

# Changsha Xianghu wastewater treatment plant upgrading reconstruction and reclaimed water reuse demonstration project

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**Year of commitment** : 2016

**Address 1 - street** : 140 410000 ,

**CO2 Impact** : Reduce CO2 4734.4 tons/year

**Water cycle** : Used Water, Purification, Used water recycling



**299 777 600**

## **Builder**

CECEP Guozhen Environmental Protection  
Technology Co., Ltd.

## **Manager / Dealer**

CECEP Guozhen Environmental Protection  
Technology Co., Ltd.

## GENERAL INFORMATION

Changsha Xianghu wastewater treatment plant (WWTP) was designed in 1992 and put into operation in June 1994. The design flow rate was  $14 \times 104$  m<sup>3</sup>/d, covering an area of 52.5 acres, located in the east of South Station Road and the south of Evening News Avenue. The project was upgraded at the original site

with a total investment of 299 million yuan. The sewage treatment adopted the process of pretreatment + A2O + MBR (membrane bioreactor) + contact disinfection, and the sludge treatment adopted the mechanical centrifugal concentration dehydration process. The effluent water quality was improved from the first level B to the surface water environmental quality standard (GB3838-2002) Class IV ( $TN \leq 8 \text{ mg/L}$ ), and the effluent was reused as the water supply for the autumn and winter dry season of Changsha Martyrs Park. In order to effectively protect the water quality of Liuyang River, implement energy conservation and emission reduction, and promote the reuse of reclaimed water in Changsha City, it was simultaneously realized of the upgrading to meet the new standards, effluent water reuse, deodorization and noise reduction, and landscape optimization in the design stage. The design features are as follows:

1. This project was the first large-scale (140,000 m<sup>3</sup>/d) reclaimed water reuse project with high water quality (quasi-surface IV standard,  $TN \leq 8$ ) in Hunan Province. After advanced treatment, the effluent can be selectively reused as the water supply for the autumn and winter dry season of Nianjia Lake and Yuejin Lake in Changsha Martyrs Park. The implementation of this project will partially achieve the goal set in the Changsha Urban Reclaimed Water Utilization Plan and greatly reduce the dependence of the two lakes on tap water supply in autumn and winter.
2. In order to save land, the advanced and reasonable MBR process was selected, and the integrated design was adopted. The plant was updated to meet new standards on a very limited footprint.
3. This project has carried out a full range of deodorization and noise reduction in Xianghu WWTP, adopted comprehensive technical measures, and actively explored the process route of noise reduction and deodorization in city center WWTP.
4. This project took Xianghu WWTP as a model for the transformation of city center WWTP, built it into a green WWTP and leisure attraction, and fully demonstrated the design concept of green municipal engineering.
5. Xianghu WWTP was designed according to the high standard requirements of intelligent water affairs in terms of automatic control. The main contents of intelligent water design include: expert database, intelligent management, water quality monitoring and early warning and visual system.
6. The land use of this project was extremely tight, the surrounding conditions were complex, and the water quality standards were strict. It had a wide demonstration effect on similar projects in the province.
7. The project had reasonable effluent quality setting, advanced process route, compact general layout, reasonable and economical total investment estimation, and low operating cost, which provided a new choice and reference method and experience for similar projects in Hunan Province.

## Data Reliability

Self-declared

## Sustainable Development

### Attractiveness :

#### 1 Social benefit

The layout and shape of the project took full account of landscape, sunlight, wind direction, image etc., so that the building and the environment penetrated each other, and the combined culture of Changsha kiln pottery and sewage reuse was deeply excavated to create a distinctive and harmonious architectural environment production and life, which makes the entire plant a greening project of the garden environment. As a green municipal renovation project in the field of urban renewal, it had the value of promotion and replication. At the same time, it can be used as a green education science base to provide secondary classrooms for primary and middle schools and play a role in raising citizens' awareness of environmental protection.

#### 2 Economic benefit

The design flow rate of this project was 140,000 m<sup>3</sup>/d, and the original site was upgraded and transformed, covering an area of 35000 m<sup>2</sup>, and the investment per ton of water was only 2135 Yuan/ m<sup>3</sup>, while the investment per ton of water for similar projects in China was about 4000 Yuan/m<sup>3</sup>, saving engineering investment over 250 million Yuan. Total land area of 34991.54m<sup>2</sup>, land index 0.25m<sup>2</sup> / (m<sup>3</sup>-d), and only 25-30% of the standard land index, lead to land saving over 77000 m<sup>2</sup>, and land costs saving over 170 million yuan. In addition, the project was located in the central city of Changsha, which had a large impact on the surrounding air and noise environment. After the transformation and upgrading, it was transformed into a garden-type municipal facility, saving considerable relocation costs.

