

IN-SITU DECENTRALIZED WASTEWATER TREATMENT SOLUTION



Company Introduction

Shanghai Onway Environmental Development Co.,Ltd

Shanghai Onway Environmental Development Co., Ltd (Onway) is a joint venture with Singapore public listed company, AnnAik Limited. With the combination of AnnAik Limited connections in the capital market and strong technical support from Shanghai Jiaotong University, Onway is able to provide customers with a full set of treatment solutions and products for decentralized wastewater. In order to meet the various needs of customers in different regions, services provided include research and development, manufacturing, sales, installation and project design, construction and operation of integrated supply chains.

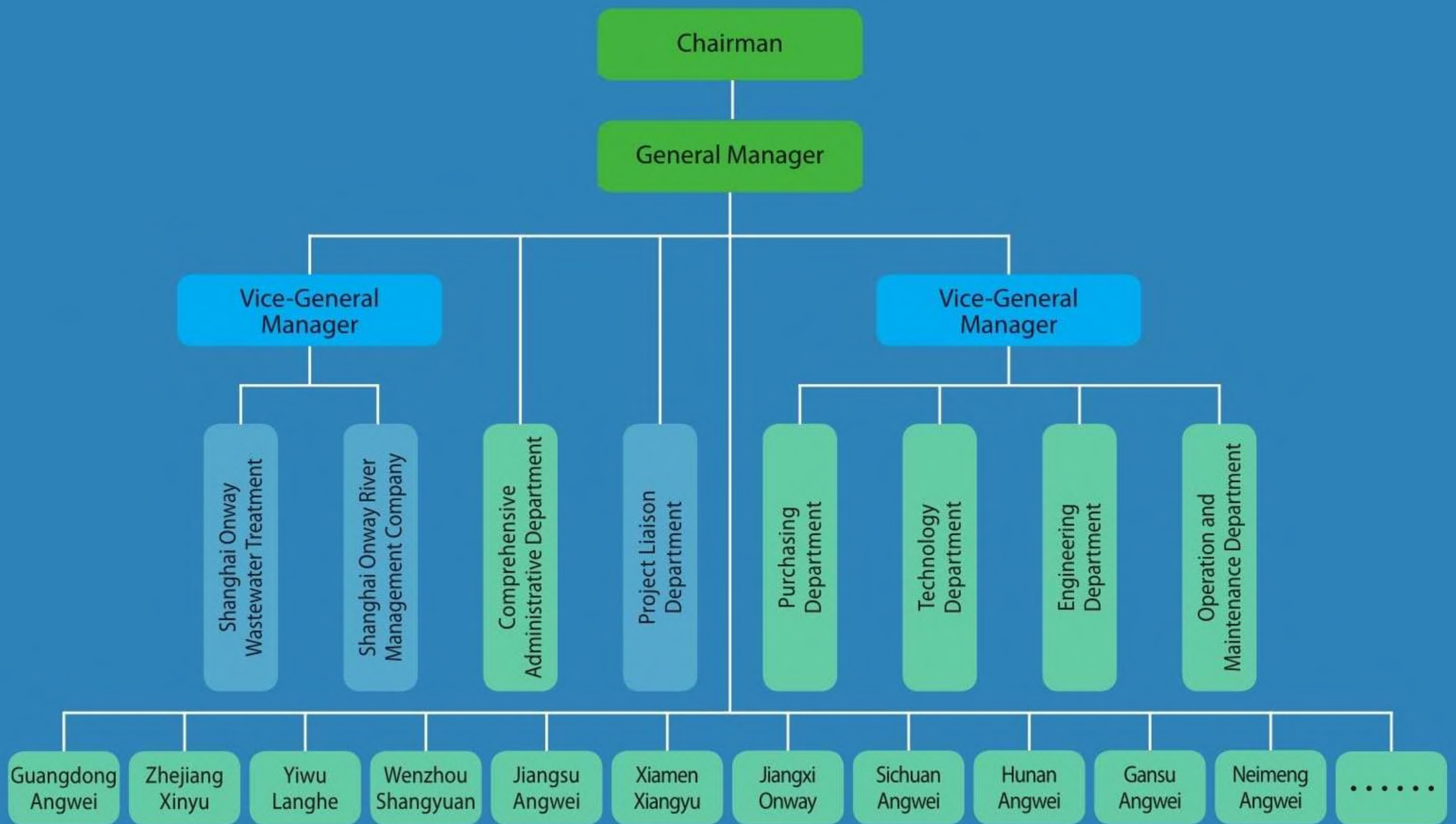
The company's technical team comprises of a group of professionals with doctoral and master qualifications, and a number of patented water treatment equipment that has been widely used in townships, villages, enterprises, schools, tourist attractions and other places of the wastewater treatment. More than **3,000** wastewater treatment projects have been completed, with a total quantity of more than 100,000 tons/day and universal approval from users.

Onway's main products are: **Composite Anaerobic Reactor, Composite Bio-Filter, High Loading Constructed Wetland, Phosphorus Removing Water Treatment Filler** and other wastewater treatment systems. Technical services provided include, but are not limited to, wastewater treatment technology diagnosis and design, construction, maintenance and management of small wastewater treatment stations, and design of wastewater reuse.

Onway has established subsidiary companies all over China to expand the scope of business in decentralised wastewater treatment in villages and towns, namely in Zhejiang, Jiangsu, Fujian, Guangzhou, Jiangxi, Sichuan, Guizhou, Hunan and Inner Mongolia. Technological innovation is the fundamental element of any enterprise, therefore Onway is fully committed to product development and application, at the same time ensuring quality of service is being rendered to every client. Onway strives to achieve quality consistence in product and service while practicing environmental protection so as to become a forward-thinking and socially respected company.

Onway has its international office in Singapore to provide all services for companies or governmental authorities in the region.

