The study of digestive gas co-generation system using micro-gas turbines

Whole term	2003.4～2005.3	

(Purpose)

Utilization of sewage sludge, being biomass derived from living thing has long been studied in the related industry. Especially for the utilization method of digestive gas, we have enough information data piled up so far. However, due to cost-effect problem, utilization of digestive gas is not active at present.

This study aims at searching for a suitable system and its scale to be applied when developing digestive gas power generation at sewage plant using a micro-gas turbine (herein-after called as MGT) which is presently drawing people's attention because of its suitability for small scaled distributed power generation system The research also aims at finding a method of refining the digestive gas, how to study the system or precautions on applying and advantages etc., in order to prepare technical data..

(Result of research)

1. Scope of MGT application

(1) Gas consumption by MGT

To run one unit of MGT of model A (30kW) or model B (80kW) in the rated output, 120 kWh (430,000 kJ/h) power is required for model A (30kW) while 320 kWh (1,150,000 kJ/h) for model B (80kW). Such necessary power can be converted into about 170,000 Nm^3/year and 460,000 Nm^3/year of digestive gas for Model A and Model B, respectively.

(2) Relation between sewage throughput and digestive gas volume to be generated

The volume of sludge produced during sewage treatment process is said to be about 1 to 2 % of all the volume of raw sewage that flows in (Moisture content 98-99%). While digesting the sludge, about 500 to 600 NL of digestive gas is generated per kg of organic substance. Assuming that the volume of sludge is 1.5% of the volume of raw sludge flown in, moisture content 98.5%, organic substance in the sludge 80%, the cubic content of the digestive gas generated will be about 1/10 of the total raw sewage water that flows in.

(3) Applicable scale of MGT

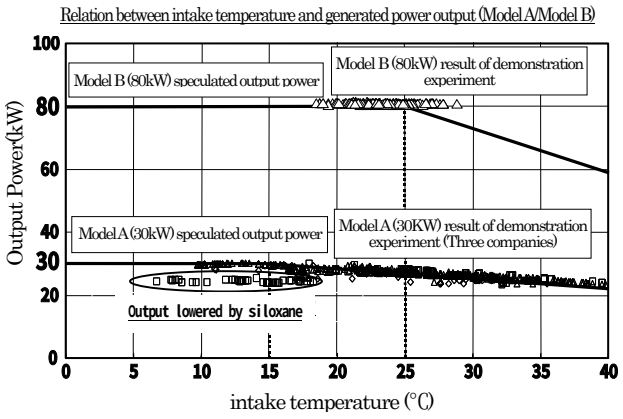
Since the digestive gas volume so generated is about 1/10 of all the raw sewage volume flown in, daily treatment volume will be about 160 m^3/day for 1kW of output power.

2. Removal of trace substance (siloxane)

The digestive gas contains some trace elements such as, inorganic and organic substances. Among others, siloxane is regarded to be the cause of various troubles in the combustion system. In MGT therefore, it is necessary to install such harmful substance removing device. As for the influence that siloxane has on MGT and its concentration standard, we have to study in the future because there is no long-term running record in Japan at present.

3．Speculated performance and the result of demonstration experiment

The figure at right shows the result of comparison between the speculated performance (output power) and demonstration experiment result. For both the models A and B, we could obtain the result almost equal to our speculation. As for the model A, there are some lower temperature ranges in the demonstration experiment. These are the result obtained when the siloxane removal device was not installed yet.



4．Effect of introduction

（1） Cost evaluation

We could not perform cost effect evaluation of this case because we have only a few examples of MGT application for sewage system, being unable to establish their initial and running costs.

（2） Evaluation on environmental load (Reduction of greenhouse effect gas)

Upon calculating the greenhouse effect gas (reduction of CO_2 emission) when MGT was used for heating the digestive facility, it is expected to reduce 235t-CO_2/unit per year in case of the model A while 624t-CO_2/unit per year in case of the model B.

（3） Evaluation on environmental load (Energy payback time (herein after called as EPT))

Upon calculating EPT of MGT (for only MGT), we could obtain the result of approx. 0.1 year. We compared this result with the other power generation systems as follows: Large scale wind power generation: 8 – 10 years; Solar system: 4 – 6 years; and solar hot water boiler: several months. This means the method using MGT could obtain considerably low value, proving itself to be an effective system with low environmental load.

Co-researcher：Japan Institute of Wastewater Engineering Technology
Ebara Corp., Sanki Engineering Co., Ltd.,
JFE Engineering Corp., Takuma Co., Ltd., Tsukishima Kikai Co., Ltd.,
Hitachi Plant Engineering & Construction Co., Ltd.
Researchers in charge：Ryuichi Takahashi, Takashi Kirihara, Hisaya Nagata, Hiroshi Nakamura

key words	Micro-gasturbine, Cogeneration