Brief introduction of the performance testing method for a decentralized domestic wastewater treatment plant “Johkasou” in Japan

Johkasou

- The Building Standards Act
  Johkasou must be installed when domestic wastewater is not discharged to public sewerage.

- What is Johkasou?
  1. Wastewater treatment facilities which are produced according to the structure standard enacted by Minister of Land, Infrastructure and Transport.
  2. Wastewater treatment facilities which are certified by Minister of Land, Infrastructure and Transport.

Various distinctive Johkasou can be developed to meet market needs such as compact, low-cost, and advanced treatment.

Johkasou certified by Minister has been a staple in a market in the last decade.
Procedure to get certificate for a new product

Step 3: Certification
Minister
Ministry of Land, Infrastructure, and Transport

Apply with Evaluation document

Manufacturer
Factory of A company
Source: A company HP

Certificate

Step 2: Evaluation
Designated performance evaluating organization

Apply with the Test report

Evaluation document

Step 1: Testing
Testing body

Apply for the test

Test report

New product!!

Brief introduction of Step 1: Testing

Two types of testing methods

<table>
<thead>
<tr>
<th></th>
<th>Water and room temperature</th>
<th>Duration of the test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field test</td>
<td>No-control in the field or simple building (13-25°C)</td>
<td>48 weeks including winter season</td>
</tr>
<tr>
<td>Temperature-controlled short term test</td>
<td>Controlled at 13°C or 20°C inside the building</td>
<td>Minimum 8 weeks with two test products Minimum 16 weeks with one test product</td>
</tr>
</tbody>
</table>

BCJ implements temperature-controlled short term test in our research laboratory.
Brief introduction of Step 1: Testing

An outline of the temperature controlled short term test with one test product (for 5 PE, 1,000 L/day)

- Frequency of water analysis: once a week for 16 weeks
- Acceptability criteria: meet target water quality over 75% (12 times)

Domestic wastewater for the test

- Transfer during 9:00-12:00
- 7:00-12:00
- 2 km
- Transfer DWW by vacuum pump
- Cooling apparatus
- Heat exchange
- Methanol, phosphate, Urea, toilet paper
- Required amount of reagents is determined based on the turbidity
- Heat exchange
- Test product
- Composite sampler
- R.T. 13°C or 20°C
- Tank
- Centralized domestic wastewater treatment plant
- BOD: 200mg/L
- N: 45mg/L
- T-P: 15mg/L
- SS: 160mg/L
- Heat the DWW to 13°C or 20°C
- Hot water
- R.T. 8°C
- Storage tank
- Supply tank
- 5°C
- Transfer during 7:30-8:00
- 13:00-7:20 cool the DWW to 5°C
Influent and effluent water quality

Average influent water quality

<table>
<thead>
<tr>
<th></th>
<th>pH</th>
<th>BOD (mg/L)</th>
<th>COD (mg/L)</th>
<th>SS (mg/L)</th>
<th>T-N (mg/L)</th>
<th>T-P (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min</td>
<td>5.8</td>
<td>180</td>
<td>90</td>
<td>145</td>
<td>40</td>
<td>4</td>
</tr>
<tr>
<td>Max</td>
<td>8.6</td>
<td>220</td>
<td>110</td>
<td>175</td>
<td>50</td>
<td>6</td>
</tr>
</tbody>
</table>

Target water quality which is declared by applicant

<table>
<thead>
<tr>
<th></th>
<th>BOD (mg/L)</th>
<th>COD (mg/L)</th>
<th>SS (mg/L)</th>
<th>T-N (mg/L)</th>
<th>T-P (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example 1</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Example 2</td>
<td>20</td>
<td>30</td>
<td>20</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>Example 3</td>
<td>10</td>
<td>20</td>
<td>10</td>
<td>10</td>
<td>1</td>
</tr>
</tbody>
</table>

Common evaluation items
pH: 5.8-8.6, Coliform group: less than 3,000 N/mL

Challenges in Southeast Asia
Sustainable Development Goals

Goal 6.3
Halving the proportion of untreated wastewater by 2030

MDGs
Sanitary issues
- Open defecation
- Bucket/container
- Pit latrine without slab
- Shared
- No tank/sewer pipe

SDGs
Environmental issues
- Primary treatment
- Secondary treatment
- Tertiary treatment

Coverage of centralized sewerage treatment systems

Less than 5%

Decentralized treatment systems!!
Decentralized treatment facilities in Southeast Asia

