Efforts for effective use of sewerage resources in Japan

Sewerage and Wastewater Management Department
Ministry of Land, Infrastructure, Transport and Tourism, Japan
There are about 2100 wastewater treatment plants in Japan. Most plants adopt aerobic treatment methods such as conventional activated sludge process or oxidation ditch process.

As for the GHG emission from sewerage system, the emission from electricity (treatment plant) accounts for 54% and the emission from sludge incineration accounts for 20%.

Greenhouse Gas Emissions from sewerage system In Japan FY 2009

- Total amount: 6.7 Mt-Co2
- Electricity (treatment Plant): 54%
- Wastewater Treatment (N_2O): 20%
- Sludge incineration (N_2O): 20%
- Fuel: 6%
- Electricity (Pump Station): 6%
- Wastewater treatment (CH_4): 4%
- Others: 0%
The material use of sewage sludge has steadily increased, since the efforts on reduction of sludge volume became an obligation by new Sewerage Law.

- The rate of material use has reached about 77% in 2009.
- The rate for cement use is the largest in any use.

Transition of material use

- Sewage Sludge Recycle Rate
- Construction Material (Cement)
- Construction Material (Excluding Cement)
- Fertilizer
- Others
- Fuel, etc
- Land fill

Utilization of Digestion gas is not included.
Energy Use of Sewage Sludge

- About 80% of sewage sludge comprises organic matter and it can be used to generate energy by producing solid fuel or biogas.
- Biomass recycle rate remains 24% in 2009 (The rate for energy generation is only 13%).
  ※Biomass recycle rate: percentage of the organic matter which is efficiently used as digestion gas or fertilizer.

Energy Use of Sewage Sludge

- **Sewage Sludge (Biomass)**
  - Methane Fermentation
    - Biogas
  - Fuel
    - Solid Fuel

Biomass Recycle Rate
- About 24% (2009)
  - Digestion gas usage 12.4%
  - Solid fuel 0.8%
  - Use for fertilizer 11.2%
  - Unused as biomass 75.6%

Total amount of biomass 1.79 million tons

- Electric generation by Digestion gas
- Fuel for natural gas vehicles
- Injection of biogas into city gas pipe
- Solid fuel usage

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※Biomass recycle rate: percentage of the organic matter which is efficiently used as digestion gas or fertilizer.
- There are digester tanks in about 300 treatment plants. About 70% of the biogas generated by digestion (218 million m³) is utilized, but the rest (86 million m³) is incinerated.
- Sewage biogas can be used more efficiently, because although about 20% of biogas (66 million m³) is used for the power generation, about 30% (86 million m³) is used only for heating digester tanks.
- In 2009, electricity generated from sewage biogas covered about 2% of the total electricity consumption in sewerage facilities.

【Biogas Yield and its Usage】

About 30% of biogas is unused
Toward Promotion of Energy Use

(Measure 1)
It is necessary to develop technologies such as low cost and high efficient energy utilization technology by the leadership of the government in order to promote the energy use by the local governments.

B-DASH Project (Government funded technology R&D and demonstration project: Breakthrough by Dynamic Approach in Sewage High technology)【2011～】

(Measure 2)
It is necessary to prepare for the promotion of energy use of sludge under the cooperation between public and private sectors.

- **Feed-in Tariff**
  (The Act on Special Measures concerning the Procurement of Renewable Electric Energy by Electric power company)

- **Obligation of Biogas Use by Energy Supply Companies** (Act of Sophisticated Methods of Energy Supply Structures)
Accelerate the government-led development of new technology and its practical application by promoting technical validation through installation of actual size plants and by formulating guidelines.

Achieving cost reduction in the sewerage projects and generation of renewable energy.

As for the methane gas, implementing high-efficient and high-temperature digestion with carrier filling digester, and high-efficient gas purification technology, etc.

<table>
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<th>Budget</th>
<th>2.4 billion yen (2011FY)</th>
<th>2.9 billion yen (2012FY)</th>
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Since July 1, 2012, electric power providers will be obliged to purchase electricity generated from renewable energy sources on a fixed-period contract at fixed prices.

