JOHKASOU SYSTEM FOR TREATMENT OF DOMESTIC WASTEWATER

JAPAN EDUCATION CENTRE
OF ENVIRONMENTAL
SANITATION

JOHKASOU SYSTEM FOR TREATMENT OF DOMESTIC WASTEWATER

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December 19,1995

Prof. Rafael Mujeriego
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08034 Barcelona, SPAIN

Dear Prof. Rafael Mujeriego,

As you may know, a special individual house waste water treatment system (known as the "Johkasou" system in Japanese) has been used for many years for the treatment of waste waters from households and business facilities, in particular in suburban areas in Japan. For the effective use and proper maintenance of this system, a national law came into force in October 1985. Since then, national and local subsidies became available for the construction of "Johkasou" and a number of technological innovations have been made, including the reductions of not only BOD, but also N and P-compounds. Please find attached a brochure for further information on this system.

The Japan Education Centre of Environment Sanitation has, for three decades, been the center of technological development for this system and for the training of specialists for the proper maintenance of this system. On the occasion of the 30th anniversary of this Centre, the Centre is planning to hold an International Symposium on Johkasou System, where it is expected that international application of similar systems will be explored.

The Symposium will take place on 30 August (Friday), 1996 in Tokyo, and I have been appointed as the chairman of the Organizing Committee by Dr.Kotei SAKAKI, President of the Centre. In this connection, I am now looking for world-renowned specialists in the field of small-scale individual treatment of waste waters. I am advised by my friends in Japan such as Prof. Shinichiro OHGAKI of the Uiversity of Tokyo that you may be interested in participating in the Symposium and sharing your experiences with multi-national experts.

I would like to know whether you are interested and able to come to Japan to participate in the Symposium. If so,then there will be a good chance that organizer will be able to bear the costs of air travel (business class) and all necessary expenses related to your stay in Japan. If you can come, then you will be requested to arrive in Japan on 27 August,because we will arrange

special field visits to "Johkasou" sites and meetings with Japanese experts prior to the Symposium, so that you can have clearer idea of the special functions of and care taken for the system.

I would appreciate it very much if you could indicate your interest by mail or fax by the 8 January of next year. Thank you very much for your consideration.

With best regards,

Sincerely

加藤三郎

Saburo KATO

President

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e r r a t a

p. 8 fig. 4

----→ naturally occurring sludge return ——→ periodical enforcing sludge return	→

——→ naturally occurring sludge return
----→ periodical enforcing sludge return

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$V_I = 2.5 + (n-5) \times 2.5 \quad (m^3)$ → $V_I = 2.5 + (n-5) \times 0.5 \quad (m^3)$

5ℓ

$V_I = 5.0 + (n-10) \times 5.0 \quad (m^3)$ → $V_I = 5.0 + (n-10) \times 0.25 \quad (m^3)$

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Height (mm)	Length (mm)
2,400	1,800
2,600	1,800

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Length (mm)	Height (mm)
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tab. 4

Classification		Type of treatment	Treatment method	Number of users for designing (persons) 5 50 51 200 201 500 501 2000 2001 5000 5001
# 2	1	Combined domestic wastewater treatment	Rotating biological contactor process	
	2		Contact aeration process	
	3		Trickling filter process	
	4		Extended aeration process	

↓

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Johkasou Systems for Treatment of Domestic Wastewater

Preface

There are many districts in Japan where public sewerage systems are not provided. In order to use flush toilets in these districts, it is necessary to install wastewater purifying facilities called "johkasous" in Japanese to treat the wastewater from toilets independently or in combination with miscellaneous domestic wastewater (known as "gray water") from baths, kitchens, laundries and so on. Everywhere in Japan, "johkasou systems" are commonly installed and used for this purpose.

Johkasou systems, uniquely developed in Japan, are now commonly used throughout the country. Johkasou systems, with proper manufacture, construction, installation, and maintenance, help us to maintain a healthy living environment and preserve water quality of public water areas such as seas, lakes and rivers. The recently developed compact johkasou systems which treat the wastewater consisting of both night soil and gray water can be installed in individual houses to discharge the effluent of less than 20 mg/*l*, in terms of BOD, which is comparable to the final treatment by public sewerage systems.

Johkasou-based wastewater management systems may prove useful in other countries or districts where sewerage systems are undeveloped.

This brochure is prepared to provide the whole picture of johkasou systems, especially the compact ones for domestic wastewater treatment in each family. It also presents information related to domestic wastewater management in Japan to help readers understand johkasou systems more clearly. For information, "johka" literally means purification, and "sou" means a tank in Japanese.

1. History of Night Soil Treatment

In Japan, people once lived in a rice-based agricultural society, night soil was stored in storage tanks and used as valuable fertilizer. In this way, people for ages managed to dispose of night soil in harmony with the ecosystem. However, the dramatic change in Japan's industrial structure after World War II, notably the rapid industrialization, resulted in population concentration in large cities on the one hand, and the spread of chemical fertilizers on the other. As the need for night soil as manure plummeted, the huge volume of night soil generated in the cities required the public facilities to treat it sanitarily.

To meet this need, Japan's unique system for the treatment of night soil was developed. In this system, night soil is collected and transported to night soil treatment facilities for centralized treatment. Before this system was fully implemented, in most cases, night soil from toilets was simply dumped into the sea. In some districts they still dispose of night soil in this way. This method has also been used for disposal of the sludge from johkasous.

In the meantime, flush toilets were introduced to Japan from European countries after the country opened its doors to western civilization. Johkasou systems were used to treat wastewater from flush toilets. Japan's first johkasou was installed in 1911, but the term "johkasou" did not appear in laws or regulations until 1944 when it was first used in the Standards for Building Site Sanitation Facilities. It was only after World War II that johkasous actually began to spread in Japan.

Johkasou spread rapidly in the 1960s when the demand for flush toilets heightened strongly with the modernization of people's life. This owes to the development of mass production technologies of johkasous using fiberglass reinforced plastic (FRP) and to the establishment of structural standards of johkasou systems laid down by the Building Standards Law enacted in 1969. As a result, sewerage systems and johkasou systems have spread side by side (see Figure 1). Johkasou systems are rather sophisticated technologically in that they use not only anaerobic and/or aerobic biological processes but also a disinfection process in rather small facilities. In the earlier stage they were produced only to treat flush toilet wastewater, not to treat gray water. This type of johkasou system is called "tandoku-shori johkasou" in Japanese terminology. " Tandoku" means sole or exclusive and "shori" means treatment. The spread of "tandoku-shori johkasou" left a problem in the treatment of domestic wastewater.

No satisfactory improvement in the quality of natural water resources, was made even with the strict control of industrial wastewater. It was recognized that the direct discharge of untreated gray water was the major cause of water pollution of public water areas. This gave rise to the need for larger johkasou systems which are capable of treating miscellaneous domestic wastewater, as well as flush toilet wastewater. The driving force

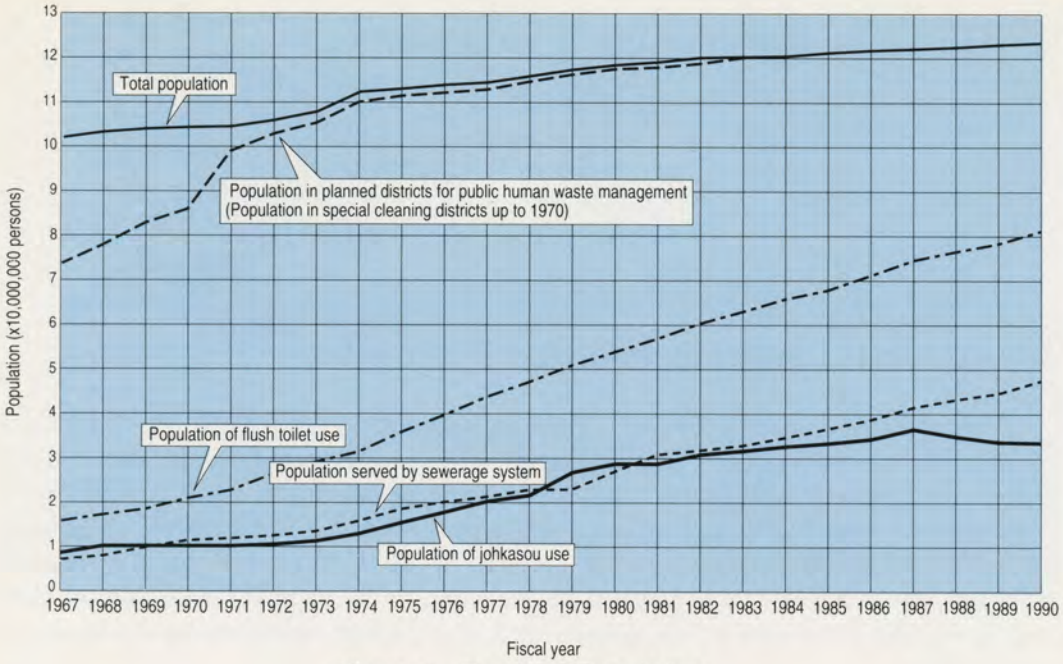


Figure 1 Trends in Population

standards for johkasou systems enforced in 1980. Small johkasou systems could still be used for domestic flush toilet wastewater, however. Johkasou systems for domestic wastewater treatment are called "gappei-shori johkasous" in Japanese terminology. "Gappei" means combined and "shori" means treatment as described before.

The late 1970s witnessed growing demands for ensuring proper installation, cleaning, and inspection of johkasou systems, and for government-approved specialists to carry out this kind of work. This was mainly because of the huge increase in the number of johkasou systems. To cope with this situation, a law called the Johkasou Law was enacted in 1983.

This law stipulates systematized regulations for (1) the manufacture, installation, maintenance and cleaning of johkasou systems, (2) the official registration of johkasou installers and maintenance operators, (3) the license of johkasou cleaning agents. As part of this legislation, the law stipulates national qualifications for people engaged in constructing and maintaining/operating johkasou systems in an effort to maintain a healthy living environment. The formers are called "qualified johkasou installation technicians" and the latters are called "qualified johkasou operators" .

This law triggered the spread of small scale gappei-shori johkasou systems for individual houses, capable of processing effluents with BOD of less than 20 mg/*l*. In 1987, the Ministry of Health and Welfare opened a special office within its Department of Water Supply and Environmental Sanitation to enforce the Johkasou Law, and to promote the spread of gappei-shori johkasou systems. At the same time, the ministry established a system of national subsidy to help people install the small scale gappei-shori johkasou systems.

This system attracted the attention of municipal authorities and the general public, resulting in the rapid spread of small scale gappei-shori johkasous throughout Japan.

2. Domestic Wastewater Treatment

2.1 Problems Caused by Domestic Wastewater

Although it has passed a long time since the pollution of river water, lake water, and coastal water was considered a pressing social problem in Japan, the problem has still not been fully resolved and further improvements must be made. An examination of contaminated water bodies has revealed that domestic wastewater accounts for a large portion of organic pollutants. In fact, it accounts for 70 to 80 percent of the all organic pollutants entering Tokyo Bay (located on the south of the greater Tokyo Metropolitan area) and Lake Teganuma (in the suburbs of Tokyo) where rapid housing development is progressing.

Domestic wastewater is responsible for a relatively larger portion of the pollutants than industrial wastewater now since enforced emission control has curtailed the pollutant load coming from plants and factories. Miscellaneous domestic wastewater has been discharged, usually without treatment, from houses with vault toilets or tandoku-shori johkasou systems.

