

[Environmental Technology Verification]

Summary of Verification Report for FY 2004

**Organic Wastewater Treatment Technologies
for Small-Scale Establishments
(Kitchens/Restaurants and Food Manufacturing Plants)**

Ministry of the Environment of Japan

I. Introduction

What is the Pilot Project for Environmental Technology Verification?

Advanced environmental technologies, even though they are commercial-ready and seem to be useful, have not necessarily been pervasive widely since the users such as local governments, companies and citizens, cannot make selection of those technologies because of the lack in objective assessments, concerning the performance in environmental conservation.

Ministry of the Environment (MOE) of Japan, therefore, launched the Pilot Project of the Environmental Technology Verification (ETV) in fiscal year 2003 as a trial implementation of ETV, to verify objectively the performance of the advanced environmental technologies by third parties.

The expectations through this project are as follows;

- ❖ dissemination of the technologies verified in this project developed by venture companies etc. will be promoted,
- ❖ environmental conservation would be achieved,
- ❖ economic activity, such as those in the regional environmental industries would be stimulated,
- ❖ suitable method and system of ETV would be established.

Figure: Structure for Project Implementation

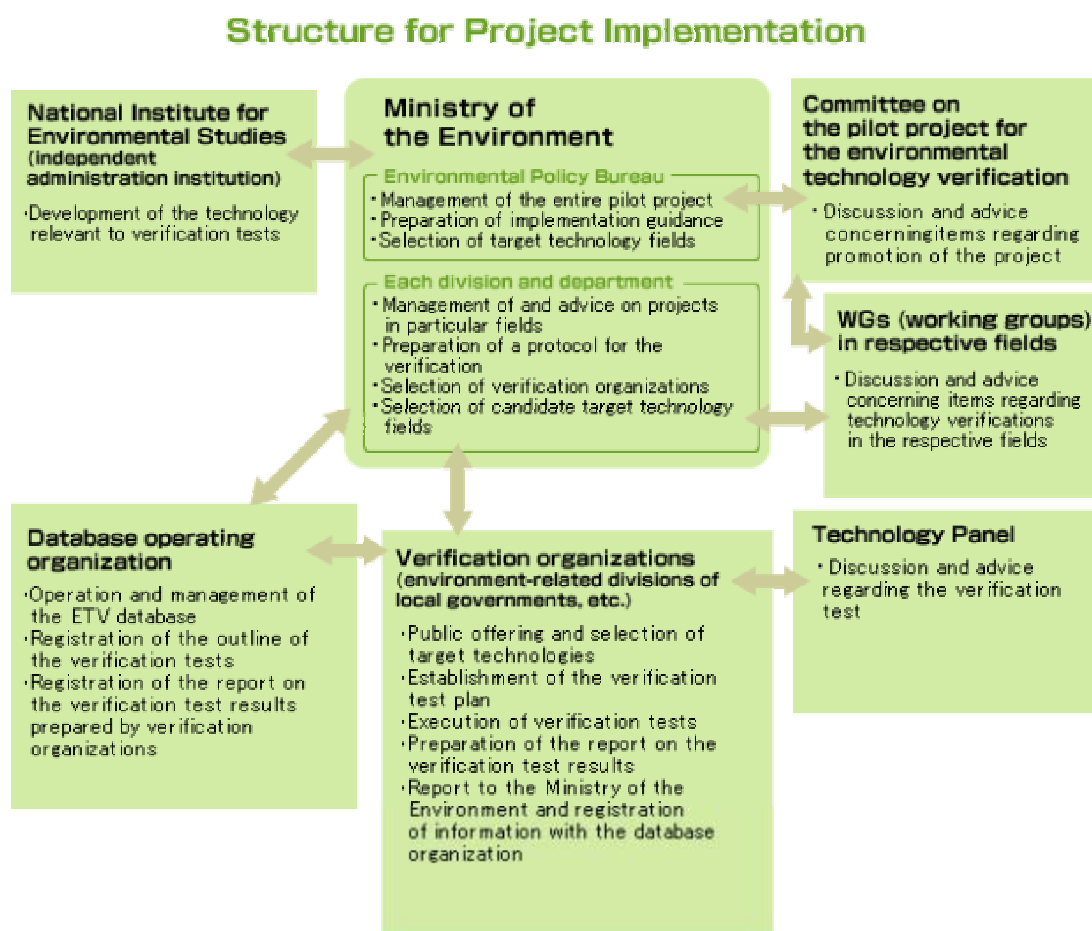
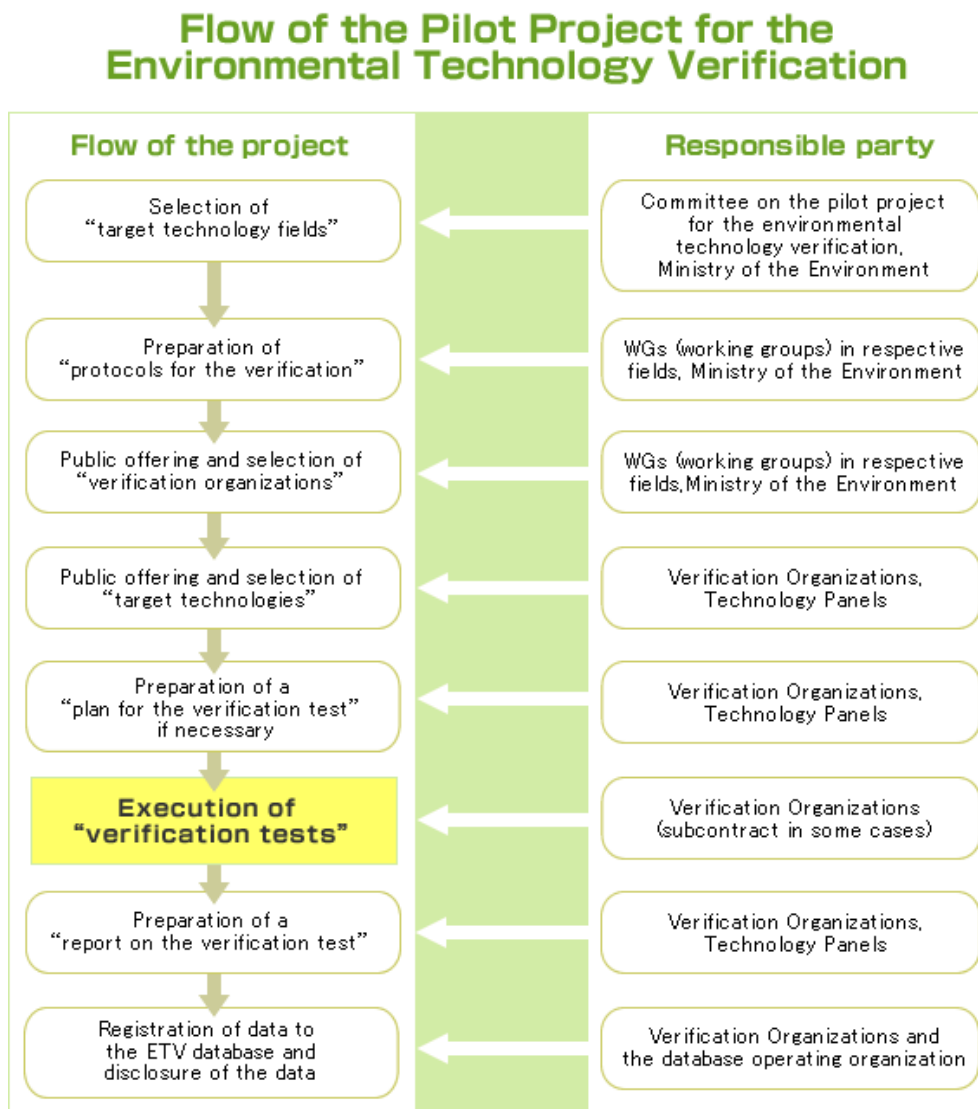


Figure: Flow of the Pilot Project for Environmental Technology Verification



Selection of target verification technology fields

In the implementation guidance for the Pilot Project for the Environmental Technology Verification in 2003, the scope of the selection of target technology fields was defined as follows:

- (1) Technology field whose developers and users (such as local governments, consumers) require verification.
- (2) Technology field for which technology verification is effective to promote their dissemination.
- (3) Technology field for which verification system such as technology certification, has not been implemented by other conventional systems.
- (4) Technology field for which verification is possible because;
 - a. Verification is possible in terms of budget and implementation system.
 - b. Verification test procedures can be established properly.

After discussions in the committee on the pilot project for environmental technology verification, the following target technical fields were selected in FY 2003.

- (1) Ethylene oxide treatment technologies
- (2) Organic wastewater treatment technologies for small-scale establishments

(3) Treatment technologies for human waste in mountain district

Contents of this report

This report summarizes the results of verification tests conducted in FY 2003 for the technical field of organic wastewater treatment technologies for small-scale establishments. It contains the following contents.

- Summary of target technical fields
- Summary of verification tests and determination of the results
- Summary of the target technologies and results of verification tests conducted in FY 2003

The verification test results described in this report are only summaries. Details of the results for each technology are available in separate reports (in Japanese only, see the database described below). Please contact each manufacturer for more information.

Database of the Pilot Project for Environmental Technology Verification

The database of the Pilot Project for Environmental Technology Verification has been created at the website (URL <http://etv-j.eic.or.jp>), in order to provide information on the progress and results of the project, including reports on the verification tests. The following information is available at the website:

[1] List of verified technologies

The technologies verified in the pilot project and the verification results thereof, such as those for environmental-protection efficiency (reports on the verification test, etc.).

[2] Protocols of the verifications/Plan for the verification tests

The " protocols of the verifications," which specifies the basic concept, test conditions and methods, and the like in conducting verification tests, and the " plan for the verification tests," which specifies detailed experimental conditions and the like for each target technology based on a protocols of the verifications.

[3] Information on public offering for verification organizations and target verification technologies

Information on public offering including when applications for verification organizations or target verification technologies are invited publicly

[4] Information on the relevant committee and working groups

Documents delivered in and summaries of the meetings of the committee on the pilot project and its working groups, in which plans for implementing the pilot project are discussed.

II. Organic wastewater treatment technologies for small-scale establishments

What are organic wastewater treatment technologies for small-scale establishments?

The organic wastewater treatment technologies for small-scale establishments verified in the pilot project are wastewater treatment technologies (apparatus, plant, etc.) for properly processing the organic wastewater from small business establishments (with a daily wastewater flow rate of less than 50 m³), such as that from kitchens/restaurants and food-processing factories. Among them in particular, prefabricated, low-cost, compact, and easy-maintenance apparatuses that can be added to existing facilities and are commercially available are verified in this project. In addition to integrated wastewater treatment technologies, a wide range of wastewater treatment technologies intended to remove a particular pollutant are also verified.

The wastewater treatment technologies are broadly divided into biological treatment and physicochemical treatment, but combined (hybrid) methods are also included.

Figure: Flow of processing of organic wastewater (example)

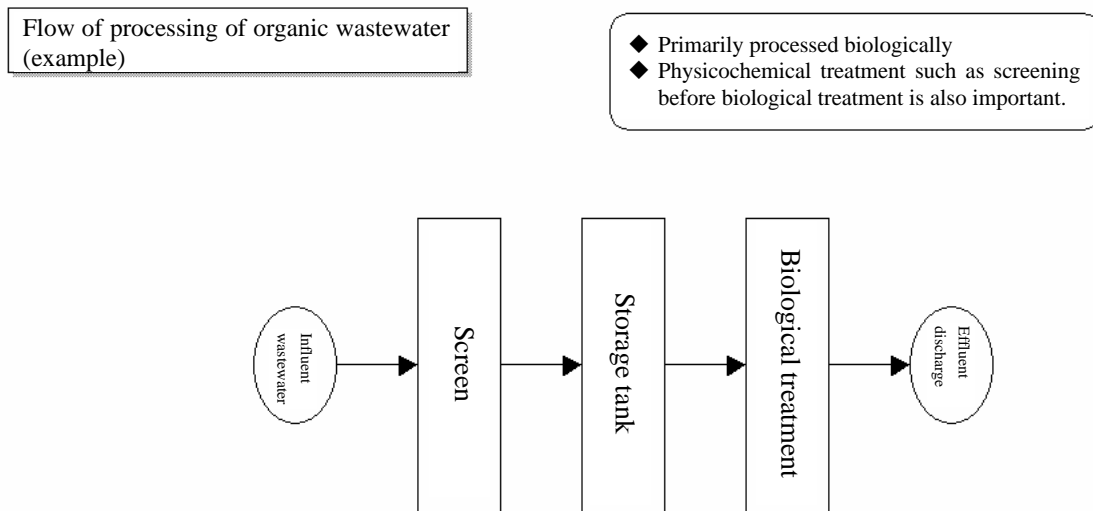
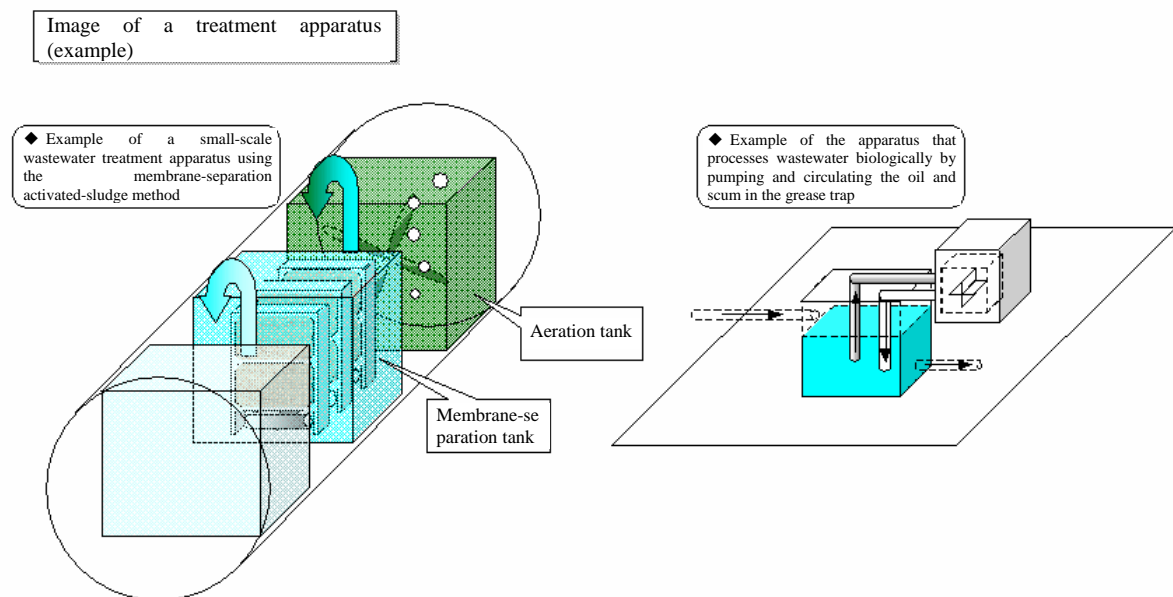


Figure: Image of an organic-wastewater treatment apparatus (example)



Why is the organic wastewater treatment technologies for small-scale establishments included in the verification fields?

The water quality of public waters in Japan has shown marked improvement as judged by biochemical oxygen demand (BOD) or chemical oxygen demand (COD), typical indicators of the organic contamination of water. However, the improvement in water quality remains unsatisfactory in closed waters such as inland seas and bays, lakes and marshes, and small and medium-sized rivers in cities (in accordance with a 2002 survey of water quality in public water systems, the rates of waters achieving the environmental standard of BOD or COD were 85.1% for rivers, 43.8% for lakes and marshes, 76.9% for seas, and 81.7% on average). Along with organic contamination, there are still many incidences of phenomena such as water bloom and red tide caused by the eutrophication of closed waters due to the increase in the use of nutritive salts containing nitrogen and phosphorus. Under such circumstances, it is necessary to take comprehensive measures to maintain water quality, including measures to reduce influent organic pollutants and prevent eutrophication.

Among wastewater from many emission sources, that from large-scale factories and business establishments, which are regulated under the Water-Pollution Control Law, has shown some improvement, but there are many small business establishments that are not regulated by the Law. Although the wastewater from small business establishments is not negligible as a source of pollution, the wastewater regulations are not suited for small business establishments from the viewpoints of cost and performance. However, if objective information on the environmental-protection efficiency and the like of low-cost, compact, and easy-maintenance wastewater treatment apparatuses, which can be placed in small business establishments, is provided, a greater number of small business establishments would introduce such wastewater treatment technologies voluntarily. Thus, it seems valuable to technically verify the low-cost, compact, and easy-maintenance organic-wastewater treatment apparatuses that can be added to the existing facilities of small business establishments, provide objective information on the environmental-protection efficiency and the like of these technologies, and promote the preservation of the local environment as well as more widespread use of these technologies (products). For that reason, the organic-wastewater treatment technology for small-scale establishments was selected as a target verification technology field in the pilot project for the verification of environmental technologies.

