governments, to promote the continual and stable development of both economy and society. The environmental protection should be included in the economical and social develop program, annual program, urban program, area and valley development plan, as well as the economical structure adjustment and technology reconstruction. The decision-making of the construction projects should routinize and standardize on the aspect of examination and supervision from the establishing the projects to constructing the project, from business register to running the project, and the environment protection should be put into the first consideration.

All levels of government administration should carry out the environmental protection responsibility system, put it into the main schedule of the government, and set it as one of the main contents of the achievement assessment for the leaders of the government, meet the request of the responsibility. To perfect the environmental management system, and to strengthen the “lawmaking, programming and supervising in consistent with the environmental protection”. To perfect the department harmonization system, to harmonize and to solve the main environment problems between the areas and the valleys

##### **4.2.2.2 strengthening the construction of legal system and protecting the environment according to the law**

The environmental protection law should be carried out strictly, and at the same time the concrete implementation and management method should be amended and perfected. Some local laws or regulations should be established such as the Environmental Protection Management Regulation for the Constructive Objects in Hunan province and the Nature Ecological Protection Regulation, etc. and the laws and regulations that are unsuitable for the market economy system should be cleaned up and adjusted, the Environmental Protection Management Regulation for the Constructive Objects in Hunan province should be carried out, and the environmental impact assessment and system of “three-simultaneity” should be put into practice. Implementing the examining and approving system for discharging for the new industrial projects in the area where the total pollution discharge need to be cut. The environment monitoring, standardizing the inspection behavior should be

strengthened, and the equipment and personnel quality of the environment monitoring team should be improved. the law execution and supervision with the emphases on system of “three-simultaneity”, industrial contamination discharge and environment protection should be developed.

#### **4.2.2.3 Increasing the environmental protection investment through different channels including government and market adjustment**

All levels of government administration should take measures such as the measure of economy, administration and law to increase the environmental protection investment, and to put the investment into effect, and put the total cost for the environmental protection department into the annual financial budget. To grasp the advantage of active financial policy continuously carried out by the government, and to shoot for bringing some environmental comprehensive control projects, infrastructure construction projects of the urban environment, ecological environmental protection and construction projects into the native enlarging inner-demand projects, and to try to get the support to the environmental protection and ecological projects from the national bank and business competent department. Promoting the industrialization and market of municipal sewage and waste solids treatment, and to attract the capital from the other provinces and foreign countries into the field of infrastructure construction projects for environmental protection. Encouraging the commercial bank to support the projects of pollution control and ecological protection at the precondition of credit safety. Supporting the implementing of the environmental protection projects and the development of environmental protection enterprises through issuing the environmental bond and stock. To carry out the favorite policy on comprehensive resource utilization, and the charge system for waste discharge amount, and to promote the pollution control activity in the enterprises. All the cities in the province should impose on the wastewater disposal fee, waste solids disposal fee and dangerous waste disposal fee to make the pollution control facilities run regularly. The city group of Changsha, Zhuzhou and Xiangtan as the experimental areas of comprehensive control of acidic rain will carry out the exchange of emission rights of sulfur dioxide and increase the standard of effluent charge of sulfur dioxide step by step.

#### **4.2.2.4 reinforcing the research on environmental protection and developing the industry of environmental protection**

The research on the topic of environmental management and policies, area economic development and environmental protection and some key environmental problems should be done to serve the government macro-decision. And the research should be focused on the technology of ecological protection, acid rain prevention and control, flue gas desulfuration as well as high concentration organic wastewater treatment, etc., To deepen the innovation of environmental technology system, to increase the investment of technology, and to improve the research equipment and the environmental research standard. To perfect and standard the environmental industrial

market, to break the department monopolization, to establish the justice and ordered market-function system through environmental criterion, technical policy and aptitude certification. To depend on the technology innovation, introduce, to digest and absorb the advance environmental protection technology, to promote the technical progress and speed the development of environmental protection industry. To pay more attention to the whole set equipment for wastewater treatment, whole set equipment flue gas desulfuration, high efficient burner as well as pollution source on-line supervision equipment, to support the environmental equipment-making main enterprises, at the same time, to support several environmental protection consulting enterprises engaged in management system attestation and consulting, the project design and environmental protection equipment management, etc., to encourage the enterprises engaged in manufacturing environmental protection product and the environmental serving enterprises to exploit the international market.

#### **4.2.2.5 strengthening the environmental management and improving the modernization standard of environmental management.**

All levels of government administration should establish and perfect the environmental protection organization, and strengthen the construction of environmental protection team, and all levels of the financial sections should increase the investment of environmental management capacity. According to the principle of unified planning, rational distribution and resource sharing, an environmental inspection network should be established and perfected, which should cover the 14 cities and state environmental control points and some of county control points, air quality auto-inspection system, the capital cities of state government, the surface water environmental inspection system with the emphases on the One Lake and the Four Rivers, the acid rain inspection system with the emphases on the acid rain pollution controlling area, ecological observation system with the emphases on the Dongting Lake and the source of the Four Rivers, and the main pollution-source-on-line- monitoring system and the environment-pollution-emergency-inspection system. To strengthen the supervision and execution ability of environmental inspection organization, to improve the environmental inspection execution standard, execution ability on the site and the ability of answering the paroxysmal pollution affairs, to establish the 110 and 12369 environmental protection request telephone station. To accomplish the construction of environmental information centers both in the cities and in the main counties, and to establish the environmental information communication network, to realize the interconnection between national environmental information-satellite-communication system and the local information-communication system, to make the environmental information be gathered, processed and promulgated unitedly. Improving the basic condition of key laboratory of water pollution control, and to establish the key laboratory of utilizable and harmless solid waste and environmental technological innovation base.

