

# Sewage Sludge Gasification

*The first wastewater and sewage sludge gasification system in Japan has commenced operations in the town of Kiyose, Tokyo. Miho Kawasaki reports.*

**T**he Tokyo Metropolitan Government (TMG) is promulgating the 10-Year Project for a Carbon-Minus Tokyo, with a stated objective of reducing greenhouse gas emissions by more than 25% from 2000 levels by 2020. A survey conducted in 2008 showed that greenhouse gas emissions for Tokyo Metropolitan administrative and business activities overall stood at 2.08 million tons, of which emissions from treatment of wastewater accounted for 876,000 tons, or 42% of the total. Accordingly, the thinking has been that initiatives on the part of the wastewater work will be essential to achieve the stated target.

The fact that greenhouse gases are emitted in large quantities from sewage treatment facilities is because sewage sludge from wastewater

treatment was burned with natural gas or oil in incinerators at conventional wastewater treatment facilities. Sewage sludge contains a significant amount of nitrogen, which, when burned, emits large quantities of nitrous oxide ( $N_2O$ ), which is reported to have 310 times as much greenhouse effect as carbon dioxide ( $CO_2$ ).

The sewage sludge gasification furnace was accordingly developed in order to reduce  $N_2O$  emissions as much as possible and reuse the pyrolysis gases that are emitted in the course of gasification. TMG built a plant in the Kiyose Water Reclamation Center (KWRC), and brought the facility fully online on July 1, 2010. Currently, the plant is processing approximately 100 tons of waste each day. The plant measures 70 x 43 meters and at its tallest point, the

smokestack, is approximately 30 meters high. The gasification furnace that comprises the heart of the plant is a cylindrical shape measuring 96 cm in diameter and 10 meters in length. Other component fixtures of the plant include a desiccator for dewatered sludge, a unit for reforming the gas that is emitted from the gasification furnace, and a gas engine for generating electricity.

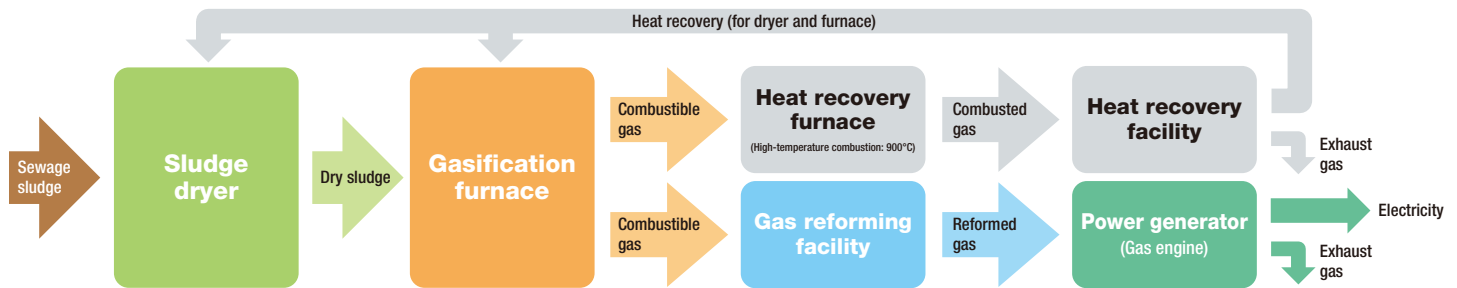
## How the Furnace Works

The sewage sludge that remains



The sewage sludge gasification furnace plant at the Kiyose Water Reclamation Center, Tokyo.

## Sewage Sludge Gasification Process



after clean water is extracted from the waste water that is delivered to the KWRC is first conveyed to the sludge dryer at the sewage sludge gasification furnace plant, where it is desiccated to between 20% and 30% of its original water content. After it is desiccated, the sewage sludge is pyrolyzed in the gasification furnace.

“Unlike a conventional incinerator, the gasification furnace doesn’t simply burn sewage sludge, it pyrolyzes it, at temperatures between 780 to 800 degrees Celsius,” explains Shinichi Sakamaki of the Tokyo Metropolitan Government’s Bureau of Sewerage. “The interior of the furnace is maintained in a low-oxygen state, which allows us to significantly reduce levels of nitrous oxide emissions.”

Pyrolytic gases extracted in the gasification furnace, including flammable gases such as carbon monoxide, hydrogen and methane, are conveyed to the heat recovery furnace and the gas reforming facility. In the heat recovery furnace, the gas is burned at a high temperature and the heat recovered is used for the sludge dryer and gasification furnace. On the other hand, in the gas reforming facility, gases containing impurities such as ash, nitrogen and sulfur are removed, and the remaining gases are conveyed to the gas engine for generating electricity. The gas engine is capable of generating 150 kw per day, which, accord-

ing to Sakamaki, is equivalent to some 30% of the electricity consumed by the gasification furnace plant.

In 2005, the amount of greenhouse gases, namely CO<sub>2</sub>, that were emitted annually at the KWRC totaled 14,400 tons. In contrast, it is estimated that the adoption of the gasification furnace will allow this amount to be reduced by 87%, or 12,500 tons.

According to Sakamaki, whereas the gasification furnace technology has been used in garbage processing centers and the like, the present facility is the first instance of such a furnace being used with sewage sludge in Japan, and there are no other similar instances anywhere else in the world.

“Constituents of sewage sludge fluctuate significantly, which complicates attempts to predict such things as quantities of heat that can be extracted from the sewage,” he says. “All of this increased the amount of time necessary to implement the furnace for this application.”

Given the potential for such a facility to be a deciding factor in environmental protection initiatives, other regional districts are showing considerable interest, with many concerned parties visiting the facility to observe the furnace in action, according to Sakamaki.

*Miho Kawasaki is a freelance writer.*