● Summary of the Water-Pollution Control Law

Factories and business establishments that have facilities emitting sewage or wastewater satisfying certain requirements (specified facilities) should comply with the Wastewater Standards regarding the water (effluent wastewater) discharged into public water systems, submit prior notification of installation of the specified facility to the prefectural governor, and obey the possible orders from the governor to change their plan. In addition, the underground penetration of wastewater containing hazardous substances discharged from specified facilities producing, using, or processing the hazardous substances stipulated by Cabinet Orders is prohibited. Those violating these regulations will be subject to punishment.

III. Verification Test Methods

Summary of Verification Test

The verification test for the present pilot project will follow the procedures defined in the “Verification Test Protocol,” common to all organic-wastewater treatment technology fields. The following items will be verified for each of the target apparatuses.

- Environmental protective effect under practical operational conditions in the range specified by an environmental technology developer
- Energy, materials, and cost required for operation
- Operational environment allowing normal operations
- Labor required for operations and maintenance

The verification test will primarily be conducted according to the steps specified below.

(1) Planning

The plan for the verification test (hereinafter referred to as the “Test Plan”) will be prepared for each target verification technology according to the Verification Test Protocol before the test is conducted. The Test Plan will be prepared by a Verification Organization in cooperation with an environmental technology developer.

(2) Verification testing process

In this stage, a verification test will be conducted according to the Test Plan described above. The verification test verifies the conformity of a target verification apparatus with its objectives specified in the planning stage. The Verification Organization may, if necessary, subcontract part of the verification test to external test organizations.

(3) Data assessment and reporting

In the final stage, all collected data will be analyzed for verification, and a report on the verification test (hereinafter referred to as the “Verification Report”) will be compiled. The Verification Organization will be responsible for analysis of the data and reporting. To accelerate the above process, the Verification Organization may subcontract an external organization to prepare a draft of the Verification Report.

The Verification Report will be submitted by the Verification Organization to the Ministry of the Environment. In the report, the suitability of the verification tests will be discussed by the working group on the organic-wastewater treatment technology (hereinafter referred to as the “Working Group”) of the committee on the pilot project for the environmental technology verification. After its approval by the Ministry of the Environment, the report will be returned to the Verification Organization. The approved Verification Report will then be issued by the Verification Organization to the environmental technology developer and simultaneously disclosed to the public.

Verification organization

In the “Pilot Project Implementation Guidance for FY 2003,” it was established that the Verification Organization will recruit businesses with target verification technologies for the Verification Test, select the technologies for the Verification Test, establish the Test Plans as required, verify the technologies (conducting of the Verification Test and preparation of the Verification Report), submit the Verification Report to the Ministry of the Environment, and register the results to the database operating organization. Thus, for each technology field, the Verification Organization was selected from among local public agencies (prefectural and government-decreed cities).

Below is the local public agency selected as Verification Organization for ethylene oxide treatment technologies in FY 2003.

- Ishikawa Prefecture
- Osaka Prefecture
- Hiroshima Prefecture

Target Verification Technologies

The selection of target verification technologies was made based on the contents of the applications for the technology/product submitted by businesses. The contents of the verification application were checked for the following points, and a comprehensive evaluation was made by the Verification Organization in the selection of the target technology, which then awaited approval by the Ministry of the Environment.

a. Technological requirements:

- Does the applied technology fall within a target verification technology field?
- Is the application form properly filled in?
- Is the technology in a commercialization stage?

b. Possibility of verification

- Is it possible to complete the verification from cost and organizational standpoints?
- Is it possible to establish a suitable Test Plan?

c. Environmental protective effect, etc.

- Is it possible to scientifically explain the principle and mechanism of the technology?
- Is there any possibility of the technology causing secondary environmental issues?
- Does it provide a high environmental protective effect?
- Is it an innovative technology?

Verification items

The verification items of the organic-wastewater treatment technologies for small-scale establishments are broadly grouped into verification items concerning water quality and verification items concerning operation and maintenance. The verification items concerning water quality are used primarily for verification of the wastewater processing capacity of the target verification apparatus, but also for verification of the stability of operation.

The verification organization determines the verification items concerning water quality so that the performance of the target verification technology is properly verified, taking into consideration the views of the environmental-technology developer, the technical specification of the target verification apparatus, and the characteristics of the influent wastewater into the verification-test site. The major verification items concerning

water quality are summarized in the following table.

Table: Examples of the verification items concerning water quality

Verification items	Explanation
pH (hydrogen ion concentration)	An indicator of the acidity or alkalinity of an aqueous solution. An aqueous solution is neutral at a pH of 7, alkaline at a pH of 7 or more, and acidic at a pH of less than 7. The environmental standards for the pH of river waters are specified in accordance with the type of river; a pH in the range of "6.5 (or 6.0) to 8.5" is allocated in accordance with local conditions. In addition, the standard pH of wastewaters, except for those discharged into the sea, is specified as "5.8 to 8.6" in the Wastewater Standards under the Water-Pollution Control Law (1970).
BOD (biochemical oxygen demand)	The amount of oxygen consumed when organic compounds in wastewater are decomposed by microbes. A higher BOD results in a decrease in dissolved oxygen, and a BOD of 10 mg/L or more often results in the generation of foul odor. The environmental standards for the BOD of river waters are specified in accordance with the type of river; a BOD of in the range of "1 mg/L or less" to "10 mg/L or less" is allocated in accordance with local conditions. In addition, the standard BOD of wastewaters discharged into rivers is specified as "160 mg/L or less" by the Wastewater Standards under the Water-Pollution Control Law (1970).
COD (chemical oxygen demand)	An amount of oxygen calculated from the amount of an oxidizing agent consumed when organic compounds in wastewater are decomposed by the oxidizing agent. COD is not used for river water in the environmental standards, and the environmental standards for the COD of the water in lakes/marshes and seas are specified in accordance with the type of water; a COD in the range of "1 mg/L or less" to "8 mg/L or less" is allocated to lakes and marshes, and "2 mg/L or less" to "8 mg/L or less" to seas, in accordance with local conditions. In addition, the standard BOD of the wastewater discharged into lakes/marshes and seas is specified as "160 mg/L or less" by the Wastewater Standards under the Water-Pollution Control Law (1970).
SS (suspended solids)	The amount of suspended solids 2 mm or less in diameter, floating or suspended in water. The environmental standards for SS in river waters are specified in accordance with the type of river, and a standard from an "SS of 1 mg/L or less" to "no observable floating solids such as garbage" is allocated in accordance with local conditions. In addition, the standard SS of the wastewater discharged into public water systems is specified as "200 mg/L or less" in the Wastewater Standards under the Water-Pollution Control Law (1970).
n-HEX (n-hexane extract)	n-HEX is a generic term indicating the amount of the nonvolatile substances that are extracted using n-hexane, including fatty-acid derivatives such as animal/vegetable oils, fatty acids, fatty-acid esters, and phospholipids, waxes and greases, and petroleum hydrocarbons. It is used as an indicator of the amount of "oils and the like" in water. n-HEX is not determined for the rivers and lakes/marshes in the environmental standards, and the environmental standards for the n-HEX of seas are specified in accordance with the type of water; n-HEX should not be detected in accordance with local conditions. In addition, an n-HEX standard of "5 mg/L or less (mineral oils) and 30 mg/L or less (animal and vegetable oils)" is specified for the wastewater discharged into public water systems by the Wastewater Standards under the Water-Pollution Control Law (1970).
Coliform bacteria	A count of Escherichia coli and bacteria with properties similar to those of Escherichia coli. The coliform bacterial count in water is used as an indicator of human-waste pollution. The environmental standards of the coliform bacterial count for river waters are specified in accordance with the type of river; a coliform bacterial count in the range of "50 MPN/100 mL or less" to "no restriction" is allocated in accordance with local conditions. In addition, the standard coliform bacterial count for the wastewaters discharged into public water systems is specified as "3,000/cm ³ or less" by the Wastewater Standards under the Water-Pollution Control Law (1970).
T-N (total nitrogen)	The content of nitrogen compounds excluding dissolved nitrogen gas (N ₂). T-N nitrogen is classified into inorganic and organic nitrogens. T-N is associated with the abnormal proliferation of plankton causing, for example, eutrophication and red tide. T-N is not determined for river waters in the environmental standards, and the environmental standards for the T-N of the waters in lakes/marshes and seas are specified in accordance with the type of water; a T-N in the range of "0.1 mg/L or less" to "1 mg/L or less" is allocated to the waters in lakes and marshes, and "0.2 mg/L or less" to "1 mg/L or less" for sea waters, in accordance with local conditions. In addition, a T-N standard of "120 mg/L or less" is specified for the wastewaters discharged into public water systems by the Wastewater Standards under the Water-Pollution Control Law (1970).
T-P (total phosphorus)	Total phosphorus is the total amount of phosphorus compounds. Total phosphorus is classified into inorganic and organic phosphoruses. The phosphorus compounds are also associated with the abnormal proliferation of plankton causing, for example, eutrophication and red tide. T-P is not determined for river waters in the environmental standards, and the environmental standards for the T-P of the water in lakes/marshes and seas are specified in accordance with the type of water; a T-P in the range of "0.005 mg/L or less" to "0.1 mg/L or less" is allocated to the waters in lakes and marshes, and "0.02 mg/L or less" to "0.09 mg/L or less" to sea waters, in accordance with local conditions. In addition, a T-P standard of "120 mg/L or less" is specified for the wastewaters discharged into public water systems by the Wastewater Standards under the Water-Pollution Control pH (hydrogen ion concentration) Law (1970).

- Environmental standards

Standards favorable for the protection of human health and preservation of the environment in terms of the pollution of public water systems that are specified in Article 16 of the Basic Environment Law.

A political and administrative objective.

- Wastewater Standards

Standards expressed in standard concentrations for health-related items and environmental items, for regulation of the effluent wastewaters from factories and business establishments that have a facility discharging wastewater into a public water system (prescribed as a "specified facility" by Cabinet Order), in accordance with the Water-Pollution Control Law.

The values shown in the table are those specified by the government in the Wastewater Standards (uniform standards). Some waters have densely located pollutant-emitting sources, making it difficult to achieve the environmental standards specified by the uniform standard of the government. Standards much more stringent than the uniform standards (extra-effluent standards) may be specified in the bylaws of the prefecture for such waters, and the regulations under the Water-Pollution Control Law are enforced in accordance with the extra-effluent standards, when stipulated.

The extra-effluent standards are determined in accordance with the local conditions of the prefecture.

Operation and maintenance verification items are used for the quantitative or qualitative evaluation of the performance in operation and maintenance, and for estimation of the cost associated with the operation. Possible verification items are listed in the following table. The verification organizations determine the verification items concerning operation and maintenance, taking into account other verification items as well.

Table: Verification items concerning operation and maintenance

Classification	Verification items
Environmental impact	Amount of generated sludge
	Amount of generated waste
	Noise and foul odor
	(If possible, qualitative evaluation of the efficiency in processing sludge, waste, and foul odors will also be conducted.)
Used resources	Electricity consumption
	Types and amounts of wastewater treatment chemicals
	Other consumables
Operations and maintenance items	Findings on water quality
	Period required for startup of the target verification apparatus
	Period required for stoppage of the target verification apparatus
	Number and skill of operators needed for operation and maintenance of the target verification apparatus
	Reliability of the target verification apparatus
	Method of solving problems
	Evaluation of the operation and maintenance manual

Details of the verification items are given in the " Protocols of the verifications," which specifies the basic concept, test condition and method, and the like during verification tests, and in the "verification-test plan," which specifies the detailed experimental conditions and the like on the basis of the outline of verification tests. For details, see the website of the project (<http://etv-j.eic.or.jp/>).

IV. Results of the verification tests conducted in 2003

Report on the verification test

The results of the verification tests are disclosed in reports on the verification tests. The reports on the verification tests include evaluation results for the properties of influent wastewater, test results during the period from installation to verification, all procedures for operation and maintenance, test results for the verification items concerning water quality during the test period, and others.

An original manuscript of the report on a verification test is prepared by the verification organization, discussed by the technology verification committee, and then summarized in a report on the verification test. The reports on verification tests will be submitted to the Ministry of the Environment and, after discussion by the working group, approved by the Ministry of the Environment.

Abstract of the report on a verification test

Abstracts of reports on verification tests are shown in this report, grouped by target technologies. Items included in the abstract of the report on verification test are explained below.

Principle

Summary of how the target apparatus processes wastewater

Targeted wastewater

Type of wastewater processed

Summary of the verification-test site

Summary of the site of the verification test

Information on the prerequisites for the verification test

* See "how to interpret the box-and-whisker plot" below for information on how to read the "Wastewater flow rate during the verification-test period."

The specification and processing capacity of the target verification apparatus and the designed capacity of the target apparatus are summarized.

-Name and type: Name and type given in the catalog

-Size and weight: Size and weight of the apparatus

-Target substances: Substances to be processed

-Daily wastewater flow rate: Amount of wastewater that can be processed in a day

-Hourly inflow rate: Amount of wastewater that can be processed in an hour

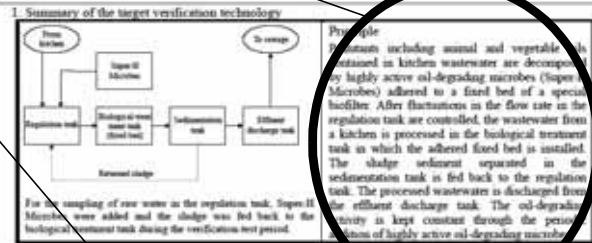
-Influent-wastewater quality: Quality of the wastewater that can be processed (standard)

-Processed-wastewater quality: Quality of the wastewater after treatment (standard)

-Processing method: Method of processing the wastewater

-Chemicals used: Types and amounts of chemicals required for processing (standard)

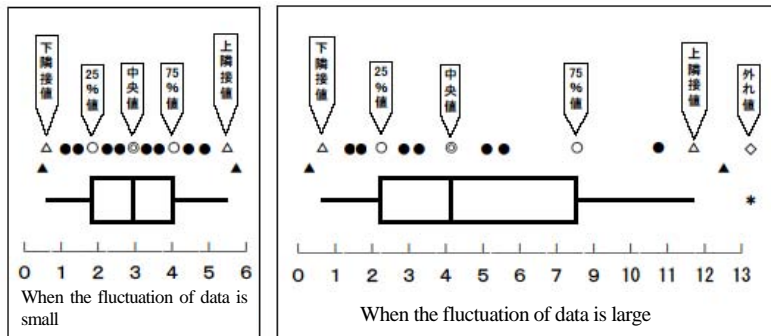
Target verification technology/environmental technology developer	Oil-degrading-bacteria-adhered fixed-bed contact aeration method / Kendo FRP Industries Co., Ltd.
Verification organization (Conducted by)	Environmental Pollution Control Center, Osaka Prefecture (Environmental Management and Technology Center in Kansai)
Verification-test period	Nov. 20, 2003 to Feb. 20, 2004
Object of technology	a. Decomposition of the pollutants in oil-containing organic wastewater b. Suppression of the generation of wastewater (sludge) and foul odor



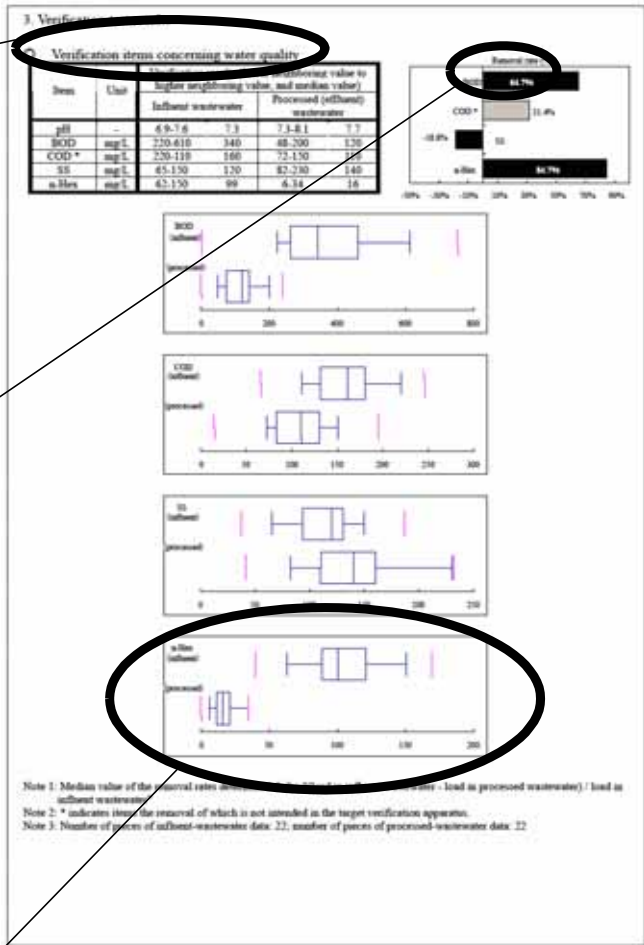
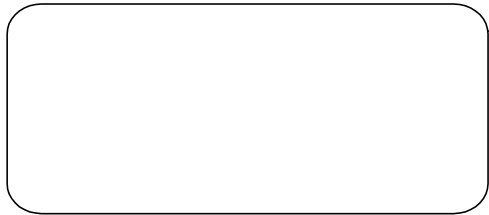
Summary of the verification-test site	
Business scale	Hotel
Location	Accommodation facility: 204 guest rooms, 723 guests; banquet hall: 400 guests; restaurant: 136 seats, and others (chapel, convenience store, etc.)
Wastewater flow rate during the verification-test period	1-7, Orai-ku, Ranku, Izumisano City, Osaka Prefecture

