

No.6005

Demonstration of Drying Sewage Sludge Containing Radioactive Materials for Storage and Transport

Hiroshi Suzuki

Mitsubishi Research Institute, Inc.
Tokyo, Japan

Hisao Tohma

Nippon Steel & Sumikin Engineering
Tokyo, Japan

Hirokazu Ishii

Japan Sewage Works Agency
Tokyo, Japan

Shigeru Kishida

Ministry of the Environment
Tokyo, Japan

Abstract

Due to the accident at Tokyo Electric Power Company's Fukushima Daiichi Nuclear Power Plant, radioactive materials were detected in sewage sludge, and Horikawa-Cho Sewage Treatment Plant, which is located in Fukushima city, had been forced to store sewage sludge within the site. The Ministry of the Environment was implementing a project to reduce the storage space volume of the stored sludge and to stabilize the sludge properties by drying sewage sludge, so that it can be easily transported outside of the site. These drying facilities operated from April 2013 to October 2014. The total volume was about 7,726 tons and the weight was reduced to one-fifth. The average radioactive concentration of the dried sludge is 44,000 Bq/kg (=44 Bq/g) and the maximum is 252,000 Bq/kg (=252 Bq/g). Now, the dried sewage sludge is stored in the Aeration Tanks, which are not currently in use for the sewage treatment system. And transport to the incinerating facility is continuing.

Introduction

Since collection system of some areas in Fukushima City is a combined system and Horikawa-cho Sewage treatment system is a conventional activated sludge processing sewage treatment system, radioactive substances were aggregated together with rain water, which resulted in a detected maximum value of 440,000 Bq/kg (= 440 Bq/g) in sewage sludge. Therefore the contaminated sludge was not allowed to be shipped out of the treatment plant, and had to be stored on the plant premises from April 2011. In order to continue the sewage treatment of Fukushima City, the Government of Japan decided to reduce the volume of the stored sludge from December 2011.

Regulations

Act on Special Measures concerning the Handling of Radioactive Pollution⁽¹⁾

The purpose of this Act is to promptly reduce the impacts of environmental pollution by instituting measures taken by interested parties, especially, the national and local governments and the relevant licensee of NPP. The guidebook on this Act provides us requirements for storage and transport.

(Requirements for Storage)

- Preventing designated wastes from spattering and discharge
- Preventing pollution of public water areas and groundwater
- Preventing the intrusion of rainwater or groundwater
- Preventing a bad smell
- Preventing harmful insects
- Safekeeping method of septicity designated wastes
- Prevention of radiation hazards
- Documentation

(Requirements for Transport)

- Preventing damage of health and environment
- Action of preventing material from leakage and spattering
- Preventing intrusion of rainwater
- Display and document for transport
- Prevention of radiation hazards
- Documentation

Ordinance on Prevention of Ionizing Radiation Hazards (Revision)⁽²⁾

This revision was made in light of the fact that disposal of waste contaminated with radioactive materials discharged by the accident is expected to move into full swing with the progress of the decontamination project. The guideline provides us the requirements for preventing radiation hazards from workers.

- Requirements to be satisfied by such facilities as incineration plants and landfills where the disposal of accident-derived waste would be performed
- Measures to prevent the spread of contamination, such as the use of dust masks and protective clothing, as well as contamination inspection
- Operation management by, for example, preparing operation manuals
- Special education for workers engaged in disposal work
- Exemption in which the disposal facility is constructed in special decontamination areas

Drying Facility

The stored dehydrated sewage sludge through April 2013 (stored sludge) and dehydrated sludge which were generated since then (generated sludge) are mixed and processed by continuous drying for 24 hours a day as show in Figure 1 (capacity of 30 t dehydrated sludge / day). Also, the weight of dehydrated sludge is reduced to one-fifth by drying. The history of the project is shown in Table 1.