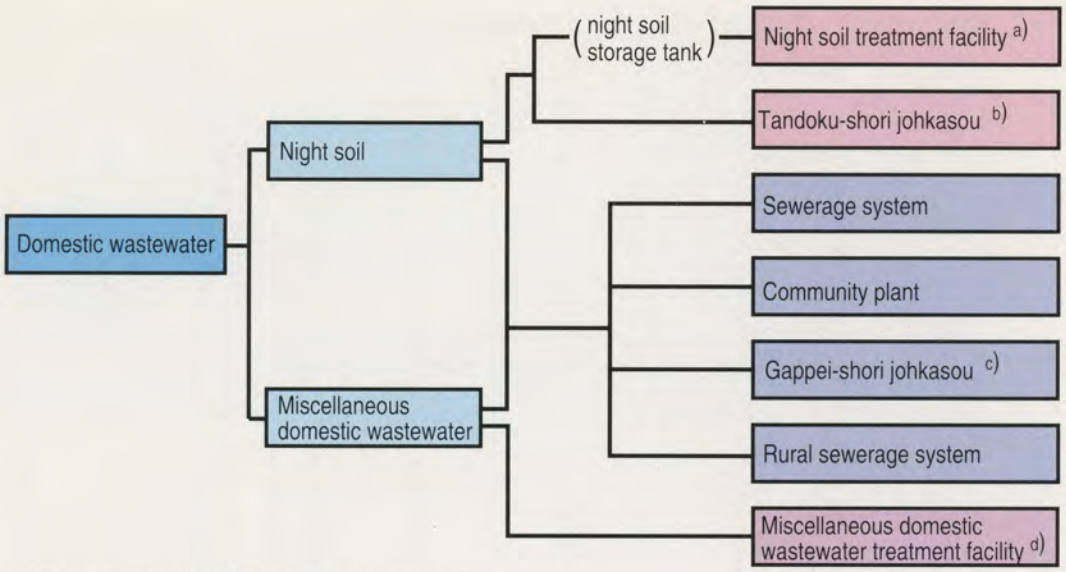
2.2 Wastewater Treatment Systems for Various Districts

Several ways are used to treat flush toilet wastewater and miscellaneous domestic wastewater. However, there is no universally applicable and suitable way. For example, modern sewerage systems are not effective or efficient in rural areas though they are efficient in large cities. This is because a large capital investment and a long construction period are required. An appropriate way must be chosen by considering the various factors relating to the planned area such as geographical conditions, population density, the effects of facility installation, and the cost effectiveness.

For treated wastewater, it is necessary to consider not only the quality but also the quantity of it because the discharged effluent may influence the purifying abilities and water flow rate of the water bodies that receive it.

Figure 2 schematically summarizes the domestic wastewater treatment systems used in Japan. There are four types of systems classified according to type of wastewater, facility size, and administrative support; "sewerage systems", "community plants", "gappei-shori johkasous" and "rural sewerage systems ".

Sewerage systems are further divided into several types according to some features such as size and the administrative system for construction and maintenance. " Public sewerage system" is the basic system. There are two types of facilities for night soil treatment; "night soil treatment facilities" and "tandoku-shori johkasous". In addition to the above, there are "miscellaneous domestic wastewater treatment facilities" that treat only



a) Night soil treatment facilities also treat sludges collected from tandoku-shori johkasous, community plants, gappei-shori johkasous and sewerage system in rural area.
b) Many are installed in individual houses.
c) Though not many facilities are installed in individual houses, the number is growing.
d) This includes facilities to treat sludge from simple sedimentation chambers for miscellaneous domestic wastewater treatment.

Figure 2 Various Systems for Domestic Wastewater Treatment

miscellaneous domestic wastewater. Treatment plants for sludge from simple sedimentation chambers, which are installed in individual houses for treatment of gray water, are also classified into this category. General features of these types of facilities are summarized in Table 1 and Figure 3.

For domestic wastewater treatment, sewerage systems are especially effective in large cities where houses, factories and offices are built close together. These facilities can also collect and treat industrial wastewater and rainwater. Since sewerage systems generally receive a large amount of wastewater, discharging the effluent greatly affects the quality and quantity of water in the water bodies that receive it.

Community plants are effective in crowded residential districts where no industrial wastewater is generated or industrial wastewater is treated before being discharged. These facilities can collectively treat domestic wastewater in each district. Unless the receiving water stream is a really small river, the effluent from these facilities does not affect the quality and quantity of the water as much as sewerage systems.

Gappei-shori johkasou systems are effective in small towns and villages. Middle to large scale gappei-shori johkasou systems have features similar to those of community plants, but small scale gappei-shori johkasou systems (see Figure 4) offer some unique advantages, in that they can be installed in individual houses with no limitation due to topography and can discharge treated wastewater on the spot.

Rural sewerage systems are used in farming villages and have features similar to those of community plants and middle to large scale gappei-shori johkasou systems.

Table 1 Feature of Domestic Wastewater Treatment Systems

Type of system or facility	Public sewerage system	Community plant	Gappei-shori johkasou	Rural sewer age system	Night soil treatment facility	Tandoku-shori johkasou	Miscellaneous domestic wastewater teatment facility
Purpose	Maintain the water quality of natural water resources and improve the living environment by collectively treating night soil, miscellaneous domestic wastewater, industrial wastewater, and rainwater.	Maintain a healthy living environment and promote public health by collectively treating night soil and miscellaneous domestic wastewater.	Maintain a healthy living environment and promote public health by treating night soil and miscellaneous domestic wastewater.	Maintain agricultural water/wastewater clean/safe and improve the living environment by collectively treating night soil,miscellaneous domestic wastewater, stock-raising wastewater and rainwater.	Maintain a healthy living environment and promote public health by treating collected night soil and johkasou sludge.	Maintain a healthy living environment and promote public health by treating night soil.	Maintain a healthy living environment and improve public health by collectively treating miscellaneous domestic wastewater from houses and sludge from simple sedimentation chambers for miscellaneous domestic wastewater treatment.
Responsible agency/party for installation, maintenance and operation	Municipalities	Municipalities	Individuals and communities	Municipalities and specified districts for improvement of the land for agricultural purposes	Municipalities	Individuals and communities	Municipalities
Applicable district	Mainly urban area	Not particularly limited	Districts where sewerage systems are unplanned but where it is strongly required to treat miscellaneous domestic wastewater	Agricultural villages within specified districts where agriculture is being promoted	Not particularly limited	Not particularly limited	Not particularly limited
Applicable population	Approx. 10,000 or more	101 up to 30,000	Not particularly limited	Up to about 1,000	Not particularly limited	Not particularly limited	101 or more
Applicable wastewater	Night soil (flush toilet wastewater), miscellaneous domestic wastewater, industrial wastewater and rainwater	Night soil (flush toilet wastewater) and miscellaneous domestic wastewater	Night soil (flush toilet wastewater) and miscellaneous domestic wastewater	Night soil (flush toilet wastewater), miscellaneous domestic wastewater, stock-raising wastewater and rainwater	Collected night soil and johkasou sludge	Night soil (flush toilet wastewater)	Miscellaneous domestic wastewater and sludge from simple sedimentation chambers
Construction period	Approx. 5 years	Approx. 1 year	Approx. 1 week up to 1 year	3-5 years	Approx. 3 years	Approx. 1 week up to 1 year	Approx. 1-2 years
Ministry competent for subsidizing	Ministry of Construction	Ministry of Health and Welfare	Ministry of Health and Welfare	Ministry of Agriculture, Forestry and Fishery	Ministry of Health and Welfare		Ministry of Health and Welfare

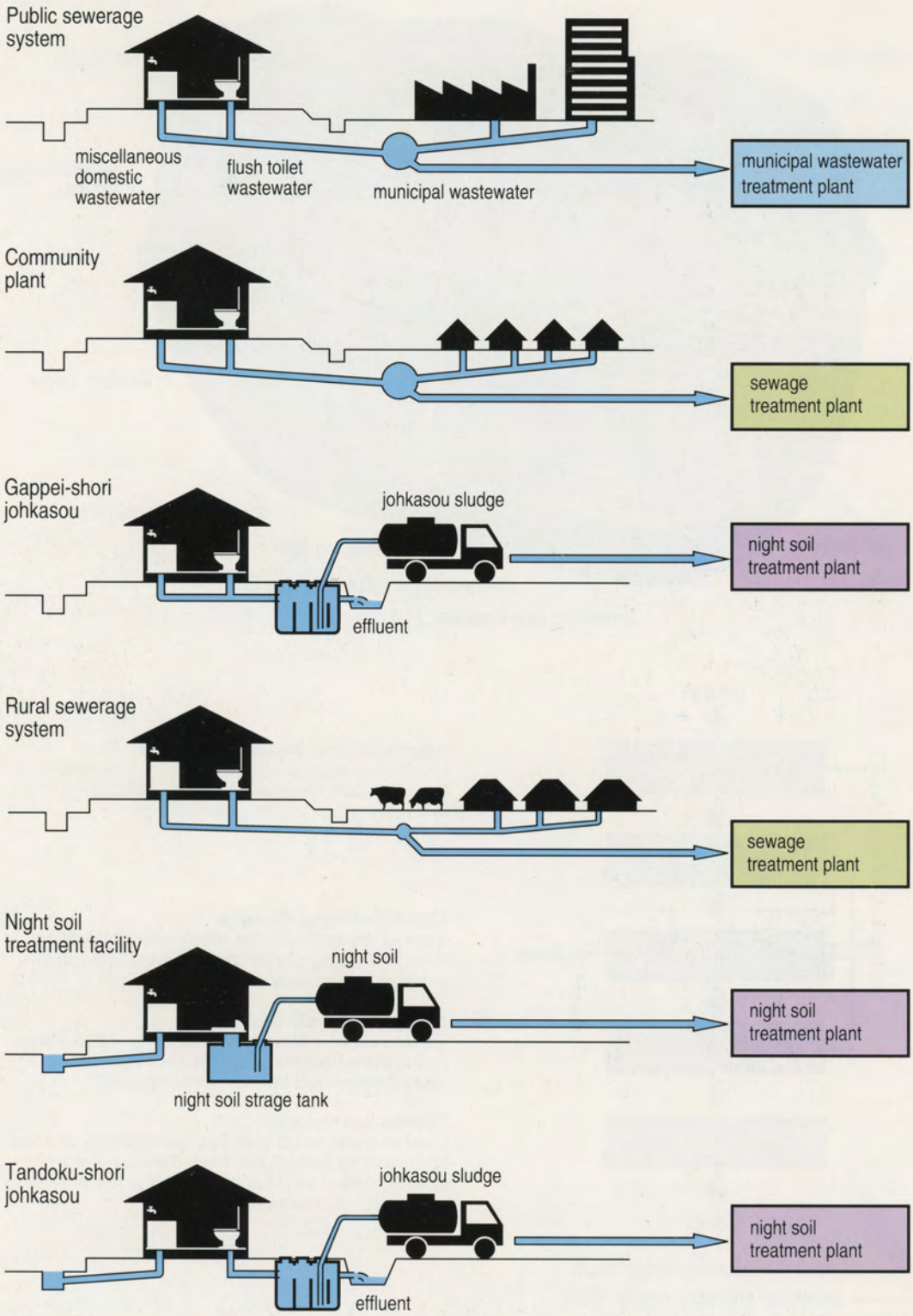
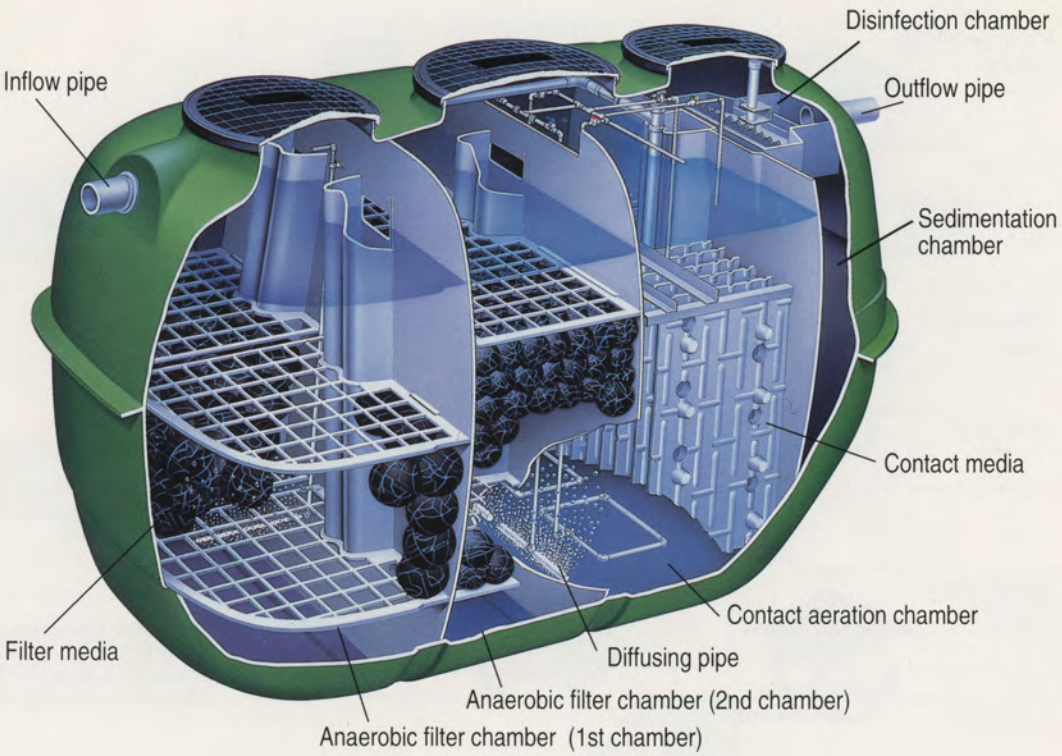
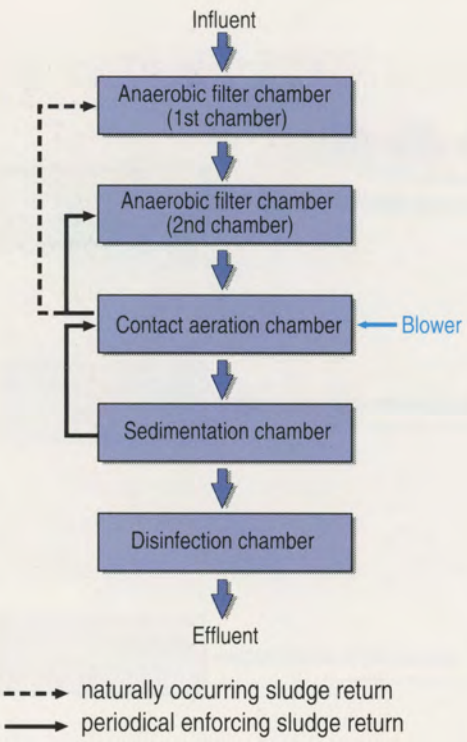


