

## IMPACTS OF FOOD WASTE DISPOSERS ON SEWAGE SYSTEMS

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### ABSTRACT

A variety of opinions concerning the introduction of Food Waste Disposers (FWDs) have been presented. However, many of these views are not based on objective grounds, as FWDs have rarely been employed in Japan. The MLIT, the Hokkaido government, and the town of Utanobori carried out a cooperative public trial. Prior to the trial, the town installed disposers in private homes in the sewered areas of the town, beginning in 1999. FWDs were first installed in 10% of the homes each year until 40% of the homes had disposers. The trial was carried out from the year 2000 to evaluate the impact of the introduction of FWDs

We investigated, among other issues, the amount of garbage generated, the quantity and quality of wastewater generated, and the condition of the sewer pipes and the wastewater treatment plant following the introduction of FWDs. This investigation was conducted by means of a case study on the introduction of FWDs in the town of Utanobori in Hokkaido.

### KEYWORDS

Food Waste Disposers (FWDs), Wastewater pollution load, Sewage pipe, Wastewater treatment plant

### INTRODUCTION

A variety of opinions concerning the introduction of FWDs have been presented. However, many of these views are not based on objective grounds, as disposers have rarely been employed in Japan. The MLIT, the Hokkaido government, and the town of Utanobori carried out a cooperative public trial. Prior to the trial, the town installed disposers in private homes in the sewered part of the town, beginning in 1999. FWDs were installed in 10% of the homes each year, until this figure rose to 40%.

The trial was then conducted, starting from the year 2000. Its purpose was to evaluate the impact of the introduction of the FWDs in terms of several parameters.

The survey is still in progress, and the final report will be released in May 2004. This will be an interim report based on the results obtained so far.

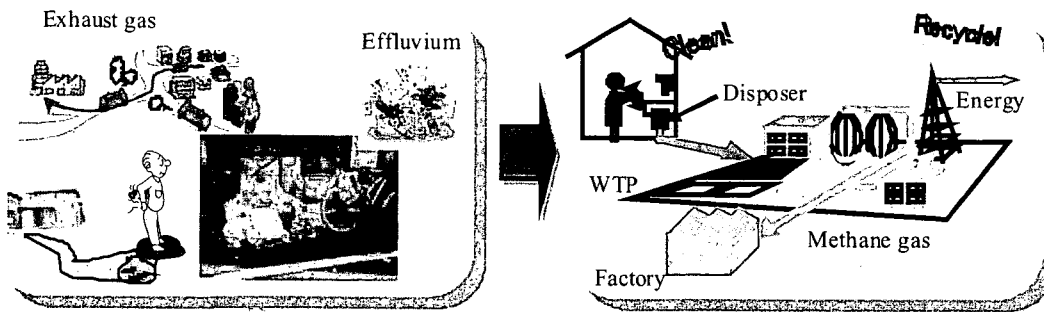
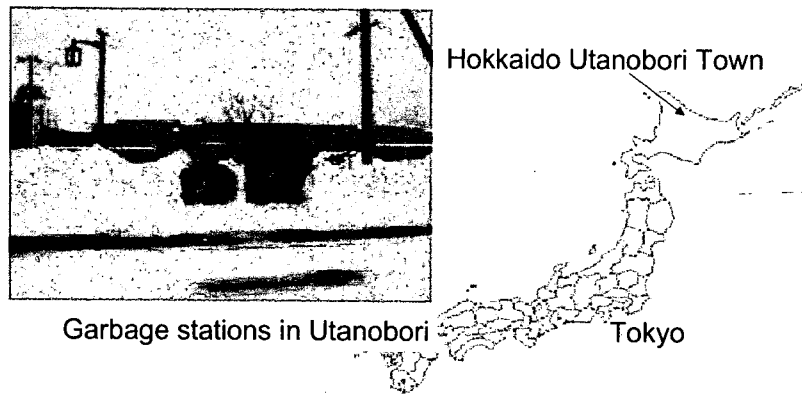


Fig.1 Background to the Study

## METHODS

### Outline of Utanobori-cho

Utanobori-cho is a farming village in the northern part of Hokkaido. The weather conditions in this town are severe, as it is a heavy snowfall area(Fig.2).



Garbage stations in Utanobori

Fig.2 Hokkaido Utanobori Town

The population of the town is 2,519. Of this, the sewered population is 1,986, which is approximately 80% of the total population. The garbage collection system in Utanobori-cho is a separate sewer system.

### Sewage Systems of Utanobori-cho

The method followed in processing the water in the wastewater treatment plant is the oxidation ditch process. The system is designed to handle a maximum wastewater flow of 1,260 m<sup>3</sup>/day. The average wastewater flow in March 2003 was 736 m<sup>3</sup>/day.

The total length of sewage pipes in the sewered area is 22,912 m, and several of these pipes are unplasticized polyvinyl chloride pipes of a 200 mm caliber.