Onway Company Structure



Background

China has a total population of 1.3 billion people, out of which 0.93 billion reside in villages and small towns. There are over **40,000** townships, **600,000** administrative villages and **3,600,000** natural villages.

Main problems in the rural water environment in China:

- **Large amounts of domestic waste discharge** – Based on an investigation by the Ministry of Housing and Urban-Rural Development, rural domestic wastewater discharged is about 8 billion tons yearly.
- **Wilful discharge of domestic wastewater, low treatment rate, resulting in poor environmental water quality** – Investigations conducted in 9 provinces, 43 counties and 7 villages showed that 96% of rural communities do not have proper drainage channels and wastewater treatment systems. Domestic wastewater is wilfully discharged, causing poor environmental water quality in rural areas.
- **Lack of mature treatment technology** – Most of the existing treatment process adopt urban domestic wastewater treatment mode, and its adaptability to rural conditions is poor.
- Due to incompatible technical design and lack of maintenance management, **current rural wastewater treatments are difficult to operate on a long-term basis.**

Consequences of water pollution in rural areas:

- Construction of infrastructure in rural areas is seriously hindered
- Restricted sustainable economic development in rural areas
- Not conducive to the protection of water resources
- Not conducive to the prevention and control of epidemic situations
- **There is an urgent need for high efficiency, low maintenance, and decentralized wastewater treatment technology suitable for rural management.**

The Chinese government places great importance to rural environmental protection:

- The Fifth Plenary Session of the 16th Central Committee proposed the “production development, well-off life, rural civilization, clean and tidy village, democratic management” in the construction of a new socialist countryside.
- The party’s “National Congress” and the national “11th Five-Year” planning have proposed building a new socialist countryside as a major decision.
- On March 2011, the environmental protection department held the rural environmental protection work conference, and issued ‘The views on further strengthening the rural environmental protection work’, a clear overview of the environmental protection work in rural areas, the main target, major tasks and policy measures in the “Twelfth Five Year Plan”.
- **The party’s “Eighteen big” on the “three rural” issues made an important exposition, promoting the integration of urban and rural development, the requirements of new rural construction, and comprehensive improvement of rural production.**



One-of-a-kind Technology

Onway has been actively promoting the construction of a socialist countryside to all levels of government. Through extensive research, application and improvement in recent years, a series of technologies and processes suitable for decentralized sewage treatment has been established.

Core technologies and products:

Composite Bio-Filter

The special structure of the filter is effective in promoting full contact of the biological membrane with air, and the composite filter material has the advantages of high efficiency and ventilation, thereby ensuring the long-term operation of the system.

Composite Anaerobic Reactor

To achieve good mixing conditions and high removal efficiency, a variety of anaerobic microbes is used to create a micro ecological system in a practical anaerobic tank structure and wastewater recirculation ratio, coupled with quality filler enhances the microbial retention ability of the system.

High Loading Constructed Wetland

Through a specially selected filler and optimized structure design, the hydraulic loading of the artificial wetland is greatly improved. As the wastewater infiltrates the filler, organics, nitrogen and phosphorus are effectively removed via physical, chemical and biological treatment. This system is simple and is easy to maintain.

Phosphorus Removing Water Treatment Filler

Main ingredients namely zirconium compound, fly ash, biomass ash, fly ash and gypsum undergo high temperature and high pressure modification to produce a porous material. The produced material is chemically stable, with high porosity and an adsorption capacity for phosphorus of more than 15.5mg P/g of filler.

Foldable Reinforced Packing Tray

The Foldable Reinforced Packing Tray has been designed to have high strength, be pressure resistant and foldable for convenient transportation and installation.

Adjustable Water Distributor

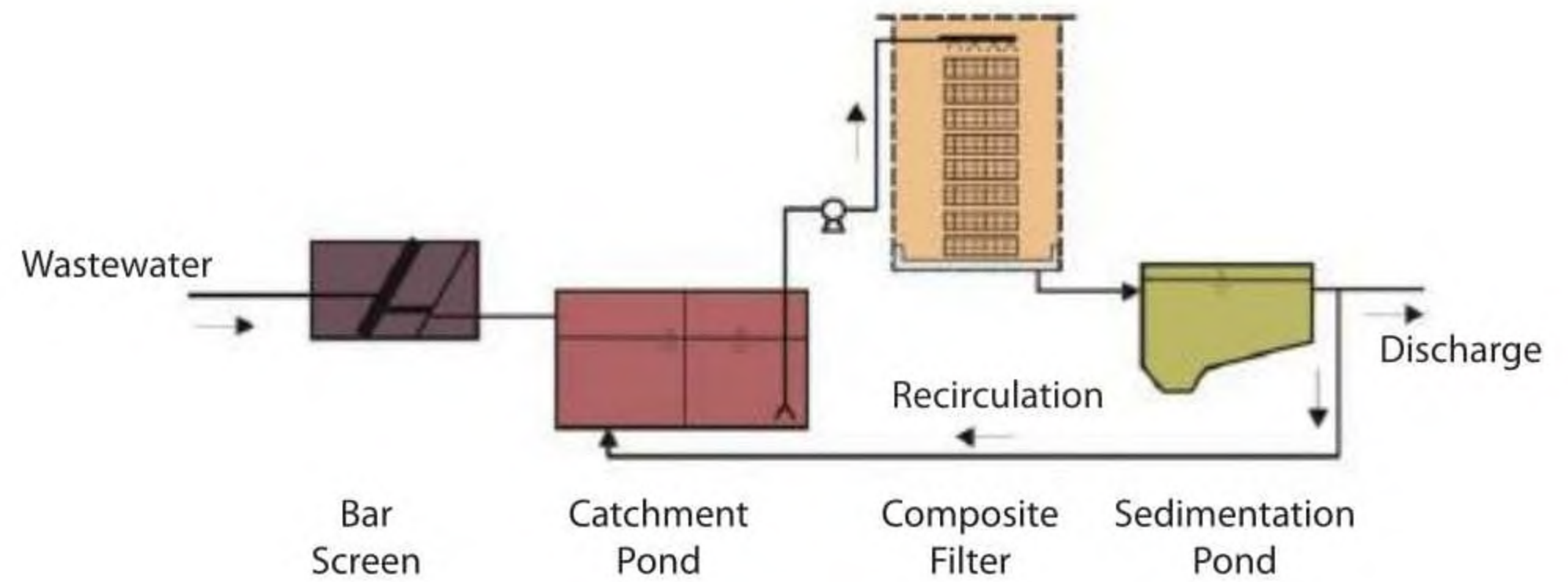
The Adjustable Water Distributor can be flexibly pieced together to suit all shapes of filters and has the convenience of easy transportation and installation.