Figure 3 Conceptual Figures of Several Domestic Wastewater Treatment Systems





Anaerobic filter chamber
Used to separate solids from influent and store them for a certain period. Anaerobic biological treatment effects can be also expected.

Contact aeration chamber
Used to eliminate organic substances from influent through bio-degradation by aerobic microorganisms attached to the contact media.

Sedimentation chamber
Used to obtain a clear and biologically stable effluent by separating suspended solids from the biologically treated wastewater through sedimentation.

Disinfection chamber
Used to obtain an effluent free from sanitary problems by contacting biologically treated wastewater with chlorine tablets and storing it to ensure inactivation of pathogenic microorganisms.

Figure 4 An Example of Gappei-shori Johkasou for Individual House Use

3. Quantity and Quality of Domestic Wastewater

The quantity of domestic wastewater, especially miscellaneous domestic wastewater and pollutant loads contained in it are known to vary with life-style, living standard, and so on.

The daily amount of domestic wastewater ranges from 200 to 250 liters per person in Japan. For the amount of pollutants per capita per day, domestic wastewater is said to contain 40–50g of BOD, 10–12g of T–N, and 1.2–1.5g of T–P.

When domestic wastewater is treated by a johkasou system, the influent is assumed to contain the wastewater amount and the pollutant loads listed in Table 2. The differences observable are partly because fewer people are at home in the daytime, and partly because wastewater from car washing, watering the plants, etc. is not received by the johkasou system.

Table 2 Amount and BOD Load of Domestic Wastewater Classified by Generation Source

Source of wastewater		Wastewater amount [l/cap.·day]	BOD	
			Load [g/cap.·day]	Concentration [mg/l]
Flush toilet wastewater	Flushing	50	13	260
Miscellaneous domestic wastewater	Cooking	30	18	600
	Washing	40	9	75
	Bathing	50		
	Washing face/hands	20		
	Cleaning	10		
Total		200	40	200

4. Structure of Johkasou Systems

4.1 Structural Standards

When flush toilets are installed in the districts where sewerage systems are not available, the Johkasou Law stipulates that johkasou systems must be installed along with them. Details on the required treatment performance, structure, etc. of johkasou systems are prescribed in the Building Standards Law. Districts for johkasou installation, and the relationship between the number of users for designing a johkasou system and the required treatment performance of it are specified in the Enforcement Ordinance of the Building Standard Law.

The number of users for designing is obtained by calculation, and does not mean the number of people which a given building can accommodate or which uses a given building.

The methods of calculation are prescribed according to the classification of each building by the Japan Industrial Standard (JIS). Table 3 shows examples of these calculation methods. The daily amount of wastewater and BOD load discharged from a building are obtained by multiplying the number of users for designing by 50//cap.·day, and 13g/cap.·day for tandoku-shori johkasous, or by 200 //cap.·day and 40 g/cap.·day for gappei-shori johkasous.

However, the structures of johkasou systems are stipulated by a Notification of the Ministry of Construction commonly known as "Structural Standards." These standards are outlined here in Table 4 . The main points of the Structural Standards are as follows:

(1) The capacity and equipment of a johkasou system must be such that the BOD concentration of its effluent and BOD removal satisfy the designated values. However, when a johkasou system is designed for 501 persons or more, the treatment performance of it is regulated by the BOD concentration alone because the effluent of such johkasou systems is subject to the Water Pollution Control Law.

(2) The recommended intervals of periodic maintenance and cleaning must be followed. For example, small scale johkasou systems may be maintained once every several months, and so they must be designed to prevent too much sludge from accumulating.

(3) Johkasou systems not stipulated in the Standards may be constructed, if they satisfy the requirements for treatment performance.

(4) Johkasou systems designed for less than 200 persons must provide some allowance in each of their treatment tanks or chambers to offset influent fluctuations since these johkasou systems, for structural reasons, do not have an equalization tank. On the other hand, johkasou systems designed for more than 201 persons may have an equalization tank to offset influent fluctuations. However, either type can be chosen in johkasou systems designed for 201 to 500 persons.

Table 3 Calculation Method of the Number of Users for Designing in Buildings Classified by Purpose of Use (Examples)

Classification number	Purpose of building use		Number of users for designing	
			Calculation formula	Remarks
2	Housing and related facilities	Residence	$n = 5 + (\frac{A - 100}{30})$	n = number of people Note that this indicates five persons when A is 100 m^2 or less, and 10 persons when A exceeds 220 m^2. A = total floor area (m^2)
		Multiple dwelling house	n = 0.05A	n = number of people Note that when "n" is up to 3.5 persons per house, the "n" per house is reckoned as 3.5 persons (or 2 persons when the house consists of one room*1) When "n" per house exceeds 6 persons, the "n" per house is reckoned as 6 persons. A = total floor area (m^2)
		Lodging house and dormitory	n = 0.07A	n = number of people A = total floor area (m^2)
		School dormitory, Self Defense Force camp, old-age home, and protective institution	n = P	n = number of people P = capacity
5	Stores and related facilities	Store and market	n = 0.075A	n = number of people A = total floor area (m^2)
		Department store	n = 0.15A	
		Restaurant (General)	n = 0.72A	
		Restaurant (With high pollutant load)	n = 2.94A	
		Restaurant (With low pollutant load)	n = 0.55A	n = number of people A = total floor area (m^2)
		Tea house	n = 0.80A	
8	Schools and related facilities	Day nursery, kindergarten, elementary school and junior high school	n = 0.25P	n = number of people P = capacity
		High school, university and various vocational schools	n = 0.31P	
		Library	n = 0.08A	n = number of people A = total floor area (m^2)

*1 "Room" here means any room, defined under the Building Standards Law, used for living, working, assembling, leisure, or other similar purposes. This does not include kitchens and dining rooms in multiple dwelling houses, however.

Table 4 Outline of Structural Standards for Johkasou Systems (Ministerial Notification No. 1292)

Classification	Type of treatment	Treatment method	Number of users for designing (persons) 5 / 50 / 51 / 200 / 201 / 500 / 501 / 2000 / 2001 / 5000 / 5001	Treatment performance: BOD removal	Treatment performance: BOD in effluent	Remarks
#1 · 1	Flush toilet wastewater treatment	Separation-contact aeration process		65 % or more	90 mg/l or less	Multi-chamber type and modified multi-chamber type
2		Separation-aeration process				
3		Trickling filter process				
4	Combined domestic wastewater treatment	Separation-contact aeration process		90 % or more	20 mg/l or less	
5		Anaerobic filter-contact aeration process				
#2 · 1	Combined domestic wastewater treatment	Rotating biological contactor process		70 % or more	60 mg/l or less	
2		Contact aeration process				
3		Trickling filter process				
4		Extended aeration process				
#3 · 1		Rotating biological contactor process		85 % or more	30 mg/l or less	
2		Contact aeration process				
3		Trickling filter process				
4		Extended aeration process				
5		Conventional activated sludge process				
#4	Flush toilet wastewater treatment	Septic tank process	(applicable to only the districts approved by regulations)	55 % or more	120 mg/l or less	
#5	Flush toilet wastewater treatment	Land infiltration process	(applicable to only the districts approved by regulations)	55 % or more	250 mg/l or less	Concerning SS concentration
#6 · 1	Combined domestic wastewater treatment	Rotating biological contactor process			20 mg/l or less	
2		Contact aeration process				
3		Trickling filter process				
4		Extended aeration process				
5		Conventional activated sludge process				

#7 Emission standard under the Water Pollution Control Law	COD (mg/l)	SS (mg/l)	N-HEX (mg/l)	pH	Total coliforms (N/ml)	Structure
	60	70	20	5.8 ~ 8.6	3,000 or less	#2. #3. #5
	45	60	20	5.8 ~ 8.6	3,000 or less	#3. #6
	30	50	20	5.8 ~ 8.6	3,000 or less	#6
#8	Specially approved processes	Qualified to be equivalent or better than the processes with structures specified by Notification Nos. 1 through 7 by the Minister of Construction.				

Note: The shadowed parts indicate the ranges of people and processes applicable to "the districts recognized to have hygienic problems by the competent authorities and specified as such by applicable regulations."