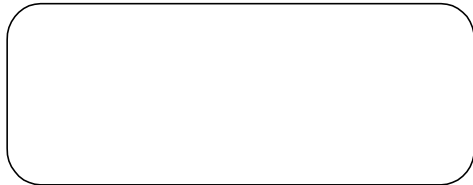
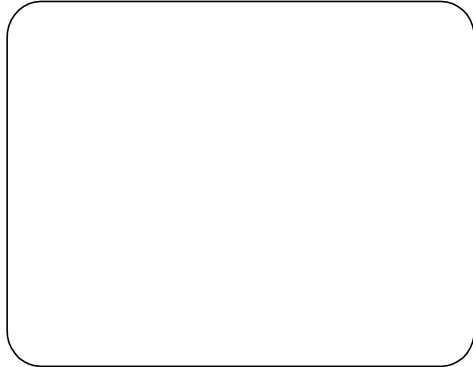
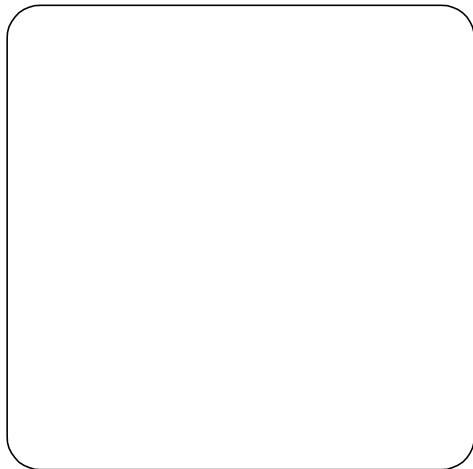
Specification and processing capacity of the target verification apparatus		
Classification	Item	Specification and processing capacity
Summary of facility	Name/type	Oil-degrading-bacteria-adhered fixed-bed contact aeration method (BN Clean system)
	Size and weight	4,000 mm (W) × 4,000 mm (D) × 3,000 mm (H); approximately 5,000 kg
Design conditions	Target substance	BOD, SS, pH, and n-Hex
	Daily wastewater flow rate	48 m ³ /day at maximum
	Inflow period	10 hours
	Hourly inflow rate	Average: 3.2 m ³ /hour
Design conditions	Influent-wastewater quality	BOD) 800 mg/L, (SS) 600 mg/L, (pH) 5.8-8.6, and (n-Hex) 150 mg/L
	Processed-wastewater quality	BOD) 600 mg/L, (SS) 600 mg/L, (pH) 5.8-8.6, and (n-Hex) 30 mg/L
Processing method		Oil-degrading-bacteria-adhered fixed-bed contact aeration method (BN Clean system)
Others	Chemicals used	Oil-degrading microbes (Super-II Microbes): 3.2 kg/month

▶ How to interpret the box-and-whisker plot



- Median value (◎): Data at the center when the data is sorted from smallest to largest
- 25% value (○): Data at the 1/4 position when the data is sorted from smallest to largest
- 75% value (○): Data at the 3/4 position when the data is sorted from smallest to largest
- Lower neighboring value (△): The measured value closest to the lower neighboring point [▲] calculated according to a formula [25% value - 1.5x (75% value - 25% value)] in the range between the lower neighboring point and the 25% value
- Higher neighboring value (▲): The measured value closest to the higher neighboring point [▲] calculated according to a formula [75% value - 1.5x (75% value - 25% value)] in the range between the higher neighboring point and the 75% value
- Missing value (◇): Values outside the lower and higher neighboring values




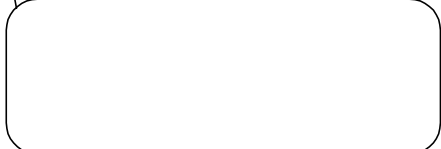


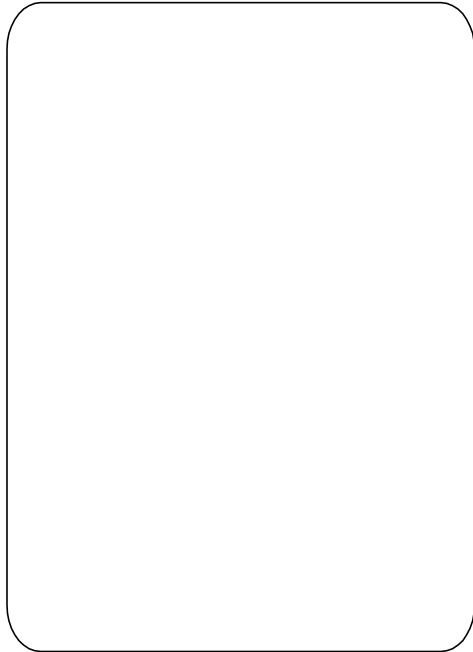
○ Items concerning environmental impact		
Item	Verification result	
Amount of generated sludge	No withdrawal of excess sludge during the verification period	
Amount of generated waste	No generation of waste during the verification period	
Noise	54 decibels (including environmental noise other than that from the facility)	
Odor	Odor index: less than 10; odor intensity: 0 to 0.5 (6-level odor-intensity scale)	

○ Items concerning used resources		
Item	Verification result	
Electricity consumption	114 kWh/day	
Wastewater treatment chemicals and other consumption	Oil-degrading microbes (Soper-H Microbes): 3.2 kg/month Bulking inhibitor: 1.0 kg (used only in the event of problems) Antifoam (solid): 0.4 kg (used only in the event of problems) Antifoam (liquid): 0.1 L (used only in the event of problems)	

○ Items concerning operation and maintenance performance		
Control point	Time and frequency of maintenance and management	Number and technical skill of the operators needed for operation and maintenance
Periodic maintenance (addition of microbial preparation, inspection and adjustment of instruments, confirmation and adjustment of processing conditions, and inspection of water quality)	140 to 170 minutes (average 150 minutes) (Once per month)	Two operators are required for periodic maintenance. Specialized knowledge and experience with operation and maintenance of the overall facility, instruments, and electric devices required.

○ Qualitative findings		
Item	Findings	
Water-quality findings		
Period required for startup	Not verified, as the facility exists and is in operation.	
Reliability of target verification apparatus	The facility generally operated normally during the verification period. However, malfunction of a flow-rate control pump (once), the large-scale proliferation of fungi, malfunction of a float switch (once), and other incidents occurred.	
Evaluation of the operation and maintenance manual	No particular problems to be solved	
Others	-----	





(Reference information)

All information on this page is provided by the environmental-technology developer on its own authority. The Ministry of the Environment and the verification organization are in no way responsible for the content of this page.

Product data

Item		Description given by the environmental-technology developer			
Name/type		BN Clean system			
Manufacturer (distributor) name		Kondo FRP Industries Co., Ltd.			
Contact address	Tel/Fax	TEL: (06)6376-0810 / FAX: (06)6376-0819			
	Website	-			
	E-mail	hiroyuki_inenaka@kondo-frp.co.jp			
Necessity of pre- and post-treatment		None			
Additional facility		None			
Life of target verification apparatus		Approximately 10 years or more			
Approximate cost (yen)	Initial cost				19,000,000
	FRP water tank (including materials and labor)		1	8,500,000	
	System parts		1 set	8,000,000	
	System installation work		1 set	2,000,000	
	Trisal run and adjustment		1 set	500,000	
	Regulation-tank installation work			Separately estimated	
	Operating cost (month)				204,980
	Sludge disposal				
	Waste disposal				
	Electricity	1,166 yen/day	30 days		34,980
	Water				
	Wastewater treatment chemicals				Included in *
	Other consumables				Included in *
	Maintenance and management subcontracting (month) *		1 set/month		170,000
	Per m ³ of processed wastewater (assumed amount of processed wastewater: 1,440 m ³ /month)				142

Other information from manufacturer

* The maintenance and management subcontracting includes costs for inspection of water quality, various parts, and consumables, preparation and submission of a management report, and others.

Summary of the target verification technology

The technologies verified in 2003 were as follows

Verification organization	Technology developer	Technology name	Page
Ishikawa Prefecture	AMS Corporation	Fat- and oil-containing-wastewater treatment apparatus using oil-degrading microbes	17
	Gate Co., Ltd.	Oil-containing-wastewater treatment technology using an oil-degrading microbe preparation	21
Environmental Pollution Control Center, Osaka Prefecture	Kondo FRP Industries Co., Ltd.	Oil-degrading-bacteria-adhered fixed-bed contact aeration method	25
	Suiko Engineering, Ltd.	Enzyme-reaction/fluidized-bed contact aeration method	29
	BioRangers, Inc.	Complex microbe/tornado biological reaction system	33
	River SS Ltd.	Coagulation/electrolytic floatation separation method	37
Hiroshima Prefecture	Aquamake Co., Ltd.	Restaurant/kitchen wastewater treatment facility "Superaqua"	41
	Kowa Emtech Ltd.	Zero-compo (kitchen oil recovery) wastewater treatment Apparatus	45

Abstract of the report on the verification test of the target verification technology

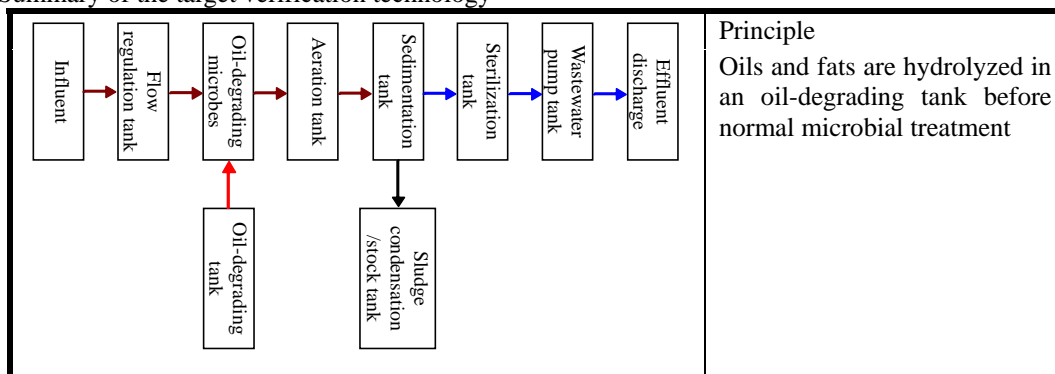
(以下、実証試験結果報告書全体概要が入る)

V. Concluding Remarks

The present pilot project will be continued into fiscal year 2004 and beyond. If necessary, changes and additions may be made to the items and contents of the verification test. The latest information and details of the modifications will be posted on the project's website (<http://etv-j.eic.or.jp>).

Target verification technology/environmental technology developer	Fat- and oil-containing wastewater treatment apparatus using oil-degrading microbes / AMS Corporation
Verification organization (Conducted by)	Ishikawa Prefecture (Ishikawa Prefectural Health Environment Center and Research Center of Environment & Pollution Co., Ltd.)
Verification-test period	Dec. 10, 2003 to Feb. 25, 2004
Object of technology	Decomposition of oil and fat in oil-containing organic wastewater

1. Summary of the target verification technology



2. Summary of the verification test

○ Summary of the verification-test site

Type of business	Food and box-lunch production
Business scale	Produces 2,000, 1,000, and 200 box lunches on weekdays, Saturday, and Sunday, respectively
Location	68 Tachihiraki, Shikamachi, Hakui-gun, Ishikawa Prefecture
Wastewater flow rate during the verification-test period	

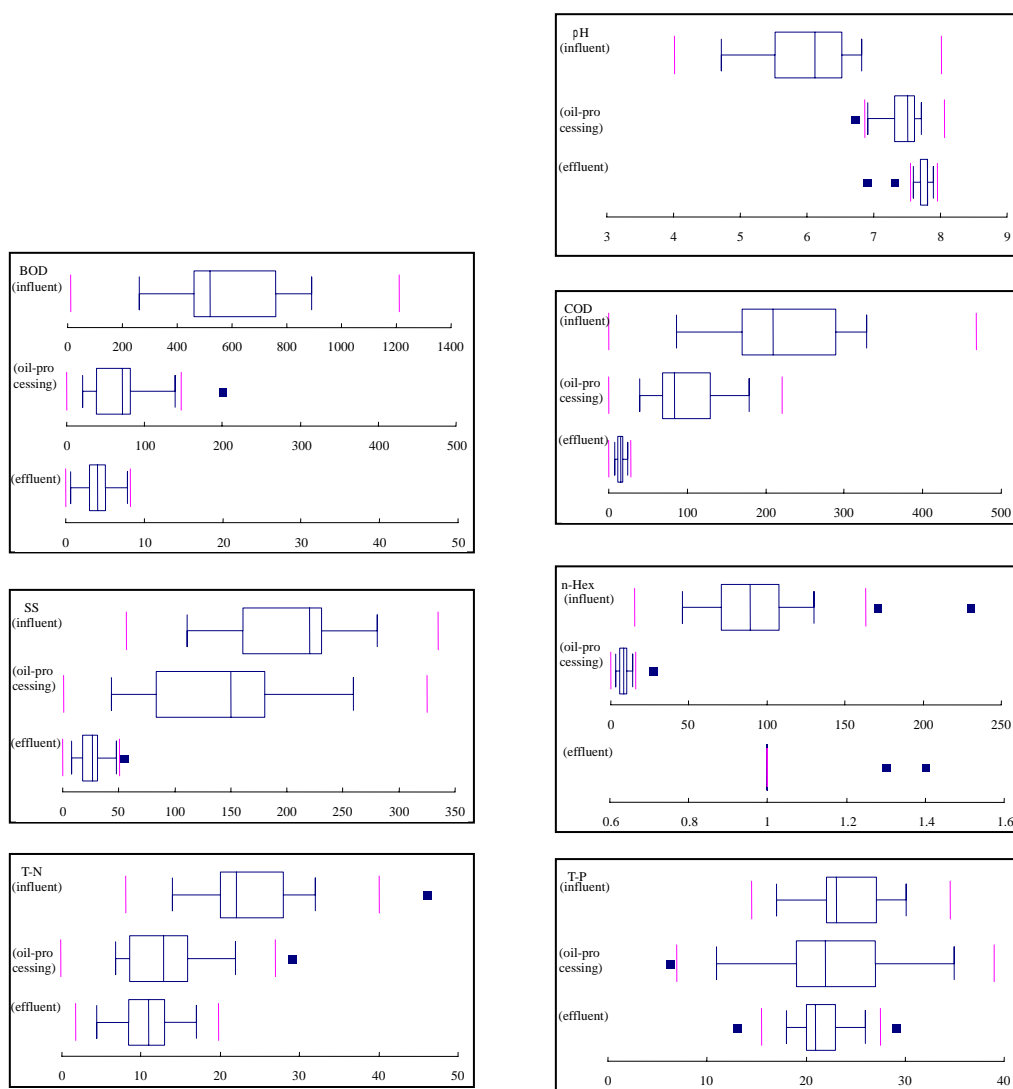
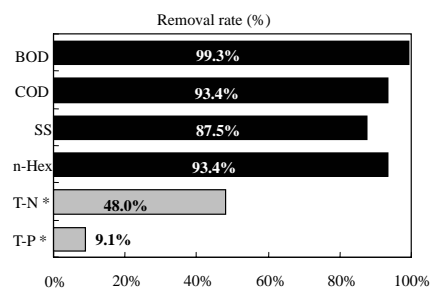
○ Specification and processing capacity of the target verification apparatus

Classification	Item	Specification and processing capacity
Summary of facility	Name/type	Oil- and fat-decomposing apparatus
	Size and weight	3,000 mm (W) × 13,700 mm (D) × 4,350 mm (H); 100,000 kg
Design conditions	Target substances	BOD, COD, SS, and n-HEX
	Daily wastewater flow rate	20 m ³ /day
	Influent-wastewater quality	(BOD) 800 mg/L, (SS) 300 mg/L, and (n-Hex) 200 mg/L
	Processed-wastewater quality	(BOD) 20 mg/L, (SS) 50 mg/L, and (n-Hex) 30 mg/L

3. Verification-test results

○ Verification items concerning water quality

Item	Unit	Verification results (lower neighboring value to higher neighboring value, and median value)			
		Influent wastewater		Processed (effluent) wastewater	
pH	-	4.7-6.8	6.1	7.6-7.9	7.8
BOD	mg/L	260-890	520	0.6-7.9	4.1
COD	mg/L	87-330	210	7.6-24	15
SS	mg/L	110-280	220	7.8-48	27
n-Hex	mg/L	46-130	89	1.0-1.0	1.0
T-N *	mg/L	14-32	22	4.4-17	11
T-P *	mg/L	17-30	23	18-26	21



Note 1: Median value of removal rates determined daily: "(load in influent wastewater - load in processed wastewater) / load in influent wastewater"

Note 2: * Indicates items the removal of which is not intended in the target verification apparatus.