One-of-a-kind Technology

1

Composite bio-filter:

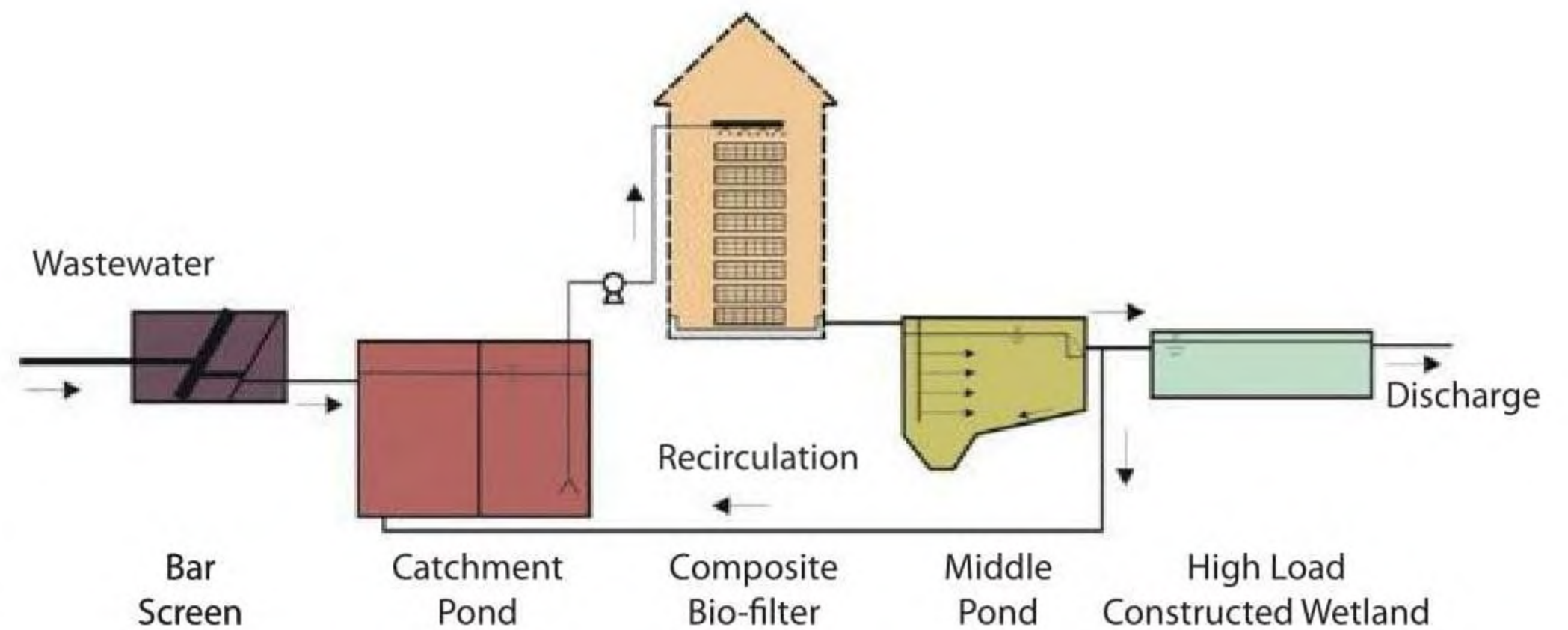
Discharge quality able to attain Chinese Wastewater Discharge GB18918 Level 2 Standard



2

Combined process of combined bio-filter and high load constructed wetland:

