

# Small-scale rural domestic wastewater treatment project

“Sewage Treatment Technology of  
**E**cological **C**ompound **M**icrocirculation (ECM) ”

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# Introduction

- Miniaturized wastewater treatment technology is a global challenge, and conquering this challenge means possessing a leading position in technology internationally.
- The “Sewage Treatment Technology of **Ecological Compound Microcirculation (ECM)**” has achieved **a world-leading position** after years of research and application.
  - The "ECM" technology solution has become one of the three recommended environmental remediation technology models in Guizhou, China.
  - The Vetiver Network International has also awarded the certificate for its innovative.

# Introduction of “Sewage Treatment Technology of Ecological Compound Microcirculation ”

- The technical scheme is composed of **seven parts**:
  1. Microcirculation biochemical reaction system
  2. Artificial wetland system
  3. Vetiver filter tank system
  4. Surface circulation and infiltration system
  5. Ecological countryside landscape system
  6. Micro power system (Wind and solar complementary)
  7. Remote sensing monitoring and intelligent system

# Introduction of “Sewage Treatment Technology of Ecological Compound Microcirculation ”

- “Microcirculation biochemical reaction system,” “wetland system,” “vetiver filter tank system,” and “surface circulation system” are four important components of wastewater treatment. Each of these components corresponds to a special treatment effect.
- This unique solution is a combined of professional techniques.
  - The related professions include **more than 20 subjects**, such as water supply, civil engineering, electrical engineering, biochemistry, microbiology, materials science, ecology, environmental protection, landscaping, artificial wetlands, vetiver technology, new energy, remote sensing.
  - This solution can be used either in a diverse and flexible combination or as a single selective option.

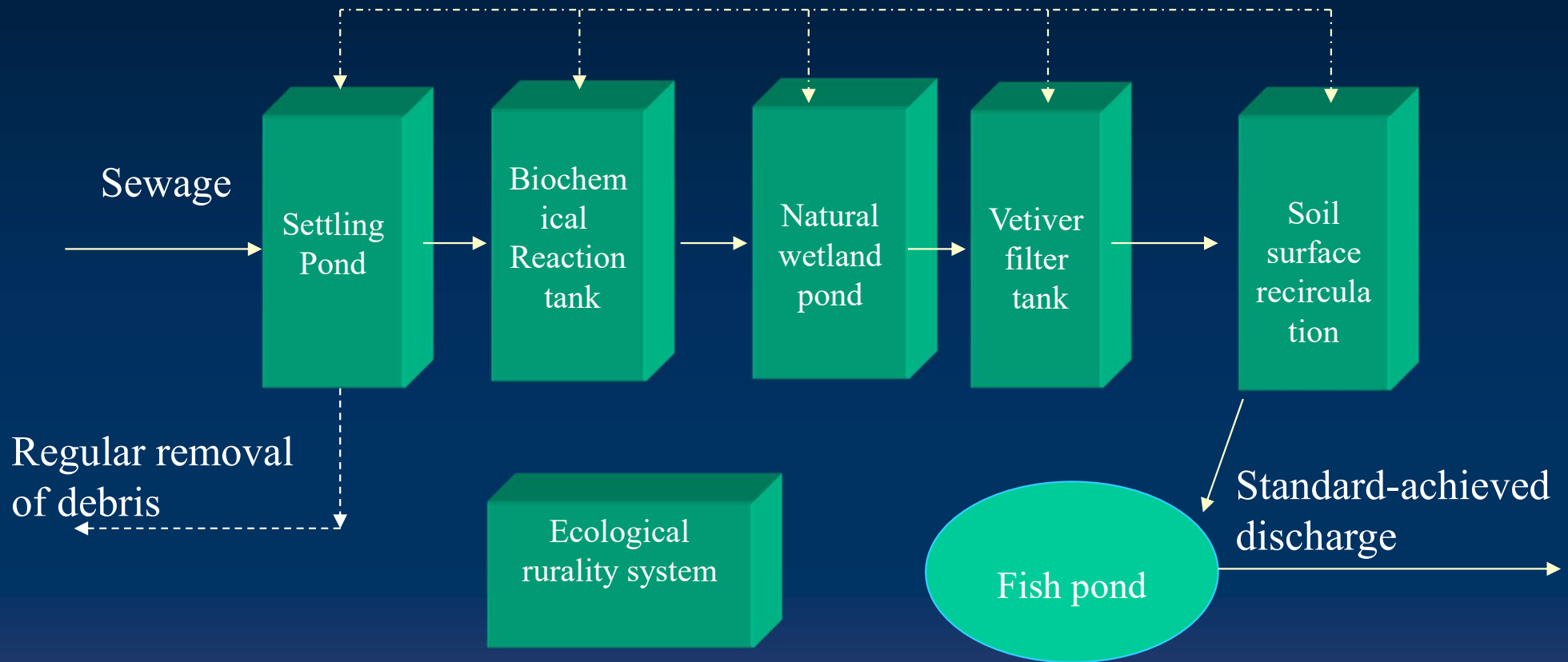
# Characteristics of “Sewage Treatment Technology of Ecological Compound Microcirculation ”

