Demonstration of a technology for highly efficient nitrogen removal using fixed-bed anammox process

**Research Consortium**
Consortium between Kumamoto City, Japan Sewage Works Agency and Takuma Co., Ltd.

**Demonstration Field**
Tobu Wastewater Treatment Plant, Kumamoto City

**Project Outline**
By applying highly efficient anammox process using the fixed-bed system for the removal of nitrogen from the reject water of sludge treatment (dewatering of anaerobic digestion sludge), continuous operation of a full-scale demonstration plant was performed. Cost and energy saving effects, as well as nitrogen removal performance were demonstrated.

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**Outline of Technology**

**Nitrogen removal technology combining partial nitritation and anammox processes**

Control of nitrogen concentration ratio by bypass method

- Reduction of BOD-SS (if necessary)
- Conversion of NH4-N and NO2-N to N2 gas
- Conversion of part of NH4-N to NO2-N

Outline of Technolog:

- Pretreatment facility
- Nitritation tank
- Anammox tank
- Conversion of NH4-N
- Carrier immobilized nitrite-forming bacteria in Nitritation tank
- Carrier immobilized anammox bacteria in Anammox tank

**Features of Demonstration Technology**

**[Features]**
- Low-cost and energy-saving nitrogen removal technology using anammox reaction
- To be applied to reject water treatment in order to reduce the nitrogen load and effluent nitrogen concentration in mainstream wastewater treatment.

**[Advantages]**
- In comparison with conventional nitrogen removal technology (biological nitrification-denitrification processes)
  1. Reduced aeration
  2. No organic matter addition for denitrification
  3. Reduced footprint
  4. Reduced sludge generation

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Outline of Technology:

- **2-stage anammox process**
- **Use of fixed-bed reactors carrier**

Schematic flow of demonstration:

<table>
<thead>
<tr>
<th>Influent water</th>
<th>Pretreatment facility</th>
<th>Nitritation tank</th>
<th>Anammox tank</th>
<th>Conversion of part of NH4-N to NO2-N</th>
<th>Treated water (Returned to water treatment facility)</th>
</tr>
</thead>
</table>

Chemical reactions:

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\text{NH}_4^+ + 1.32\text{NO}_2^- + 0.066\text{HCO}_3^- + 0.13\text{H}^+ \rightarrow 1.02\text{N}_2 + 0.26\text{NO}_3^- + 0.066\text{CH}_2\text{O}_{0.5}\text{N}_{0.15} + 2.03\text{H}_2\text{O}
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