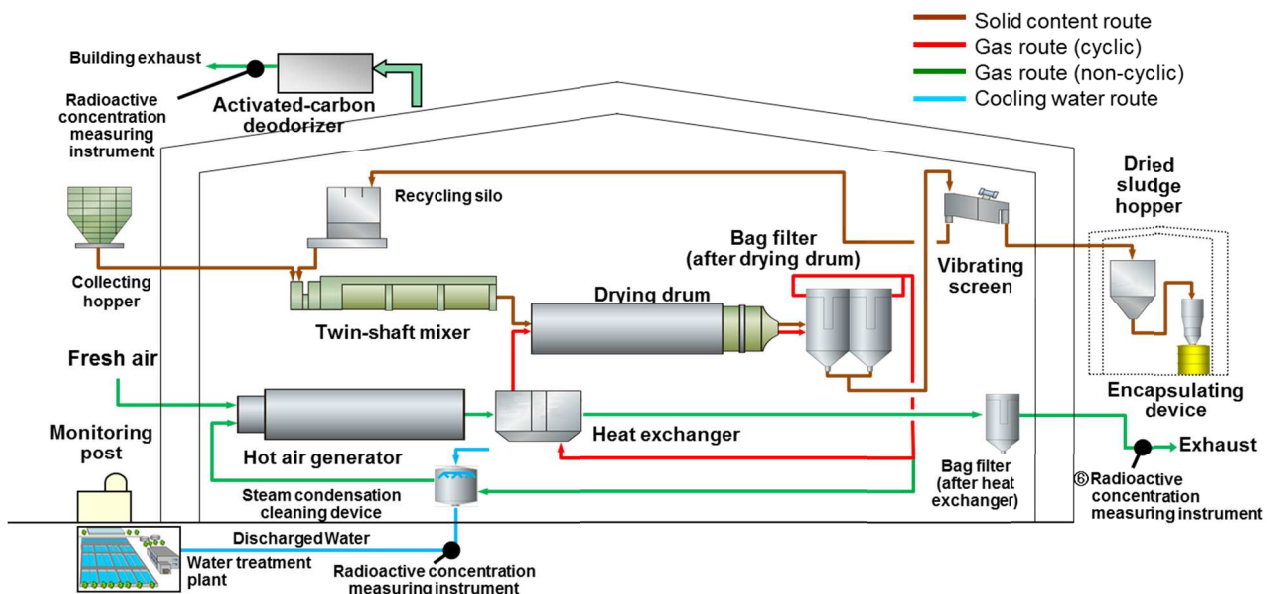


Figure 1 Overview of the Drying Facility

Table 1 History of Project⁽³⁾

Mar. 2012	Completed Development of Facility Plan and Design Work
Sep. 2012	Started Civil Engineering Work
Jan 2013	Completed Installation of Major Drying Facility
Apr. 2013	Started Full Scale Operation after Verifying Trial Operations
Aug. 2014	Completed Drying Whole Volume of Stored Sewage Sludge
Sep. 2014	To Remove High Concentration Sludge in the Facility, Started Drying Operation for Sludge with Relatively Low Level of Radioactivity Concentration
Oct. 2014	Completed Drying Operation for Sludge
Feb. 2016	Started Transport to Incinerating Facility
Mar. 2016	Completed Dismantling of the Drying Facility

Characteristics of Dried Sewage Sludge

Regarding the activity concentration of Dried Sewage Sludge, average is 44 Bq/g and maximum is 252 Bq/g (See Table 2). It would be categorized as LSA-I in IAEA transport regulations. It should be transported in such a manner that under routine conditions of transport there will be no escape of the radioactive contents from the conveyance nor will there be any loss of shielding.

The dried sewage sludge is transported under the domestic laws, but we check the requirements of IAEA transport regulations.

Table 2 Characteristics of Sewage Sludge⁽³⁾⁽⁴⁾

Dehydrated Sewage Sludge	Volume		7,726 Mg
	Activity concentration at treatment	average	9 Bq/g
		maximum	334 Bq/g
Dried Sewage sludge	Volume		1,525 Mg
	Activity concentration	average	44 Bq/g
		maximum	252 Bq/g
	Radiation level at the surface of 200-L drum	average	0.005 mSv/h
		maximum	0.027 mSv/h
Lower Limit for the designated waste in Japan			8 Bq/g
Activity Limit for exempt material (Cs-134, Cs-137)			10 Bq/g
Activity Limit for LSA-I (Cs-134, Cs-137)			300 Bq/g

Measures for Storage and Transport

Encapsulating and Temporary Storage

Dried sewage sludge was put into bags made of polyethylene which were filled with nitrogen and sealed with heat, and then they were sealed in 200-L drums. And the packages are stored in the Aeration Tanks, which are not currently in use for the sewage water system (See Figure 2).



(Encapsulating)



(Temporary Storage)

Figure 2 The State of implementation of measures (1/3)

Check before transport

Radiation levels at surfaces of all packages were measured before transport. Some packages were opened and the stored objects were checked among the one-time transport (See Figure 3).



(Measuring Dose Rate for packages)



(Checking stored object)

Figure 3 The State of implementation of measures (2/3)

Packing and Measuring Dose Rate

56 packages were transported at one time. The conveyance is 10-ton freight vehicles, of wing body type. The forklift with attachment for drum is used for packing the package into the conveyance. Also, dose rate for the conveyance is measured under the requirements of the Act on Special Measures concerning the Handling of Radioactive Pollution.



(Packing the packages into the conveyance)



(Measuring Dose Rate for the conveyance)

Figure 4 The State of implementation of measures (3/3)

Communication

The sewage facility is located in a residential area. The residents have been anxious about their health with a high radioactivity report. The officers of Fukushima city have continued to talk with the residents. The Ministry of the Environment and the contractors offered information about radiation risks and prevention measures to them. And the transport schedule was made so as not to disturb neighborhood residents.

Conclusions

Dried sewage sludge was put into bags made of polyethylene which were filled with nitrogen and

sealed with heat, and then they were sealed in 200-L drums. These packages are temporarily stored in the Aeration Tanks at present and will be transported to the incinerating facility. The condition of packages would satisfy the requirements of IAEA regulations without “Marking, Labeling and Placarding”. We should check the condition of each package before the transport.

Acknowledgments

This work was the demonstration project of the Ministry of the Environment, Japan. Contractors are Japan Sewage Works Agency, Nippon Steel & Sumikin Engineering Co. Ltd and Mitsubishi Research Institute, Inc. The location of the project is Sewage management center , Horikawa-cho, Fukushima City, Fukushima Prefecture.

References

- (1) Act on Special Measures concerning the handling of Environment Pollution by Radioactive Materials Discharged by the Nuclear Power Station Accident Associated with the Tohoku District-Off the Pacific Earthquake That Occurred on March 11, 2011, Ministry of the Environment, Japan, August 2011
- (2) Ordinance on Prevention of Ionizing Radiation Hazards, Ministry of Health, Labour and Welfare Ordinance No. 89 of 8 July 2013
- (3) http://shiteihaiki.env.go.jp/initiatives_fukushima/specified_waste/fukushima.html (Japanese)
- (4) Regulations for the Safe Transport of Radioactive Material, 2012 edition – Specific Safety Requirements No.SSR-6, International Atomic Energy Agency Vienna, 2012