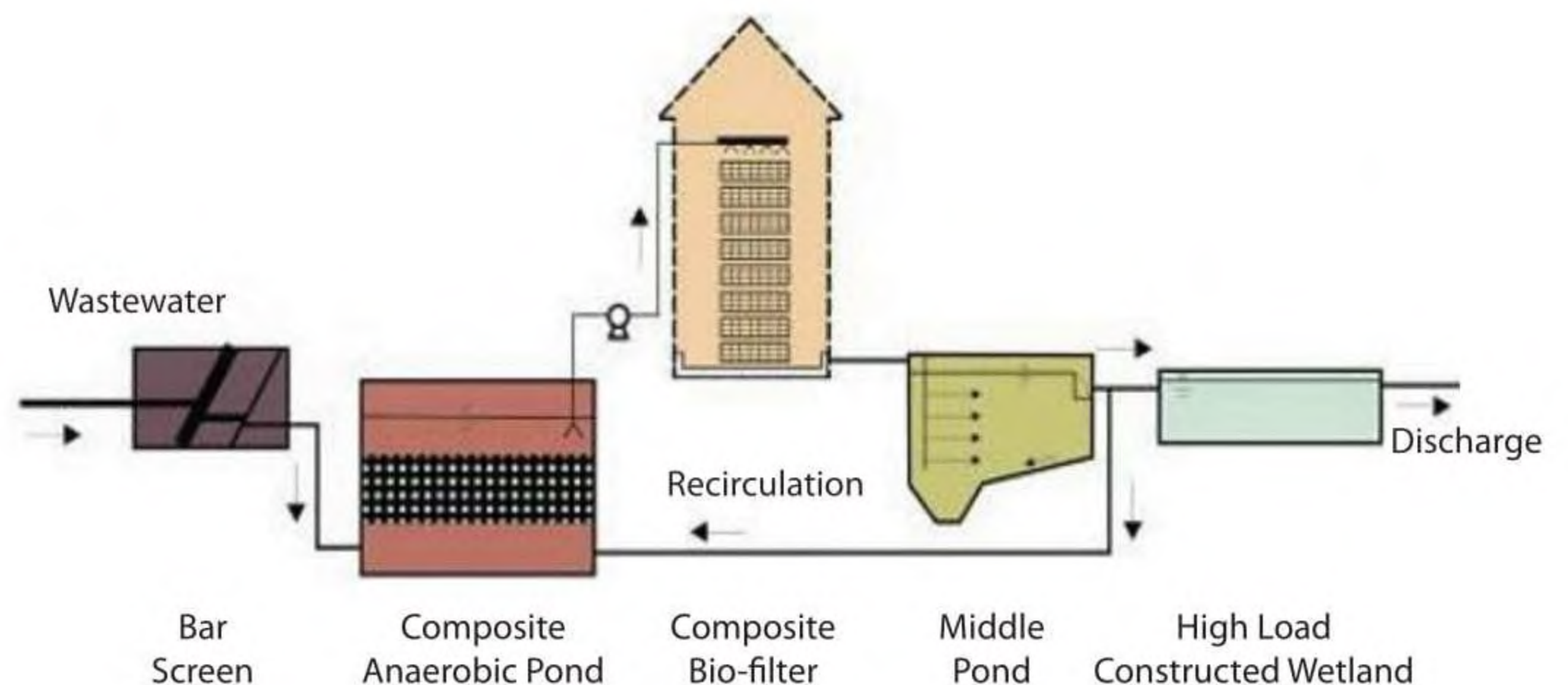
Discharge quality able to attain Chinese Wastewater Discharge GB18918 Level 1 "B" Standard



3

Combined anaerobic - Combined bio-filter - High load constructed wetland combined process:

Discharge quality able to attain Chinese Wastewater Discharge GB18918 Level 1 "A" Standard



Pollutant Removal Mechanism

High efficiency oxygen supply

- Altering the traditional biological filter, which has a closed column-like structure, to a open structure supported by filler material, aeration and oxygen supply to the composite bio-filter is enhanced.
- The packing tray is designed for ease of assembly and disassembly, replacement and washing, with a composite filler that can enhance effect of treatment.
- Modular design that allows operation in series, parallel or mixed modes.

Nitrogen removal

- The aerobic environment in the composite bio-filter aids the distribution of ammonia nitrogen converted into nitrate nitrogen.
- Through the anaerobic environment in the constructed wetland, nitrate nitrogen is converted into gas that is released from the system through denitrification.
- The effluent of the system is recirculated back to the anaerobic tank for a second treatment, enhancing nitrogen removal in the system.

Phosphate removal

- Dependent on phosphorus adsorption and chemical precipitation effect of the phosphorus removal filler.
- Main components of the phosphorus removal filler are a combination of zirconium, fly ash, gypsum that becomes a highly porous material under high temperature and pressure. Adsorption capacity of the filler is at least 15.5mg P/g of filler.



Filler material for pollutant removal

Process		COD	BOD ₅	SS	NH ₃ -H	TP
Regulating Pool	Influent	350	180	180	35	4
	Effluent	310	155	130	30	3.6
	Removal Rate	11%	14%	28%	14%	10%
Composite Bio-filter	Influent	310	155	130	30	3.6
	Effluent	120	40	60	15	2.5
	Removal Rate	61%	74%	54%	50%	31%
Middle Pond	Influent	120	40	60	30	3.6
	Effluent	100	30	30	15	2
	Removal Rate	17%	25%	50%	0%	20%
Constructed Wetland	Influent	100	30	30	15	2
	Effluent	60	20	20	8	1
	Removal Rate	40%	33%	33%	47%	50%

Process Characteristics

Modular design

The modular construction of the treatment station has a flexible assembly that is designed according to treatment requirements, making it applicable to a wide range of wastewater treatment capacities ($5\text{m}^3/\text{d}\sim 3000\text{m}^3/\text{d}$).

Non-clogging

The filter adopts a combined structure, which overcomes the shortcomings of the traditional filter that clogs easily, allowing it to be operated stably for a long time.

High pollutant treatment efficiency

The composite filter material has an organic matter volume load that can reach $1.0\text{kg-BOD}_5/\text{m}^3\text{d}$, strengthening the system's processing effect. A combination of the composite bio-filter and high load constructed wetland process is able to attain an effluent of GB18918-2002 Grade B standard. The composite anaerobic combined bio-filter and high load constructed wetland combined process is able to attain an effluent of GB18918-2002 Grade A standard.

Small land area

For a $60\text{m}^3/\text{d}$ flow, the combined composite bio-filter sewage treatment covers an area of about 25m^2 . For a combination of composite bio-filter and high load constructed wetland, the system covers an area of about 200m^2 , 1/3 of what a traditional pure constructed wetland would take up.

Low operating costs, savings in investment

As compared to the traditional biochemical treatment process, more than 1/3 water engineering costs can be saved. Operating costs are generally not more than $0.0225\text{USD}/\text{m}^3$.*

Low energy consumption

Additional aeration is not necessary as natural ventilation is being used. Only a pump with an energy consumption of about 0.1kWh per ton of water is needed.

Simple and convenient

The system can run automatically without the need of special personnel management, only periodic inspection is required.

Environmentally friendly

There are no noise or smell emitted from the treatment stations that have been designed to blend into the surrounding environment.

This process is suitable for wastewater of small quantities, rural domestic wastewater with large changes in quantity and quality, tourist scenic spots, sewage in expressway service, landscape water, lake water and other wastewater systems that are not able to connect to main pipe networks, requiring onsite treatment.