Table 3 Calculation Method of the Number of Users for Designing in Buildings Classified by Purpose of Use (Examples)

Classification number	Purpose of building use			Number of users for designing	
				Calculation formula	Remarks
2	Housing and related facilities	Residence		$n = 5 + (\frac{A - 100}{30})$	n = number of people Note that this indicates five persons when A is 100 m^2 or less, and 10 persons when A exceeds 220 m^2. A = total floor area (m^2)
		Multiple dwelling house		n = 0.05A	n = number of people Note that when "n" is up to 3.5 persons per house, the "n" per house is reckoned as 3.5 persons (or 2 persons when the house consists of one room*1) When "n" per house exceeds 6 persons, the "n" per house is reckoned as 6 persons. A = total floor area (m^2)
		Lodging house and dormitory		n = 0.07A	n = number of people A = total floor area (m^2)
		School dormitory, Self Defense Force camp, old-age home, and protective institution		n = P	n = number of people P = capacity
5	Stores and related facilities	Store and market		n = 0.075A	n = number of people A = total floor area (m^2)
		Department store		n = 0.15A	
		Restaurant	General	n = 0.72A	
			With high pollutant load	n = 2.94A	
		Restaurant	With low pollutant load	n = 0.55A	n = number of people A = total floor area (m^2)
		Tea house		n = 0.80A	
8	Schools and related facilities	Day nursery, kindergarten, elementary school and junior high school		n = 0.25P	n = number of people P = capacity
		High school, university and various vocational schools		n = 0.31P	
		Library		n = 0.08A	n = number of people A = total floor area (m^2)

*1 "Room" here means any room, defined under the Building Standards Law, used for living, working, assembling, leisure, or other similar purposes. This does not include kitchens and dining rooms in multiple dwelling houses, however.

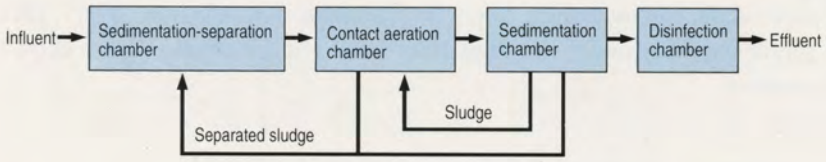
4.2 Details of Treatment Method

1. Tandoku-shori Johkasou Systems

(Johkasou systems for flush toilet wastewater treatment)

(1) Separation-contact aeration process

This method of treatment is most widely used in the tandoku-shori johkasou systems currently used. This method combines the use of a sedimentation-separation chamber and a contact aeration chamber. The following figure shows the flowchart of this process.



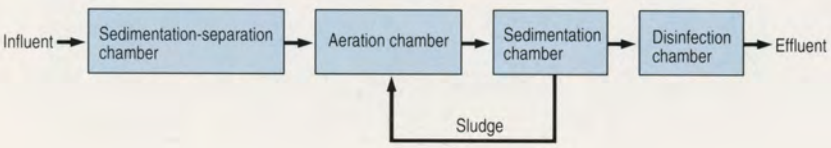
The sedimentation-separation chamber is used to separate solid matter contained in the influent through sedimentation and store it. The contact aeration chamber is used for the aerobic biological treatment of effluent coming from the sedimentation- separation chamber using the bio-mass attached and grown on the contact media packed in this chamber. The sedimentation chamber is used to separate suspended solids (SS) in the effluent coming from the contact aeration chamber through sedimentation. The disinfection chamber is used to disinfect the biologically treated wastewater by contacting it with chlorine tablets.

Each unit involved in this process has a capacity equal to or greater than the values calculated below:

Sedimentation-separation chamber : $V_1 = 0.75 + (n-5) \times 0.09$ (m^3)
Contact aeration chamber : $V_2 = 0.25 + (n-5) \times 0.025$ (m^3)
Sum of sedimentation and disinfection chambers : $V_3 = 0.15 + (n-5) \times 0.015$ (m^3)
Note that "n" denotes the number of users for designing.

(2) Separation-aeration process

This process uses the activated sludge method, and combines the use of a sedimentation-separation chamber and an aeration chamber. The following figure shows the flowchart of this process.



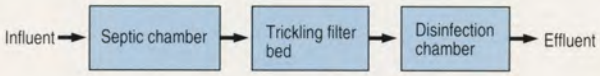
The aeration chamber is used for the aerobic biological treatment, by activated sludge, of the effluent from the sedimentation-separation chamber. The sedimentation-separation, sedimentation, and disinfection chambers perform the same functions as described for the separation-contact aeration process.

Each unit involved in this process has a capacity equal to or greater than the values calculated below:

Sedimentation-separation chamber : $V_1 = 0.75 + (n-5) \times 0.09$ (m^3)
Aeration chamber : $V_2 = 0.45 + (n-5) \times 0.06$ (m^3)
Sum of sedimentation and disinfection chambers : $V_3 = 0.15 + (n-5) \times 0.02$ (m^3)
Note that "n" denotes the number of users for designing.

(3) Trickling filter process

This treatment method is not normally used in johkasou systems currently. This process combines a septic chamber and a trickling filter bed. The following figure shows the flowchart of this process.



The septic chamber is designed to separate solid matter in the influent through sedimentation and store it. Classified by its internal structure, this chamber comes in two types: a multi-chamber type and a modified multi-chamber type. The trickling filter bed is used for the aerobic biological treatment of the effluent coming from the septic chamber by using the bio-mass attached and grown on the filter media packed in the filter bed. The disinfection chamber performs the same function as described for the separation-contact aeration process.

Each unit involved in this process has a capacity equal to or greater than the values calculated below:

Septic chamber : $V_1 = 1.5 + (n-5) \times 0.1$ (m^3)
Trickling filter bed : $V_2 = 0.75 + (n-5) \times 0.05$ (m^3)
Disinfection chamber : $V_3 = 0.15 + (n-5) \times 0.015$ (m^3)
Note that "n" denotes the number of users for designing.

(4) Septic tank processes (trickling filter type, flat oxidation type, soil penetration type with sand bed, simple aeration type) **and extended aeration process** (separation-aeration type, total aeration type)

These methods of treatment are based on the structural standards enacted in 1969, and are not included in the currently applicable structural standards. However, more than 50% of the currently installed tandoku-shori johkasou systems use one of these methods.

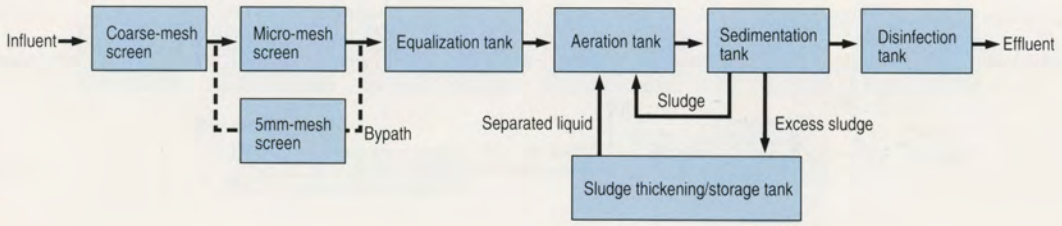
2. Gappei-shori Johkasou Systems

(Johkasou systems for domestic wastewater treatment)

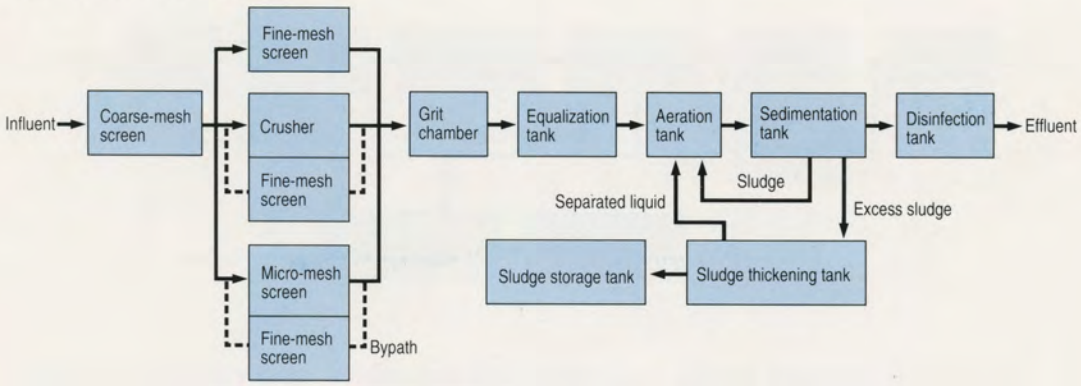
(1) Activated sludge process

This treatment method is further classified into an extended aeration process and a conventional activated sludge process. The extended aeration process is used in many johkasou units. For large-scale facilities that can receive the wastewater of 5,001 persons or more people per johkasou unit, however, the conventional activated sludge process is used. The following figures show the flowcharts of the activated sludge process.

(1) Number of people: 201 to 500



(2) Number of people: 501 or more



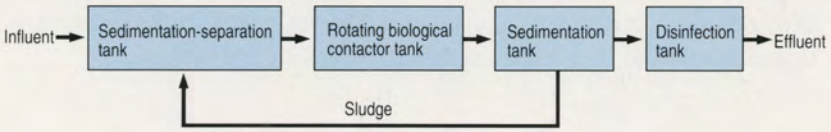
Screens of different mesh size are used to remove refuses from the influent. The equalization tank is designed to equalize the flow rate of the influent to ensure the stable functioning of aerobic biological treatment and sedimentation. The aeration, sedimentation, and disinfection tanks perform the same functions as described for tandoku-shori johkasou systems.

A sludge thickening/storage tank is designed to concentrate and store the excess sludge resulting from the wastewater purifying process. The sludge storage tank is used to store the concentrated sludge transferred from the sludge thickening tank for a certain period.

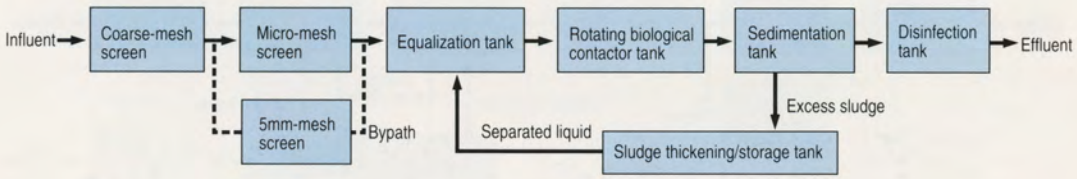
(2) Rotating biological contactor process

The following figures show the flowcharts of this process.

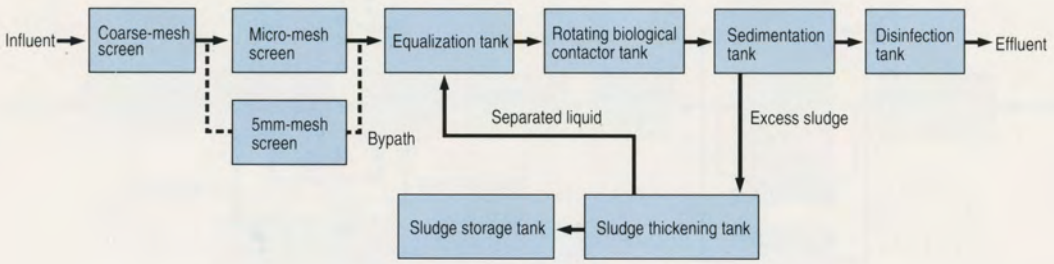
(1) Number of people: 51 to 500



(2) Number of people: 201 to 500



(3) Number of people: 501 or more



The primary treatment facility may contain a sedimentation-separation tank or a flow rate equalization tank according to the inflow conditions of the influent and treatment capacity. The sedimentation-separation tank performs the same function as the sedimentation-separation chamber of tandoku-shori johkasou systems and the equalization tank performs the same function as described for the activated sludge process.

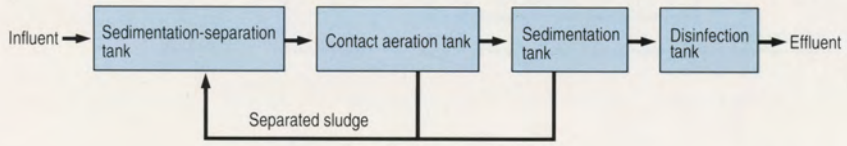
The rotating biological contactor tank has rotating discs that rotate like water wheels in the tank filled with wastewater. In this way, the effluent from the sedimentation-separation or equalization tank is aerobically treated by the bio-mass attached and grown on the surfaces of these rotating discs.