#### 3 Environmental benefit

The upgrading of Changsha Xianghu WWTP will greatly reduce the pollutants discharged into Liuyang River. This project not only carried out a full range of deodorization and noise reduction for the Xianghu WWTP, but also improved the landscape environment of the plant as a whole. After advanced treatment, the effluent was used as the water supply for the Nianjia Lake and Yuejin Lake in Changsha Martyrs Park in autumn and winter.

### Well Being :

#### 1 Deodorization measures

This project treated the odor in a decentralized approach. The odor from pretreatment unit, anaerobic / anoxic tank and MBR tank was treated by biological filtration. The odor produced by sludge dewatering room and sludge storage tank was treated by ion deodorization equipment. This project conducted a closed design for each odor gas source. The odor gas was collected by the fan, and the negative pressure operation was carried out. The waste gas collection rate was about 95 ~ 100 %. The collected odor gas was discharged after deodorization by the biological filter. The odor removal efficiency can reach more than 90 %, which can effectively improve the air environment quality of the surrounding area. The odor gas collection and treatment measures adopted in this project were feasible.

#### 2 Noise reduction measures

In order to control the noise pollution during the operation period, the following measures were taken in this project: 1. Sealing measures were adopted for the equipment with high noise, sound insulation doors, windows, and ventilation mufflers were installed, and wall sound-absorbing materials were installed indoors. 2. Plant greening as far as possible to choose the dense leaves tall tree-shrub combination of three-dimensional green way to enhance the noise barrier.

### Social Cohesion :

After the completion of the project, the following impacts on the society had occurred:

1. It actively promoted the process of water reuse in Changsha

2. It played a positive role in creating a beautiful, comfortable, healthy, clean, harmonious coexistence of people and nature, thus contributing to the protection of people's health and improving their quality of life.

3. It provided some jobs for the society.

4. A waterscape of Changsha kiln pot was purposely designed at the main entrance of the plant to highlight the culture of combining Changsha kiln pot and wastewater reuse.

5. It was mainly based on environmental protection and ecological effects of plant communities, supplemented by water culture and education display bases. The treated water was reused in the landscape design, and the results of water treatment were displayed directly. The tour route was designed to let the public understand the whole wastewater treatment process, promote water conservation and environmental protection, further strengthen the environmental awareness of the local government and the publics, and promote the implementation process of sewage treatment.

#### Resilience :

1. Improve water quality

Liuyang River is one of the drinking water sources in Changsha City. The upgrading and transformation of Xianghu WWTP has greatly reduced the pollutants discharged into Liuyang River. After the completion and operation of the 140,000 m<sup>3</sup>/d scale, the annual reduction is as follows: CODCr reduction of 13100 tons/year, BOD5 reduction of 4740 tons/year, total suspended solids SS reduction of 8320 tons / year, TN reduction of 960 tons / year, and TP reduction of 140 tons / year. This project had improved the water quality of the Liuyang River Basin, realized the clear water and blue sky, and made every citizen live at ease.

2. Improve watershed ecological environment

After the completion of Xianghu WWTP, the aquatic ecosystem in the watershed will be restored and improved, and the biodiversity of Liuyang River basin will be enriched, thus forming a stable watershed ecosystem. It was of far-reaching significance to improve the living environment of Hunan cities, enhance the quality of cities, and the construction of the environment-friendly and energy-saving society in Changsha-Zhuzhou-Xiangtan urban agglomeration.

#### Responsible use of resources :

This project adopted a variety of new energy-saving equipment, new technology and new measures. Under the design water quality and existing site conditions, the overall process was simulated iteratively using Biowin software based on the ASM kinetic model of the activated sludge system. Finally, the process conditions and operating parameters that can meet the standards stably and at the same time save electricity and chemical agent consumption, and the construction drawing design was completed accordingly.

After the upgrading and reconstruction of this project, the power consumption was 0.46 kW-h /m<sup>3</sup>. At present, the power consumption of WWTPs using membrane treatment process in China was between 0.50 and 0.60 kW-h/m<sup>3</sup>. Comparative analysis showed that the energy consumption of this project was reasonably low. The minimum annual energy saving of the project was 2 million kW-h / a, and the annual electricity saving is 1.6 million yuan.