### Installation of FWDs

In Utanobori-cho, FWDs were installed in 300 homes (639 persons), mainly apartments in a housing complex. This was done between August 1999 and March 2003. The ratio of installed FWDs to the number of residents in March 2003 was 36%.

### 1. Wastewater pollution load due to the use of FWDs

#### 1) Amount of garbage turned over to FWDs

This investigation measured the amount of garbage that was being sent to garbage stations before and after the introduction of FWDs. Thus, the amount of garbage being disposed of through FWDs was determined, and this garbage was weighed. Further, the garbage that was mixed with burnable waste was segregated, because in Utanobori-cho,

garbage was turned over to the garbage station as burnable waste. Further, kinds of garbage in which a decline was observed following the introduction of FWDs were examined. The investigation was carried out a total of 18 times, once every 2-3 months between July 2000 and January 2003.

2) Increase in load due to the use of FWDs

The analysis of the FWD drain revealed that it had been made artificially, by using the garbage that had been collected from 10 houses in Utanobori-cho in which FWDs had been set up. For the one week during which the investigation was conducted, the garbage collected in the homes that were part of the investigation was preserved without the use of FWDs and was collected daily. The investigation was conducted a total of 15 times between June 2000 and July 2003.

**2. Effect on the Sewer Pipes**

1) Investigation of the condition of sewer pipes

It was predicted that pulverizing garbage using FWDs and allowing it to flow into the sewer system would increase the deposition of material in the sewer pipes. The condition of the sewer pipes was examined using a TV camera, both before the installation of FWDs in July 1999 and in September 2003 after they were introduced.

2) Composition of the deposited material

Deposit was gathered from sewer pipes in the districts in which FWDs had been introduced, and its composition was investigated.

**3. Effect on Wastewater Treatment Plant**

It was predicted that the rise in the influent load at the wastewater treatment plant would worsen the quality of the effluent water and increase the production of sewage sludge.

**RESULTS**

**1. Wastewater Pollution Load due to the Use of FWDs**

1) The amount of garbage sent to FWDs

Table 1 shows the results of a survey of the quantity of burnable garbage in a housing estate in Utanobori-cho, where FWDs were installed in August 2001. It shows that the introduction of the disposers reduced the amount of kitchen garbage by almost half.

Table 1. Reduction in the Quantity of Burnable Garbage

Period		Disposer	Burnable garbage (g/cap/day)		
				Rate	Weight
2000	Jul	Before installation	387.3	46.9%	182
	Sep		355.8	39.1%	139
	Nov		405.1	69.8%	283
	Feb		350.0	65.5%	229
May	443.2		46.7%	207	
2001	Aug	After installation	332.7	27.5%	91
	Oct		379.8	24.8%	94
	Jun		300.1	39.1%	117

Following the installation of FWDs, an approximate decrease of 100g/cap/day was observed in the garbage handled by the garbage station. In other words, the garbage turned over to FWDs is presumed to be about 100 g/cap/day. Following the installation of FWDs, a significant decrease in fruit and vegetable garbage was recorded.

2) Increase in load due to the use of FWDs

The results on the quality of the water in the disposer drain, expressed in terms of loading dose per 100 g of garbage, is shown in Table 2.

Table 2. Increase in the Pollutant Load Per Unit Production by Disposer Drainage

	SS	BOD	COD <sub>Mn</sub>	T-N	T-P	n-Hex	Cl <sup>-</sup>
Design manual	45	58	27	11	1.3	—	—
Our study	8.23	11.3	5.47	0.73	0.11	1.75	0.33
	(+18%)	(+19%)	(+20%)	(+7%)	(+8%)	(—)	(—)

The pollution loads per 100g of garbage for various pollutants are given as follows—SS: 8.2 g; BOD: 11.3 g; COD<sub>Mn</sub>: 5.5 g; TN: 0.73 g; TP: 0.11 g; Cl<sup>-</sup>: 0.33 g, and n-Hex: 1.75 g. Further, the increase in the daily per capita load was found to be 19% for SS and 21% for COD.

## 2. Influence on the Sewer Pipe

### 1) Investigation of the condition of the sewer pipe

Photo 1 and Photo 2 show images of the pipe before and after the installation of the disposers. Although the main pipe had not been cleaned even once since it first became functional in 1991, it was almost completely free of deposited material before the installation of the disposers. However, when the interior of the pipe was photographed 12 months after the installation of the disposers, a large amount of deposited material could be seen at the bottom. Further, a significant amount of material had been deposited in the part where the inclination of the sewer pipe was gradual (Table 3).