Note 3: Number of pieces of influent-wastewater data: 17; number of pieces of oil-processing data: 17; and number of pieces of effluent-wastewater data: 17

○ Items concerning environmental impact

Item	Verification result
Amount of generated sludge	0.35 kg/day (dry)
Amount of generated waste	Residue after sludge withdrawal: 0.06 kg/day (dry)


○ Items concerning used resources

Item	Electricity consumption
Electricity consumption	97.3 kWh/day
Chemical consumption	Oil-degrading microbes: 0.5 L/day
Other consumables	Disinfectant: 0.2 kg/day

○ Items concerning operation and maintenance performance

Control point	Time and frequency of maintenance and management	Number and technical skill of the operators needed for operation and maintenance
Replenishment of oil-degrading microbes	5 minutes (once per month)	No specialized knowledge or technical skill needed, as the apparatus is automatically controlled and unmanned.
Replenishment of disinfectant	5 minutes (once per month)	No specialized knowledge or technical skill needed, as the apparatus is automatically controlled and unmanned.
Disposal of sludge (transportation in a vacuum car)	5 minutes (once every three months)	Qualification such as the water-purifier tank technology manager or other and technical skill is needed. Subcontract a management company.
Maintenance and inspection (periodic inspection)	30 minutes (once every two weeks)	Qualification such as the water-purifier tank technology manager or other and technical skill is needed. Subcontract a managing company.

○ Qualitative findings

Item	Findings
Water-quality findings	Influent wastewater: White and turbid Outlet of fat- and oil-degrading tank: Pale brown Effluent wastewater: Transparent 
Period required for startup	Not verified, as the facility exists and is in operation.
Period required for shutdown	
Reliability of target verification apparatus	The apparatus operated constantly during the verification-test period.
Method of resolving problems	The manufacturer or a management company will handle possible malfunctions.
Evaluation of the operation and maintenance manual	No particular problems to be solved
Others	-----

(Reference information)

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○ Product data

Item		Description given by the environmental-technology developer			
Name/type		Oil- and fat-decomposing apparatus			
Manufacturer (distributor) name		AMS Corporation			
Contact address	Tel/Fax	TEL: (076) 241-0371		FAX: (076) 247-8012	
	Website	http://www.e-ams.co.jp			
	E-mail	naruse@e-ams.co.jp			
Size (mm) and weight		3,000 (W) × 13,700 (D) × 4,350 (H); RC apparatus: 100 (t); FRP apparatus: 4.5 (t)			
Necessity of pre- and post-treatment		None			
Additional facility		None			
Life of target verification apparatus		50 years			
Approximate cost (yen)	Item		Unit cost	Quantity	Total
	Initial cost (RC apparatus)				8,300,000
	Oil-decomposing unit				1,916,000
	Main processing tank			1 set	643,000
	Civil concrete work			1 set	160,000
	Apparatus installation work			1 set	810,000
	Electric and piping work			1 set	100,000
	Others				203,000
	Biological treatment unit				6,384,000
	Main processing tank			1 set	1,474,000
	Civil concrete work			1 set	568,000
	Apparatus installation work			1 set	3,330,000
	Electric and piping work			1 set	321,000
	Others			1 set	691,000
	Operating cost (month)				88,000
	Sludge disposal		25,000	0.525 m ³	13,100
	Waste disposal		-----	-----	-----
	Electricity		12	2,919kWh	35,000
	Water		-----	-----	-----
	Wastewater treatment chemicals		2,400	15L	35,700
Other consumables		900	5.5kg	5,000	
Maintenance and management subcontracting*		0	1 set	0	
Per m ³ of processed wastewater (assumed amount of processed wastewater: 600 m ³ /month)				151	

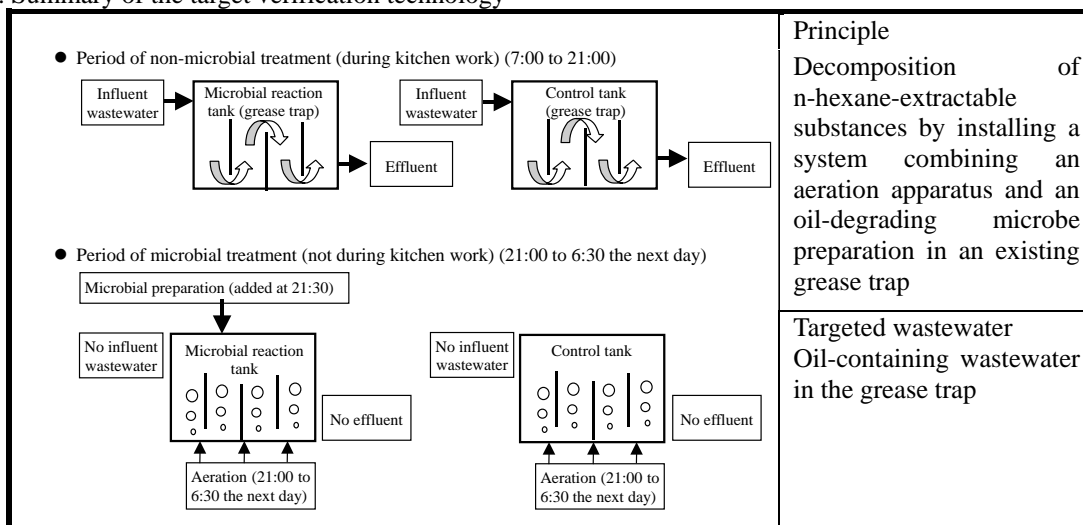
○ Other information from manufacturer

- Very effective for oil- and fat-containing wastewater for discharge into sewage and public water systems
- Already commercialized and supplied

* The cost of maintenance and management subcontracting was set to 0, assuming that maintenance and inspection are subcontracted to the same company handling the sludge.

Target verification technology/environmental technology developer	Oil-containing-wastewater treatment technology using an oil-degrading microbe preparation / Gate Co., Ltd.
Verification organization (conducted by)	Ishikawa Prefecture (Ishikawa Prefectural Health Environment Center, and Research Center of Environment & Pollution Co., Ltd.)
Verification-test period	Dec. 4, 2003 to Feb. 26 (27), 2004
Object of technology	Decomposition of the oils collected in an existing grease trap

1. Summary of the target verification technology



2. Summary of the verification test

○ Summary of the verification-test site

Type of business	University restaurant (restaurant and tea house)
Business scale	Restaurant: 200 seats; teahouse: 32 seats
Location	1-1, Asahidai, Tatsunokuchi-cho, Nomi-gun, Ishikawa Prefecture
Wastewater flow rate during the verification-test period	<p>The box plot shows the distribution of wastewater flow rate in m³/day. The x-axis ranges from 0 to 25. The data points are: minimum at ~3, Q1 at ~12, Median at ~15, Q3 at ~18, and maximum at ~22.</p>

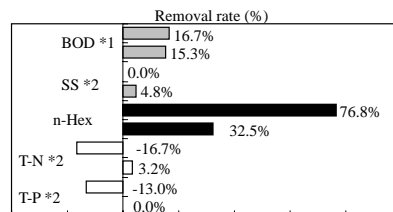
○ Specification and processing capacity of the target verification apparatus

Classification	Item	Specification and processing capacity
Summary of facility	Name/type	Oil-containing-wastewater processing technology, using an oil-degrading microbe preparation
	Target substance	n-Hex
Design conditions	Momentary maximum inflow rate	Momentary maximum inflow rate into grease trap: 133 L/min
	Processing capacity	Size of grease trap: 1,180 mm (W) × 380 mm (D) × 900 mm (H)

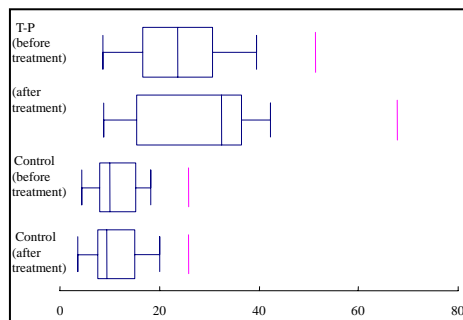
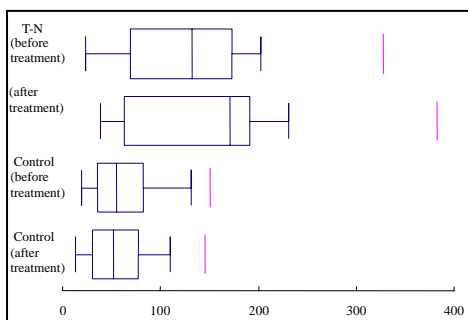
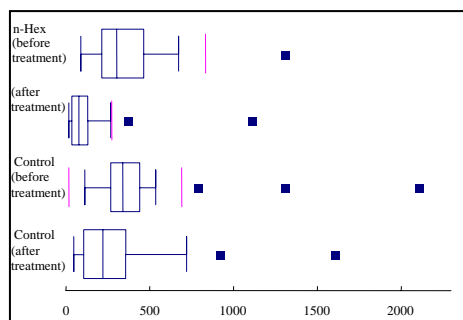
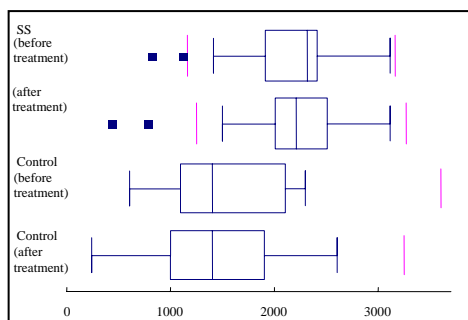
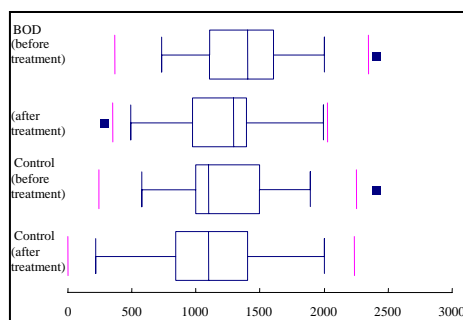
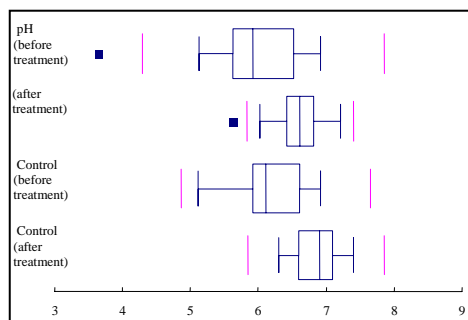
3. Verification-test results

○ Verification items concerning water quality

Item	Unit	Verification results (lower neighboring value to higher neighboring value, and median value)			
		Water quality before microbial treatment		Water quality after microbial treatment *3	
pH *1	-	5.1-6.9	5.9	6-7.2	6.6
BOD *1	mg/L	720-2,000	1,400	490-2,000	1,300
SS *2	mg/L	1,400-3,100	2,300	1,500-3,100	2,200
n-Hex	mg/L	70-660	290	8-260	65
T-N *2	mg/L	20-200	130	38-230	170
T-P *2	mg/L	7.8-39	23	8.2-42	32



The values in the top rows are the values of the target verification apparatus, while those in the bottom rows are the control values.





Note 1: Median value of the removal rates determined daily: "(load in influent wastewater - load in processed wastewater) /load in influent wastewater"

Note 2: *1 indicates an item the removal of which is not intended in the target verification apparatus; *2 indicates a reference item; *3 indicates the value of the effluent in the tank before discharge, which differs from the actual value of the effluent discharged.

Note 3: Total number of pieces of data: 17

○ Items concerning environmental impact

Item		Microbial reaction tank	Control tank
Amount of residue generated	On the tank wall above the water	12 g/day; oil content: 30%	13 g/day; oil content: 53%
	On the tank wall under the water	0.3 g/day; oil content: 7.4%	0.5 g/day; oil content: 18%
	Sediment	55 g/day; oil content: 8.4%	31 g/day; oil content: 29%
Pipe clogging		Fine granular residues observed 	Translucent icicle-like oil mass (1 cm) observed 
Odor		Foul odor above the tank when the microbes are activated and the cover is removed	Faint kitchen smell and faint oil smell


○ Items concerning used resources

Item	Verification result
Electricity consumption	1.13 kWh/day
Wastewater treatment chemicals and other consumption	Microbial preparation (trade name: "GS-1"): 40 g/day Microbe nutritional activator: 120 g/day

○ Items concerning operation and maintenance performance

Control point	Time and frequency of maintenance and management	Number and technical skill of the operators needed for operation and maintenance
Addition of microbial preparation	3 minutes (once per day)	No specialized knowledge or technical skill needed
Addition of microbe nutritional activator	3 minutes (once per day)	No specialized knowledge or technical skill needed
Adjustment of aeration balance	5 minutes (once per week)	No specialized knowledge or technical skill needed
Blower inspection (periodic inspection)	10 minutes (once per month)	No specialized knowledge or technical skill needed

○ Other qualitative findings

Item	Findings
Water-quality findings	Not during microbial treatment: Both the influent and effluent wastewaters (in the microbial-reaction and control tanks) are milky white. During microbial treatment: Brownish milky-white to yellowish-brown precipitates are generated in both the microbial-reaction and control tanks. 
Period required for startup	
Period required for shutdown	Not verified, as the facility exists and is in operation
Reliability of target verification apparatus	The apparatus operated constantly during the verification-test period.
Method of resolving problems	Contact the manufacturer or a dealer if there is a problem.
Evaluation of the operation and maintenance manual	No particular problems to be solved
Others	-----

(Reference information)

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○ Product data

Item	Description given by the environmental-technology developer			
Name/type	Oil-containing-wastewater processing technology, using an oil-degrading microbe preparation (GS-I)			
Manufacturer (distributor) name	Gate Co., Ltd.			
Contact address	Tel/Fax	TEL: (076) 233-0001; FAX: (076) 233-0009		
	Website	http://w2222.nsk.ne.jp/gate/		
	E-mail	gate@p2222.nsk.ne.jp		
Size (mm) and weight	Blower (HP-120): 256 mm (W) × 200 mm (D) × 222 mm (H), 7 kg Blower (HP-80): 235 mm (W) × 180 mm (D) × 196 mm (H), 5 kg Aeration pipe: 300 mm (L) × 8 pieces, 1 kg Preparation: Dry white powder; volume density: approximately 0.6			
Necessity of pre- and post-treatment	Food residues are to be removed as part of pretreatment.			
Additional facility	A suitable grease trap is required.			
Life of target verification apparatus	Approximately 30 years Microbial preparation (GS-I): 2 years			
Approximate cost (yen)	Item	Unit cost	Quantity	Total
	Initial cost			252,016
	Aeration system	-----	1 set	250,000
	Operating cost (month)			42,676
	Sludge disposal	-----	-----	-----
	Waste disposal	-----	-----	-----
	Electricity	12 yen/kWh	28.3kWh	340
	Water	-----	-----	-----
	Wastewater treatment chemicals			42,336
	Microbial preparation GS-I	45 yen/g	840g	37,800
	Microbe nutritional activator	1.8 yen/g	2,520g	4,536
	Other consumables	-----	-----	-----
	Maintenance and management subcontracting	-----	-----	-----
Per m ³ of processed wastewater (assumed amount of processed wastewater: 188 m ³ /month)				

○ Other information from manufacturer

- Gate microbes are microbes isolated from natural environments in Japan. The species and properties of the microbes were characterized by DNA analysis and the biochemical identification method.
- Gate microbial preparations contain no surfactant (neutralizer) or enzyme.
- Gate microbial preparations were commercialized in collaboration with universities and public test organizations.