#### **4.2.2.6 strengthening the environmental education and improving the awareness of environmental protection**

The education for environmental knowledge, environmental legal system and environmental awareness should be done. All levels of research institute, administration academies and cadre schools should add the content of environmental education and improve the environmental awareness and comprehensive decision ability of all the leaders and the managers of the enterprises.

The environmental education should be expanded from the urban to the rural area, and great efforts should be made to improve the farmers' environmental consciousness. All of the press medium should pay more attention to the environmental propaganda and supervision from the public opinion and establish a supervision system from both the consensus and the public. The environmental information issuance system should be perfected and standardized to ensure that the environmental information be open to public and to induce the public to build up a sustainable consumption concept adapted to the situation of the country and province, and advocate the living style of the green civilization

### **4.3 the environmental protection investment**

#### **4.3.1 the environmental protection investment of the Tenth-Five Years in Hunan**

According to the environmental protection task during the Tenth-Five Years, the total environmental protection investment is estimated to be ¥ 24,700,000,000, which will be 1.05% times of GDP, and 0.30% more than that in the Ninth of Five Years.

##### **4.3.1.1 the investment of industrial pollution prevention and control**

The investment of industrial pollution prevention and control is mainly used for the disposal and comprehensive utilization of industrial wastewater, waste gas and waste solids and the closure and movement of the enterprises with serious pollution. It is estimated that the sulfur dioxide will be decreased 155,000 tons, COD 81,200 tons, industrial smoke and dust 71,000 tons, industrial powder and dust 140,000 tons, the total investment will be ¥ 11,300,000,000.

##### **4.3.1.2 the construction investment of urban environmental infrastructure**

The wastewater disposal capacity will increase 2920,000 tons per day, the harmless disposal capacity of the waste solids 11,200 tons per day, the disposal capacity of dangerous waste 247 tons per day, the disposal capacity of medical waste 40 tons per day, the COD discharge amount will decrease 160,000 tons, the project construction of gasification will be advanced. The total investment will be ¥ 9,000,000,000.

#### **4.3.1.3 the investment on ecological environmental protection**

The ecological function protection area, the ecological reserve area and natural reserve area will be established and the ecological environmental protection supervision, the biologic diversity protection and the rural ecological environmental protection, etc. will be launched. The total investment will be ¥ 3,910,000,000.

#### **4.3.1.4 investment on the construction of environmental management**

Investment on the construction of environmental management will be mainly used to strengthen the environmental monitoring, the investigation on ecological environmental status and the biological diversity, the construction of environmental enforcement capacity, the construction of environmental information system as well as the environmental propaganda and scientific research, etc. The total investment will be ¥ 490,000,000.

### **4.3.2 the analysis on investment source:**

#### **4.3.2.1 Investment dominated by governmental**

The projects construction for water pollution control in urban environmental infrastructure need about investment of ¥ 3,700,000,000. This part of capital will mainly come from the investment of urban construction and maintenance fee, infrastructure investment from finance budget and urban wastewater treatment fee collected. Key environmental protection projects can also get some investment from national finance. The governments will attract the foreign capital and civil capital through applying the market mechanism, and can even through securities business to finance.

#### **4.3.2.2 Investment dominated by enterprises**

The industrial water pollution control will need about ¥ 1,000,000,000, this part capitals are mainly collected by the corresponding enterprises, which normally could be classified into two types: the first comes from the construction fund of environmental protection installation for the new projects, the second from the enterprises' own funds, bank loan or pollution control fund. Another way for the enterprises with serious pollution is to close or to move out from the downtown area, the charge for which could be collected according to some related policy. Sometimes

government would finance to some key industrial pollution control projects or technology model projects.

### **4.3.3 the investment on the key projects for water pollution control**

The key projects for water pollution control mainly include the industrial wastewater control key projects and the water pollution control key projects for urban environmental infrastructure, totally, there will be 39 projects in near future, which cost totally about ¥4,700,000,000, by now only less than ¥400,000,000 has been fulfilled, about ¥4,300,000,000 need to be invested. This doesn't include the charges for water treatment fittings used for the disposal of the waste solids and air pollution control in industrial pollution control and that of household garbage, as well as the installations and equipments related with water in construction of ecological environmental protection and environmental protection capacity. The specific situation of the projects are listed in table 4-1 in detail.

4.3.3.1 there are 16 key projects specifically for industrial wastewater treatment, the total investment for which should be about ¥1,000,000,000. It is estimated that the COD will be decreased by 53,000 tons per year.

4.3.3.2 there are 24 key projects for wastewater treatment invested for municipal infrastructure construction, which need about ¥3,700,000,000 in total. The municipal sewage treatment capacity will increase 2,090,000 tons per day, and the COD will be decreased by 67,000 tons per year.

## **4.4 Requirement analysis on related equipment**

### **4.4.1 requirement analysis on related equipment for the industrial water pollution control in Hunan**

Comparing with the Ninth-Five Years, the scale of the industrial water pollution control during the Tenth-Five Years has been reduced, most of which are the old problems that are difficult to be handed and need a large sum of money, and because of the capital, technology and industrial structure, etc. few problems are completely settled, although most of the them are considered as key projects.

For example, the comprehensive projects for wastewater treatment in Zhuzhou chemical plant. Since it is an old enterprise built at the early of 1950s, most of the production processes are out of date and aging, it is very difficult for the enterprise to realize the complete solution for the wastewater treatment project by itself. The key problem of the wastewater treatment technology is that a large amount of sludge produced from the wastewater treatment process is hard to be dewatered by the normal equipment in the market. Beside this, the pesticide wastewater from Nantian Co., the dye wastewater from Zhubugang, the wastewater coming from ramie

degumming process from Yueyang and the pulp and paper-making wastewater from Yueyang and Changde could not be treated properly, and almost all projects have had been delayed for a long time because of the technology and equipment.