The sedimentation and disinfection tanks perform the same functions as in tandoku-shori johkasou systems. A sludge thickning/storage tank and a sludge storage tank are the same as described for the activated sludge process.

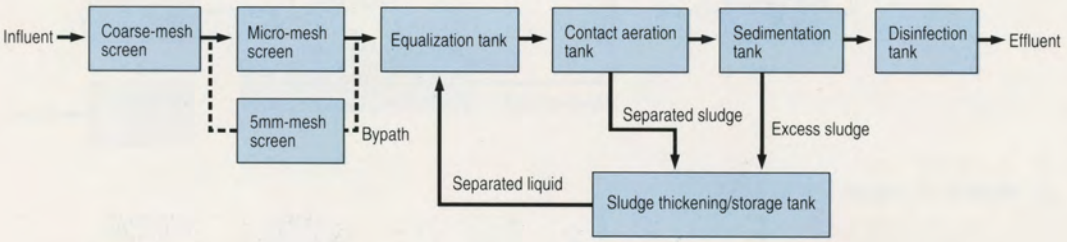
(3) Contact aeration process

This treatment method is most widely used in small to large-scale facilities. The following figure shows the flowchart of this process.

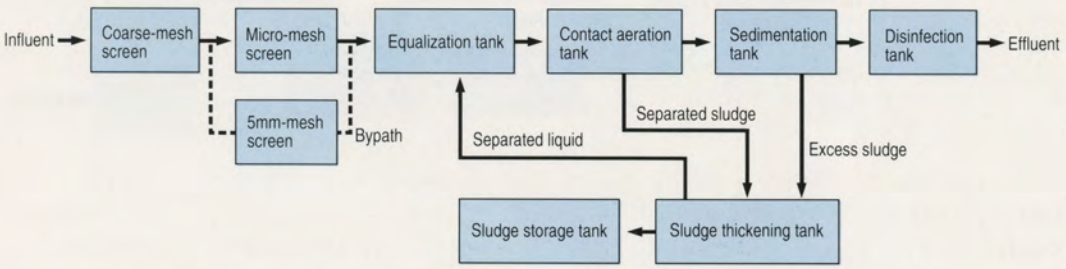
(1) Number of people: 51 to 500



(2) Number of people: 201 to 500



(3) Number of people: 501 or more



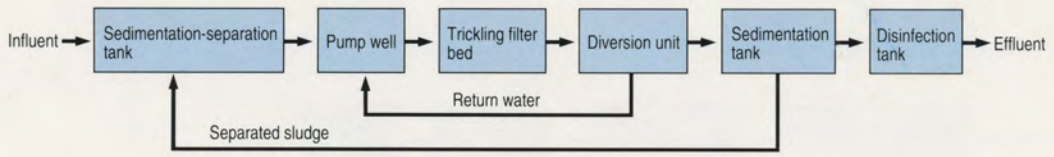
The contact aeration tank has the same structure and function as the contact aeration chamber used in tandoku-shori johkasou systems. The only difference is that the contact aeration tank in this case has its contact media packed more densely than the tandoku-shori johkasou system.

The sedimentation-separation, sedimentation, and disinfection tanks perform the same functions as tandoku-shori johkasou systems. The equalization tank and sludge controlling facilities play the same roles as described for the activated sludge process.

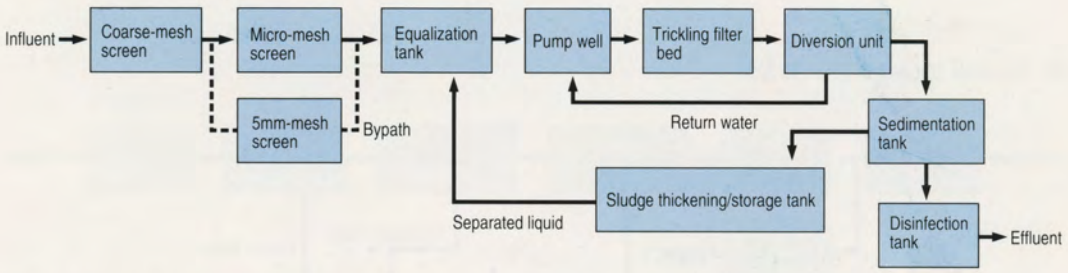
(4) Trickling filter process

The following figures show the flowcharts of this process.

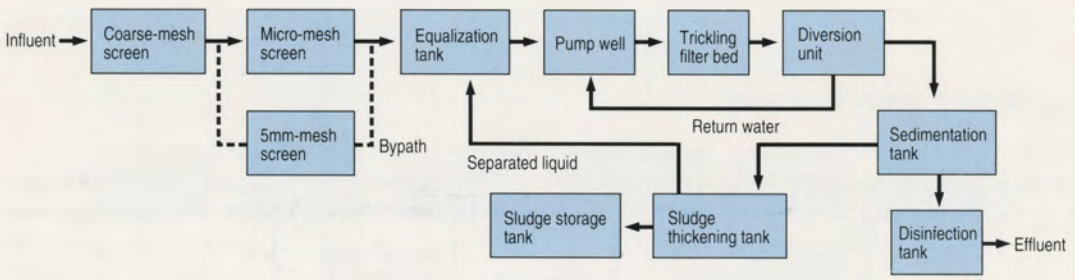
(1) Number of people: 51 to 500



(2) Number of people: 201 to 500



(3) Number of people: 501 or more



This trickling filter process is the same as in tandoku-shori johkasou systems except that a portion of the effluent from the trickling filter bed is returned by using the diversion unit and pump well.

The sedimentation-separation, sedimentation, and disinfection tanks perform the same functions as in tandoku-shori johkasou systems. The equalization tank and sludge controlling facilities are the same as described for the activated sludge process.

(5) Separation-contact aeration process

This treatment method is used for the small-scale gappei-shori johkasou systems designed to receive the wastewater up to 50 persons per johkasou unit, and is essentially the same as the contact aeration process.

Each unit involved in this process has a capacity equal to or greater than the values calculated below:

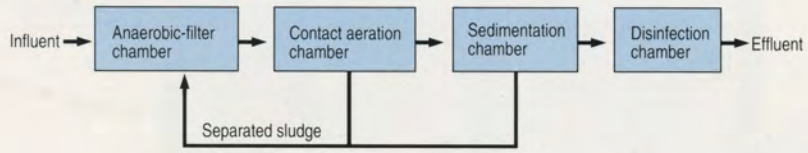
Sedimentation-separation chamber :	n = 5	$V_1 = 2.5$	(m^3)
	$6 \leqq n \leqq 10$	$V_1 = 2.5 + (n-5) \times 2.5$	(m^3)
	$11 \leqq n \leqq 50$	$V_1 = 5.0 + (n-10) \times 5.0$	(m^3)
Contact aeration chamber :	n = 5	$V_2 = 1.0$	(m^3)
	$6 \leqq n \leqq 10$	$V_2 = 1.0 + (n-5) \times 0.2$	(m^3)
	$11 \leqq n \leqq 50$	$V_2 = 2.0 + (n-10) \times 0.16$	(m^3)
Sedimentation chamber :	n = 5	$V_3 = 0.3$	(m^3)
	$6 \leqq n \leqq 10$	$V_3 = 0.3 + (n-5) \times 0.08$	(m^3)
	$11 \leqq n \leqq 50$	$V_3 = 0.7 + (n-10) \times 0.04$	(m^3)

Disinfection chamber: Same as described in (1) Separation-contact aeration process for tandoku-shori johkasou systems.

Note that "n" denotes the number of users for designing.

(6) Anaerobic filter-contact aeration process

This treatment method is most widely used in small-scale gappei-shori johkasou systems. The following figure shows the flowchart of this process.



The anaerobic filter chamber performs the same function as the sedimentation-separation tank, and has an additional function to remove organic matter. Furthermore, gasification through the anaerobic decomposition of organic matter helps to reduce the amount of sludge. The contact aeration, sedimentation, and disinfection chambers perform the same functions as those in tandoku-shori johkasou systems.

Each unit involved in this process has a capacity equal to or greater than the values calculated below:

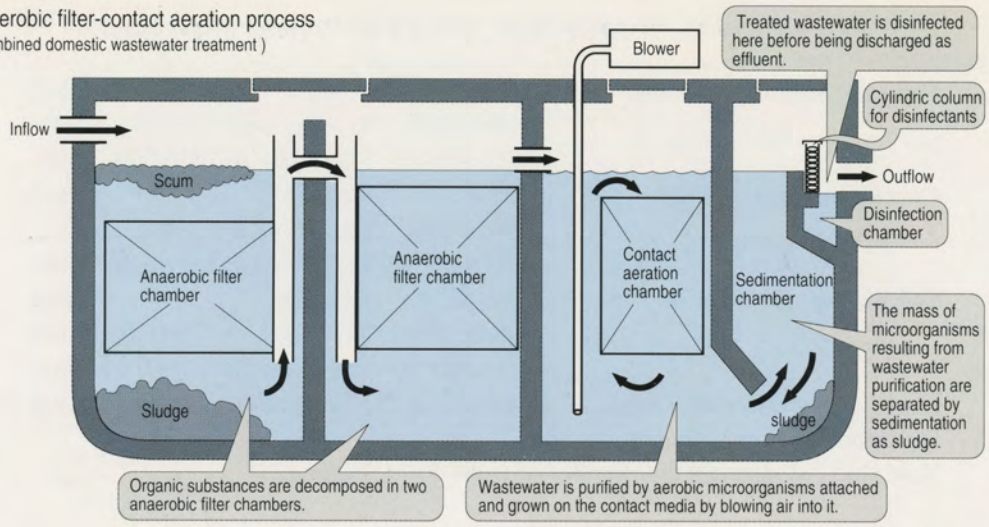
Anaerobic filter chamber :	n = 5	$V_1 = 1.5$	(m^3)
	$6 \leqq n \leqq 10$	$V_1 = 1.5 + (n-5) \times 0.4$	(m^3)
	$11 \leqq n \leqq 50$	$V_1 = 3.5 + (n-10) \times 0.2$	(m^3)

Contact aeration, sedimentation, and disinfection tanks: Same as described in (5) Separation-contact aeration process for small-scale gappei-shori johkasou systems.

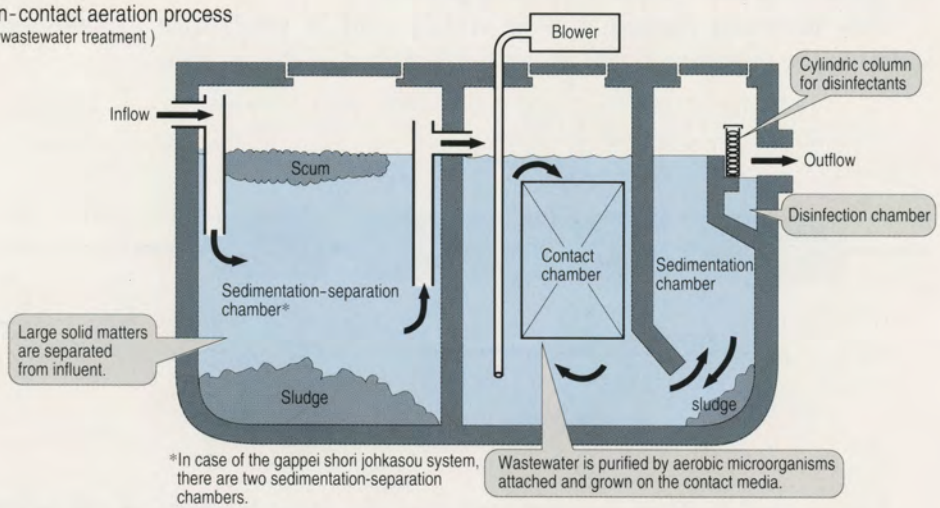
Note that "n" denotes the number of users for designing.

