Conceptual Wastewater Treatment Plant with Eco-complex in China

Concept WWTP Committee
The history of wastewater treatment

100 years of Activated Sludge

- 1900: Sanitation
- 1914: Water Blackening
- 20th Century: Eutrophication
- The early 21st Century: Water Shortage

Future Demand
- Climate change
- Resources reservation
- Sustainable development
- Ecological civilization

What is the next?

Diseases Control COD Removal N, P Removal Water Reuse

建设面向未来的中国污水处理概念厂
In the process of developing our future goals, we have found the potential for a combination of sustainability and efficiency.

——《Wastewater management roadmap towards 2030 of Netherlands》

1. **Water**
   - Drinking Water, Sewage, Reclaimed water

2. **Nutrition**
   - Organic matter, N, P, CO₂

3. **Energy**
   - Heat, Electricity
After three national “Five-year Plan”, China experienced remarkable fast development in WWTP building in the past 15 years.

- **10th Five**: 22 M ton/d, 481 WWTPs
- **11th Five**: Rapid growth in the last decade
- **12th Five**: 157 M ton/d, 3717 WWTPs
Existing problems

>60% of WWTP processes are based on extended aeration (SBR+OD), which lead to high level energy consumption.

- more energy consumption, up to 30%-50%
- longer HRT, 3 times

Anaerobic sludge digestion is less developed.

- Only 50 WWTPs with digesters, account less than 3% of all.
- Less 30% still operated
Current WWTPs are not sustainable

- Unsustainable processes
- Energy-intensive processes
- No resource recovery
- Less environmentally friendly
Ideas of Conceptual WTPs

To build up a (series of) future-oriented (2030-2040) domestic wastewater treatment plant with a timeline of five years. Drive the development of STP with a sustainable model.

National Industrial Park for Environmental Science & Technology
Conceptual WWTP

- Water Reuse
- Energy Recovery
- Materials Recycle
- ……”

Eco-complex in Yixing

- Agricultural
- Watland
- Plant
- Landscape
- ……”

4 Objectives

- Sustainable Water Quality
- Energy Self-sufficient
- Resource Recovery
- Eco-friendly
Technology Roadmap

Step I: Process integrated design

Part I: Carbon pre-concentration and phosphorus separation

Part II: Nitrogen transformation

Part III: Advanced treatment

Part IV: Energy recovery using anaerobic technology

Part V: Recovery and utilization of N+P

Part VI: Friendly Environment
### Key Technology Development

<table>
<thead>
<tr>
<th></th>
<th>Oxygen demand (g/p·d)</th>
<th>Energy consumption (Wh/p·d)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Conventional process+Anaerobic digestion</td>
<td>Conventional process+Anaerobic digestion+Anammox (reject water)</td>
</tr>
<tr>
<td>Areation for COD removal</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>Areation for nitrogen removal</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Energy for pumping and mixing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>biogas power generation</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>Net capacity</td>
<td></td>
<td></td>
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</tbody>
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CWWTP with Eco-complex

CWWTP In Yixing

- Water Reuse
- Energy Recovery
- Materials Recycle
- ……

Eco-complex Park

- Agricultural
- Watland
- Plant
- Landscape
- ……

4 Objectives

- Sustainable Water Quality
- Energy Self-sufficient
- Resource Recovery
- Eco-friendly
Eco-complex: related with multi-key factors in the recycling process

Concept WWTP will be the core of the ecological complex plant. Concept WWTP will not only concerned about the sewage treatment, but also concerned about the water reuse, energy recovery and resources recycling.
## Site Selection - Yixing

- National Industrial Park for Environmental Science & Technology
- Yangtze River Delta —Geographical advantages

<table>
<thead>
<tr>
<th>Ma’anshan</th>
<th>Suzhou</th>
<th>Changzhou</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nanjing</td>
<td>Yixing</td>
<td>Shanghai</td>
</tr>
<tr>
<td>Wuhu</td>
<td>Hangzhou</td>
<td>Jiaxing</td>
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Site Selection - Yixing

◆ Yixing has an urgent need for environmental governance
◆ Taihu entrance
◆ Demonstration of ecological civilization demonstration area
Yixing concept WWTP will be a……

1. Wastewater treatment plant for demonstration of Forward-looking sewage treatment technology
2. Resource factory of the landmark of Biomass treat
3. R&D center for Pushing the test/pilot to engineering
4. Equipment development and testing center for leading high standards industry equipment production
## Functional Division

<table>
<thead>
<tr>
<th>Functional division</th>
<th>Land property</th>
<th>Area (Mu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 CWWTP</td>
<td>Construction</td>
<td>120.5</td>
</tr>
<tr>
<td>2 Modern Agriculture</td>
<td>Construction</td>
<td>38.6</td>
</tr>
<tr>
<td>3 Ecological Landscape</td>
<td>Farm</td>
<td>1767.9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>1927</strong></td>
</tr>
</tbody>
</table>

- Concept WWTP
- Modern Agriculture
- Ecological Landscape
The philosophical system of ecological complex

1. Concept WWTP provides water, nutrition, energy to the modern agriculture, ecological landscape.

2. Modern agriculture and ecological landscape consume the fertilizer/sludge/reclaimed water of CWWTP, and produce a benign material cycle.

3. Ecological landscape is a good base for the region, and it provides sports and leisure area for Yixing.

Water, fertilizer, organic matter, heat, carbon

Organic waste

Concept WWTP

Modern Agriculture

Ecological landscape
Integrated innovation of international advanced concepts and technologies to lead the future direction of the development of the concept WWTP

1. Water quality needs for Taihu Lake and sensitive water bodies
   - TN < 3 mg/L
   - TP < 0.1 mg/L

2. The need for the healthy water quality needs
   - EDCs, PPCP

3. The need for the sense
   The plant should be elegant, pleasant, opening, accessible, natural, and to show the harmony between the WWTP and External environment.
Connecting map of reclaimed water with the reuse targets
建设面向未来的中国污水处理概念厂

Nutrient Cycle

概念厂

作物/蔬菜
CROPS / VEGETABLES

花卉
FLOWERS

水果
FRUITS

化肥
FERTILISER

3000吨/年

50吨/日
有机质

作物/蔬菜
CROPS / VEGETABLES
建设面向未来的中国污水处理概念厂

Nutrient Cycle

概念厂
50吨/日
有机质

生物质

Biomass

Nutrient Cycle
建设面向未来的中国污水处理概念厂

有机质

4250立方米/日

沼气

BIOGAS

能源

ENERGY

Electricity 354KW/d
Heat 4200KW/d
Cold 3870KW/d

概念厂 (WWTP)

概念厂 WWTP

Energy Cycle
Concept WWTP with Eco-complex

WWTP IS THE BEATING HEART OF THE ECOLOGICAL
Ongoing Urbanization process

- 100 million inhabitants from rural to urban
- Urbanization in the mid-western regions

--“The 12th session of the National People’s Congress at the 2nd meeting of the government work report”

Urbanization in western countries come to the end, while the process is ongoing in China.

China is still one of the biggest market of wastewater treatment in the world.
The development of multidisciplinary science and technology provides opportunities for the transformation of the WWTP: materials science, chemistry, microbiology, irrigation, agriculture, architecture, geology, planting and breeding, horticulture ...

‘The Greenhouse village’
Thank you!