At the same time, the amount of PAC and carbon source was controlled below 30 mg/L. Compared with other projects of similar water quality, PAC and carbon source can be saved about 20 mg/L. The annual saving of PAC and carbon source was about 1000 t, which was about RMB2.5 million yuan.

## Testimony / Feedback

*This project was the first high-quality ( quasi-surface class IV standard, TN ≤ 8 ), large-scale ( 140,000 m<sup>3</sup> / d ) reclaimed water reuse project in Hunan Province. Under the background of extremely limited land use, sensitive surrounding environment and strict effluent requirements, the project simultaneously realized the upgrading and reconstruction of the plant area, tail water regeneration and reuse, full-field deodorization and noise reduction, and overall landscape optimization. The whole life cycle concept was implemented in the design process. By utilizing the MBR, Biowin and other new technologies, the project had fully realized land saving, energy saving, water saving and material saving. At the same time, the project also provided new choices and methods and experiences worthy of reference for similar projects in our province. It had a wide range of demonstration and promotion value, fully embodied the green municipal design concept of ' green, recycling and low carbon ', and constructed an innovative, optimized, environmentally friendly and ecologically beautiful new ' green ' modern sewage treatment plant.*

## Governance

CECEP Guozhen Environmental Protection Technology Co., Ltd.

**Holder Type :** Public Local Firm

CECEP Guozhen Environmental Protection Technology Co., Ltd.

**Builder Type :** Other

CECEP Guozhen Environmental Protection Technology Co., Ltd.

**Manager / Dealer Type :** Public

(1) Project construction

The two sets of sewage treatment systems in the north and south were reformed step by step. Different working surfaces were constructed at the same time, and the professional cross-operation method was adopted. Firstly, the sewage system on the south side was implemented. After that, the construction of the north side system was started. At the same time, the equipment on the south side was installed and debugged. During the construction of the project, the production plan of limiting production + stopping production + limiting production was adopted to minimize the social impact of the shutdown of the sewage treatment plant.

(2) Operation management

1. Establish and improve the production management organization. 2. Carry out the necessary qualification examination for the employees. 3. Organize the professional and technical training of operators before they go to work. 4. Hire experienced professional and technical personnel responsible for the technical

management of the factory. 5. Select professional and technical personnel for technical training. 6. Establish and improve the factory management rules and regulations, including job responsibility system and safety operation procedures. 7. Regular assessment of employees and the implementation of reward and punishment system. 8. Organize professional and technical personnel to enter the post in advance, participate in the whole process of construction, installation, commissioning and acceptance, and lay the foundation for future operation. 9. Organization to participate in the national sewage treatment industry technical information network activities.

**Business Model :**

BOT

**Sustainable Solutions**

**Description :**

1. Provide experience for upgrading and reconstruction of WWTP  
 Changsha Xianghu WWTP was designed in 1992. The effluent quality met the first level B standard of Discharge Standard of Pollutants for Wastewater Treatment Plant (GB 18918-2002). The effluent flows into Liuyang River and then into Xiangjiang River. With the completion of the Xiangjiang Changsha comprehensive hub, the self-purification capacity of the Xiangjiang Changsha section had decreased, which had posed a serious threat to the safety of drinking water in the Changsha-Zhuzhou-Xiangtan reservoir area. Therefore, the Xianghu WWTP was in urgent need of upgrading. In this project, the AAO + MBR process was selected as the upgrading and reconstruction process of Changsha Xianghu WWTP. The effluent quality was excellent and met the quasi-IV standard of Surface Water Environmental Quality Standard (GB 3838-2002), which could be directly reused. Based on the activated sludge-anaerobic digestion (ASDM) kinetic model, the Biowin software was used to simulate the whole process repeatedly in the early stage of the design. Finally, the process conditions and operating parameters that can not only meet the standard stably, but also save the power consumption and chemical agent consumption, and the optimization design was completed accordingly.



(2) Provide a method for the construction of urban sewage treatment plant

Xianghu WWTP was built in the suburbs, surrounded by fish ponds, wasteland, etc. With the development of the city, the surrounding area of the plant had become a high-rise urban commercial and residential area, led to a shortage of land for this project. In order to effectively utilize the site, the original buildings and structures in the plant were firstly retained as far as possible during the design process. The new MBR structures integrated the aerobic tank, membrane tank, blower room, pump room, equipment room, dosing room, power distribution room and other functions, and carried out a fully integrated design. At the same time, the odor and noise pollution control measures were further strengthened to avoid the impact on the surrounding environment.


**Photo credit**

Hunan Architectural Design Institute Group Co., Ltd.



**Contest**

**Building candidate in the category**



**Users' Choice**