Due to the great difference between the different industrial wastewater treatment projects and the variety and uncertainty of the technological scheme and process, it is very difficult and unnecessary to assess the equipment requirement. It is worth to be mentioned that the technology is the key factor for industrial wastewater treatment, if the efficient technology could not be supplied, the best equipment could not work well. Indeed, some general devices, such as lift pump, sludge-dewatering equipment are needed by almost all projects, especially, the dewatering equipment with high-efficiency, which is urgently needed not only in the projects being built in the handy future but also in the rebuild projects having been built and running unsteadily.

The equipment demand analysis about the key items of industrial wastewater treatment during the Tenth Five Years plan in Hunan is in table4-2

#### **4.4.2 the analysis on equipments requirement for the key projects of the municipal wastewater treatment**

From the table 4-1, it can be seen that, during the Tenth-Five Years, the investment of the municipal wastewater plant takes up about 80% of the total investment in the field of wastewater treatment key projects, which indicate that after the long period of hard work, the industrial wastewater pollution has been controlled primarily, while the too much need to be done for the municipal wastewater pollution control, which will be the key works in the environmental protection in Hunan during the period of the “Tenth-Five years” or even longer. In order to enlarge the inner requirement and to promote the economic development, China has increased the investment on infrastructure since 1998. The urban infrastructure is one of the most important parts, and the huge investment will bring enormous market share with no doubt.

The installation, equipment and the instruments required by municipal wastewater plant have some comparability, comparing with that in industrial wastewater treatment projects. But it must be noticed that since the economy in China is still in developing, there are so many problems to be solved. Though the advanced process with huge investment and high running cost come into Chinese market through the foreign (especially from Europe) environmental protection loan, only suitable for China (especially in Hunan) is the process with little investment and low running cost and will occupy the whole market of the medium and the minor wastewater treatment plant. Hunan, located in the South China with heavy rain, where pollutants concentration in the wastewater is much lower than that in the North China and even in the western countries, so emphasis should be put on the treatment technology and its efficiency. On the other hand, wastewater treatment equipment and technology has

shown a trend of being industrialized and marketable, and the proportion of the equipment and technology has increased in the total investment in the project.

The municipal wastewater plants to be built in recent years in Hunan are of medium and minor scale in general, which can treat wastewater about 50000-150000 m<sup>3</sup>/d. The main technology used for the plants could be oxidation ditch and/or SBR process (or its innovation) . The related single technology equipments includes:

- Automatic-grid-dregs-removal equipments
- Whole set of sand removal and washing equipments
- clarifier sludge-stickling-and-sucking equipments
- Efficient aeration equipments
- general used sewage equipments , such as fan, pump, etc.
- Sludge concentration and dewatering equipments
- Sludge digesting equipments
- Whole set of biogas utilization equipments
- Automatic controlling system, instrument, etc
- Some equipments specifically used in the oxidizing ditch and/or SBR

According to the research and analysis made by Chinese expert on wastewater treatment , the market share of main technical equipments of wastewater treatment plant in China is :

- Consultation service : 3%—5%
- Civil engineering : 35%—45%
- General used equipments : 5%—15%
- Appropriation equipments : 10%—15%
- Self controlled instrument : 5%—10%
- Others : 20%—30%

Estimation according to these shown that market share of main technical equipments used in key projects in Hunan during the “tenth-five” is :

- Consultation service : ¥ 185,000,000
  - Civil engineering : ¥ 1,480,000,000
  - General used equipments : ¥ 370,000,000
  - Appropriation equipments : ¥ 463,000,000
  - Self controlled instrument : ¥ 277,000,000
  - Others : ¥ 925,000,000
- Total : ¥ 3,700,000,000  
Total: ¥ 3,700,000,000

The equipments demand analysis of the key projects for municipal sewage disposal during the Tenth Five Years Plan in Hunan is in table4-3

**Table 4-1 Point projects of water pollution protection in whole province during the tenth five years plan**

I. Projects of industrial pollution control												
No.	Title of the project	River valley belonged to	Region	Scale of the construction	Main content and technology of construction	Benefit of the project	Total investment of the project (Ten thousand yuan)	Accomplished investment (Ten thousand yuan)	Demand of the investment (Ten thousand yuan)	The beginning and terminative year	项目进展	备注
1	Chemical fiber wastewater treatment in Shaoyang	Zhijiang River	Shaoyang	15 thousand ton per day	Biochemical oxidation process		1300	300	1000	2001.6-2003	在建	
2	Deguming wastewater treatment in Yiyang hemp spinning mill	Zhishui River	Yiyang	15 thousand ton ramie deguming wastewater is treated per day	Biological oxidation	3 thousand ton COD are removed per year	2260	760	1500	2000—2002	在建	
3	Wastewater treatment in Yuanjiang paper mill	Dongting Lake	Yiyang	80 thousand ton wastewater is treated per day		COD are removed in large quantities	3200	1000	2200	2000—2003	在建	
4	Wastewater synthetic treatment in Zhuzhou chemical plant	Xiangjiang River	Zhuzhou		Change the water-washing into acid-washing. Remove the hydrargyrum and reclaim the dichloroethane in the chloroethylene work section. The comprehensive utilization of the	The discharge amount of wastewater is reduced by 4.8 million ton per year. The discharge amount of hydrargyrum is reduced by 2.8 ton per year. The	9500	4000	5500	1997 - 2002	续建	