Target verification technology/environmental technology developer	Oil-degrading-bacteria-adhered fixed-bed contact aeration method / Kondo FRP Industries Co., Ltd.
Verification organization (Conducted by)	Environmental Pollution Control Center, Osaka Prefecture (Environmental Management and Technology Center in Kansai)
Verification-test period	Nov. 20, 2003 to Feb. 20, 2004
Object of technology	a. Decomposition of the pollutants in oil-containing organic wastewater b. Suppression of the generation of waste (including sludge) and foul odor

1. Summary of the target verification technology

```

graph LR
    Kitchen((From kitchen)) --> RegTank[Regulation tank]
    SuperH[Super-H Microbes] --> RegTank
    RegTank --> BioTank[Biological-treatment tank (fixed bed)]
    BioTank --> SedTank[Sedimentation tank]
    SedTank --> EffTank[Effluent discharge tank]
    EffTank --> Sewage((To sewage))
    SedTank -.->|Returned sludge| RegTank
    
```

For the sampling of raw water in the regulation tank, Super-H Microbes were added and the sludge was fed back to the biological treatment tank during the verification-test period.

Principle
Pollutants including animal and vegetable oils contained in kitchen wastewater are decomposed by highly active oil-degrading microbes (Super-H Microbes) adhered to a fixed bed of a special biofilter. After fluctuations in the flow rate in the regulation tank are controlled, the wastewater from a kitchen is processed in the biological treatment tank in which the adhered fixed bed is installed. The sludge sediment separated in the sedimentation tank is fed back to the regulation tank. The processed wastewater is discharged from the effluent discharge tank. The oil-degrading activity is kept constant through the periodic addition of highly active oil-degrading microbes.

2. Summary of the verification test

○ Summary of the verification-test site

Type of business	Hotel
Business scale	Accommodation facility: 504 guest rooms, 723 guests; banquet hall: 400 guests; restaurant: 156 seats; and others (chapel, convenience store, etc.)
Location	1-7, Orai-kita, Rinku, Izumisano City, Osaka Prefecture
Wastewater flow rate during the verification-test period	

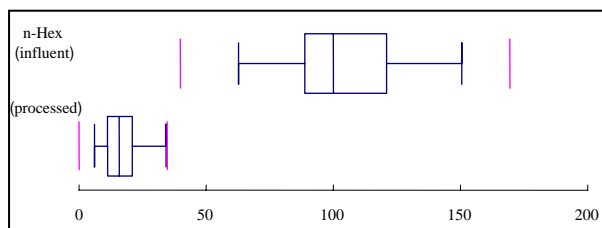
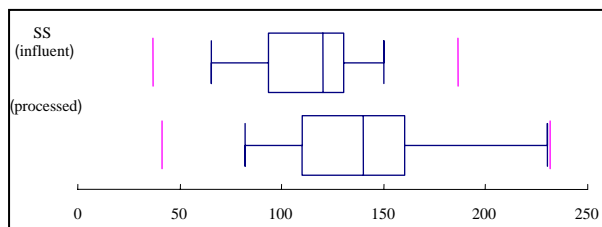
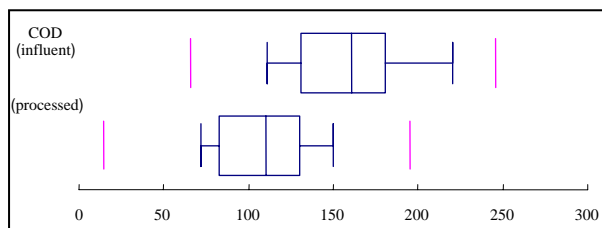
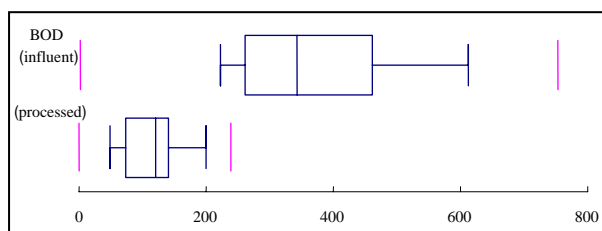
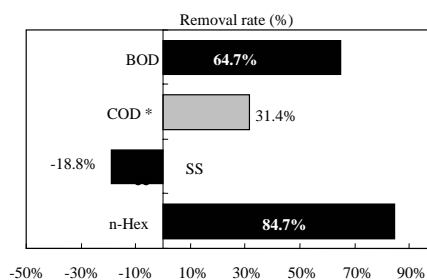
○ Specification and processing capacity of the target verification apparatus

Classification	Item	Specification and processing capacity
Summary of facility	Name/type	Oil-degrading-bacteria-adhered fixed-bed contact aeration method (BN Clean system)
	Size and weight	4,000 mm (W) × 4,000 mm (D) × 3,000 mm (H); approximately 5,000 kg
Design conditions	Target substance	BOD, SS, pH, and n-Hex
	Daily wastewater flow rate	48 m ³ /day at maximum
	Inflow period	10 hours
	Hourly inflow rate	Average: 3.2 m ³ /hour
	Influent-wastewater quality	(BOD) 800 mg/L, (SS) 600 mg/L, (pH) 5.8-8.6, and (n-Hex) 150 mg/L
	Processed-wastewater quality	(BOD) 600 mg/L, (SS) 600 mg/L, (pH) 5.8-8.6, and (n-Hex) 30 mg/L
Others	Chemicals used	Oil-degrading microbes (Super-H Microbes): 3.2 kg/month

3. Verification-test results

○ Verification items concerning water quality

Item	Unit	Verification results (lower neighboring value to higher neighboring value, and median value)			
		Influent wastewater		Processed (effluent) wastewater	
pH	-	6.9-7.6	7.3	7.3-8.1	7.7
BOD	mg/L	220-610	340	48-200	120
COD *	mg/L	220-110	160	72-150	110
SS	mg/L	65-150	120	82-230	140
n-Hex	mg/L	62-150	99	6-34	16



Note 1: Median value of the removal rates determined daily: "(load in influent wastewater - load in processed wastewater) / load in influent wastewater"

Note 2: * indicates items the removal of which is not intended in the target verification apparatus.

Note 3: Number of pieces of influent-wastewater data: 22; number of pieces of processed-wastewater data: 22

○ Items concerning environmental impact

Item	Verification result
Amount of generated sludge	No withdrawal of excess sludge during the verification period
Amount of generated waste	No generation of waste during the verification period
Noise	54 decibels (including environmental noise other than that from the facility)
Odor	Odor index: less than 10; odor intensity: 0 to 0.5 (6-level odor-intensity scale)



○ Items concerning used resources

Item	Verification result
Electricity consumption	114 kWh/day
Wastewater treatment chemicals and other consumption	Oil-degrading microbes (Super-H Microbes): 3.2 kg/month Bulking inhibitor: 1.0 kg (used only in the event of problems) Antifoam (solid): 0.4 kg (used only in the event of problems) Antifoam (liquid): 0.1 L (used only in the event of problems)

○ Items concerning operation and maintenance performance

Control point	Time and frequency of maintenance and management	Number and technical skill of the operators needed for operation and maintenance
Periodic maintenance (addition of microbial preparation, inspection and adjustment of instruments, confirmation and adjustment of processing conditions, and inspection of water quality)	140 to 170 minutes (average: 150 minutes) (Once per month)	Two operators are required for periodic maintenance. Specialized knowledge and experience with operation and maintenance of the overall facility, instruments, and electric devices required.

○ Qualitative findings

Item	Findings
Water-quality findings	  Influent wastewater Processed wastewater
Period required for startup	Not verified, as the facility exists and is in operation.
Reliability of target verification apparatus	The facility generally operated normally during the verification period. However, malfunction of a flow-rate control pump (once), the large-scale proliferation of fungi, malfunction of a float switch (once), and other incidents occurred.
Evaluation of the operation and maintenance manual	No particular problems to be solved
Others	-----

(Reference information)

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○ Product data

Item	Description given by the environmental-technology developer				
Name/type	BN Clean system				
Manufacturer (distributor) name	Kondo FRP Industries Co., Ltd.				
Contact address	Tel/Fax	TEL: (06)6376-0810 / FAX: (06)6376-0819			
	Website	-			
	E-mail	hiroyuki_inenaka@kondo-frp.co.jp			
Necessity of pre- and post-treatment	None				
Additional facility	None				
Life of target verification apparatus	Approximately 10 years or more				
Approximate cost (yen)		Item	Unit cost	Quantity	Total
		Initial cost			19,000,000
		FRP water tank (Including materials and labor)		1	8,500,000
		System parts		1 set	8,000,000
		System installation work		1 set	2,000,000
		Trial run and adjustment		1 set	500,000
		Regulation-tank installation work			Separately estimated
		Operating cost (month)			204,980
		Sludge disposal	-----	-----	-----
		Waste disposal	-----	-----	-----
		Electricity	1,166 yen/day	30 days	34,980
		Water	-----	-----	-----
		Wastewater treatment chemicals			Included in *
	Other consumables			Included in *	
	Maintenance and management subcontracting (month) *		1 set/month	170,000	
	Per m ³ of processed wastewater (assumed amount of processed wastewater: 1,440 m ³ /month)			142	

○ Other information from manufacturer

* The cost of maintenance and management subcontracting includes costs for inspection of water quality, various parts, and consumables, preparation and submission of a management report, and others.

Target verification technology/environmental technology developer	Enzyme reaction/fluidized-bed contact aeration method / Suiko Engineering Ltd.
Verification organization (Conducted by)	Environmental Pollution Control Center, Osaka Prefecture (Environmental Management and Technology Center in Kansai)
Verification-test period	Nov. 20, 2003 to Feb. 20, 2004
Object of technology	a. Decomposition of the pollutants in oil-containing organic wastewater b. Suppression of the generation of waste (including sludge) and foul odor

1. Summary of the target verification technology

```

            graph LR
            KW[Kitchen wastewater] --> RWP[Raw-water pump tank]
            RWP --> FR[Flow-regulation tank (enzyme reaction tank)]
            FR --> FBCA[Fluidized-bed contact aeration tank]
            FBCA --> OT[Overflow tank]
            OT --> DPT[Discharge-pump tank]
            DPT --> SD[Sewage discharge]
            
            FR --> MD[Metering device]
            MD --> FBCA
            
            FBCA --> SS[Sludge storage tank]
            SS --> FR
            
            FBCA --> OT
            OT --> ES[Excess sludge]
            ES --> DPT
            
            OT --> RS[Returned sludge]
            RS --> FR
            
            subgraph Microbes [Enzyme (lipase) + oil-degrading microbes]
            direction TB
            E1[Enzyme (lipase)]
            E2[+ oil-degrading microbes]
            end
            Microbes --> FR
            
            subgraph Sampling [Sampling]
            RWP --> S[Sampling]
            end
            S --> Microbes
        
```

* For sampling of the raw water in the raw-water-pump tank, the enzyme and the oil-degrading microbes were added to the flow regulation tank during the verification-test period.

Principle

This technology consists of two processes. In the first process, fats and oils are digested and decomposed by an enzyme (lipase) and oil-degrading microbes added to the wastewater in the flow regulation tank (enzyme reaction tank). In the second process, the fatty acids and BOD components contained in the wastewater are decomposed by biological processing by the fluidized-bed contact aeration method. After solid/liquid separation occurs in the overflow tank, the processed wastewater is discharged as the effluent.

2. Summary of the verification test

○ Summary of the verification-test site

Type of business	Restaurant (a complex facility serving Okonomiyaki (Japanese-style pancakes), fried Chinese noodles, rice bowls, noodles, Western foods, café-style foods, and others):
Business scale	522 seats; 2,000 guests/day; business area: 590 m ²
Location:	3-28, Orai-Minami, Rinku, Izumisano City, Osaka Prefecture
Wastewater flow rate during the verification-test period	<p style="text-align: right;">(m³/day)</p>

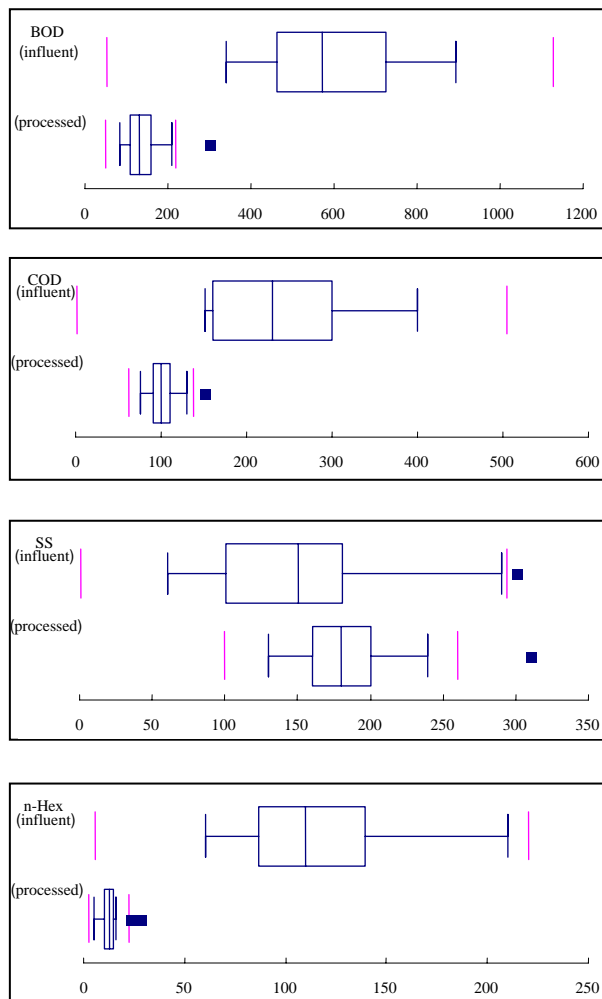
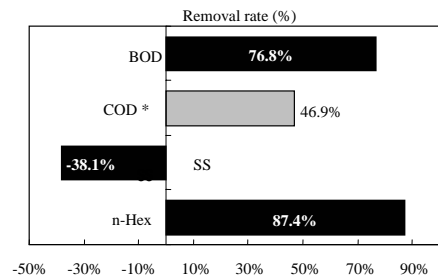
○ Specification and processing capacity of the target verification apparatus

Classification	Item	Specification and processing capacity
Summary of facility	Name/type	Enzyme-reaction-system and fluidized-bed decomposition facility / SK-50
	Size and weight	2,900 mm (W) × 23,000 mm (D) × 2,950 mm (H); approximately 300,000 kg
Design conditions	Target substance	BOD, SS, pH, and n-Hex
	Daily wastewater flow rate	50 m ³ /day
	Inflow period	14 hours
	Hourly inflow rate	Hourly average inflow rate: 3.6 m ³ /hour; hourly maximum inflow rate: 9.0 m ³ /hour
	Influent-wastewater quality	(BOD) 1,000 mg/L, (SS) 600 mg/L, (pH) 5.1-8.9, and (n-Hex) 100 mg/L
	Processed-wastewater quality	(BOD) 600 mg/L, (SS) 600 mg/L, (pH) 5.1-8.9, and (n-Hex) 30 mg/L
Others	Chemicals used	Enzyme (lipase): 0.03 kg/day; oil-degrading microbes: 0.09 kg/day

3. Verification-test results

○ Verification items concerning water quality

Item	Unit	Verification results (lower neighboring value to higher neighboring value, and median value)			
		Influent wastewater		Processed (effluent) wastewater	
pH	-	5.6-6.6	6.1	7.1-7.6	7.3
BOD	mg/L	340-890	570	83-210	130
COD *	mg/L	150-400	230	76-130	100
SS	mg/L	60-290	150	130-240	180
n-Hex	mg/L	61-210	110	5-16	13



Note 1: Median value of the removal rates determined daily: "(load in influent wastewater - load in processed wastewater) / load in influent wastewater"

Note 2: * indicates items the removal of which is not intended in the target verification apparatus.

Note 3: Number of pieces of influent-wastewater data: 22; number of pieces of processed-wastewater data: 22

○ Items concerning environmental impact

Item	Verification result
Amount of generated sludge	No withdrawal of excess sludge during the verification period
Amount of generated waste	No observable waste generated during the verification period
Noise	57 decibels (including environmental noise other than that from the facility)
Odor	Odor index: 14 to 15; odor intensity: 0.5 to 3.5 (6-level odor-intensity scale)


○ Items concerning used resources

Item	Verification result
Electricity consumption	109.1 kWh/day
Wastewater treatment chemicals and other consumption	Enzyme: 0.49 L/day Oil-degrading microbes: 0.52 L/day

○ Items concerning operation and maintenance performance

Control point	Time and frequency of maintenance and management	Number and technical skill of the operators needed for operation and maintenance
Periodic maintenance (confirmation of the operational condition of the apparatus and addition of lipase and oil-degrading microbes)	65 to 150 minutes (average: 85 minutes) (Once per week)	One operator required. Specialized knowledge and experience required for operation, maintenance, and management of the overall facility, instruments, and electric devices.