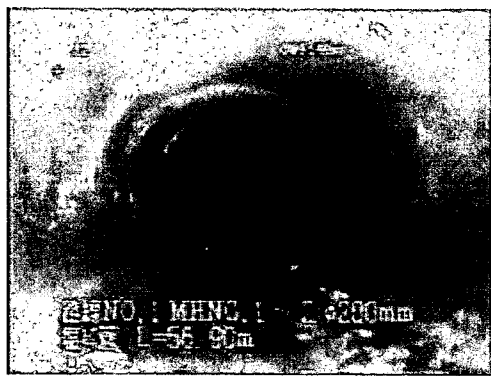


Photo 1 (before installation, July, 1999)

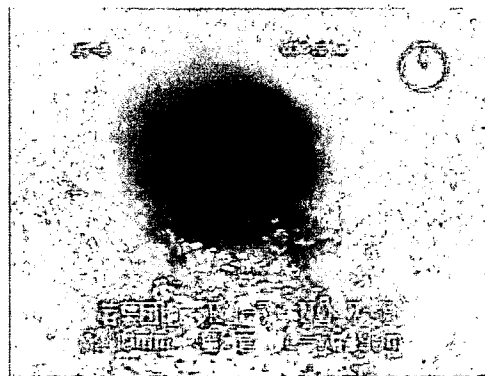


Photo 2 (after installation, August 2000)

### 2) Composition of deposited material

The deposited material comprised eggshells and shells of shellfish. These solid materials tended to be deposited at locations where the gradient of the pipe was gentle. These results suggest that following the installation of disposers, it is necessary to inspect pipes more frequently and clean them more often as necessary.

Table 3. Relationship between the inclination of the sewer pipe and the amount of deposit

Inclination (‰)	Length of the sewer pipe according to inclination (m)	Amount of deposit (cm <sup>3</sup> )	Rate of deposit (%)
10 ≤	81	809	1.9
7.5 ≤ < 10	194	2,561	6.0
5 ≤ < 7.5	314	2,306	5.4
2.5 ≤ < 5	208	3,519	8.2
0 ≤ < 2.5	53	1,064	2.5
≤ < 0	46	32,592	76.1
Total	896	42,851	100

### 3. Effect on Wastewater Treatment Plant

Fig. 3 showed the change in the influent water quality and the processing water from 1991 to 2001. No clear change was observed in the quality of the influent and processing water before and after the introduction of FWDs.

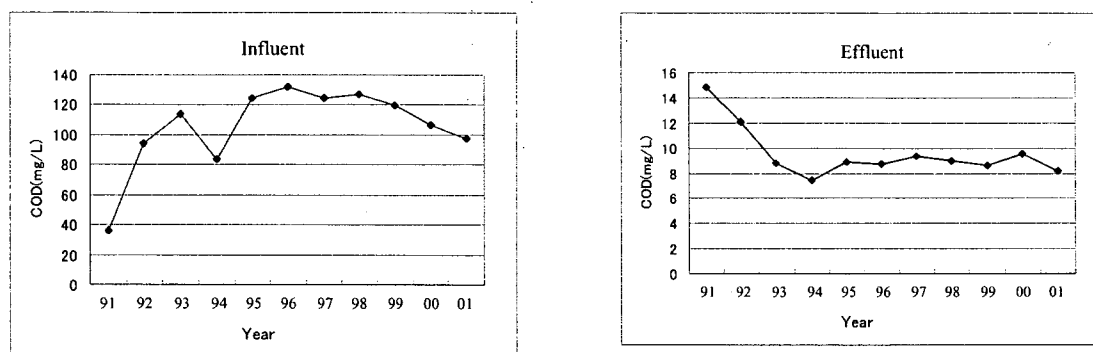


Fig. 3 Annual Variations in the Influent and Effluent Water

### CONCLUSIONS

This study investigated, among other issues, the amount of garbage generated, the quantity and quality of wastewater generated, and the condition of the sewer pipes and wastewater treatment plants following the introduction of FWDs. This investigation was conducted by means of a case study on the introduction of the FWDs in the town of Utanobori in Hokkaido, where the FWDs was used in 36% of the homes in the sewer area.

This report estimated the per unit increase in pollution load that resulted from the use of the garbage grinder in the town of Utanobori. The results are as follows:

- 1) The amount of burnable garbage by weight was halved.
- 2) The amount of garbage processed with the FWDs was 100g/cap/day, which is about half the amount of garbage put out per person per day.
- 3) The pollution loads of various pollutants per 100 g of garbage were as follows. SS: 8.2 g; BOD: 11.3 g; COD<sub>Mn</sub>: 5.5 g; TN: 0.73 g; TP: 0.11 g; Cl<sup>-</sup>: 0.33 g, and n-Hex: 1.75 g.
- 4) The amount of deposit in the sewer pipe increased following installation of the FWDs.
- 8) No clear change in the quality of the influent and processing water was observed before and after the introduction of the disposer.

Disposers were introduced as part of the wastewater treatment system for the first time in Japan in the town of Utanobori. Therefore, in this sense, the results obtained were valuable. The author hopes that this report will contribute to debates on the evaluation of the impact of the introduction of disposers.

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