					waste acid of titanium white. The comprehensive utilization of wastewater.	discharge amount of arsenic is reduced by 35 ton per year.						
5	Hexi sewage treatment plant in Zhuzhou	Xiangjiang River	Zhuzhou									
6	The washing water of blast furnace gas treatment in Xiangtan iron works	Xiangjiang River	Xiangtan		Sedimentation and circulation	The discharge amount of wastewater is reduced by 31.06 million ton. The discharge amount of cyanide is reduced by 7.6 ton	3949.00	1400	2549	2000-2005	在建	
7	Organophosphorus pesticide wastewater treatment in Nantian company	Xiangjiang River	Xiangtan		Biochemical treatment	COD is removed by 1.2 thousand ton	4000.00	320	3680	2000-2005	在建	
8	Manganiferous wastewater treatment in electrochemical factory	Xiangjiang River	Xiangtan		Reclaim and recycle the manganese water	The discharge amount of wastewater is reduced by 21 million ton	2900.00	2100	800	2000-2005	完成部分设备安装	
9	Dying wastewater treatment in Zhubugang region	Xiangjiang River	Xiangtan		Chemical process and biochemical process	COD is removed by 720 ton. Relieve other organic pollution	500	250	250	2005-2010		
10	Sewage plant of Hengyang steel pipe Ltd.	Xiangjiang River	Hengyang	20 thousand ton wastewater is treated per day	Dispose the wastewater in whole plant by oil removal, floatation, aeration,	COD is removed by 600 ton per year. Petroleum is removed by 70 ton	4500	200	4300	2000-2004	已作规划	

					filtration and reclamation processes.	per year. Suspension is removed by 70 ton per year.						
11	Project of alkali reclamation in Xidu paper mill	Xiangjiang River	Hengyang	15 thousand ton paper-making wastewater is treated per day	Add alkali reclaiming facility as a complement	Reclaim alkali 10 thousand ton per year	5000	0	5000	2002-2006	已作规划	
12	Salt mine wastewater treatment in Xiangli	Lishui River	Changde	0.15 million ton per year	Recycle the wastewater	COD is removed by 800 ton	1200	100	1100	1999 - 2005	在建	
13	Project of the sanitary produce in Hurong Paper corporation	Lishui River	Changde	15 thousand ton	Stop pulping, recycle the wastewater	COD is removed by 2400 ton	5000	0	5000	2000 - 2005	规划	
14	Project of Dongting ramie deguming wastewater advanced treatment	Dongting Lake	Yueyang			COD is removed by 500 ton per year	5200	600	4600	2001-2005	在建	
15	Project of Yueyang paper-making wastewater treatment	Changjiang River	Yueyang	50 thousand ton wastewater is treated			4681	800	3881	2001-2005	在建	
16	The fitting environmental protection project of centralized pulping in Hongjiang paper mill	Yuanshui River	Huaihua	The capability of alkali reclaiming is increased by 100 thousand ton per day. 10 thousand middle-phase wastewater is treated per day	Reconstruction of the alkali reclaiming facilities, biochemical treatment of the middle-phase wastewater, reclamation of the off-machine water	1.7275 million yuan as new efficacy are acquired by saving 0.15 million ton water, reclaiming pulp 300 ton and saving coal	3000	1500	1500	2001-2003	在建	
Subtotal							97914	18174	79740			
Projects of municipal environmental infrastructure construction												

17	Sewage plant in Shaoyang city	Zhijiang River	Shaoyang	0.1 million ton per day	Construct a new factory building. Lay the main pipe of sewage trapping. Adopt the oxidation process.	Remove COD by 5500 ton. Improve the municipal aquatic environment	19725	0	19725	2001-2003	已批可研	*
18	Sewage plant in tuanzhou, Yiyang	Zhishui River	Yiyang	0.1 million ton wastewater is treated per day		COD is removed by 5500 ton per year	19980	200	19780	2000—2002	已动工	
19	Lengshuitan xiahexian sewage plant in Yongzhou city	Xiangjiang River	Yongzhou	0.1 million ton wastewater is treated per day	Construct sewage plant, municipal sewage pipe system	Improve the water quality of the downstream. In favor of improving the municipal construction quality of Yongzhou city	16520	0	16520	2002~2005	规划	
20	Sewage plant in Daozhou city	Xiangjiang River	Yongzhou	50 thousand ton wastewater is treated per day	Oxidation ditch process	Improve the water quality of the downstream	6495	860	5635	2000~2003	续建	* 省计委已批准立项，与市污水处理厂打捆建设
21	Longqian sewage plant	Xiangjiang River	Zhuzhou	0.1 million ton domestic wastewater is treated per day	Manage of the water delivery and water distribution. Full set of processing facility. Biochemical treatment	COD is removed by 6800 ton per year. SS is removed by 8300 ton per year. Improve the water	16000	0	16000	2002—2005年	已批可研	*