○ Qualitative findings

Item	Findings
Water-quality findings	 Influent wastewater Processed wastewater
Period required for startup	Not verified, as the facility exists and is in operation
Reliability of the target verification apparatus	The facility generally operated normally during the verification period. However, malfunction of a discharge pump (once) was observed.
Evaluation of the operation and maintenance manual	No particular problems to be solved
Others	-----

(Reference information)

All information on this page is provided by the environmental-technology developer on its own authority; the Ministry of the Environment and the verification organization are in no way responsible for the content of this page.

○ Product data

Item	Description given by the environmental-technology developer			
Name/type	Enzyme-reaction-system and fluidized-bed decomposition facility / SK-50			
Manufacturer (distributor) name	Suiko Engineering Ltd.			
Contact address	Tel/Fax	TEL: (06) 6943-6112 / FAX: (06) 6943-8456		
	Website	http://www.suiko-e.co.jp		
	E-mail	a.tamu@suiko-e.co.jp		
Necessity of pre- and post-treatment	None			
Additional facility	None			
Life of target verification apparatus	Overhaul of the apparatus and others: Approximately every 5 years			
Approximate cost (yen)	Item	Unit cost	Quantity	Total
	Initial cost			27,500,000
	Civil and culvert processing-tank installation work		1 set	17,300,000
	Installation work (machine, piping, electricity)		1 set	10,200,000
	Operating cost (month)			329,130
	Sludge disposal	-----	-----	-----
	Waste disposal	-----	-----	-----
	Electricity	1,296 yen/day	30 days	38,880
	Water	-----	-----	-----
	Wastewater treatment chemicals			170,250
	Lipase	10,000 yen/kg	14.7 kg/month	147,000
	Oil-degrading microbes	1,500 yen/kg	15.5 kg/month	23,250
	Other consumables	-----	-----	-----
	Maintenance and management subcontracting	30,000 yen	4 times/month	120,000
	Per m ³ of processed wastewater (assumed amount of processed wastewater: 1,500 m ³ /month)			219

○ Other information from manufacturer

- The facility complies with the standards for processed-wastewater quality; fluctuations in the amount of fats and oils in the kitchen wastewater are compensated for through the proper adjustment of the amount of lipase- (liquid) and oil-degrading microbes injected.
- No withdrawal of excess sludge was required in the facility since its installation in Feb. 2002, as SS components in the processed wastewater can be discharged at a particular concentration together with the effluent by fluidizing the carrier using adhered biological film in accordance with the fluidized-bed method.

Target verification technology/environmental technology developer	Complex microbe/tornado biological reaction system / BioRangers, Inc.
Verification organization (Conducted by)	Environmental Pollution Control Center, Osaka Prefecture (Environmental Management and Technology Center in Kansai)
Verification-test period	1st stage: Nov. 25, 2003 to Dec. 19, 2003 2nd stage: Jan. 8, 2004 to Mar. 4, 2004
Object of technology	a. Decomposition of the pollutants in oil-containing organic wastewater b. Suppression of the generation of waste (including sludge) and foul odor

1. Summary of the target verification technology

	<p>Principle</p> <p>A biological reaction system, by bringing complex oil-degrading microbes (Oppenheimer Formula™) into contact with oils and supplying oxygen needed for efficient decomposition. Oils and other organic matter are decomposed more efficiently in the oxidation tank, as microbes, oils, and oxygen are efficiently brought into contact with each other. Following solid/liquid separation into processed wastewater and sludge in the sedimentation tank, the processed wastewater is discharged as the effluent. The sludge obtained through sedimentation separation is fed back to the oxidation tank, where the excess sludge is reduced in volume, thereby enabling high-efficiency, low-cost wastewater treatment.</p>
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2. Summary of the verification test

○ Summary of the verification-test site

Type of business	Restaurant (located on a college campus) * This verification test is conducted using a test plant installed by the environmental-technology developer at the verification-test site assigned by the verification organization.
Business scale	500 seats; 2,000 guests/day
Location:	1-1, Gakuen-cho, Sakai City, Osaka Prefecture
Wastewater flow rate during the verification-test period	

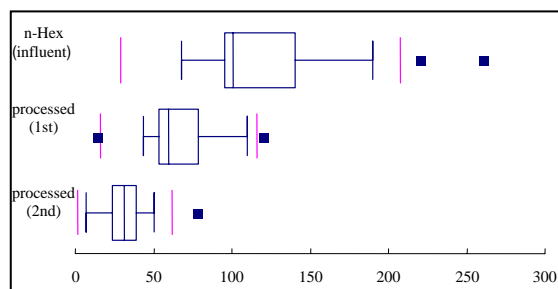
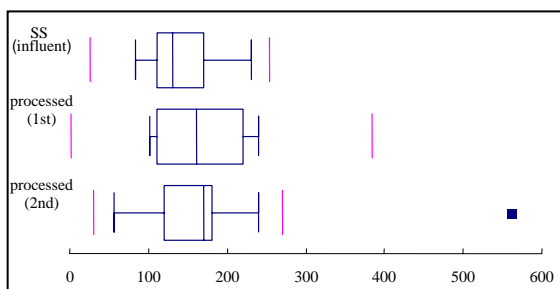
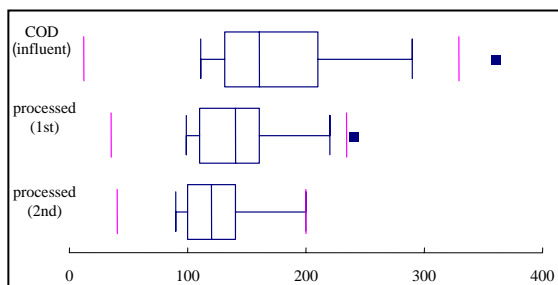
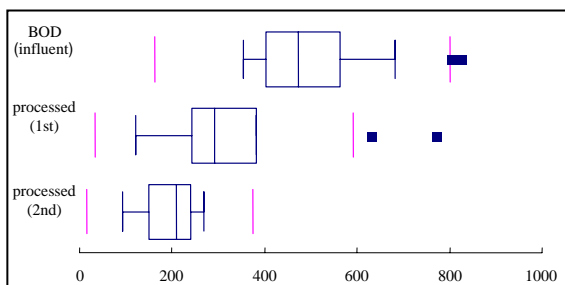
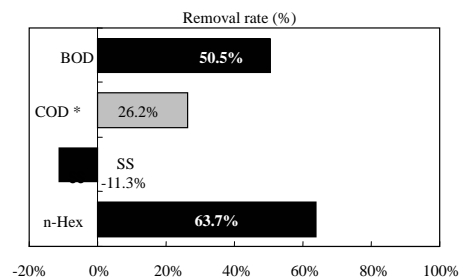
○ Specification and processing capacity of the target verification apparatus

Classification	Item	Specification and processing capacity
Summary of facility	Name/type	BRS-100-110 (test plant)
	Size and weight	Oxidation tank: φ556 mm × 1,050 mm (H) (actual effective capacity: 0.105 m ³); approximately 40 kg Sedimentation tank: φ506 mm × 1,050 mm (H) (actual effective capacity: 0.084 m ³); approximately 35 kg
Design conditions	Target substance	PH, BOD, SS, and n-Hex
	Daily wastewater flow rate	0.3 m ³ /day (1st), and 0.45 m ³ /day (2nd)
	Inflow period	24 hours
	Hourly inflow rate	0.012 m ³ /hour (1st) and 0.018 m ³ /hour (2nd)
	Influent-wastewater quality	(pH): 5.0-10.0; (BOD): 850 mg/L; (SS): 600 mg/L; and (n-Hex): 840 mg/L
Processed-wastewater quality	(pH): 5.1-8.9; (BOD): 600 mg/L; (SS): 600 mg/L; and (n-Hex): 30 mg/L	
Others	Chemicals used	Microbial preparation (Oppenheimer Formula I): 1 g/day

3. Verification-test results

○ Verification items concerning water quality

Item	Unit	Verification results (lower neighboring value to higher neighboring value, and median value)			
		Influent wastewater		Processed (effluent) wastewater	
pH	-	5.0-7.1	6.3	5.9-6.7	6.3
BOD	mg/L	350-680	470	120-380	290
COD *	mg/L	110-290	160	94-270	210
SS	mg/L	83-230	130	98-220	140
n-Hex	mg/L	67-190	100	43-110	59
				7-50	31



Note 1: Median value of removal rates determined daily: "(load in influent wastewater - load in processed wastewater) / load in influent wastewater"

Note 2: * indicates items the removal of which is not intended in the target verification apparatus.

Note 3: Number of pieces of influent-wastewater data: 22; number of pieces of processed-wastewater data: 9 (1st) and 13 (2nd)

Target verification technology/environmental technology developer	Complex microbe/tornado biological reaction system / BioRangers, Inc.
Verification organization (Conducted by)	Environmental Pollution Control Center, Osaka Prefecture (Environmental Management and Technology Center in Kansai)
Verification-test period	1st stage: Nov. 25, 2003 to Dec. 19, 2003 2nd stage: Jan. 8, 2004 to Mar. 4, 2004
Object of technology	a. Decomposition of the pollutants in oil-containing organic wastewater b. Suppression of the generation of waste (including sludge) and foul odor

1. Summary of the target verification technology

	<p>Principle</p> <p>A biological reaction system, by bringing complex oil-degrading microbes (Oppenheimer Formula™) into contact with oils and supplying oxygen needed for efficient decomposition. Oils and other organic matter are decomposed more efficiently in the oxidation tank, as microbes, oils, and oxygen are efficiently brought into contact with each other. Following solid/liquid separation into processed wastewater and sludge in the sedimentation tank, the processed wastewater is discharged as the effluent. The sludge obtained through sedimentation separation is fed back to the oxidation tank, where the excess sludge is reduced in volume, thereby enabling high-efficiency, low-cost wastewater treatment.</p>
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2. Summary of the verification test

○ Summary of the verification-test site

Type of business	Restaurant (located on a college campus) * This verification test is conducted using a test plant installed by the environmental-technology developer at the verification-test site assigned by the verification organization.
Business scale	500 seats; 2,000 guests/day
Location:	1-1, Gakuen-cho, Sakai City, Osaka Prefecture
Wastewater flow rate during the verification-test period	

○ Specification and processing capacity of the target verification apparatus

Classification	Item	Specification and processing capacity
Summary of facility	Name/type	BRS-100-110 (test plant)
	Size and weight	Oxidation tank: φ556 mm × 1,050 mm (H) (actual effective capacity: 0.105 m ³); approximately 40 kg Sedimentation tank: φ506 mm × 1,050 mm (H) (actual effective capacity: 0.084 m ³); approximately 35 kg
Design conditions	Target substance	PH, BOD, SS, and n-Hex
	Daily wastewater flow rate	0.3 m ³ /day (1st), and 0.45 m ³ /day (2nd)
	Inflow period	24 hours
	Hourly inflow rate	0.012 m ³ /hour (1st) and 0.018 m ³ /hour (2nd)
	Influent-wastewater quality	(pH): 5.0-10.0; (BOD): 850 mg/L; (SS): 600 mg/L; and (n-Hex): 840 mg/L
Processed-wastewater quality	(pH): 5.1-8.9; (BOD): 600 mg/L; (SS): 600 mg/L; and (n-Hex): 30 mg/L	
Others	Chemicals used	Microbial preparation (Oppenheimer Formula I): 1 g/day

(Reference information)

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○ Product data

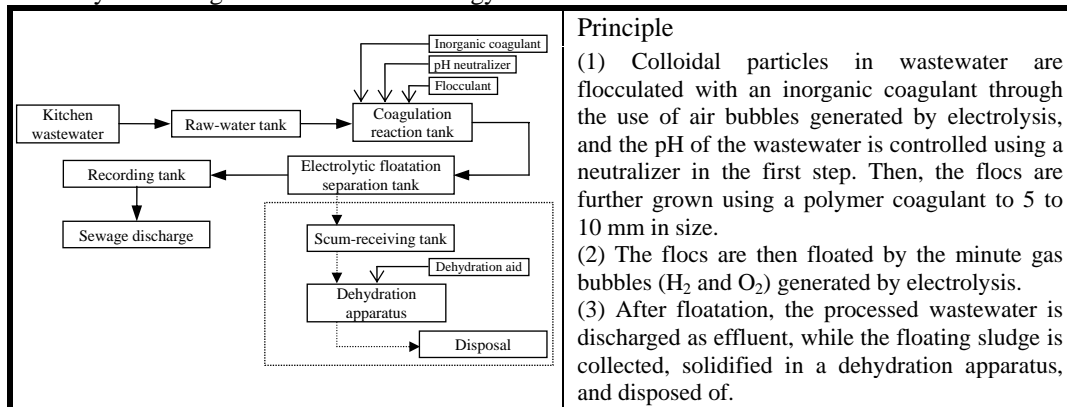
Item	Description given by the environmental-technology developer				
Name/type	Complex microbe/tornado biological reaction system / 10-100				
Manufacturer (distributor) name	BioRangers, Inc.				
Contact address	Tel/Fax	TEL: (03) 5833-7181 / FAX: (03) 3863-1520			
	Website	www.bri.co.jp			
	E-mail	info@bri.co.jp			
Size and weight	(Oxidation tank 1012) ϕ 1,200 mm \times 1,400 mm (H); effective capacity: 1.154 m ³ ; approximately 100 kg (Sedimentation tank 1515) ϕ 1,500 mm \times 1,800 mm (H); effective capacity: 2.120 m ³ ; approximately 160 kg				
Design calculation	Oxidation tank	((Required holding time): 0.7838 hours; (required effective capacity): 0.3266 m ³ ; (designed capacity): 1.154 m ³			
	Sedimentation tank	(Effective capacity): 1/6 or less of the daily wastewater flow rate; (load per water surface area): 8 m ³ /m ² ·day or less (Water surface area of tank): 1.767 m ² ; (required effective capacity): 1.6667 m ³			
	Main instruments	(Circulation pump): 0.09 m ³ /min, ϕ 40, 0.40 kW, 1 piece (Scum withdrawal pump): 0.03 m ³ /min, ϕ 16, 0.02 kW, 1 piece (Sludge withdrawal pump): 0.03 m ³ /min, ϕ 16, 0.02 kW, 1 piece (Control panel): Indoor & outdoor, relay-type, timer controlled			
Necessity of pre- and post-treatment	None				
Additional facility	Pump tanks (raw water, effluent discharge), flow regulation tank, and automatic microbial-preparation-adding device				
Life of the target verification apparatus	Tanks: 15 years; pumps and other instruments: 3 years				
Approximate cost (yen)	Item		Unit cost	Quantity	Total
	Initial cost				
	System			1 set	3,000,000
	Electric and piping work			1 set	300,000
	Other apparatuses			1 set	300,000
	Operating cost (month)				
	Sludge disposal		-----	-----	-----
	Waste disposal		-----	-----	-----
	Electricity		200 yen/day	30 days	6,000
	Water		-----	-----	-----
	Wastewater treatment chemicals		50,000 yen/kg	0.5 kg/month	30,000
	Other consumables		-----	-----	-----
	Maintenance and management subcontracting		10,000 yen	Once/month	10,000
Per m ³ of processed wastewater (assumed amount of processed wastewater: 300 m ³ /month)				153	

○ Other information from manufacturer

- Assumed inflow rate: 10 m³/day; assumed oil concentration (n-hexane extractable substances): 100 mg/L
- Oppenheimer formula I was used as the microbial preparation.
- The entire system is placed on the ground.
- The maintenance and inspection include examination of pH, DO, MLSS, and SV, adjustment of the timer, examination of instruments, and others. An apparatus equipped with an automatic microbial-preparation-adding device was used. Travel expenses are excluded.

