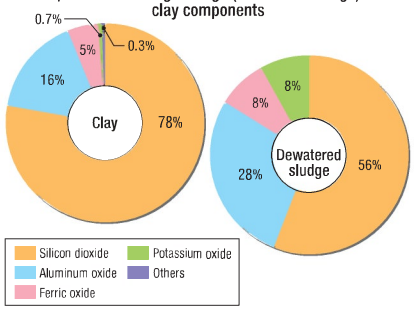
2. Utilization of sludge

Most of the sludge generated by sewage treatment was disposed of in coastal landfills, and the rest was dumped into the sea. However, taking into consideration the impact this has on the environment, disposal in coastal landfills was abolished by the end of September 1998, and sea dumping was also abolished by the end of March 1999. Currently, among the 170 tons of sludge generated a day, 100 tons of sludge is used as material for cement and the remaining 70 tons is made into fuel, and is used in factories in the city as an alternative to coal.

Comparison of sewage sludge (dewatered sludge) and clay components



(1) Use of sewage sludge as material for cement

a. Effective use of sludge developed in cooperation with private enterprises

Due to similarities of components between sewage sludge and clay for cement raw material, cement production using sewage sludge in place of clay has been in operation since FY 1997 in cooperation with the private companies.

b. Advantages of using sewage sludge as material for cement

- **No waste is generated**
  Since sludge is added directly into the cement production process, the whole volume of sludge can be used as material for cement and no waste is generated.
- **No odor is generated**
  Since sludge is added into the process with a temperature of about 1,500°C, components of odor are completely decomposed and no odor is generated.
- **A large volume of sewage sludge can be recycled**
  Recycling of 40,000 tons of sewage sludge per year as material for cement is one of the largest scale operations of this kind in Japan.
- **Geographical advantage**
  Since private cement production factories are located near the water purification plants in the city, there are advantages, such as lower transportation cost, less problems with odor during transport, easier cooperation with the cement production factories in the operations, etc.

(2) Producing fuel from sewage sludge (from October 2015 onwards)

a. Recycling waste into fuel

Producing fuel from sewage sludge is a project that has been in place since October 2015, where it replaces the co-incineration of general waste that had been in practice from April 1999 with a sewage sludge treatment method. The purpose of the project is to produce fuel from sewage sludge collected in the Hiagari Sewage Treatment Plant from 4 other sewage treatment plants, sell the recycled resource to business operators in the city that possess coal boilers as an alternative to coal.

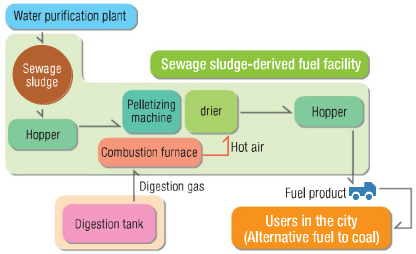
b. Characteristics of sewage sludge fuel

Co-incineration with general waste is a unique sludge treatment method in Kitakyushu City, where the water purification plant and the incineration plant are located closely. The sludge drying facility was constructed for this sludge treatment method.

- **Generating high-calorific value fuel**
  "Granulation and drying method" is adopted which is capable of transferring 100% of the energy sewage sludge possess to product fuel.
- **Contributing to a low-carbon society**
  Using the digestion gas generated from within the Hiagari Sewage Treatment Plant as fuel, which significantly reduces the amount of CO_2 generated.
  Also, as the produced fuel is carbon neutral, substantial reduction of CO_2 generation can be expected when the fuel is used by the business operators in the city, which contributes to a low-carbon society for the city.

c. Project implementation using the DBO approach

When implementing the project, the DBO (Design-Build-Operate) approach is adopted, which allows the application of private-sector know-hows to the project so that the design, construction, maintenance and operation of the advanced sewage sludge fuel facility and sale of the production fuel can take place steadily at low costs over a long period of time.



3. Utilization of unused energy

(1) Utilization of digestion gas (Hiagari Sewage Treatment Plant)

The digestion gas generated from sludge in the sewage treatment process contains a large quantity of methane gas, and is a precious energy source with a calorific value at 24MJ/ . Kitakyushu effectively utilizes this as fuel for drying sewage sludge to make sewage sludge fuel and for electric power generation (150kW).

(2) Utilization of natural energy (Shinmachi, Hiagari, Kitaminato Water Purification Plants)

Within the lands and facilities of the water purification plants, solar power, wind power and small hydro power generation systems are installed, and the number of the power generation systems will be increased in the future.

- Solar power generation: Shinmachi (210kW), Hiagari (270kW), Kitaminato (97kW)
- Wind power generation: Hiagari (3kW)
- Small hydraulic power generation: Hiagari (1kW)

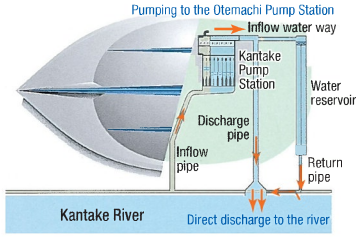
4. Effective use of sewer system facilities

(1) Effective use of water purification plants and pump stations

The water purification plants and pump stations are precious spaces with abundant greenery and water in the urban area. Kitakyushu City has been promoting the projects which prepare the spaces as sports facilities, parks, open areas and places where citizens can experience nature, enjoy plays, study and research water. In Sone Water Purification Plant, a part of the premises has been open to the citizens as a community park, where the park and the sewer system have been developed in an integrated manner.

Kantake Pump Station

The Media Dome, opened in 1998 is located in an urban area and is the largest all-weather and versatile event facility in Kitakyushu City. Under the Media Dome, there are underground facilities: "Kantake Pump Station" and "Rainwater Reservoir" for transferring sewage forcibly, by which the amount of polluted water to be discharged to the Kantake River is controlled.

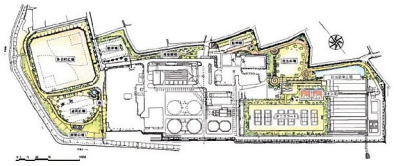


Sone Water Purification Plant

"Yoshida Taiyo-no-Oka Park" utilizes recycled resources effectively and serves as a place for environmental education for citizens to learn the circulation system of sewer system facilities.

- Plant area: About 5.8ha
- Main facilities:
  [West side] Rest house, multi-purpose square, lawn square, waterfall, parking lot
  [East side] Tennis court, parking lot, lawn square

Map of Yoshida Taiyo-no-Oka Park



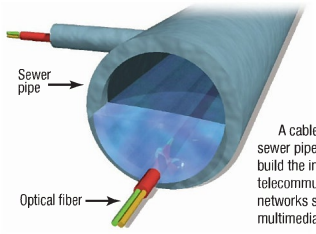
(2) Effective use of sewer pipes

The Sewerage Service Act was revised as part of deregulations in FY 1996, and persons other than administrators for the sewer system became able to use parts of sewer pipes. This revision is for the purpose of facilitating effective use of underground spaces by making the sewer pipes open to telecommunication business operators who intend to install optical fibers in order to promote the preparation of a sophisticated information infrastructure.

Also in Kitakyushu City, the relevant regulations, etc. were prepared in April 1999 to call telecommunication business operators' attention to effective use of sewer pipes.

Consequently, about 6 km optical fibers have been installed so far, making use of sewage pipes.

Preparation of optical fiber network



A cable laid in the sewer pipe enables us to build the information and telecommunications networks supporting the multimedia society.