The outlines of compact types of johkasou systems are illustrated in Figure 5 for more clear understanding of the structural standards of them.

1. Anaerobic filter-contact aeration process
(Combined domestic wastewater treatment)



2. Separation-contact aeration process
(Flush toilet wastewater treatment)



3. Separation-aeration process
(Flush toilet wastewater treatment)

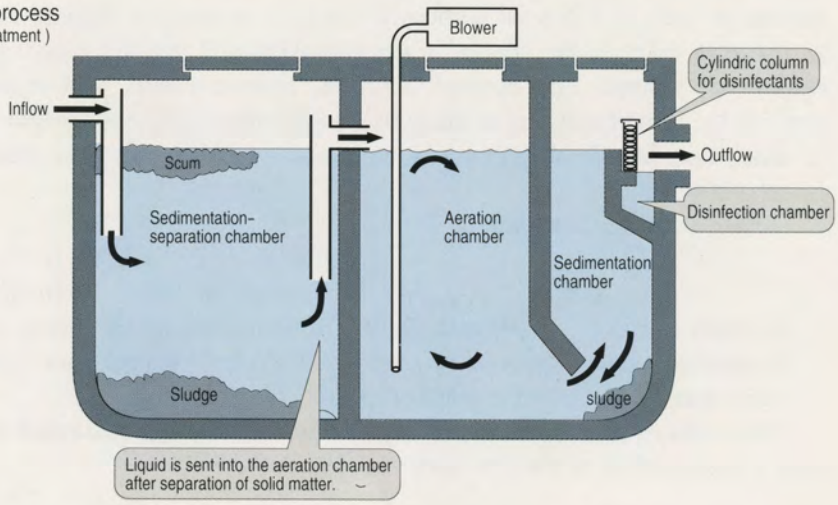


Figure 5 Structure of Compact Types of Johkasou Systems

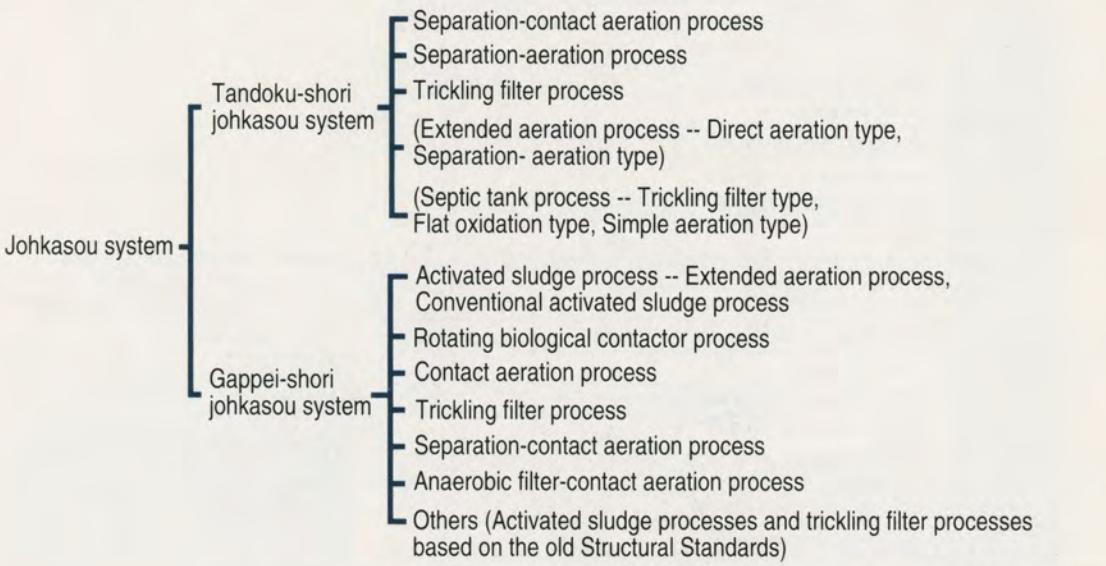
5. Types of Johkasou Systems and Their Spread

5.1 Types of Johkasou Systems

Johkasou systems adopt treatment methods determined by the structural standards set forth under the Building Standards Law according to treatment performance and the number of users for designing as described earlier. However, there are other types of johkasou systems now being used that are based on the old Structural Standards formulated in 1969. Johkasou systems being used in these days are summarized in Figure 6. In this figure, the treatment methods of johkasou systems based on the old Structural Standards are parenthesized.

Gappei-shori johkasou systems have originally been constructed in medium to large sizes. In recent years, small-scale gappei-shori johkasou systems which are installed in individual houses have become increasingly popular.

Small-scale gappei-shori johkasou systems that are normally applied to the number of users for designing up to 50 persons, are based on either a separation-contact aeration process or an anaerobic filter-contact aeration process. Note that in addition to the types listed in Figure 6, there is a different type of johkasou system, the modified gappei-shori johkasou system, which can accept and treat miscellaneous domestic wastewater along with the treated wastewater from tandoku-shori johkasou systems.



Note: Types in ( ) are based on the old Structural Standards and are no longer manufactured.

Figure 6 Types of Johkasou Systems

5.2 Current Situation of Johkasou Use

According to the statistics of fiscal year 1990, there were 81.40 million people who used flush toilets in Japan, accounting for 65.9% of the country's total population of 123.53 million. When classified by the treatment system, sewerage systems served 47.80 million people (38.7%); johkasou systems served 33.59 million people (27.2%); and vault toilets were used by 38.94 million people (31.5%).

Table 5 shows the number of johkasou units, classified by the treatment method, installed as of the end of fiscal year 1991. Table 6 lists those classified by the number of users for designing per johkasou system.

There are approximately 6.14 million johkasou units installed in the whole country, 95.5% of which are tandoku-shori johkasou systems. When tandoku-shori johkasou systems are classified by the treatment method used, the separation-contact aeration process accounts for 41.3%, the extended aeration process of direct aeration type (old standard) accounts for 39.2%, and the separation-aeration process accounts for 16.5%. Similarly, as for gappei-shori johkasou systems, the anaerobic filter-contact aeration process accounts for 44.1%, the contact aeration process accounts for 32.4%, and the activated sludge process (old standard) accounts for 9.9%. Small-scale gappei-shori johkasou systems, consisting of anaerobic filter-contact aeration and separation-contact aeration process, show steady growth in the number of units installed, but only 1.40 million units (50.9% of gappei-shiki johkasou systems) have been installed to date. When classified by scale or the number of users for designing, 85.4% of all johkasou systems are for the number of users for designing up to 20 people per unit and 97.7% are for those up to 100 people.

Table 5 Number of Installed Johkasou Units Classified by the Treatment Method
(as of the end of fiscal year 1991)

Classification	Treatment method	Number of units	Percentage to total
Tandoku-shori johkasou systems	Separation-contact aeration process	2425.3	41.3
	Separation-aeration process	967.2	16.5
	Trickling filter process	2.3	0.0
	Direct aeration type (old standard)	2300.6	39.2
	Septic tank process (old standard)	94.9	1.6
	Others (new and old standards)	79.0	1.4
	Total	5869.3	100.0
Gappei-shori johkasou systems	Extended aeration process	7.7	2.8
	Rotating biological contactor process	1.0	0.4
	Contact aeration process	89.1	32.4
	Trickling filter process	0.1	0.0
	Separation-contact aeration process	18.6	6.8
	Anaerobic filter-contact aeration process	121.2	44.1
	Activated sludge process (old standard)	27.1	9.9
	Trickling filter process(old standard)	0.5	0.2
	Others (new and old standards)	9.5	3.4
	Total	274.8	100.0
Total		6144.1	

Expressed in units of 1,000

Table 6 Number of Installed Johkasou Units Classified by Capacity
(as of the end of fiscal year 1992)

Number of users for designing per johkasou system	Number of units installed (percentage)
～ 20	5973.6 (85.4%)
21 ～ 100	862.5 (12.3%)
101 ～ 200	85.4 (1.2%)
201 ～ 500	62.3 (0.9%)
501 ～	14.6 (0.2%)

Expressed in units of 1,000

6. Functions of Johkasou Systems and Precautions for Use

6.1 Functions of Johkasou Systems

Johkasou is, in a word, a wastewater treatment facility based on aerobic biological treatment. For this reason, substances to be removed are subject to some limitations. The components expressed by such indices as BOD, COD, and SS are typical ones that can be removed by johkasou systems.

The functions of johkasou systems can be described as follows by using BOD as an index. Assume that the BOD load in domestic wastewater per capita per day is 40g; 13g from night soil and 27g from miscellaneous domestic wastewater. For tandoku-shori johkasou systems, the target or goal of wastewater treatment is such that BOD removal is 65% or more, and BOD concentration in the effluent is 90 mg/*l* or less. Therefore, if the BOD load of untreated miscellaneous domestic wastewater is added to the BOD load in the effluent from tandoku-shori johkasou systems, the generated BOD load of 40g can only be reduced to about 32g. However, since most johkasou units of gappei-shori type are designed to achieve the effluent with BOD of 20 mg/*l* or less at BOD removal of 90% or more, the generated BOD load of 40g can actually be reduced to one-tenth, that is, to about 4g.

6.2 Precautions for Johkasou Use

Though compact in size, the johkasou system is a biological treatment facility that is designed to receive discharged wastewater without a time lag. Therefore, when using johkasou systems, much care must be taken as described below.

(1) Use an appropriate amount of flushing water for toilets.
Toilet flushing water does not only drain night soil and clean the bowl, but also is used to dilute the night soil. Therefore, it is very important to use the appropriate amount of water (about 50*l* per capita per day). Conversely, an excessive amount of flushing water may badly affect the quality of treated wastewater.

(2) Use cleaning chemicals properly.
Various chemical agents used to clean toilet bowls are available on the market, but care must be taken because agents containing hydrochloric acid or sodium hydroxide may affect the pH value of the wastewater, and agents containing sodium hypochlorite can inactivate the microorganisms in the johkasou units. Improper use of these chemicals may decrease the efficient function of the system.

(3) Do not drop anything but toilet paper into the bowl.
The pipe connected to the johkasou tank or the filter bed in it may get clogged up with foreign matter. Therefore, only use toilet paper, and never dispose of diapers, cigarette butts, and so on in the toilet.

(4) Do not turn off the power source. Do not block the ventilation port or blower air inlet.
Since johkasou systems use aerobic biological treatment, it is important that the blower operates normally to supply oxygen and agitate the water. Care must also be taken not to block the ventilation port or blower air inlet.

(5) Never place objects on the johkasou unit and make sure that the manhole cover is always closed.
When objects are placed on the johkasou unit, its proper functioning may be hindered by the load. Also, objects placed on the manhole may inhibit maintenance, and cleaning. For safety purposes, always make sure that the manhole is closed tight.

(6) Always make sure that there is plenty of disinfectant in supply.
Because the wastewater treated by the johkasou system may contain pathogenic microorganisms, it is important to disinfect the treated wastewater before discharging it. For this reason, an adequate supply of disinfectant must always be kept. Chlorine-based tablets are generally used as disinfectants.

(7) Do not discharge an abnormally large amount of wastewater at one time.
Under normal conditions the gappei-shori johkasou system will continue to work properly even when it receives a rather large amount of wastewater. However, if an abnormally large amount of wastewater comes into the johkasou system, wastewater may overflow before being sufficiently treated.