						quality of Zhuzhou city zone						
22	West of river sewage plant in Zhouzhou city	Xiangjiang River	Zhuzhou	0.1 million ton domestic wastewater is treated per day			20000	0	20000	2003-2005	规划	
23	Tieniubu sewage plant	Xiangjiang River	Xiangtan	0.24 million ton domestic wastewater is treated per day	Biochemical treatment	COD is removed by 4380 ton in first phase	10000	0	10000	2005-2010		
24	West of river sewage plant	Xiangjiang River	Xiangtan	0.36 million ton domestic wastewater is treated per day	Biochemical treatment of oxidation process	COD is removed by 6570 ton in first phase	17000	5000	12000	2000-2005	在建	
25	West of city sewage plant in Hengyang city	Xiangjiang River	Hengyang	0.15 million ton domestic wastewater is treated per day	Oxidation ditch process is adopted. 0.15 million ton domestic wastewater is treated per day	COD is removed by 5500 ton per year. BOD is removed by 3600 ton per year	17000		17000	1999-2005	已批可研	
26	Sewage plant in Leiyang city	Xiangjiang River	Hengyang	80 thousand ton domestic wastewater is treated per day	80 thousand ton domestic wastewater is treated per day	COD is removed by 2500 ton per year	7000	0	7000	2000-2005	规划	
27	Sewage plant in Changning city	Xiangjiang River	Hengyang	60 thousand ton domestic wastewater is treated per day	60 thousand ton domestic wastewater is treated per day	COD is removed by 1500 ton per year	6000	0	6000	2000-2005	规划	
28	Sewage plant in Chenzhou city	Xiangjiang River	Chenzhou	0.24 million ton per day	Oxidation ditch		18894	6000	12894	2001-2005	管网建设*	

29	Xingkaipu sewage plant	Xiangjiang River	Changsha	0.15 million ton per day			20000	0	20000		规划	*
30	Zhaojiagang sewage plant in Changsha city	Xiangjiang River	Changsha	0.1 million ton domestic wastewater is treated per day			46000	0	46000	2003-2005	规划	
31	Sewage plant in Loudi city	Xiangjiang River	Loudi	0.1 million ton per day in first phase	Construct according to national standard, dispose 0.1 million ton per day	COD is removed by 3.6 thousand ton per year	14600	4600	10000	2001-2005	已批建议书	*
32	Municipal sewage plant in Zhangjiajie city		Zhangjiajie	0.17 million ton per day	Construction of the sewage trapping channel. Sewage plant		17000	0	17000	2001-2005	可研	*
33	Sewage treatment works in Deshan city zone	Yuanshui River	Changde	60 thousand ton per day	Oxidation ditch process	COD is removed by 2.5 thousand ton per year	8700	0	8700	2001-2005	规划	
34	Regulation works of Dongjiang Lake environmental protection		Chenzhou	Construction of environmental administrative capability of Dongjiang Lake			1500	0	1500	2001-2005	规划	
35	The comprehensive treatment of the environmental pollution of the Brother River and Huanyuan River in Huanyuan county	Yuanshui River	Xiangxi		Comprehensive treatment		22000	0	22000	1998-	续建	
36	Municipal sewage plant in Jishou city	Yuanshui River	Xiangxi	80 thousand ton per day	Treatment of the municipal sewage		19000	0	19000		已批立项	
37	The comprehensive treatment of the aquatic	Yuanshui River	Xiangxi	20 thousand domestic	Sewage trapping project, project of		4756	0	4756		已批可研	

	environment in Fenghuang county, the national historic and cultural famous town			wastewater is treated per day	drinking water							
38	Municipal sewage plant in Huaihua city	Wushui River	Huaihua	0.1 million ton wastewater is treated per day	Method of oxidation channel	Reduce the discharge amount of the contaminant	15100	0	15100	2002—2005	拟建	*
39	The comprehensive treatment of the environment in Taipingxi, Huaihua city	Wushui River	Huaihua	Construct 18 kilometers sewage trapping channel	Sewage trapping project	Reduce the discharge amount of the contaminant	5000	300	4700	2001-2002	在建	
40	The comprehensive treatment of the Qushui River in Huaihua city	Qushui River	Huaihua		Sewage treatment, pollution sources control, watercourse regularization	Reduce the discharge amount of the contaminant	12000	3000	9000	2000-2005	在建	
-							Subtotal		369380	19960	349420	
							Total		467294	38134	429160	

Table4-2 the equipment demand analysis about the key items of industrial wastewater treatment during the Tenth Five Years plan in Hunan

Unit : 10000 yuan

NO.	Item	Valley	Region	Construction scale	Main content and process	Item benefit	Total investment	Water pump	Fan facility	Sludge dehydration equipment	Aeration equipment
1	The disposal of dyeing wastewater in Zhufugang	Xi anj i ang	Xi angtan		Chemical and biological methods	To decrease COD 720 tons and to alleviate other organic pollution	500	20	50	30	60
2	Wastewater disposal of the steel tube limited company in Hengyang	Xi anj i ang	Hengyang	The treatment capacity is 20000t/d	To take oil-removal、flotation、aeration、filtration、reclamation process to treat wastewater of the whole plant	To cut COD 600t/a , petroleum 70t/a and suspended substance 700t/a	4500	150			
3	Recycle project of alkali in Xidu paper mill	Xi anj i ang	Hengyang	To treat papermaking waste water 15000t /d	To increase alkali recycling on the basis of wastewater treatment system in existence	To recycle alkali 10000t /a	5000	80			
4	The wastewater treatment of	Li shui	Changde	150000t/a	To use wastewater	To decrease COD 800t	1200	300		200	

	salt mine in Xi angli				circularly						
5	The clean production item of paper in Furong	Li shui	Changde	15000t	To cease paper pulp making and to recycle the waste water	To decrease COD 2400t	5000	300			300

Note: The items in construction now are not in consideration.