1. The technology has a strong ability for pollutant removal, requiring a small area (40 to 600 m<sup>2</sup>).
2. The treatment system was buried underground to achieve the re-use and development of land;
3. Low energy consumption and less maintenance: daily energy consumption of electricity is only 6 to 8 kilowatt hour. After installing wind and solar power, the cost would decreased to 0.02 cubic meter per Chinese yuan;
4. High efficiency and long service life: high volume load and flexible operation, with **service life up to 25 years**;
5. Strong decontamination ability : more than 98% of the contaminants can be removed; clean the sludge every three or four years;

# Qualities of “Sewage Treatment Technology of Ecological Compound Microcirculation ”

6. Ecological and environmental friendship: a combination of a variety of plants and recycling use of wastes with ecological and environmental effect;
7. The technology operates in a fully automated manner.
8. The technology has a low average annual maintenance cost, requiring only 5,000 to 8,000 Chinese yuan per one hundred cubic meters.
9. With appropriate management, it is possible to cultivate vetiver seedlings and create additional economic benefit.

# Flow Chart of “Sewage Treatment Technology of Ecological Compound Microcirculation ”



The following is a brief introduction of each part in this system

# Characteristics of “Biochemical Reaction System”

1. The system covers a small area, fully automatic operation, does not need sludge returning tank.
2. Short time of sewage biochemical reaction: about 16 hours only. Primary biochemical metabolites are  $\text{CH}_4$ ,  $\text{CO}_2$  and  $\text{H}_2$ , and the cleanout cycle of the sludge is about 3-4 years;
3. Low operating costs: when the system is activated, energy consumption of per ton wastewater treatment is between 0.1-0.2 kwh. When the wind speed or solar energy meet the requirements, the system can realize automatic operation;
4. Strong decontamination: The sewage treated by this system can meet Class A discharge standards (G18918-2002);
5. Applicable range: Chemical oxygen demand (COD) should less than 2000 liter per milligram (mg/L), suspended substance (SS) < 50 mg/L , biochemical oxygen demand (BOD) 1000 mg/L, ammonium < 30 mg/L, total phosphorus (TP) < 8 mg/L, total nitrogen (TN) < 100 mg/L and organic animal and plant oil < 5 mg/L.



# Functions of “Constructed Wetland Pond”

- 1. Through the constructed wetland, the effluent from the previous step is treated a second time to ensure water quality.
- 2. With a sensible combination of different water plants to achieve a natural combination of ecology and landscape.



# Functions of “Vetiver Filter Tank”

- 1. Via the third treatment of effluent from constructed wetland pond (including excessive nitrogen and phosphorus coming from the death of water plant), to implement treble assurance on effluent water quality
- 2. Vetiver's newest product, Huaxiang No. 1, has a more developed root system with a strong adsorption capacity and is easy to survive.
- 3. The roots of vetiver has high removal capacity for components in low concentration wastewater.

# Functions of Surface Water Recirculation and Infiltration

1. A final adsorption of the treated effluent from the previous steps using the roots of a variety of water plants to meet the standard discharge of the water;
2. At the same time, the filtration capacity of soil is used to filter water;
3. Through the fourth stage of treatment, finally achieving the goal of wastewater treatment.



# Comparison with Traditional Scheme

Representative company	Unpowered anaerobic wetland technology	Traditional digester technology scheme	Membrane Bio-Reactor	A2O oxidation technical scheme	ECM Technology
Technical representative	A number of small enterprises	Traditional enterprises	Beijing Capital Group	China Union Engineering Company	Guangzhou Vetiver Ecological Company
Land area (m <sup>2</sup> )	200-500	500-1000	20-200	100-300	40-100
Supporting design	None	None	Power plant	Greenery landscape	Ecological complex landscape
Space usage	Surface-based	Surface-based	Surface-based	Subsurface	Subsurface
Wastewater treatment capacity	Low	Grade B	Grade A	Grade A	Grade A
Secondary pollutant	Yes	Yes	No	No	No
Landscape effect	Small	Small	None	Obvious	Remarkable
Lifespan	3-5 years	5-8 years	10-15 years	10-15 years	More than 20 years
Construction cost (Per family)	¥2000-4000	¥3000-5000	¥4000-6000	¥10,000-15,000	¥8000-1,2000
Energy cost (Per ton)	None	None	2-3 kilowatt	1-1.2 kilowatt	0.03-0.05 kilowatt
Operating cost (Per ton)	None	None	¥1-1.5	¥0.5-0.6	¥0.02-0.03
Maintenance cost (Per year)	¥10,000-20,000 (Wetland pipeline cleaning)	¥8,000-15,000 (Plant and silt cleaning)	¥15,000-40,000 (Plant and silt cleaning)	¥10,000-20,000 (Membrane replacement)	¥3,000-5,000 (Plant cleaning)

- By comparing with the common wastewater treatment, our ECM technology has the characteristics of low operating costs, easy maintenance, and low energy consumption.

