Research Trends and Results

Empirical Studies for The B-DASH Project (Solid fuel forming, sewage heat utilization, nitrogen removal, phosphorus removal / recovery)

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1. Introduction

Sewerage infrastructure is social capital essential to public life and its potential uses, e.g., utilization of sewage sludge and sewage heat as energy, and utilization of phosphorus as resource are increasingly sought as a response to the issues of global warming and the tight supply of resources and energy, as well as measures for reducing greenhouse gases.

New technologies responding to such social and administration needs have begun to be developed but are less used in practice since many sewerage service providers are cautious about their introduction. For this reason, the Sewerage and Sewage Purification Department of the MLIT launched the "Breakthrough by Dynamic Approach in Sewage High Technology" (B-DASH) project in fiscal 2011, and the Water Quality Control Department of the NILIM serves as an executing agency of this empirical study. The objective of the B-DASH project is to reduce the costs of sewerage projects, create renewable energy through the verification and dissemination of innovative technologies and support the overseas development of the water business by Japanese enterprises.

2. Outline of the B-DASH Project

Under the B-DASH Project, the NILIM contracts out studies of innovative technologies to the public and conducts peer reviews of research organizations (contractor) that build full-scale sewage treatment plants in order to verify treatment stability, the applicability of technology, and the cost reductions, decreases in greenhouse gas emissions, and energy-saving effects resulting from introduction of the technology, etc. Based on the results of such verifications, the NILIM formulates guidelines for introducing the technologies. In formulating research findings and guidelines, the advice and evaluations of experts are obtained.

In fiscal 2011, two empirical studies of biogas utilization technology were conducted and the corresponding guidelines were formulated in July 2013.

In fiscal 2012, five empirical studies concerning technology for converting sewage sludge into solid fuel, technology for utilizing unprocessed sewage heat, and technology for removing and recovering nitrogen and phosphorus derived from sludge treatment were adopted. In fiscal 2013, these studies were continued to verify results and formulate guidelines.

In fiscal 2013, two empirical studies concerning power generation system technology using exhaust heat from combustion of sewage sludge were adopted, and the technology was put into practice.

Of these technologies, this paper gives an overview of the verification technologies adopted in fiscal 2012.

3. Outline of verification technologies adopted in fiscal 2012

(1) Technology for converting sewage sludge into solid fuel

(i) Empirical study on next-generation technology for converting sewage sludge into solid fuel without emitting greenhouse gas (Joint Research Organization of Nagasaki City, Nagasaki Institute of Applied Science, and Mitsubishi Nagasaki Machinery MFG Co., Ltd.)

This technology consists of the steps of hydrothermal reaction, high-rate digestion, dehydration, and drying processes. The plant hydrolyzes the degradable solid organic matter in sewage sludge by hydrothermal reaction, converts water-soluble organic matter into digester gas through high-rate digestion to utilize it as a heat energy source, and dehydrates and dries the residue in the remaining sludge to form solid fuel (**Photo 1**).

Figure 1: Appearance of Verification Facility (Nagasaki Eastern Sewage Treatment Facility)

(ii) Empirical study on the utilization of waste heat using low-cost technology for converting sewage sludge into solid fuel (JFE Engineering Corp.)

The technology uses the unutilized waste heat of an incinerator (about 300 °C) and surplus digester gas as a heat source for drying sludge in order to manufacture solid fuel with surface solidification drying equipment, and uses the solid fuel for the incinerator to reduce the use of supplemental fuel (**Figure 2**).

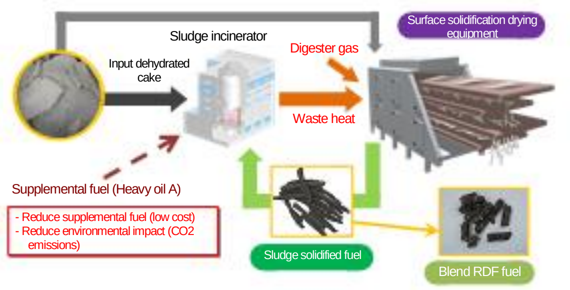

Figure 2: Processing Flow (Surface solidification drying technology)

(2) Technology for utilizing unprocessed sewage heat

○ Empirical study on sewage heat utilization using in-line heat-recovery technology (Joint research organization of Osaka City, Sekisui Chemical Co., Ltd., and Toa Grout Kogyo Co., Ltd.)

This technology installs a heat exchanger in a sewage pipeline when renovating deteriorated pipe, such as incurrent pipes and sewage mains at treatment facilities. Untreated sewage flows through the heat exchanger, and recovers sewage heat to utilize it for local air conditioning via a heat pump. The technology enhances the efficiency of the heat pump by utilizing the sewage temperature, which is higher than outside in winter and lower in summer (**Figure 3**).

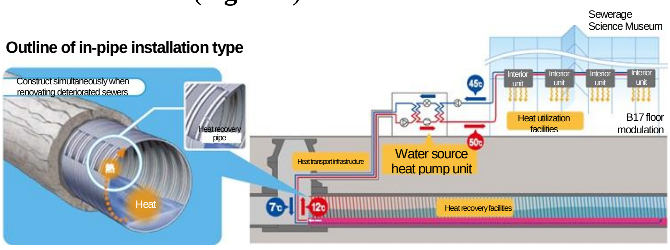

Figure 3: Flow in Verification Facility (In-pipe heat recovery technology)

(3) Technology for removing and recovering nitrogen and phosphorus derived from sludge treatment

(i) Technical empirical study on highly efficient nitrogen removal technology for fixed bed type Anammox process (Joint research organization of Kumamoto City, Japan Sewage Works Agency, and Takuma Co., Ltd.)

For removing nitrogen in the returned water derived from sludge treatment, this technology applies Anammox reaction technology and a fixed bed (function of Anammox bacteria converts ammonia and nitrite nitrogen into nitrogen gas under an anaerobic conditions) to reduce air demand, chemical costs, sludge generation, etc. (**Figure 4**).

Figure 4: Appearance of Verification Facility (Kumamotoshi Eastern Purification Center)

(ii) Empirical study on innovative technology for nutrient removal and resource recycling (Joint research organization of Swing Corporation, Kobe City, and Mitsubishi Shoji Agri-Service Corporation)

This technology aims to improve phosphorus yield as MAP (magnesium phosphate ammonium) suitable for fertilizer raw material by removing and recovering phosphorus directly from digestive fluid with a complete mixing crystallization reactor, and to control piping blockade with MAP (**Figure 5**).

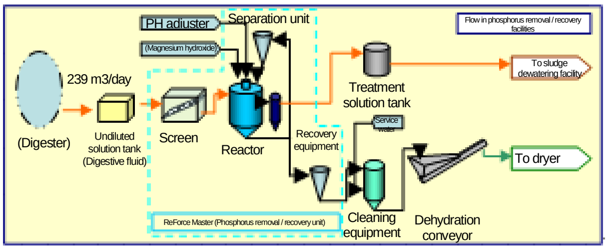

Figure 5: Flow in Verification Facility (Phosphorus removal / recovery technology)

4. Future development

The NILIM will continue to spearhead verification studies and in turn formulate guidelines on technology introduction based on study findings, and promote the dissemination of guidelines.

[Reference]

http://www.nilim.go.jp/lab/ebg/index.htm