Table 4-3 The equipments demand analysis of the key projects for municipal sewage disposal during the Tenth Five Years Plan in Hunan province

Unit : 10000 yuan

No.	Items	Valley	Region	Construction scale	Main content and process	Item benefit	Total investment of item	Water pump	The grid(sets)	Dehydration for sludge and sand	Aeration equipments
1	Municipal sewage disposal plant of Shaoyang	Zijiang	Shaoyang	100000t/d	To build a new workshop , to lay cut-dirt pipe and to adopt oxidation channel process.	To decrease COD 5500t , to improve the urban water environment	19725	200	300	100	400
2	The sewage disposal plant of Yongzhou Lengshui tan xi ahexian	Xiangjiang	Yongzhou	The treatment capacity is 150000t/d	To build up sewage disposal plant and urban blow-off pipe net	To improve water quality of lower reaches and to advance urban construction of yongzhou	16520	300	400	150	500
3	Sewage disposal plant of Daozhou	Xiangjiang	Yongzhou	The treatment capacity is 50000t/d	oxidation channel process	To improve water quality of lower reaches of the river	6495	100	150	50	400
4	Sewage disposal plant of Longquan	Xiangjiang	Zhuzhou	100000t/d	To set up discharging management and the whole biochemical treatment	To cut COD 6800t/a , SS8300t/a and improve water quality of zhuzhou	16000	200	300	100	400

5	Sewage disposal plant of Zhuzhou hexi	Xi angji ang	Zhuzhou	100000t/d			20000	200	300	100	400
6	Sewage disposal plant of Ti eni ufu	Xi angji ang	Xi angtan	240000t/d	Biochemical treatment	Cut COD 4380t	10000	400	600	200	800
7	Sewage disposal plant of Hengyang chengxi	Xi angji ang	Hengyang	150000t/d	oxidation channel process, 150000t/d	Cut COD5500t/a , BOD 3600t/a	17000	300	400	150	500
8	Sewage disposal plant of Lei yang	Xi angji ang	Hengyang	80000t/d	80000t/d	Cut COD2500t/a。	7000	150	250	80	300
9	Sewage disposal plant of Changning	Xi angji ang	Hengyang	60000t/d	60000t/d	Cut COD1500t/a。	6000	100	150	50	200
10	Sewage disposal plant of Xi nkai pu	Xi angji ang	Changsha	150000t/d			20000	300	400	150	500
11	Sewage disposal plant of Changsha zhaoji agang	Xi angji ang	Changsha	100000t/d			46000	200	300	100	400
12	Sewage disposal plant of Loudi	Xi angji ang	Loudi	100000t/d	100000t/d	Cut COD 3600t	14600	200	300	100	400
13	Sewage disposal plant of Zhangji ajie		Zhangji ajie	170000t/d	(1) to lay the dirt-cut pipes (2) to build Sewage disposal		17000	300	400	150	500

					plant						
14	Sewage disposal plant of Deshan	Yuanshui	Changde	60000t/d	oxidation channel process	Cut COD2500t	8700	100	150	50	200
16	Sewage disposal plant of Ji shou	Yuanshui	Xi angxi	80000t/d	Urban sewage disposal		19000	150	250	80	300
17	Sewage disposal plant of Huai hua	Wushui	Huai hua	100000t/d	oxidation channel process	Decrease letting of contamination	15100	200	400	50	200
	Total							3400	4950	1710	5860

Note: the items in construction and other comprehensive items are not included in it. The investment is estimated according to the relevant equipments in Changde municipal sewage plant.

## **The investigation on the environmental protection market running mechanism in Hunan province**

### **5 · 1 The diagnoses of the current environmental protection investment and financing system**

According to the statistic, 2.18 billion Yuan is invested in the construction of the municipal environmental infrastructure in Hunan province, of which 0.55 billion Yuan is invested in the construction of municipal wastewater plant. The investment is composed of the environmental loan from Japan and the financial appropriation of all governmental levels in Hunan province half and half. 0.6 billion Yuan is invested in the construction of industrial pollution source treatment, of which 0.21 billion Yuan is invested in the construction of industrial wastewater treatment. Among the rest, 0.13 billion Yuan is national budgetary bankroll; 6 million Yuan is environmental grant-in-aid; 22 million Yuan is environmental special loan; 0.306 billion Yuan is the loan from domestic bank; 46 million Yuan is the foreign capital; 90 million Yuan is the bankroll raised by the enterprises. From the final source of the bankroll, it can be seen that the government investment is the main financial resource, which also shown that the construction of wastewater treatment project is under the guide of government and not runs in market mechanism. The characteristics are:

——The channel of investment is simplex, lacking of the economic interest driving mechanism. And it is not helpful for the domestic and foreign social bankroll's entrance into the area of environmental protection

On the one hand it caused the insufficient fund for environmental protection; some urgent environmental problems can't be solved in time; and the improvement on environmental quality go slowly; which makes the public unsatisfied. On the other hand, it caused that the plentiful spare social fund can't find a way of investment; fund of the financial organization can't be loaned out; meanwhile, some momentous projects of environmental treatment still need the foreign loan. It is substantially help the foreign technologies and capital find the way in environmental protection market, and restrains the domestic technologies and bankroll market from finding the way while we have cost a lot.

——The cost of the investment is very high, which makes the government and enterprises pay out too much.

Since the traditional investment system for the environmental protection is mainly dominated by the government, and the accounting mechanism for input and output and its economic cost is not established, the investment is often done without taking

the cost into account. Furthermore, the poor management makes the management cost much higher than the technical cost. For example, the technical charge for the municipal sewage treatment fundamental facilities cost about 700-800 Yuan per m<sup>3</sup> wastewater, but the actual running cost is about 1000-2000 Yuan. The main reason is that the current investment system doesn't run in the market mechanism and doesn't construct the accounting mechanism for input and output and economic cost.

——The poor effect of investment, which results in a great waste

The current environmental protection investment system is not on the basis of economic consideration. Therefore, both the industrial pollution controlling facilities and the fundamental facilities of municipal environmental protection have the problem that treatment process can not run successfully after constructed, which mostly caused by poor management, except for the technical reasons and unmatched facilities partially. The enterprises transfer this cost caused by pollution control to society by not running the facilities. This causes a great waste of environmental protection investment and causes the investment can't work efficiently in environmental protection and promoting the economic development.