MDGs → SDGs

27gBOD
Gray water

13gBOD
Black water

27gBOD
Gray water

13gBOD
Black water

Sanitation condition

Environmental condition

Regulation

- Ministry of Environment and Forestry has issued new effluent standard for domestic wastewater (2016).
- This new and stringent regulation for domestic wastewater is a major step forward to improve water environment.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Unit</th>
<th>Old Regulation</th>
<th>New Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>-</td>
<td>6-9</td>
<td>6-9</td>
</tr>
<tr>
<td>BOD</td>
<td>mg/L</td>
<td>100</td>
<td>30</td>
</tr>
<tr>
<td>COD</td>
<td>mg/L</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>TSS</td>
<td>mg/L</td>
<td>100</td>
<td>30</td>
</tr>
<tr>
<td>Oil and Grease</td>
<td>mg/L</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Ammonia</td>
<td>mg/L</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>Total Coliform</td>
<td>N/100 mL</td>
<td>-</td>
<td>3,000</td>
</tr>
<tr>
<td>Discharge</td>
<td>L/person/day</td>
<td>-</td>
<td>100</td>
</tr>
</tbody>
</table>
The Stakeholders Meeting in Indonesia

To tackle this urgent problem, we have launched “the Stakeholders Meeting on domestic wastewater treatment” in 2015.

Central gov.  
BSN  
Manufacturers  
Univ.  
Local gov.  

Industry-Academia-Government Collaboration

Summary of discussion

- **We need more manufacturers to distribute domestic wastewater facilities in all Indonesia.**
- **However, it's easy to make a profit if they produce poor performance and/or weak tanks.**

To eliminate low quality treatment facilities from the market

Performance testing method and Reliable certification system are required!!
Significance of this study for the Workshop

Summary
1. Proposal for treatment process for low-volume, high-load effluent
2. Proposal for means of greenhouse gas emissions reduction

Objectives
1. Contribution to “halving the proportion of untreated wastewater” in the SDGs
2. Contribution to “the mitigation of greenhouse gas emissions” in The Paris Agreement (COP21)

Transition of johkasou development goals

- Sewerage: 97.9% (2015)
- Wastewater: 90.4% (2016)

* Sanitation → Sanitation + Environment
  - BOD removal → BOD, N, P removal
  - Downsizing
  - Diversification of influent
  - Global warming countermeasures
  - Maintenance efficiency improvement
  - Earthquake-resistant structures

Aquatic infrastructure coverage ratio in Japan

The system to minimize environmental loads in the water cycle

Build the system to minimize environmental loads in the water cycle

Water resources security, Carbon reduction, Promotion of water-saving devices available in emergencies

Efficient use of water resources, Carbon reduction, Promotion of water-saving devices for water use in emergencies

Low-flush toilets

Sanitation security
Toilet cleaning
Waste conveyance

Functionality

Other water-saving devices (shower)
Hot water saving
Energy-saving devices

Functionality
Carbon reduction

Correlation coefficient of greenhouse gas emissions with water consumption

0.20 kg-CO₂ m⁻³-water

Water-saving devices contribute to efficient use of water resources, reduce carbon, enable use of water in emergencies
Aquatic environmental load discharge and greenhouse gas emissions

Aquatic environmental load discharge = Water quality × Water volume

Advanced treatment

Reduces aquatic environmental load discharge without heavier facility

Energy consumption rises 3) ~ 5)
Greenhouse gas emissions increase

Greenhouse gas emissions?

Scope & object of jokhasou greenhouse gas emissions study

Scope of jokhasou greenhouse gas emissions study

Object of study: jokhasou for detached households (over 90% of shipped jokhasou)

3) Japan Institute of Wastewater Engineering and Technology: 水処理場におけるエネルギー管理に関する技術資料 (Japanese), pp.15–16, 2009
**Purpose of study**

- Assess the influence of water-saving devices on jokkasou's performance and greenhouse gas emissions

**Intention of water-saving devices**

- Influence on effluent quality before & after the introduction of water-saving devices
- Influence on GHGs emissions before & after the introduction of water-saving devices

**Summary**

- Decentralized small-scale jokkasou is easily influenced by users' water use
  - Unstable performance
  - Increased GHG emissions

- Water-saving devices: Saving water by 22%
- Circulation from aerobic chamber to anaerobic chamber
- Flow control function

- C • N reduction
- GHG emissions reduction
  - Reduce BOD load by 24.8%
  - Reduce GHG emissions by 38%
  - Remove N by nitrification • denitrification
  - Efficient use of water resources • Aquatic environment protection • Global warming countermeasures • Decentralized small-scale jokkasou
7.5 Johkasou Navigator Certification Organization