(8) For the gappei-shori johkasou system, never drain vegetable waste or used cooking oil into the system.
Although the gappei-shori johkasou system accepts wastewater from kitchens, vegetable waste must not enter the system. This is because vegetable waste will accumulate in the tank and increase the generation of sludge. Cooking oil causes a very high BOD load, and may overload the johkasou system. For this reason, never allow used cooking oil to enter the system.

7. Construction of Johkasou Systems

To ensure that the johkasou system functions as designed, it must be constructed properly. As medium to large-scale johkasou systems are built of concrete at installation sites, so the same precautions as in constructing an ordinary wastewater treatment facility must be observed.

Small-scale johkasou systems are usually manufactured at factories mainly using fiberglass reinforced plastic (FRP). When constructing this type of johkasou system, the procedure shown in Figure 7 is followed. Table 7 summarizes the average-sized gappei-shori johkasou systems made of FRP. Note that the blower power consumption is based on the anaerobic filter-contact aeration process.

Figure 8 shows some examples of johkasou unit installation.

When installing a johkasou system, it is important to keep it horizontal. Otherwise, the air blown from the diffuser will be uneven and aeration or agitation may not be fully achieved. Furthermore, if the overflow weir is not level, wastewater may overflow from the weir at a rapid rate, causing sludge to be washed out. When installing a FRP johkasou unit underground, it is necessary to pay attention to large rocks, soil conditions, and water pressure. Should sharp rocks cut into the FRP wall, they may open holes causing water to leak out. Similarly, excessive soil and water pressure may damage the FRP structure.

The johkasou contractors that install the system must be licensed by the prefectural governor. These licensed contractors must employ qualified johkasou installation workers who are qualified for this installation work by passing a national examination.

Table 7 Approximate Dimensions of a Gappei-shori Johkasou Made of FRP (anaerobic filter-contact aeration process)

Number of users for designing	Width (mm)	Height (mm)	Length (mm)	Blower power consumption (W)
5	1,200	2,400	1,800	58
6	1,300	2,600	1,800	67
7	1,500	2,700	1,800	86
8	1,500	2,900	1,900	89
10	1,700	3,200	2,000	112

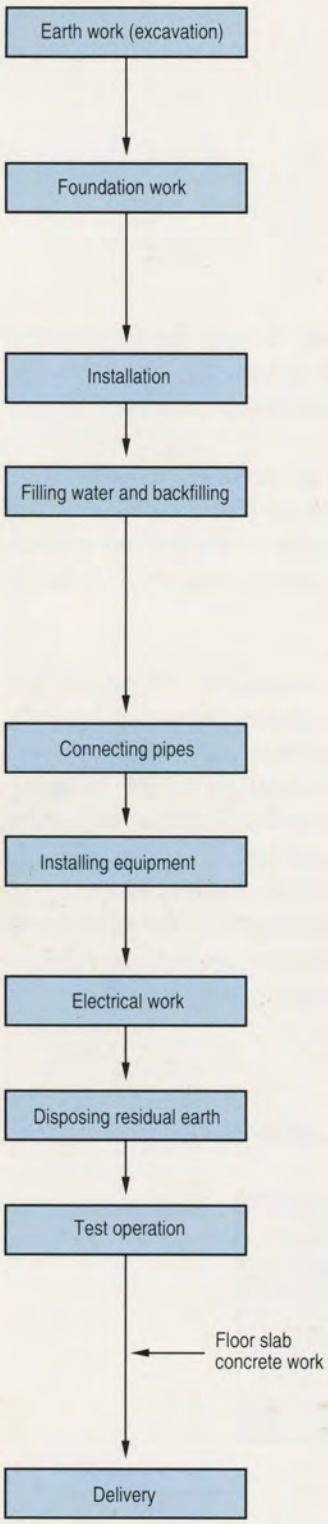


Figure 7
Construction Procedure for an FRP Johkasou System

Earth work (excavation)
Excavate a hole of the necessary size to install the johkasou main unit. Shoring may be required depending on the characteristics of soil or subsoil at the installation site. Excavation at the place with high ground water level requires dewatering.

Foundation work
Lay down a layer of rubble which is sufficiently compact to keep the johkasou main unit horizontal and prevent the ground from sinking or rising. Next, after pouring leveling concrete, pour the baseplate reinforced concrete to facilitate the horizontal installation of the johkasou main unit and to transmit the weight of the main unit and superstructure to the ground.

Installation
Install the johkasou main unit, then check that it is level.

Filling water
Fill the tank with tap water to protect it against damage and deformation during backfilling and check for leveling. Then, check for water leak.

Backfilling
First, tamp down the lower half and compact the earth by pouring water. Then, tamp down the upper half in the same way and fill in with earth up to the bottom level of the inflow and outflow pipes.

Connecting pipes
After sufficiently compacting the piping pathway section, fill in with earth and connect the inflow and outflow pipes.

Installing equipment
Install auxiliary equipments such as the blower and the pump. The blower and other equipments that may generate vibration or noise must be installed after preparing the appropriate foundations.

Electrical work
Install a power supply special for the johkasou unit, and be sure to ground it to the earth.

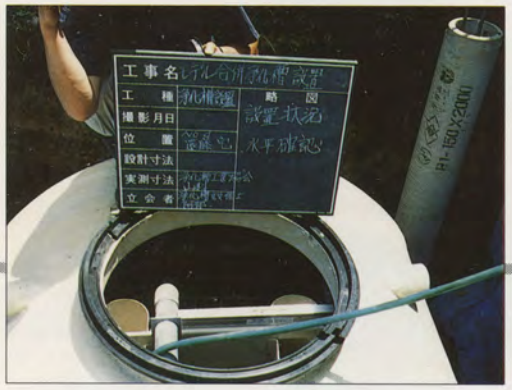
Disposing residual earth
Dispose of excess residual sand and earth by transporting it to the designated place.

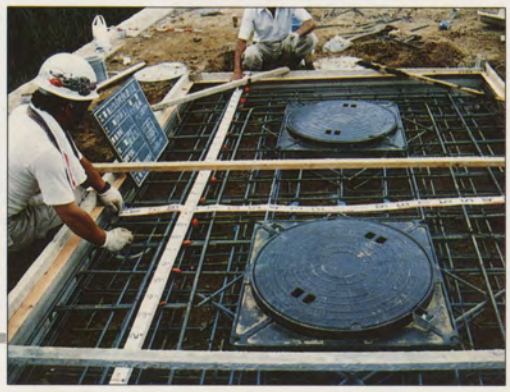
Test operation
After construction work is completed, check whether each unit involved in the johkasou system and its auxiliary equipments operate properly. At this time, also check for levelness, water leak, and the flow conditions of water.

* Floor slab concrete work
Pour concrete on top of the backfilled earth to facilitate maintenance/inspection work, prevent the penetration of rainwater, and keep the johkasou main unit from rising. This work can also be done after backfilling or connecting pipes.

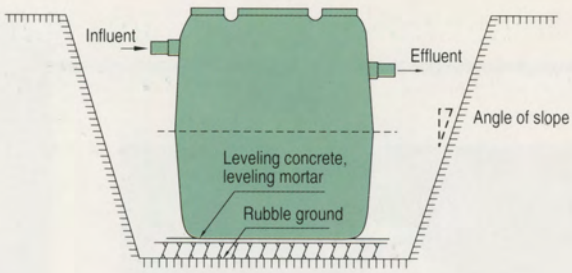
Delivery
Deliver the johkasou system to the johkasou manager together with the necessary documents after confirming proper operating of it. The details of how to use the johkasou system and the regulation of maintenance/cleaning of it have to be explained to the johkasou manager.


工事名
工種
撮影月日
位置
設計寸法
実測寸法
立会者
略図
設置状況
水平確認



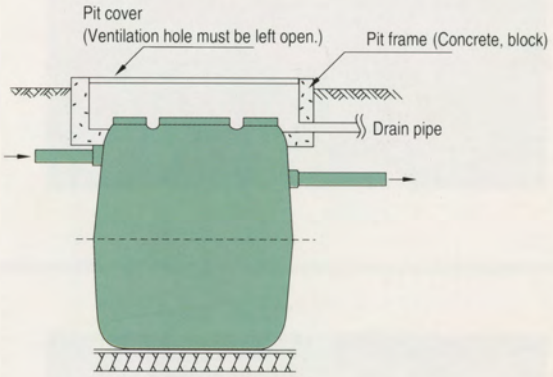


a) Standard installation



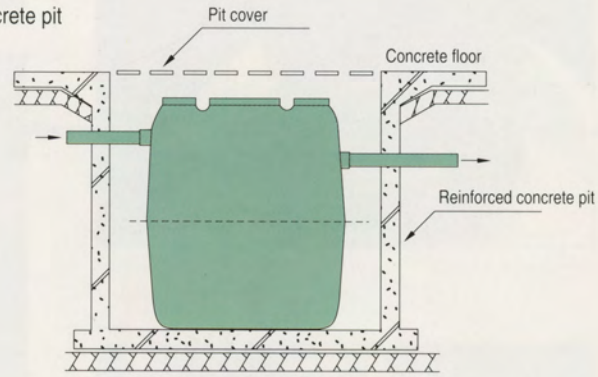
b) Installation of a johkasou unit with a pit

When installation conditions require the inflow pipe to be buried deep underground, the johkasou system must also be buried deep. In this case, install a pit in the upper part of the johkasou unit.



c) Installation of a johkasou unit in a reinforced concrete pit

When installing a johkasou system under a parking lot, etc. where it is subject to a large load, first construct a reinforced concrete pit to contain the installed johkasou system.



d) Installation of a johkasou unit with lift-preventing concrete

When installing a johkasou system at the lot with high underground water level, construct lift-preventing concrete to prevent the johkasou system from being raised by underground water pressure.

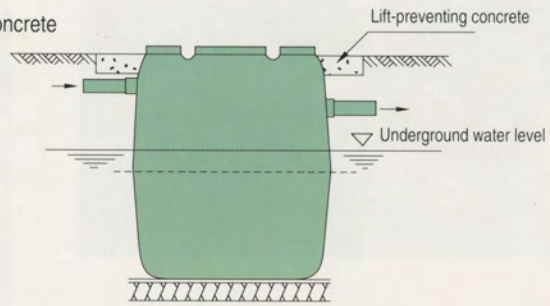


Figure 8 Examples of Installing an FRP Johkasou

8. Maintenance and Cleaning of Johkasou Systems and Water Quality Examination

8.1 Obligation of Johkasou Users

The johkasou system combines various units into a compact facility. These units include some subunits to separate suspended solids from wastewater through sedimentation, purify pollutants through a biological process, store separated sludge, and disinfect treated wastewater by using chlorine disinfectant. As long as the johkasou system operates properly, the amount of separated and stored sludge should gradually increase over time, and the amount of chlorine disinfectant should decrease. Therefore, unless the johkasou system is properly managed, the accumulated sludge may exceed the system's storage capacity , resulting in sludge flowing out into the effluent and large consumption of chlorine.

To prevent these problems, the johkasou user (in most cases, called the "johkasou manager" under the Johkasou Law) must use the johkasou system correctly and must maintain and clean it as part of statutory obligations. The johkasou user must also receive an annual water quality examination. This examination is to be conducted by the inspecting agency specified by the prefectural governor.

Since johkasou managers do not always have expert knowledge concerning maintenance and cleaning, these jobs are entrusted to johkasou maintenance and johkasou cleaning vendors. Fig.9 summarizes the general system for maintenance and cleanig of johkasou systems and water quality examination.