On account of the foregoing, Chinese government will take some measures to reform the charge system of waste discharge and the policies of environmental protection investment in recently years, and will establish a multivariate and socialized investment and financing system for environmental protection, in order to break the traditional simplex investment system, and to promote the construction and development of the bankroll of environmental protection and investment market, and to realize the integration of environmental protection technologies and bankroll, to make the environmental protection run according to the market principle and industrialization. The fundamental content including:

——The financing modes being more and more multivariate

Besides strengthening the financial support to environmental protection, the government will establish a special fund for environmental protection, and issue environmental protection lottery. The enterprises engaged in environmental protection have the priority to come into the market and issue stock. A multivariable environmental protection financing system should be realized, and the government investment and the social financing should be integrated and supplied each other to amplify the environmental protection bankroll sources. The problem that bankroll and investment of environmental protection is deficient should be resolved.

——The subject of investment being more and more multivariate

The construction of the multivariable and socialized investing and financing system

for environmental protection will change the situation that government being the main subject of investment, and will provide well investing environment and enormous investing market for domestic and foreign enterprises, individuals, financial institutions, investment firms and governments. The multivariatization of subject of investment is in favor of forming competitive mechanism and quickening the progress of environmental protection technologies and development of environmental protection industry.

——The investment manner being more and more multivariate

The multivariable and socialized investing and financing system of environmental protection create multivariable investment manner and service manner for various subjects of investment for environmental protection. Different subjects of investment can select direct or indirect or integrated investing manner in accordance to their economic capability and technical capability to take part in the investment of environmental protection. That will be in favor of exerting the environmental protection enterprises' own superiorities.

——The modernization of enterprise institution

In the multivariable and socialize environmental protection investing and financing system, the environmental protection enterprises must construct modern enterprise institution, make clear the relations between ownership and management and take part in the market competition in accordance to the regulation of market economy. Otherwise they will be fought down in the market. Therefore, the establishment of the multivariable and socialize environmental protection investing and financing system will promote the reform and system change of the enterprises, and strengthen the competitive capability and increase the integral quality of the environmental protection enterprises. From another point of view, only if the environmental protection enterprises reform the dated enterprise institution and establish the modern enterprise institution and new enterprise operation manner, the multivariable and socialized investing and financing system of environmental protection can exert its function of allocating social resources reasonably and pushing the environmental protection industrialization. Otherwise, even though the multivariable and socialized investing and financing system of environmental protection is established, it is impossible of allocating the resources reasonably and is adversely to push the environmental protection industrialization.

Based on the above, henceforth the government will reform the environmental protection investing and financing system thoroughly. The information issued in public already suggest that the reform in concerned policies that will come on henceforth including:

——The reform in fee charging policy

The fee charging policy is one of the uppermost policies that promote the establishment and development of the multivariable and socialized investing and financing system for environmental protection. The principle of waste discharger paying his own charges and waste disposer collecting fees by the fee charging policy should be established. Making the waste disposer have good prospects of gain by adjusting the interest distribution relation between waste discharger and waste disposer. The phenomena that price is distorted in fee charging should be changed. The price of fee charging should be different for different objects. The criterion of fee charging and the use of fee charging and the service of pollution treatment should be strictly defined and controlled. The transparency of fee charging and the use of fee charging should be increased. And a mechanism of monitoring by government and public should be set up.

——The reform in tax policy

The tax policy is the one of the most effective economic adjusting and controlling means of the government. The multivariable and socialized investing and financing system for environmental protection can be established through the change of tax categories and tax rate. An environmental tax with high tax rate on the productive activity that is adverse to environmental protection, and a low tax rate or zero tax rate for the enterprises that has taken environmental pollution treatment measures should be imposed. That can promote not only the public enthusiasm of investing on the environmental protection, but also the adjustment of industrial structure. Establishing the tax policy should define the enterprise scopes covered by the policy and the category of industrial activity.

——The reform in financial policy

The financial institution itself is the service institution that adjusts and controls the flow direction and distribution of social bankroll. Financial policy is one of the important means that lead the bankroll of the fund raising institutions into the field of environmental protection investment. After the market economy is carried out, the financial institution become commercial organization, and the government have no right to interfere the flow direction of bankroll of the financial institution by administrative means. The financial institution itself decides the flow direction of bankroll, assumes risks and assumes sole responsibility for its profits or losses. Therefore, the financial policy should exert the function of economic inducement.

Through establishing the investment preferential policy by national providing a loan and paying interest in the form of a deduction when selling a bill of exchange to make the bankroll of financial institution inflow largely into the field of environmental

protection and to promote the formation of the multivariable and socialize investment channel of environmental protection.

——The reform in fiscal policy

The reform in fiscal policy mainly is to change the national investment mechanism in environmental protection. On the one hand, a national finance accounting mechanism on the environmental protection investment for the input and output and economic cost should be setup. The efficiency and benefit of financial investment should be increased. On the other hand, the national financial investment of environmental protection should be turn to ancillary and hortative investment.

——The reform in financing policy

The national policies should permit the financing activities of environmental protection. Environmental protection is also a public service economic activity. The country should permit issuing the environmental protection lottery just like the gymnastic lottery and the handicapped welfare lottery, permit establishing open fund of environmental protection, and let the excellent environmental protection enterprises have the priority to enter the securities business and issue the stocks, or permit establishing environmental protection investing and financing firm. In this way the multi-channel, multi-form social financing channel can be constructed.