*Based on operating costs in China and converted into USD at exchange rate of $1\text{RMB} = 0.15\text{USD}$.

Varied Selection



1. Ground Equipment Model (20m³/d)
2. Underground Station Mode (60m³/d)
3. Underground Equipment Model (2m³/d)
4. Ground Station Mode (200m³/d)

Patents



Cost of Operation

Technical investment and floor area reference table

Technology type	Area per ton of water(m ²)	Quality of effluent
Composite Bio- Filter	0.5(0.25~2.5)	Level 2 Standard
Composite Bio-Filter and High Loading Constructed Wetland combination	3.0(2.5~7.0)	Level 1 Grade B
Composite Anaerobic, Composite Bio-Filter and High Loading Constructed Wetland combination	3.5(3.0~8.5)	Level 1 Grade A

* Ranged values are indicated in the brackets, the larger the treatment volume, the smaller land area occupied per ton of water

Operational cost** (Example: 100m³/d treatment volume)

Labour cost

The wastewater treatment station only requires one part-time staff with 45 USD monthly salary for periodic checks. No specialised management of the system is required. The average cost of manpower is 1.50 USD daily, equivalent to labour costs of 0.015 USD per ton of water.

Electrical cost

The technology of the composite filter can simplify the process of wastewater treatment through the natural ventilation and oxygen supply, to meet the oxygen demand of microorganisms. The wastewater treatment station has an installed capacity of 0.25kW, and a backup capacity of 0.25kW. The average daily power consumption of 6kWH, at a cost of (high and low peak average) 0.09 USD/kWH. A daily cost of 0.54 USD for electricity is equivalent to less than 0.006 USD per ton of water consumption.

Chemical cost

The wastewater treatment station does not use any reagents, so there are no chemical costs.

Daily operational cost

Equivalent cost of treatment per ton of wastewater including costs of labour, electricity charges and chemical dosage = 0.021 USD/m³ of wastewater.

The main operating expenses of the wastewater treatment station are labour and electrical charges for the pump, operational costs are generally not more than 0.0225 USD per ton of wastewater.

**Based on operating costs in China and converted into USD at exchange rate of 1RMB = 0.15USD.

Operation and Maintenance



1. Maintenance Management System
2. Site Maintenance
3. Maintenance Team

Automatic operation, local management, fast response, stable and reliable

- The wastewater treatment station utilizes a PLC automatic control with an automatic fault alarm. The system is operated without need for management from a specialist, only periodic inspections are required. Operation and management is extremely simple, ensuring a long-term and stable treatment process.
- A mobile maintenance team of professional and technical personnel would be responsible for a designated area of wastewater treatment station inspection and immediate response of not more than 24 hours for maintenance or other issues.
- A regional or central monitoring platform with real-time monitoring of the station's operation would be gradually established. When faced with abnormalities with the system, appropriate maintenance team would be notified immediately to respond.
- There is a set of comprehensive management rules and regulations and detailed maintenance records keeping.

Extent of Use

At present, this technology has been widely applied in Shanghai, Songjiang District, Chongming Island, Pudong New Area, Qingpu District, Jinshan District, Fengxian District and Anhui, Nanling, Hubei, Nanchang, Yunnan, Dali, Zhejiang, Wenzhou, Shaoxing and Huzhou, Guangzhou, Foshan, Fujian, Xiamen, Jiangxi, Nanchang, Inner Mongolia and other places. There are more than 3,000 constructed and new wastewater treatment systems ranging from 5~1,000m³/d, with a total processing capacity of about 100,000m³/d, servicing about 100,000 households in rural areas. These projects solve the problem of the wastewater discharge from villages, improving the water quality of the environment, therefore obtaining good reviews from both local government and the general public. Achieving good social and environmental benefits, this technology would help create a starting point for a new socialist countryside.



Completed projects in Shanghai



Bird's eye view of treatment station in Xiamen, Fujian



Distribution map of projects in China



Yongjia Qiaotou Town Luo Xi Village, Yongjia County, was the first batch of rural wastewater treatment pilot villages. Using the combination of composite bio-filter and constructed wetland process, the treatment capacity of 70m³/d benefits 480 households in the village. Through third-party testing, the effluent quality has been tested to reach grade B standard.

Projects



Guangzhuang village wastewater treatment station, Yichang City, Hubei Province



Wastewater treatment station, Yongli Village, Shanghai



No.5 wastewater treatment station, Damang village, Shanghai



Xiachangping village wastewater treatment station, Xiangshan County, Hubei Province



Geguanying village wastewater treatment station, Eryuan County, Yunnan Province



Xidian village wastewater treatment station, Yiwu City, Zhejiang Province



Wastewater treatment station, Zhujiajiao Town, Shanghai



Yujiadai village wastewater treatment station, Huzhou City, Zhejiang Province

Case Study



1. Wastewater treatment system in Gangyan Township
2. High-loading constructed wetland
3. Bio-filter room
4. Effluent outlet



The town wastewater treatment station at Gangyan Township in Chongming County, Shanghai, has a treatment capacity 500m³/day. Utilizing the combination of composite bio-filter and high load constructed wetland, the system serves a population of about 4,380 people. The project, covering an area of 1300m², was completed and commenced operations in September 2009 collecting and treating wastewater from 1,400 households. Operation is

fully automated and only regular inspections are required. Management is very simple and there is no need for special personnel to manage the system. Operating costs are mainly only electricity at less than 0.015 USD/m³* of water. The system's effluent is able to reach Chinese urban wastewater discharge (GB18918-2002) Level 1 Grade B standard, individual effluent concentrations have been tested to have surpassed Level 1 Grade A standard.

*Based on operating costs in China and converted into USD at exchange rate of 1RMB = 0.15USD.