Target verification technology/environmental technology developer	Coagulation and electrolytic floatation separation method / River SS Ltd.
Verification organization (Conducted by)	Environmental Pollution Control Center, Osaka Prefecture (Environmental Management and Technology Center in Kansai)
Verification-test period	Jan. 8, 2004 to Feb. 13, 2004
Object of technology	Separation of oils and suspended solids in oil-containing organic wastewater

1. Summary of the target verification technology



2. Summary of the verification test

○ Summary of the verification-test site

Type of business	Restaurant
Business scale	Restaurant: 2F, 100 seats; 1F, 80 seats; other, 15 seats; number of guests: 1,200/day
Location:	Suita service area, Meishin Expressway (Suita City, Osaka)
Wastewater flow rate during the verification-test period	

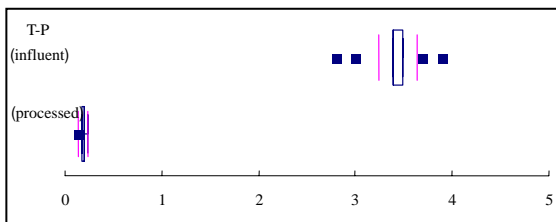
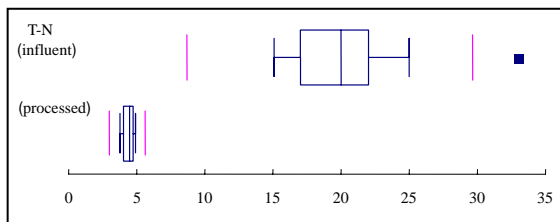
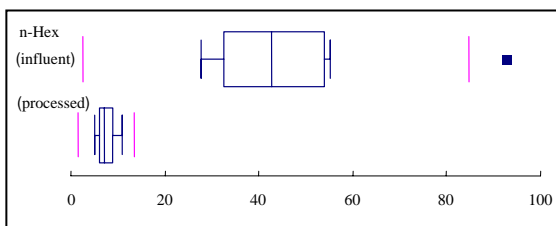
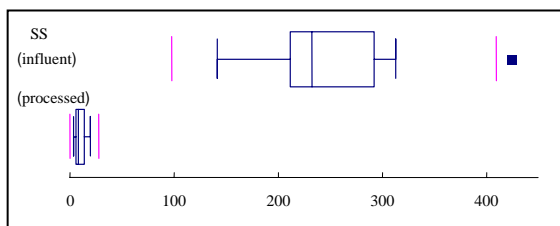
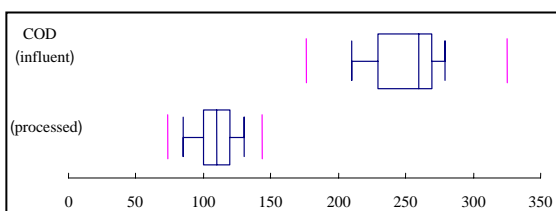
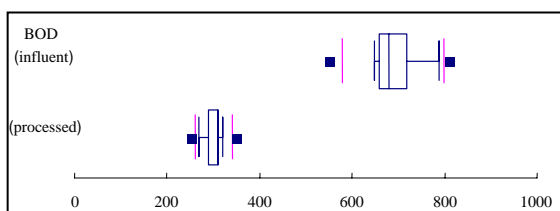
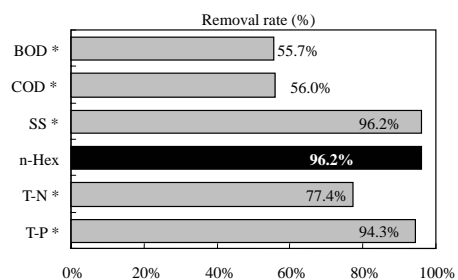
○ Specification and processing capacity of the target verification apparatus

Classification	Item	Specification and processing capacity
Summary of facility	Name/type	Electrolytic floating apparatus and dehydration apparatus
	Size and weight	15,000 mm (W) × 3,000 mm (D) × 3,600 mm (H); 61,000 kg
Design conditions	Target substance	pH and n-Hex
	Daily wastewater flow rate	144 m ³ /day at maximum
	Inflow period	24 hours at maximum
	Hourly inflow rate	Average: 3.2 m ³ /hour
	Influent-wastewater quality	(BOD) 750 mg/L, (SS) 300 mg/L, (n-Hex) 150 mg/L
	Processed-wastewater quality	(pH): 5.8-8.6; (n-Hex): 30 mg/L
Others	Chemicals used	Coagulation- electrolytic floatation separation method Dehydration (screw press) method PAC, sodium hydroxide, polymer coagulant (anionic or cationic)

3. Verification-test results

○ Verification items concerning water quality

Item	Unit	Verification results (lower neighboring value to higher neighboring value, and median value)			
		Influent wastewater		Processed (effluent) wastewater	
pH	-	4.9-5.4	5.1	6.8-7.1	6.9
BOD *	mg/L	650-790	680	270-320	310
COD *	mg/L	210-280	260	85-130	110
SS *	mg/L	140-310	230	4-20	8
n-Hex	mg/L	110-220	170	5-11	7
T-N *	mg/L	15-25	20	3.8-4.9	4.5
T-P *	mg/L	3.4-3.5	3.4	0.17-0.23	0.20



Note 1: Median value of removal rates determined daily: "(load in influent wastewater - load in processed wastewater)/load in influent wastewater"

Note 2: * indicates items the removal of which is not intended in the target verification apparatus.

Note 3: Number of pieces of influent-wastewater data: 10; number of pieces of processed-wastewater data: 10

○ Items concerning environmental impact

Item	Verification result
Amount of generated sludge	26.5 kg/day (dry), and 133.9 kg/day (water content: 80.2%)
Amount of generated waste	No observable waste generated during the verification period
Noise	70 decibels (including environmental noise other than that from the facility)
Odor	Odor index: 14; odor intensity: 1 (6-level odor-intensity scale)



○ Items concerning used resources

Item	Verification result
Electricity consumption	120 kWh/day
Wastewater treatment chemicals and other consumption	PAC (10% solution): 1,500 kg/month Sodium hydroxide (24% solution): 1,200 kg/month Anionic-polymer coagulant: 26 kg/month Cationic-polymer coagulant: 13 kg/month

○ Items concerning operation and maintenance performance

Control point	Time and frequency of maintenance and management	Number and technical skill of the operators needed for operation and maintenance
Periodic maintenance (disposal of dehydrated cake, addition of various chemicals, inspection and adjustment of instruments, confirmation and adjustment of processing conditions, inspection of water quality, and others)	55 to 360 minutes (average: 170 minutes) (Three times per week)	One operator is required for periodic maintenance. Specialized knowledge and experience are required for operation, maintenance, and management of the facility in general, instruments, and electric devices.

○ Qualitative findings

Item	Findings
Water-quality findings	  Influent wastewater Processed wastewater
Period required for startup	Not verified, as the facility exists and is in operation
Period required for shutdown	
Reliability of the target verification apparatus	The facility generally operated normally during the verification period. However, malfunction of the dehydration pump (three times) and clogging of the pipe in the dehydration apparatus (once) were observed.
Evaluation of the operation and maintenance manual	No particular problems to be solved
Others	-----

(Reference information)

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○ Product data

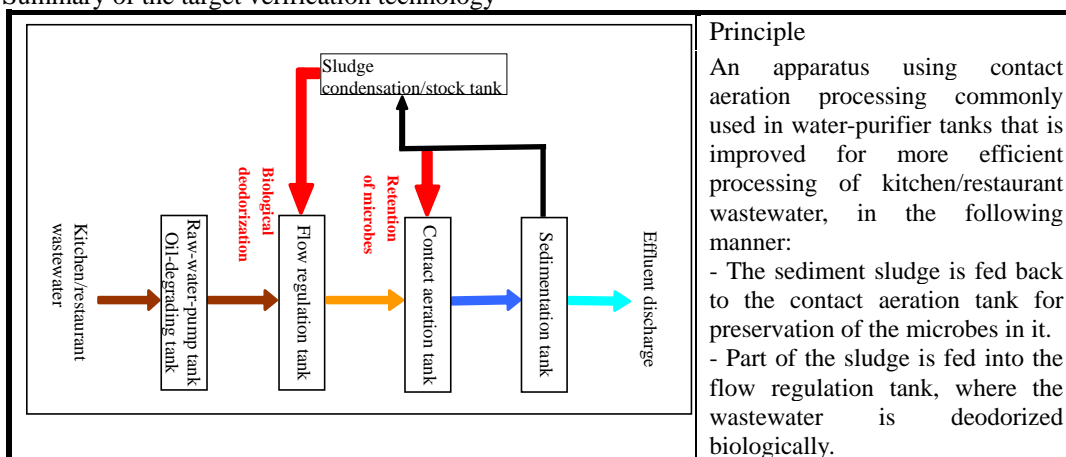
Item	Description given by the environmental-technology developer				
Name/type	Coagulation and electrolytic floatation apparatus / ORE-004				
Manufacturer (distributor) name	River Seisakusho Ltd.				
Contact address	Tel/Fax	TEL: (072) 296-9018 / FAX: (072)296-9038			
	Website	www.river-ss.co.jp			
	E-mail	river@river-ss.co.jp			
Size and weight	12,000 mm (W) × 2,000 mm (D) × 3,000 mm (H); 30,000 kg				
Necessity of pre- and post-treatment	None (An oil/water separator may be required, depending on the quality of wastewater.)				
Additional facility	None				
Life of the target verification apparatus	Instruments: approximately 5 years; Size and weight apparatuses: approximately 10 years				
Approximate cost (yen)		Cost	Unit cost	Quantity	Total
		Initial cost			25,000,000
		○ Civil work			Separately estimated
		○ Construction			separately estimated
		○ Apparatuses			25,000,000
		Operating cost (month)			310,870
		Sludge disposal	20 yen/kg	4,500 kg	90,000
		Waste disposal	-----	-----	-----
		Electricity	602 yen/day	30 days	18,060
		Water	-----	-----	-----
		Wastewater treatment chemicals			108,810
		PAC	40 yen/kg	1,800 kg/month	72,000
		Sodium hydroxide	37 yen/kg	900 kg/month	33,300
		Polymer coagulant	1,300 yen/kg	2.7 kg/month	3,510
		Other consumables			4,000
	Maintenance and management subcontracting	3,000 yen/day	30 days	90,000	
	Per m ³ of processed wastewater (assumed amount of processed wastewater: 900 m ³ /month)			345	

○ Other information from manufacturer

- The cost for sludge disposal varies depending on the type of the sludge and the dealer used, and thus is estimated separately. The cost specified in the table is a reference value for disposal of a dehydrated cake with water content of 80% or less.
- The consumables include pump parts and pH electrodes.
- A period of one hour per day on average would be required for maintenance and inspection.
- The assumed inflow rate is 30 m³/day.
- A filter press is normally used as the dehydration apparatus, and thus there is basically no need for the polymeric coagulant for coagulation (anionic or cationic).
- The unit costs for chemicals (PAC and sodium hydroxide) are the prices when the chemicals are supplied in a tank truck. The unit costs differ when chemicals are purchased in plastic bottles (the polymer coagulant is a powder).

Target verification technology/environmental technology developer	Restaurant/kitchen wastewater treatment facility "Superaqua" / Aquamake Co., Ltd.
Verification organization (Conducted by)	Hiroshima Prefecture (Hiroshima Prefectural Health and Environment Center, Hiroshima Environment & Health Association)
Verification-test period	Nov. 30, 2003 to Feb. 23, 2004
Object of technology	a. Consistent high-efficiency processing, suitable for the site to which the effluent is discharged b. Suppression of the generation of excess sludge and foul odor

1. Summary of the target verification technology



2. Summary of the verification test

○ Summary of the verification-test site

Type of business	Restaurant (sushi and grilled meat)
Business scale	Sushi: 127 seats; grilled meat: 124 seats
Location:	Mawaru-Sushi-Matsuri (Saijo) and Yakushoku-Dogen-Shitirinya (Saijo) 1 and 2, 4382, Oaza-Misonou, Saijo-cho, Higashi-Hiroshima, Hiroshima Prefecture
Wastewater flow rate during the verification-test period	(m ³ /day)

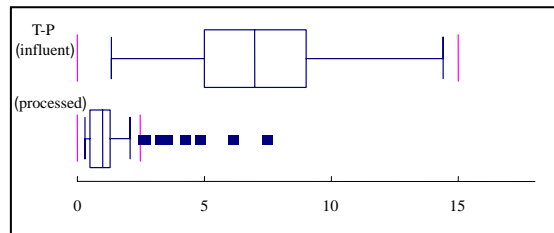
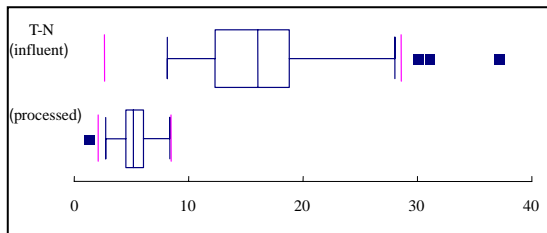
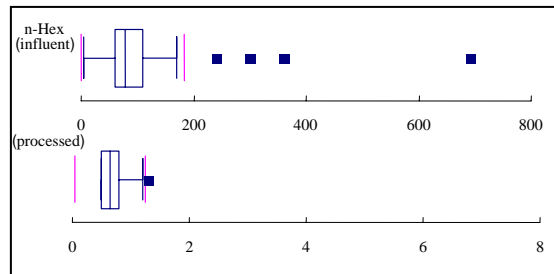
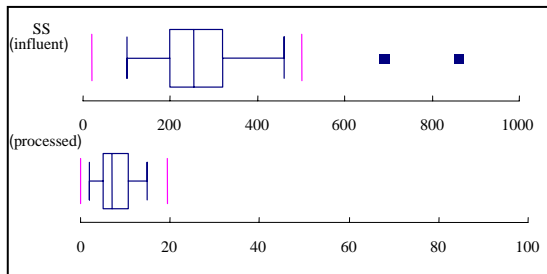
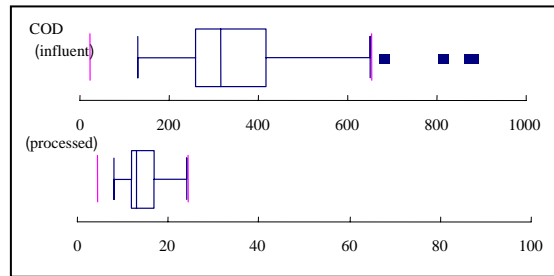
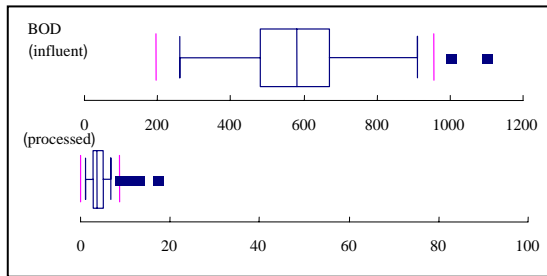
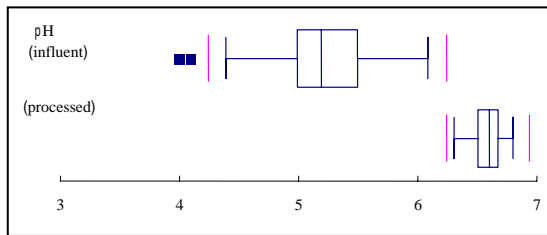
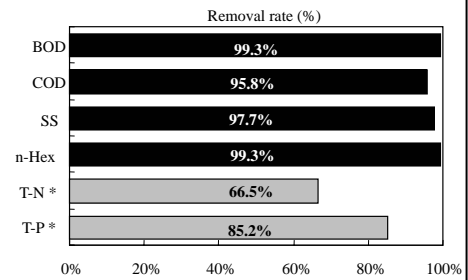
○ Specification and processing capacity of the target verification apparatus

Classification	Item	Specification and processing capacity
Summary of facility	Type	AM-PT-25
	Size and weight	6,000 mm (W) × 10,000 mm (D) × 3,200 mm (H); 6,000 kg
Design conditions	Target substance	BOD, COD, SS, and n-Hex
	Daily wastewater flow rate	25 m ³ /day
	Processed-waste water quality	(BOD): 30 mg/L or less; (pH): 5.8-8.6 Compliant with the technical standard based on the land development guidelines of Hiroshima Prefecture

3. Verification-test results

○ Verification items concerning water quality

Item	Unit	Verification result (lower neighboring value to higher neighboring value, and median value)			
		Influent wastewater		Processed wastewater	
pH	-	4.4-6.1	5.2	6.3-6.8	6.6
BOD	mg/L	260-910	580	1.1-6.8	3.65
COD	mg/L	130-650	315	8.1-24	13
SS	mg/L	100-460	255	2-15	7
n-Hex	mg/L	5-170	78.5	<0.5-0.7	<0.5
T-N *	mg/L	8-28	16	2.7-8.3	5.15
T-P *	mg/L	1.5-16	7.75	0.3-2.1	0.97



Note 1: Median value of removal rates determined daily: "(load in influent wastewater - load in processed wastewater) / load in influent wastewater"

Note 2: * indicates items the removal of which is not intended in the target verification apparatus.