Feed-in Tariff for Renewable Energy (July. 2012~)

- Promote the utilization of non-fossil fuel and the efficient utilization of fossil fuel by operators of energy utilities (Electric, Oil, Gas Supplier)
- General gas providers are obliged to utilize more than 80% of biogas generated in their supply areas in 2015. (the obligation is only for the biogas available in reasonable price for the gas providers)

Act of Sophisticated Methods of Energy Supply Structures (August. 2009~)
Injection of biogas into the city gas pipe

- Osaka Gas
  - Buying of highly-refined biogas
  - Supply as city gas

- Shinko Environmental Resolution
  - Construction and operation of high refining facilities of Kobe Biogas

- Kobe City
  - Supply of Kobe Biogas

Pipe introduction rate (initial); about 80,000 m³/yr (as converted to 45 MJ)

Low-carbon circulation type city planning

Homes
- Kitchen
- Bath

Wastewater
- Kobe-City Higashinada Treatment Plant

Reclaimed wastewater
- Sewage sludge

Injection of biogas into the city gas pipe

Gas pipe
- Odorization
- Adjustment of calorific power
- Removal of trace components

Gas pipe

Kobe biogas
- For City gas supply
- For internal usage

Automobiles fuels
- City buses, vehicles for home delivery
- Operation started in August 2008
- Number of vehicles filled with biogas; 10,650 vehicles/year

Wastewater
- Kobe City Higashinada Treatment Plant

Reclaimed wastewater
- Sewage sludge

Digestion gas

Digestion gas refining facilities
- Middle-pressure gas tank

Kobe biogas station

Refined gas

Kobe biogas

CH4: 97% or more
CO2: 3% or less
Higher calorific power: about 39MJ/m³

CH4: about 60%
CO2: about 40%
Higher calorific power: about 23MJ/m³

Case of Biogas Use in Sewerage System
(Kobe City)
Increase the amount of biomass by treating not only sewage sludge but also food waste (coffee grounds), raw garbage (disposer) and septic tank sludge, etc.

Generated methane gas is used to generate electricity which is used inside the treatment plant. Dry sludge is used for the fertilizer, etc.

**【PFI (private finance initiative) Project in Kurobe City】**

- Increase the amount of biomass by treating not only sewage sludge but also food waste (coffee grounds), raw garbage (disposer) and septic tank sludge, etc.
- Generated methane gas is used to generate electricity which is used inside the treatment plant. Dry sludge is used for the fertilizer, etc.

**Digestion gas generation facility**

**Retention Facility**

**Use for fertilizer**
Wastewater Treatment Plant as an Energy Supply Facility

- **Increasing energy self supply rate** by utilizing energy from sewerage
- Work as **Energy Supply Hub** by concentrating the treatment of other biomass which generate in a region.
- **Utilization of wastewater heat** from sewerage pipe network in the city

**Benefits for Community**
- Climate Control
- Business Improvement of Sewage Projects

**Electricity**

- **Electric Power Provider**

**Heat**

- **Heat Supply Facilities**

**Energy Supply Hub**

- **Incineration heat wastewater heat**

**Solid Fuel Production**

- **Bio solid fuel production**

**Energy Use**

- **Wastewater Treatment Plant**

**Wastewater Heat as an Energy Supply Facility**

- **Office Building**
- **Household**
- **City Gas Plant**

**Energy Supply Structures**

- **CNG Car Fuel**
- **Biogas Station**

**Biogas Use Promotion by Act of Sophisticated Methods of Energy Supply Structures**

- **Feed-in Tariff**

- **(Wastewater heat utilization by deregulation)**

- **Biogas Use Promotion by Act of Sophisticated Methods of Energy Supply Structures**

- **(R&D by B-DASH Project)**

- **Methane Fermentation Facility**

- **Scrap Wood**

- **Farm Sludge**

- **(Biogas Use Promotion by Act of Sophisticated Methods of Energy Supply Structures)**