Case Study



1. Wastewater treatment system in Wuhu Dapu New Village, Anhui Province (1000m³/d)
2. Discharge Well
3. Filter Room

Wuhu Dapu New Village in Anhui Province is an experimental wastewater treatment system of 1,000m³/d capacity. The project, that covers an area of 3,300m² and serves 3,000 households in the village, was put into

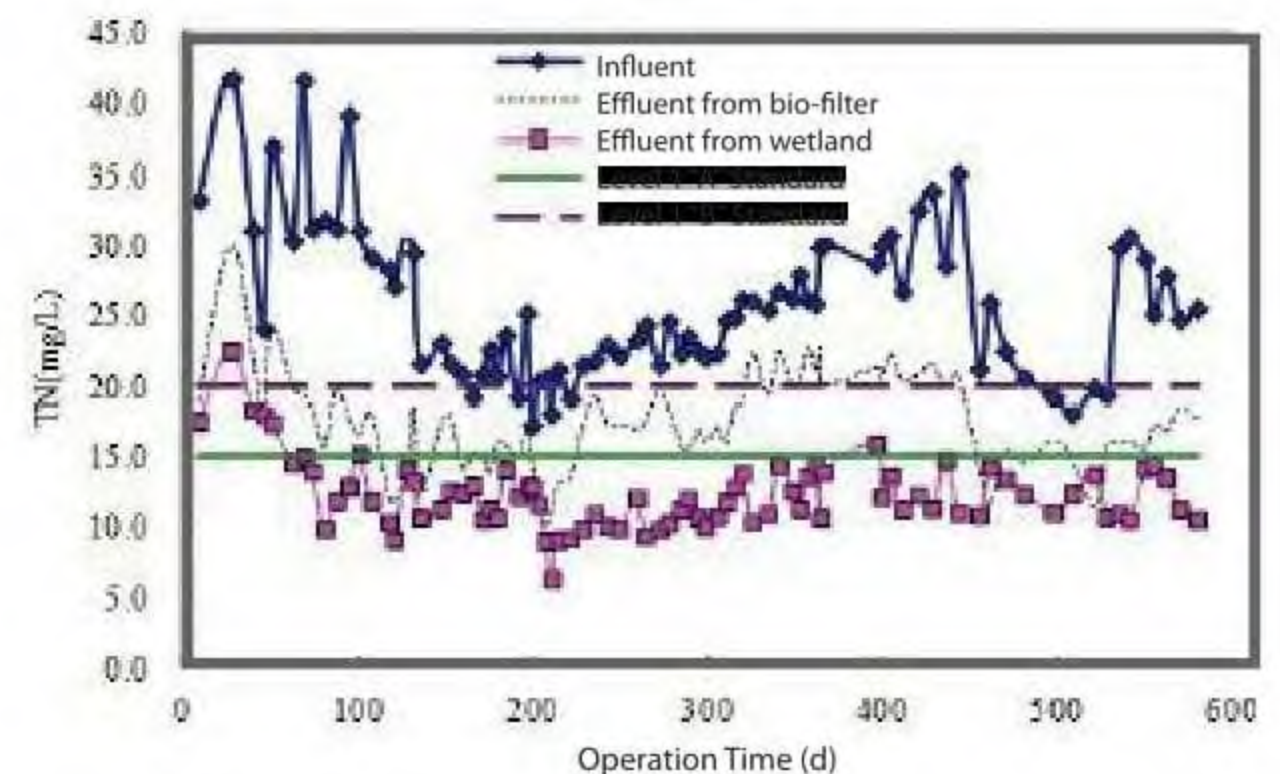
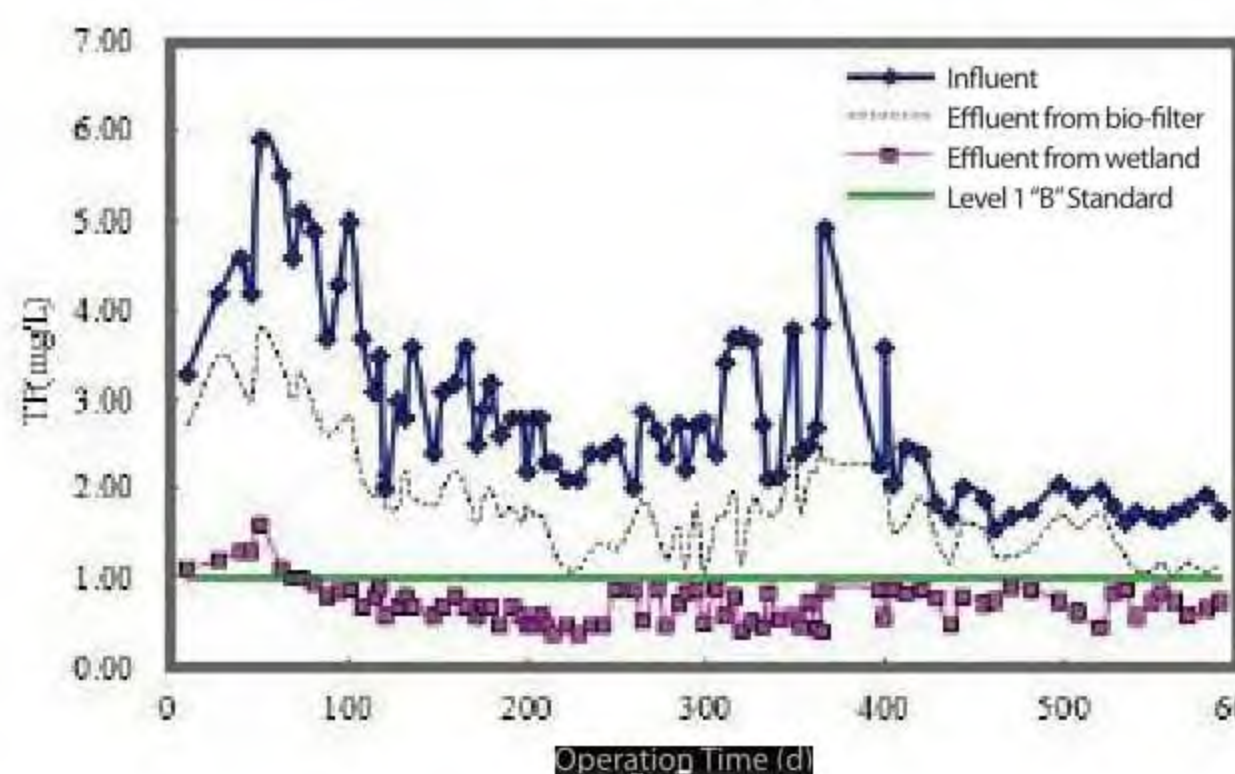
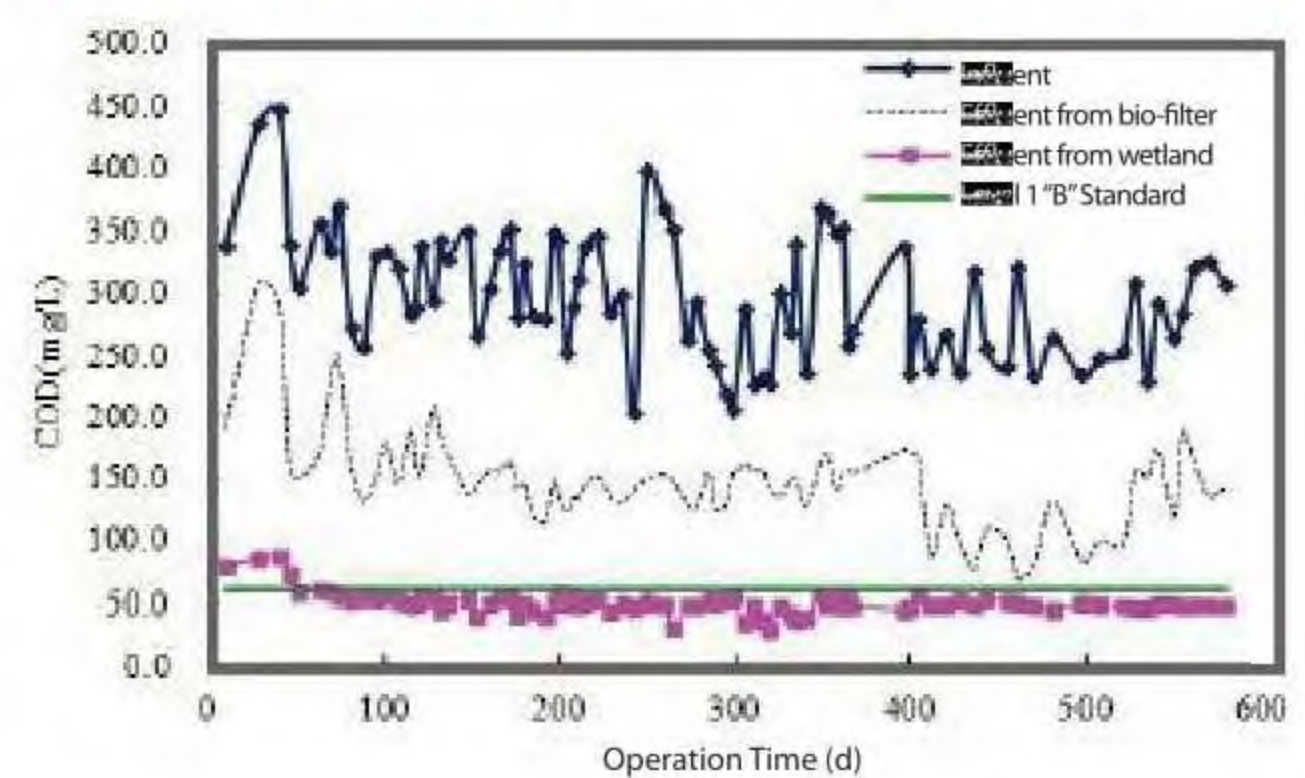
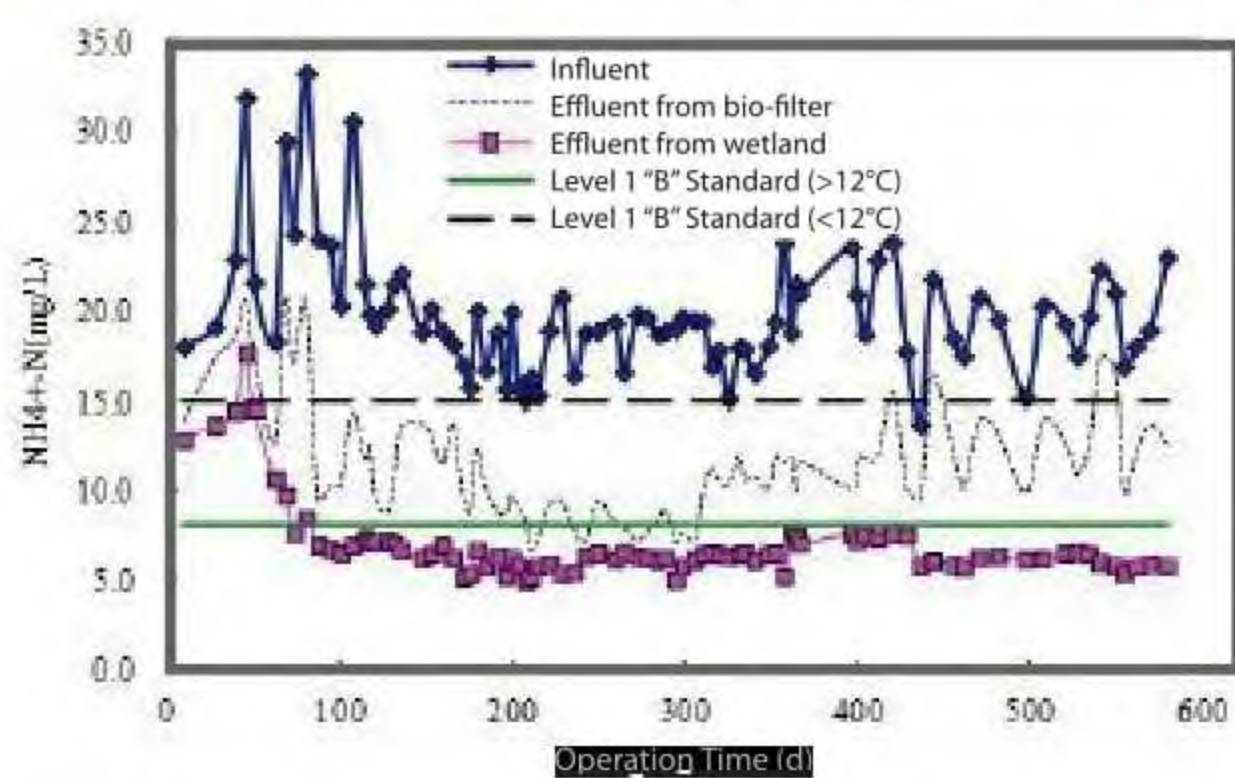
operation in May 2010. According to Nanling County environmental monitoring results, the effluent COD and NH₃-N concentration are below 40mg/L and 3.5mg/L respectively, meeting Level 1 Grade A discharge standards.