## **5 · 2 The characteristics of environmental protection market in Hunan province**

China is devoted to the construction of general adoption of the market principle since the reform and open policy is implemented. Most of the industrial markets have been open entirely. Only tiny markets of the special industries and rising industries are the exception, and the environmental protection market is one of them. The environmental protection market in China is a complete rising industry that grows up in the environment of market economy. As far as the open of the market, there aren't any market barriers. As far as the market operation and market manage, because of the limited time of Chinese environmental protection industrial market, the development of the market is undeveloped. The market operation of the environmental protection projects of the municipal infrastructure, such as municipal wastewater treatment plant, generally can be operated canonically in agreement with the national requirements of project management, for instance, adopting the tender system, system of inspect and control etc. Certainly, several areas will adopt some governmental act during the course of invitation to bid and bid of the projects in order to attract the investor. But it is very few. It is noteworthy that the domestic professional companies for environmental protection are always in adverse position during the competitive courses of projects because that the small scale of the company and the lacking of experiences in operating the big project. For example, almost all the equipment and

civil work contractor of the constructing municipal wastewater treatment projects in Hunan province are not professional companies of environmental protection. The professional companies of environmental protection usually only participate in the early work of the projects and provide consultation. The standardization of the market behavior increases the difficulty of entering the market of the projects actually. It will be a long time for the local enterprise and public institutions of environmental protection to become larger and better.

Comparing with the projects for municipal infrastructure construction, There are numerous of those projects for industrial wastewater treatment, which are widely various in treatment scales and in technologies. The operation mode is also verified from different areas. Although the provincial environmental protection bureau require the projects in whole province whose investment scale is more than 0.1 million Yuan to implement the tender system, only very few projects can implement the tender system earnestly on account of the sources and characters of the projects differ in thousands ways. The market management is almost in a natural status and in unordered free competition.

It was mainly shown as:

——It is difficult to control the qualification of the enterprises and their products

According to the requirements of the Hunan environmental protection bureau, the companies that are engaged in device, construction and equipment offering of the projects for pollution control must have the corresponding qualification. However, only very few of them have it. The department in charge of the designing and construction certification is construction management department. In the past, many companies or organizations that are engaged in device and construction of general industrial and civil buildings got qualification at different levels because that during that time, there are so many constructions since the implementation of the reform and open policy. And those resulted in a few accidents and caused very bad influence. Since 2000, the issuance of the designing and construction certificate have been control very strictly, and almost been suspended or in the phase of adjustment. In the past, the environmental protection market has no requirements for the qualification of the enterprises and product. There are only 6 environmental protection enterprises, which got the certification for environmental protection professional designing. Now it's very difficult to apply for the certificate. In the beginning of 2002, the Hunan environmental protection bureau and Hunan construction committee come to an agreement and issue for accepting the application for the environmental protection professional designing certificate. But up to now, they can't come to an agreement on the specific requirements and the method of operation. And then, the qualification management of environmental protection market in whole province can't be efficiently carried out. In fact, most of the enterprises of environmental protection are designing and constructing without the certificate now. The local administrative department of environmental protection actually doesn't restrict the enterprises

without certificate but with appropriate technology and product to engage in corresponding business for environmental protection locally.

——The unfair market competition still exists

It is still existed the local or departmental protectionism in several places on account of the imperfect market system. The market permission requirements for some products are unreasonable, and some man-made barriers were set. For instance, in a city, for the treatment of oil smoke of meal and drink industry, it is one of the conditions for the product entrance that the products or technology should be listed as the environmental protection point technology spreading plan of provincial environmental protection bureau and provincial bureau of science and technology. Many technology-qualified products having been authorized by related national department are refused. It is undeniable that few enterprises compete for the business by unfair means, such as rake-off, bribe and fabricating the certificate etc. Such behaviors deceive the management department and the consumer, and not only cause the loss of the consumer, but also disorder the order of market economy. These are just the point targets that the Chinese government is cracking down. Along with the administrative means becoming more and more perfect, such things will be fewer and fewer.

——The price, salary and profit rate are entirely free. Lack of communicating means of market information

From the present situation, the price of environmental protection product is made by the enterprise itself, and the range of changing is dependent on the market competitive situation and the administrative level of enterprise. The wage level is different from enterprises one to another, because of the different forms of ownership of the environmental protection enterprises. The profit rates of the environmental protection products have no uniform standard. According to the elementary investigation, the average profit rate of the environmental protection industry is about 15 percents, and the highest one is above 50 percents. The entirely free system of the price, salary and profit rate is the essential factors for the market development, but sometimes, the suppliers and the users as well as the employee for environmental protection industry don't know one another, and don't get the deserved profits from the free market in many cases as a result of unfitting market information communicating means, which could be shown that the consumer can't find the most appropriate manufacturing plant; and the manufacturing plant can't find the most appropriate consumer; the technologies and talents of environmental protection can't find the most appropriate outlet while some enterprises in need of technologies and talents can't find the most appropriate objects. Some ill-disposed people often utilize the obstacle of the information communication, which causes some unfair phenomena.

Anyhow, the environmental protection market in Hunan province is becoming more and more perfect. Recently some competent units and individuals enter into this market by means of employing the local talents who are expert at technologies, policies and market. The enterprises supported by the great capability often develop more successfully than the old enterprises.

## **appendix I the main laws and standards about water environment**

I the law of water pollution control in PRA

II the conservation regulation of Hunan

III the regulation for pollution comprehensive control of Xiangjiang River valley in Hunan

IV the environmental quantity standard for surface water

V the discharging standard for wastewater

**appendix II the relevant documents for the management of the environmental industry market**

I the office procedure for the certification of environmental engineering design

II the office procedure for the certification of operationing capacity of environmental protection equipments

III the office procedure for the identification of environmental protection production