Contents

(I) Intro  - NPO Johkasou Navigator Certification Organization

(II) Business system of johkasou in Japan

(III) Operational management and its optimization

(IV) Business model of diffusion

(V) Summary - utilization of sustainable johkasou system

(I) Intro

- NPO Johkasou Navigator Certification Organization

Logo mark

- Assessing and certificating domestic wastewater treatment technologies, products and services
- Spreading and developing johkasou system for urban development and life quality improvement
- Training, supporting business management and municipal administration
- Supporting overseas technology transfer and international businesses
- Building networks between academy-industry and public-private for aquatic environmental protection

69
(I) - 1 Activities

- Presentation and lecture
- Practical training
- Visiting research

(I) - 2 Assessment-certification system

Points of corporate engagements

- Environmental load management
- Qualification registration management
- Maintenance management and legal regulation
- Maintenance checklist
- Inputs and outputs of business activities
- Environmental business system
- Business management planning
- Environmental control policy
- Correction management of environmental control system
- Training, education for emergency
- Quality management
- Inspection management
- Chemicals management
- Machinery management
- Water quality maintenance/development management

- Assessing and certificating the appropriateness of a range of jokkasou business engagements
(II) Business system of johkasou in Japan

- Flow chart for installation (according to Johkasou Law)

(II) - 2 Solutions for spread of the johkasou system

1. Access to installation and maintenance state
2. Information management for guidance on unmanaged plants
3. Access to information about inappropriate johkasou and its supervision
4. Promoting the legal inspection and the effective use of it
5. Promoting the transfer from cesspools to johkasou
6. Planning and reviewing domestic wastewater treatment scheme
7. Appropriate black water treatment during disaster
8. Residents inquiry/claim handling system
9. Business management for johkasou promotion businesses
10. Information collection for policy drafting (development scheme)
11. Business efficiency improvement and cost reduction
12. Black water/sludge treatment scheme
(III) Operational management and its optimization

1. Municipality-led promotion
2. Establishment of maintenance management system
3. Realization of appropriate operational management (supervision system)
4. Development of johkasou-related corporations and their skills
5. Waste treatment (sludge etc.)

⇒ Proposing the johkasou operational management system that uses ICT

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**ICT Service Utilization**

- **Operational status monitoring**
  - Appropriate effluent control
  - New/Change/Cancel state
  - Construction/Maintenance/Inspection/Cleaning state

- **Johkasou information management**
  - Promotion of database
  - (Construction/Inspection/Cleaning recording)

- **Easy check of management status**
  - Promotion of appropriate use
  - (Inspection result/Contract contents/Scheme)

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1. Standardize the unified management system using ICT!
2. Make management more timely and precise (PDCA and correction)
3. Effectively reduce municipal labour and operational costs
### Main functions of ICT system

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Correction</td>
<td>1. Operation diagnosis</td>
<td>• Diagnose the management status in 4 phases</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Technical knowledge free! Easy check</td>
</tr>
<tr>
<td></td>
<td>2. Malfunction detection</td>
<td>• Detect malfunction and notify the solutions</td>
</tr>
<tr>
<td>2. Unified management</td>
<td>3. PDCA state</td>
<td>• Access to state of installation/operation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Access to state of certificate/register</td>
</tr>
<tr>
<td></td>
<td>4. Map</td>
<td>• Enable access to distribution of installed johkasou</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Promote the efficiency of on-site check</td>
</tr>
<tr>
<td>3. Operation efficiency</td>
<td>5. Database</td>
<td>• Promote the johkasou database</td>
</tr>
</tbody>
</table>

- **Appropriate operational management** even for beginners!
- Unified management enables **access to the status** to improve operational efficiency
- Supports **service quality improvement** of companies and supervisors!

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![Sample1 Main Menu](image-url)
Utilization of sludge

Sludge generated during the process of wastewater treatment can be recycled and reused as treatment function adjuster for johkasou

(V) Summary – utilization of sustainable johkasou system

- Municipality-led promotion
  - Contributes to local development
    - Public sanitation
    - Job creation
    - Energy
    - Waste treatment
    - Disaster countermeasure

- Business system construction scheme development
  - Legal system scheme construction
    - Installation
    - Maintenance
    - Cleaning
    - Inspection
    - Waste treatment

- Operational management correction
  - High utilization through technology cooperation
    - ICT
    - Sensor
    - Control
    - IOT

Approach to the sustainable development of wastewater treatment plants!!