Societal Evaluation



Utilizing the combination of the Composite Bio-filter and Constructed Wetland, this project takes up an area of 250m² with a treatment capacity of 60m³/d servicing 250 households. This project was completed on November 2007 and has been in stable operation ever since. Removal efficiency of COD, TN and TP are 75%, 65% and 70% respectively, and effluent discharge concentrations are below 60mg/L, 15mg/L and 1.0mg/L respectively.

Actual operation results of Cao Bang village wastewater treatment station



Media Reports and Exhibitions



2007 Shanghai

China International Industry Fair Environmental Technology and Equipment Exhibition, showcasing high efficiency and ease of management of the system

2008 Shanghai

Shanghai Science and Technology Activities Week, highlighting the "energy-saving emission reduction, ecological civilization" characteristics of the system

2009 Beijing

China International Energy Conservation and Emission Reduction and New Energy Materials Technology Expo, placing focus on the advantages of the process in terms of energy-saving emission reduction

2011 Changsha

Hunan Environmental Protection Industry Fair, showing the feasibility of equipment process

Inspection by Government Leaders



On the 9th of July 2014, Vice-Chairman of the Standing Committee of the National People's Congress Yan Junqi conducted an inspection of the wastewater collection and treatment system construction in Zhenghe Village and Piaohe Village in Jinze Town of Qingpu District, Shanghai city.

In early 2008, Vice-Chairman Yan read an article about the "Jiaotong University Filter" on the Jf Daily¹. She felt that this was a meaningful and interesting piece of technology, but was afraid that it would be short-lived. With knowledge of this technology in mind, Vice-Chairman Yan enquired about the progress of this technology on her visit to Shanghai. From there she learnt that this technology is already being applied to Shanghai, Anhui, Hubei, Yunnan, Zhejiang, Guangdong, Fujian and other parts of China, with more than 500 constructed and ongoing projects serving more than 60,000 households. With the current pressure China faces with regards to environmental issues, Jiaotong University has been actively fighting alongside the country's national strategies, helping to contribute back to the society via new technology and innovation. Vice-Chairman Yan has therefore given her stamp of approval on this technology and hopes that university will continue to support the improvement of rural living environment by coming up with solutions to current problems through incubation, transformation and

raising awareness, so that the results would be able to benefit more rural areas.

The wastewater collection and treatment system construction in Piaohe Village in Jinze Town of Qingpu District, Shanghai city utilizes the "Jiaotong University Filter" technology. Commenced on July 2010, this project that services 391 households covers an area of 400m² with a treatment volume of 120m³/day. The system is still in operation till today and its discharge is able to meet China GB18918 Level 1 Grade B discharge standards.



¹ Jf Daily is a newspaper in China.

Visits by Government Leaders and other counterparts



Shanghai Municipal Committee



Director of agricultural water



Former chairman of French Parliament



British counterparts



The Japanese delegation

Business Model

Recommended mode of construction

For project scale of less than 20m³/d, small equipment model is recommended.

For project scale of more than 20m³/d, wastewater treatment station is recommended.

If clients are to choose "Turn-Key Project" model, they may complete civil construction on their own and Onway will install the system on site.

Business model

Onway is able to provide various types of business models to suit clients' needs:

Business Model	Capital Investment	Planning and Design	Construction/ supply of materials	Operation and Maintenance	Business Model
Public-Private-Partnership	PPP	[Red bar]			
Build-Operate-Transfer	BOT	[Orange bar]			
Redesign-Operate-Transfer	ROT	[Yellow bar]			
Design-Build-Operate	DBO		[Green bar]		
Engineering, Procurement, Construction	EPC		[Blue bar]		
Operation and Maintenance	OM				[Purple bar]
Others					

Other Technology and Products

Onway is able to provide the following technology for clients with a restriction on land space:



Contact oxidation technology



Flat sheet membrane bioreactor technology

Service Model

Onway's technical team reacts accordingly to market demand, with continuous research and development on new technologies, new products for decentralized wastewater treatment. Providing engineering consulting, design, construction, commissioning and maintenance of services, Onway promises to deliver technical support, operation and maintenance for life to clients who utilize our wastewater treatment technology.

Let us work together to focus on decentralized wastewater treatment, to create a better environment.