Note 3: Number of pieces of influent-wastewater data: 78; number of pieces of processed-wastewater data: 78

○ Items concerning environmental impact

Item	Verification result
Amount of generated sludge	0.88 kg/day (dry); 46.1 kg/day (water content: 98.1%)
Amount of generated waste	No generation of waste during the verification period
Noise	None (in four-stage evaluation: none, slightly noisy, noisy, and very noisy)
Odor	Slight odor (in four-stage evaluation: none, slight odor, odor, and strong odor)

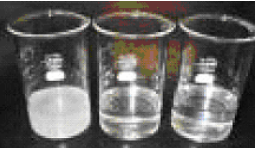
○ Items concerning used resources

Item	Verification result
Electricity consumption	75.3 kWh/day
Wastewater treatment chemicals and other consumption	Solid chlorine agent (trade name: "Sunplant 90W"): 0.21 kg/day

○ Items concerning operation and maintenance performance

Control point	Time and frequency of maintenance and management	Number and technical skill of operators needed for operation and maintenance
Maintenance and management subcontracting (normal maintenance and management of the water-purifier tank)	70 to 120 minutes (once per week)	One operator. Skill in the maintenance and management of common water-purifier tanks is required.
Withdrawal of excess sludge	130 minutes (once every three months)	Subcontract a professional company.

○ Qualitative findings

Item	Findings
Water-quality findings	Influent wastewater: Deep white, slight fish and shellfish odor; transparency: approximately 3 Processed wastewater: Pale white, slight chemical odor; transparency: 30 or more Photos from left: Raw-water-pump tank (= influent wastewater), sedimentation tank, and sterilization tank (= processed wastewater) 
Period required for startup	Not verified, as the facility exists and is in operation
Period required for shutdown	
Reliability of the target verification apparatus	The apparatus operated consistently during the verification-test period.
Method of solving problems	Subcontract a managing company for water-purifier tanks and the like.
Evaluation of the operation and maintenance manual	The "Summary and handling methods of Superaqua" is easy to read, as it contains only the information required for customers and is described with drawings bulleted text. The "operation manual" is intended for companies managing water-purifier tanks, and requires specialized knowledge.
Others	<ul style="list-style-type: none"> ○ High-quality effluent water discharged ○ Suppression of the generation of excess sludge confirmed ○ No generation of abnormal noise or foul odor

(Reference information)

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○ Product data

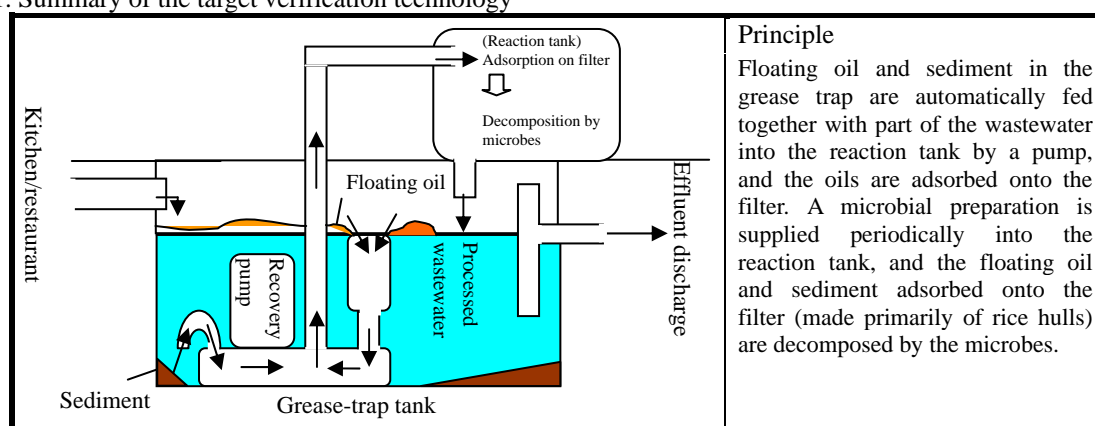
Item		Description given by the environmental-technology developer			
Name/type		Restaurant/kitchen wastewater treatment apparatus, "Superaqua" / AM-PT-25			
Manufacturer (distributor) name		Aquamake Co., Ltd.			
Contact address	TEL/FAX	TEL(082) 849 - 6866 / FAX(082) 849 - 6867			
	e-mail	kusu.stnkco@do4.enjoy.ne.jp			
Size and weight		6,000 mm (W) × 10,000 (D) × 3,200 (H); 6,000 kg			
Necessity of pre- and post-treatment		A grease trap should be installed to prevent the excessive inflow of oils.			
Additional facility		None			
Life of the target verification apparatus		30 years			
Startup period		One month including piping work			
Approximate cost (yen)	Cost		Unit cost	Quantity	Total
	Initial cost				8,250,000
	○ Civil work			1 set	4,000,000
	○ Equipment			1 set	4,000,000
	○ Others			1 set	250,000
	Operating cost (month)				200,300
	Sludge disposal		35,000/m ³	1.5 m ³	52,500
	Waste disposal		-----	-----	-----
	Electricity		20/kW	2,280 kW	45,600
	Water		-----	-----	-----
	Wastewater treatment chemicals		2,000/kg	0.6 kg	1,200
	Other consumables			1 set	1,000
	Maintenance and management subcontracting			1 set	100,000
Per m ³ of processed wastewater (assumed amount of processed wastewater: 750 m ³ /month)				267	

○ Other information from the manufacturer

- Resistant to fluctuations in load.
- Reduces the generation of excess sludge
- Suppresses the generation of foul odors in the flow regulation tank
- Allows highly stabilized processing performance to be maintained through the maintenance and management of common water-purifier tanks

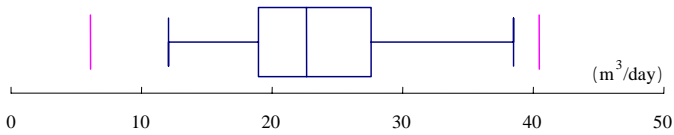
Target verification technology/environmental technology developer	Zerocompo (wastewater treatment apparatus for kitchens <<oil recovery>>) / Kowa Emtech Ltd.
Verification organization (Conducted by)	Hiroshima Prefecture (Hiroshima Prefectural Health and Environment Center, Hiroshima Environment & Health Association)
Verification-test period	Nov. 25, 2003 to Feb. 28, 2004
Object of technology	a. Automatic removal of floating oils and sediments from the grease trap b. Suppression of waste and foul odors

1. Summary of the target verification technology



2. Summary of the verification test

○ Summary of the verification-test site

Type of business	Hotel (banquet, wedding banquet, dining, lodging, sport facility, meeting room, and others)
Business scale	Accommodation facility: 46 guest rooms; restaurant: 80 seats; 4 banquet halls: 470 guests at maximum; others (wedding hall and others)
Location	9-7, Midori-cho, Fukuyama City, Hiroshima Prefecture
Wastewater flow rate during the verification-test period	

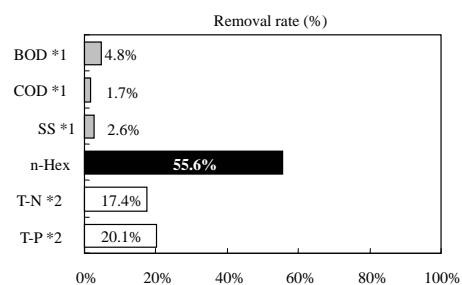
○ Specification and processing capacity of the target verification apparatus

Classification	Item	Specification and processing capacity
Summary of the facility	Type	Z-025
	Size and weight	(Apparatus) 415 mm (W) × 410 mm (D) × 520 mm (H); 35 kg (Pump unit) 231 mm (W) × 275 mm (D) × 241 mm (H); 5 kg
Design conditions	Target substance	n-Hex
	Processing capacity	Grease-trap capacity: Approximately 70 to 300 liters Number of meals served: Approximately 200/day

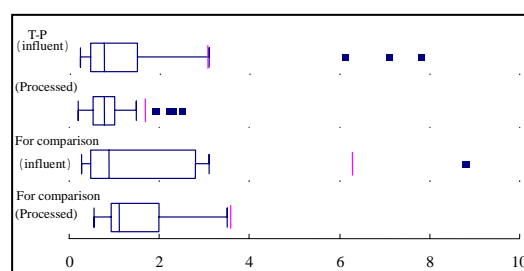
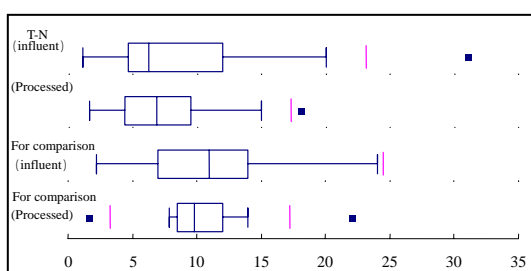
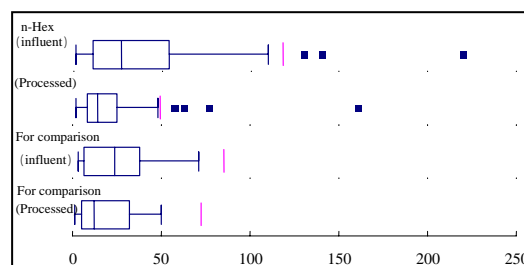
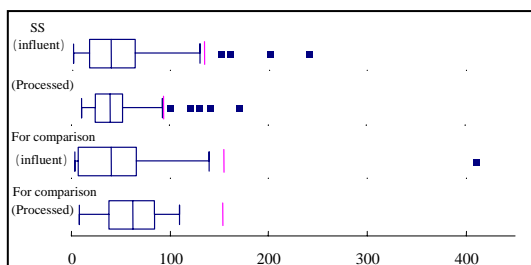
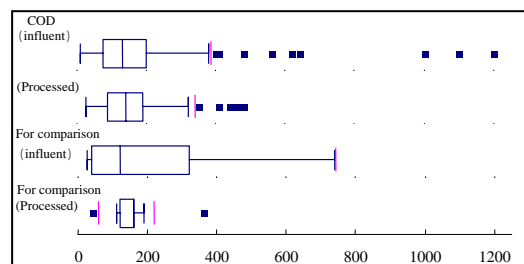
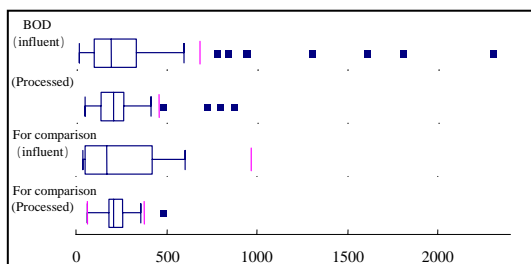
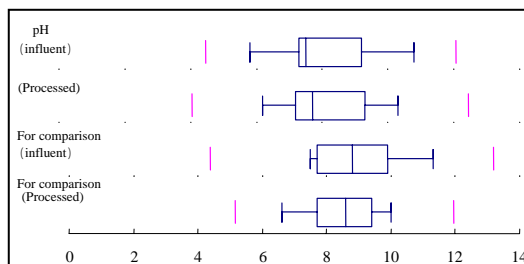
3. Verification-test results

○ Verification items concerning water quality

Item	Unit	Verification result (lower neighboring value to higher neighboring value, and median value)			
		Influent wastewater		Processed wastewater	
pH *1	-	5.8-11.3	7.7	6.2-10.3	7.7
BOD *1	mg/L	13-770	190	44-410	200
COD *1	mg/L	8.5-410	130	26-320	140
SS *1	mg/L	1-130	39.5	10-92	39
n-Hex	mg/L	1.5-110	25.5	1.7-48	14
T-N *2	mg/L	1.1-24	6.55	1.6-15	6.8
T-P *2	mg/L	0.23-3.1	0.825	0.21-1.5	0.78



The qualities of the influent and processed wastewaters into and out of a grease trap when the verified apparatus is not in operation are also shown at the bottom of the respective graphs for comparison purposes.



Note 1: Median value of removal rates determined daily: "(load in influent wastewater - load in processed wastewater) / load in influent wastewater"

Note 2: *1 indicates items the removal of which is not intended in the target verification apparatus; *2 is a reference item.

Note 3: Number of pieces of data: influent and processed wastewater (from pH to n-Hex): 77; influent and processed wastewater (T-N and T-P): 39; control (influent and processed wastewater): 9

○ Items concerning environmental impact

Item	Verification result
Amount of generated sludge	0.024 kg/day, dry
Amount of generated waste	0.36 kg/day, wet The rice-hull filter can be disposed of as general waste, depending on the municipality.
Noise	None (in four-stage evaluation: none, slightly noisy, noisy, and very noisy)
Odor	None (in four-stage evaluation: none, faint odor, odor, and strong odor)]



○ Items concerning used resources

Item	Verification result
Electricity consumption	2.4 kWh/day
Water consumption	1.1 m ³ /day
Wastewater treatment chemicals and other consumption	Liquid microbial preparation (trade name: "Kabios"): 0.052 L/day
Other consumables	Filter (trade name: "Biocore"): 0.11 kg/day

○ Items concerning operation and maintenance performance

Control point	Time and frequency of maintenance and management	Number and technical skill of operators required for operation and maintenance
Daily inspection	5 minutes (once per day)	No specialized knowledge or technical skill is required for normal operation. One-man operation is possible.
Periodic inspection (confirmation of settings, refill of consumables, and simple cleaning)	15 to 30 minutes (twice per month)	
Maintenance (filter exchange, tank cleaning, and periodic inspection)	60 minutes (twice per month)	
Others (setting and adjustment)	Until confirmation of normal operation (set time)(Once during the verification-test period)	

○ Qualitative findings

Item	Findings
Water-quality findings	<p>The influent wastewater and the effluent wastewater exhibited a faint fish and shellfish odor, were pale white, and had a transparency of approximately 13. Oil films and bubbles caused by the surfactant were occasionally observed.</p> <div style="display: flex; justify-content: space-around;">   </div> <p style="text-align: center;">2003/11/26 (Before operation) 2004/01/25 (60 days after operation)</p>
Period required for startup	5 days [total working period: 330 minutes] * Including installation and trial run
Period required for removal	1 day [total working period: 135 minutes]
Reliability of the target verification apparatus	The apparatus operated consistently during the verification-test period.
Method of solving problems	Operate according to the operation and maintenance manual. Specialized knowledge will be required for adjustment of the operational conditions.
Evaluation of the operation and maintenance manual	No particular problems to be solved,
Others	<p>a. The generation of floating oils and the like is suppressed with no deterioration in water quality.</p> <p>b. The generation of foul odor as well as noise is also suppressed.</p> <p>c. The amount of waste such as oils decreased compared to that obtained by processing in the existing grease trap before installation of the apparatus.</p>

(Reference information)

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○ Product data

Item	Description given by the environmental-technology developer				
Name/type	Zerocompo / Z-025				
Manufacturer (distributor) name	Kowa Emtech Ltd.				
Contact address	TEL/FAX	TEL: (084) 943-7734 / FAX: (084)943-9934			
	Website	http://www.kowa-m.co.jp			
	e-mail	info@kowa-m.co.jp			
Size and weight	415 mm (W) × 410 mm (D) × 510 mm (H); 35 kg				
Necessity of pre- and post-treatment	A grease trap with a suitable capacity selected in accordance with the kitchen wastewater flow rate should be installed and managed as specified by the manufacturer.				
Additional facility	Power supply: single phase, 100 V, 50/60 hz, 15 A; water supply: tap water; pressure: 2 kgf/cm ² or more				
Life of the target verification apparatus	7 years				
Startup period	5 to 7 days (confirmation of the installation and operational conditions, no effects on the business of the establishment)				
Approximate cost (yen)	Cost		Unit cost	Quantity	Total
	Initial cost				1,240,000
	Zerocompo (including transportation)		1,060,000	1 set	1,060,000
	Installation and adjustment		80,000	1 set	80,000
	Civil, electric, and water work		100,000	1 set	100,000
	Operating cost (month)				16,900
	Sludge disposal		----	----	----
	Waste disposal		0*	1 set	0*
	Electricity		1,400	1 set	1,400
	Water		3,200	1 set	3,200
	Wastewater treatment chemicals				12,300
	Biocore (20 L)		5,000	1.5 L	7,500
	Biological preparation (1.5 L)		4,800	1 L	4,800
	Other consumables		----	----	----
Maintenance and management subcontracting		----	----	----	
Per m ³ of processed wastewater (assumed amount of processed wastewater: 360 m ³ /month)				46	

○ Other information from the manufacturer

- The floating-oil suction device (Q Pot: patented) collects only floating oils efficiently. At the same time, the suction port at the bottom collects sediments, thereby continuously cleaning the interior of the grease trap.
 - The removal of floating oils and others suppresses the generation of foul odors.
 - A compact and simple apparatus that can be installed in existing grease traps
 - Highly active degrading microbes decompose the recovered oil and sludge, thereby reducing the amount of waste.
 - The pumps and reaction tank are automatically controlled, eliminating the need for adjustment after startup.
- * The waste-disposal cost was shown in the table as 0, as the waste can be disposed as general waste, depending on the municipality.