# Examples of wastewater treatment

## A wastewater treatment case in Caixin Village



# Biochemical reaction tank construction



# Construction of wetland ponds and vetiver filtration pools



# Vetiver seedlings transplanted to floating island





# Installation of the equipment for biochemical reaction



# Installation of wind and solar power supply systems



# Fully automated intelligent control system



# Placement of microbial agent into biochemical reaction tank for testing



# The main system after completing construction



# One part of the view after project completion



# The other part of the view after project completion



# Artificial wetland system





# Floated vetiver filtering system



# Zhenning Dingqi Town Ma'an shan Wastewater Treatment



# The ongoing construction site



# The overall appearance of the project



# The landscape after 5 months of operation



# Vegetation system utilizing river channel construction (no land occupation)



# Wastewater containing animal and plant oils



# Aerobic process in biochemical reaction pool





# Water quality after 5 months of treatment



# —Xixiu District Jichang Township Qixin Resettlement Community Wastewater Treatment Project



# Small-scale and simple landscape design



# Decoration using the tire crafts



# Rainwater and wastewater separation



# Vetiver starts to take effect after two months planting



# —Pingba Baiyun Feihu Mountain Wastewater Treatment Project



# Photo of the construction in progress





# Photo of the site 70 days after project completion



# Integration of landscape with local culture



# On-site inspection by local leaders in China





Photo of vetiver  
grass root  
systems after  
more than 90  
days of growth

# —Puding Xiushui Niujiào Group Wastewater Treatment Project



# A picture of the completion of construction



# —Puding Xiushui Baobao Group Wastewater Treatment Project



# Vetiver floating island designed by the local landform





# —Wastewater Treatment Project in Dongtun



# A small but functional treatment station



# Visit led by Jiapei Huang, Vice Governor of Guizhou Province



# Xiaoqi Jin, director of Forestry Bureau of Guizhou Province was listening to the introduction of the project (8 March 2016)



# Ministry of Agriculture leaders visit Dingqi project



# Yuan Xiong, leader of Anshun was on site inspection



# Ministry of Agriculture leaders visited the wastewater treat system



**Zhihong Zhang, Director of Department of Ecology and Energy, Guizhou Provincial Agricultural Commission was on site inspection (24 March 2016)**





# Director Lu Hai from the Guiyang Environmental Protection Station led a team to visit the project (June 8, 2016)



**Professor Xia Hanping, an international expert in patchouli grass from the South China Botanical Garden, Chinese Academy of Sciences, visited the Dingqi project site**



# Canadian ecological expert visited the site for investigation





# Certificate issued by the Vetiver Network International

The Vetiver Network International

Proven & green environmental solutions

## **Vetiver Grass Technology Innovation Award**

The Board of The Vetiver Network International  
Hereby Recognizes

**Feng Ziyuan**

*Guangzhou Vetiver Grass Industry Science and  
Technology Co. Ltd.*

for innovation in the development and  
application of Vetiver Grass Technology for a  
*Rural Sewage Treatment System in Caixin Village,  
Puding Country of Guizhou Province, China*

*Richard G. Grimshaw – Founder*

*Jim Smyle – Chairman*

*Paul Truong – Technical Director*

April 4, 2017

## 国际香根草网络

杰出的绿色环保解决方案

### 香根草技术创新奖

香根草网络国际委员会  
特此确认

冯子元  
及

广州市香根草业科技有限公司

在中国贵州省普定县财新村的农村小型污  
水处理系统中采用香根草综合技术进行的开发  
和应用为世界性首创技术

国际组织创始人——Richard • Grimshaw

国际网络主席——Jim Smyle

国际技术总监——Pual Truong

4月•04•2017年

# Technical Group of Guangzhou Vetiver Grass Industry Science and Technology Co. Ltd.

- **A professional team with experts in different fields.**
- Overall project designer: Ziyuan Feng (senior engineer)
- Project chief engineer: Kun Tian (senior engineer)
  - Designer of biochemical system: Kun Tian (senior engineer)
  - Designer of vetiver technique: Ziyuan Feng (international expert on Vetiver)
  - Designer of constructed wetland: Ruigui Zhang (landscape engineer)
  - Designer of pipeline network and civil engineering: Jing Guo (Civil engineer)
  - Designer of telemetry and automatic control system: Yonghe Li (Electrical engineer)
- Project Manager: Yunsheng Yang (Senior Engineer)
- Project Construction: BaoLiang E (Environmental Engineer)
- Technical Consultants: A total of over 20 domestic and international professors, PhD advisors, and senior experts from various fields of expertise (specific list omitted).

# We hope to have further cooperation with you !



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