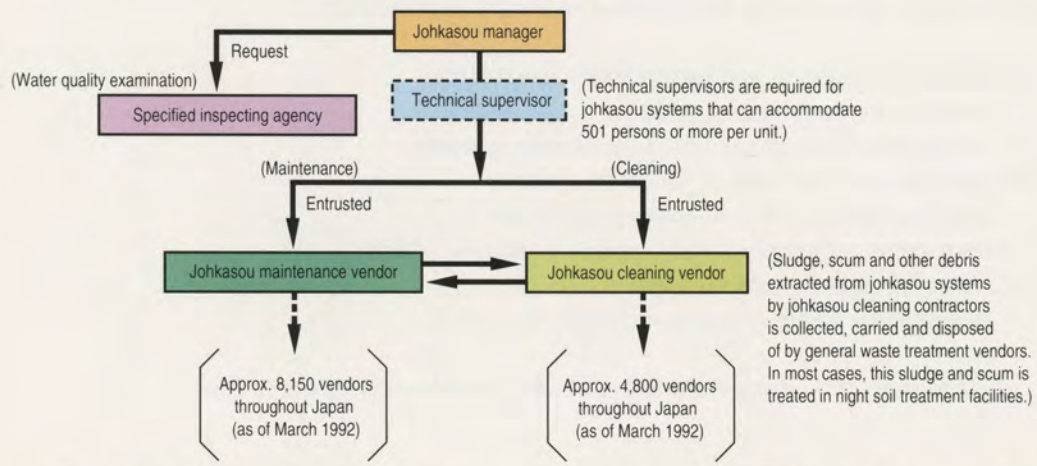


Figure 9 Organization for Maintenance, Cleaning and Water Quality Examination

8.2 Maintenance

Maintenance operations are necessary to adjust the johkasou system or repair it as required. More specifically, these operations include monitoring the operating status of each unit of the facility and the auxiliary equipments, and the water quality of the final effluent, in order to discover faults or defects early and take corrective action.

The procedures to be followed and the minimum frequency of this maintenance are stipulated according to the method of treatment and the size of the johkasou system. As to the gappei-shori johkasou system for household use based on the anaerobic filter-contact aeration process shown in Figure 5, for example, the procedures for maintenance, which are to be followed at least three times a year, are stipulated as follows.

(1) For the anaerobic filter chamber, measure the transparency and pH of the effluent and check the condition of sludge accumulation. When the amount of accumulated sludge is considered to be near the storage capacity limit, the johkasou manager must contact the johkasou cleaning contractor and request cleaning.
(2) For the contact aeration chamber, measure the water temperature, transparency, pH, and dissolved oxygen in the chamber, then check the amount and color of the bio-mass attached to the contact media. When the bio-mass is found to have grown thick, forcibly separate them by applying back-washing and transfer the residual sludge to the anaerobic filter chamber.
(3) For the sedimentation chamber, measure the transparency and pH of its effluent and check the condition of sludge accumulation. When scum or deposited sludge is found, transfer it to the anaerobic filter chamber.
(4) For the disinfection chamber, check the residual amount of chlorine disinfectant in the column and measure the residual chlorine in the effluent. Replenish the column with chlorine disinfectant if necessary.
(5) For the blower, check, clean and repair each component according to its maintenance specifications.

The johkasou system can only be maintained by qualified johkasou operators. This qualification can be acquired by passing the related national examination or by completing lecture courses approved by the Minister of Health and Welfare.

National examination and lecture curricula include:

- Introduction to johkasou systems
- Administrative management of johkasou systems
- Structure and function of johkasou systems
- Introduction to johkasou construction work
- Inspection, adjustment, and repair of johkasou systems
- Management of water quality
- Introduction to the cleaning of johkasou systems

As of March 1991, there were about 30,000 johkasou operators in Japan.

8.3 Cleaning

Cleaning involves extracting the generated sludge and scum from the johkasou system and conditioning sludge in the tank. The primary purpose of cleaning is to extract sludge from inside the johkasou unit before accumulated sludge flows out into the effluent.

The procedures and the minimum frequency for cleaning are stipulated by the Ministry of Health and Welfare ordinance for each method of treatment.

As to the gappei-shori johkasou system for household use, based on the anaerobic filter-contact aeration process, for example, the procedures for cleaning which is to be done at least once a year are as follows.

(1) Use a vacuum car capable of carrying 2 to 4 metric tons sludge.
(2) For the first anaerobic filter chamber, drain all scum and deposited sludge, wash the pressing cover of the filter media with tap water, then drain all the water from the bottom of the chamber.
(3) For the second anaerobic filter chamber, contact aeration chamber, sedimentation chamber, and disinfection chamber, the necessary amount of water to be drained is variable, depending on the condition of sludge accumulation in each unit facility.
(4) After extracting sludge, fill the chamber with tap water to the designated level.
(5) Carry the extracted sludge by using the vacuum car to the sludge treatment facility (for example, night soil treatment facility) for sanitary treatment.

To upgrade the vocational skills of those who clean johkasou systems, various courses are offered including "Training course for qualification of johkasou cleaning technicians" and "Training course for johkasou cleaning workers."

Through "Training course for qualification of johkasou cleaning technicians", participants acquire expert knowledge of public health, environmental protection, introduction to administrative management of johkasou systems, basic knowledge of science, principles of wastewater treatment, structure/function of johkasou systems, cleaning practice, and sanitation/safety considerations. Through "Training course for johkasou cleaning workers", trainees learn about the Johkasou Law, mechanisms of johkasou systems, types/ methods of johkasou systems, and cleaning practices.

As of March 1991, there were approximately 11,000 johkasou cleaning technicians in Japan. Approximately 4,000 trainees have received "Training course for johkasou cleaning workers".

9. Treatment of Johkasou Sludge

The sludge and scum that accumulates in johkasou systems is extracted by a vacuum car during cleaning by a johkasou cleaning vendor licensed by the city mayor or village headman. Most of the extracted johkasou sludge is carried to night soil treatment facilities (built by the city, town and village authorities) and treated together with collected night soil. Some extracted johkasou sludge is disposed of in sewerage systems or dumped into the sea. Figure 10 shows how sludge is actually treated and disposed of based on the statistics of fiscal year 1989. The amount of sludge dumped into the sea is gradually declining.

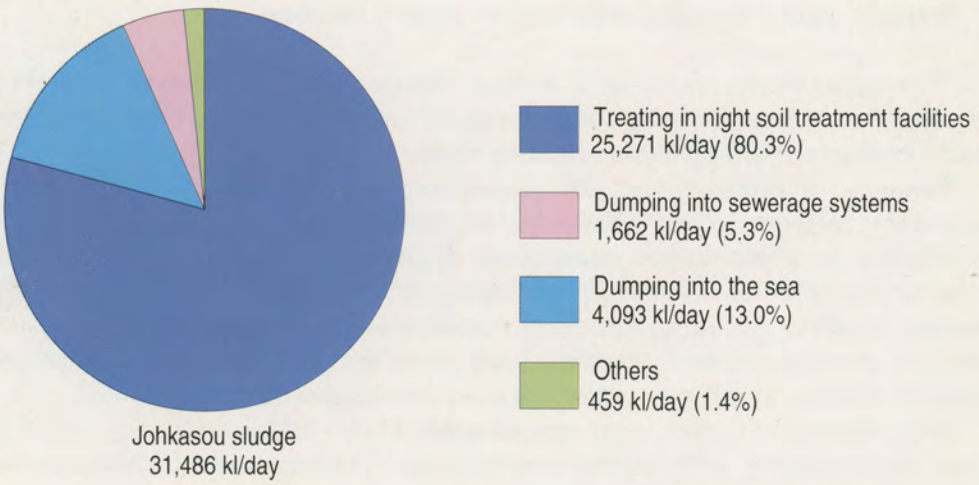


Figure 10 Current Status of Johkasou Sludge Treatment and Disposal (as of the end of fiscal year 1989)

The amount of sludge from johkasou systems has increased in recent years due to the proliferation of johkasou systems including small-scale gappei-shori johkasou systems being installed. In some districts, this type of sludge causes the problem to exceed the capacity limit of conventional night soil treatment facilities where it is mixed with collected night soil and treated together. To solve this problem, treatment facilities special for johkasou sludge have been built in these districts.

10. Advantages of Using the Gappei-shori Johkasou Systems

The advantages of using the gappei-shori johkasou system, including those described above, may be summarized as follows:

- Flush-type toilets can be installed.
- Miscellaneous domestic wastewater can be also treated to prevent water pollution.
- Facilities can be constructed at low cost.
- Facilities can be constructed in a short time.
- Wastewater collection and johkasou installation are not affected by topographic conditions at the site.

11.2 Outline of the Gappei-shori Johkasou Installation Promotion Project

Although johkasou systems were originally intended to facilitate the installation of flush toilets, due to the high performance of gappei-shori johkasou systems it was recognized that they effectively helped to maintain the water quality of public water bodies.

In districts where sewerage systems are underdeveloped, there are growing needs for household johkasou systems to perform the same function of treating miscellaneous domestic wastewater as sewerage systems do. For this reason, the government authorities have instituted a national system to fund the installation of gappei-shori johkasou systems. In other words, a subsidy equivalent to the difference in installation costs between a gappei-shori johkasou and a tandoku-shori johkasou system is provided to promote the installation of gappei-shori johkasou systems. This program, called the Gappei-shori Johkasou Installation Promotion Project, was inaugurated in 1987.

This subsidy system requires that municipalities provide financial aid to those wishing to install a gappei-shori johkasou system with the amount equivalent to the difference in installation costs between a gappei-shori johkasou and a tandoku-shori johkasou system in districts where miscellaneous domestic wastewater must be treated (except where sewerage systems construction projects are planned). The relevant municipalities are subsidized by the government for one-third of this financial support. Details of this system are illustrated in Figure 11 using a five-person capacity johkasou system as an example.

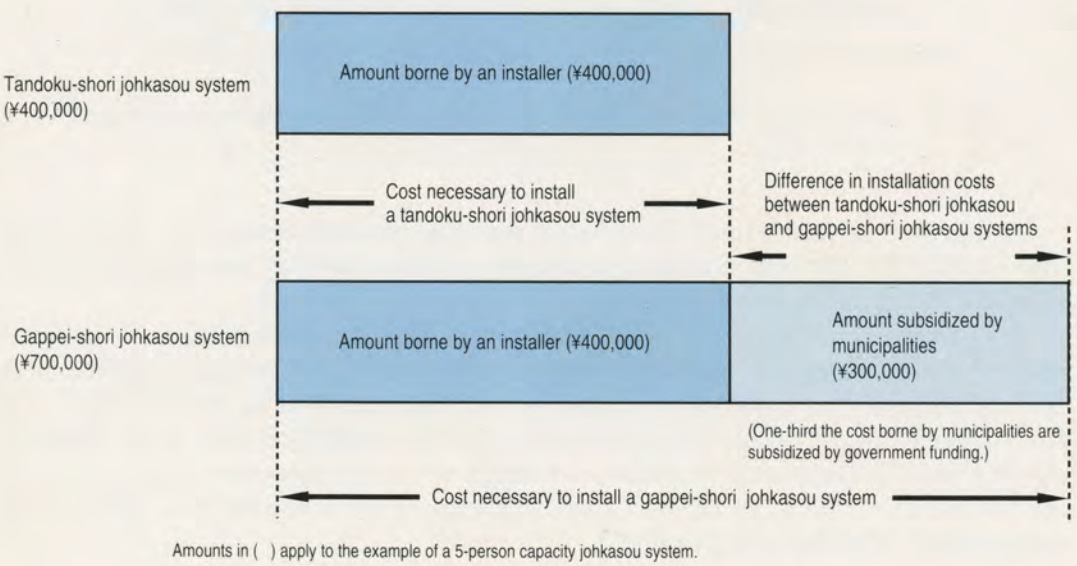


Figure 11 Conceptual Diagram of Financial Aid

Note that most prefectures including the Tokyo Metropolis provide municipalities with similar assistance in addition to this government aid.

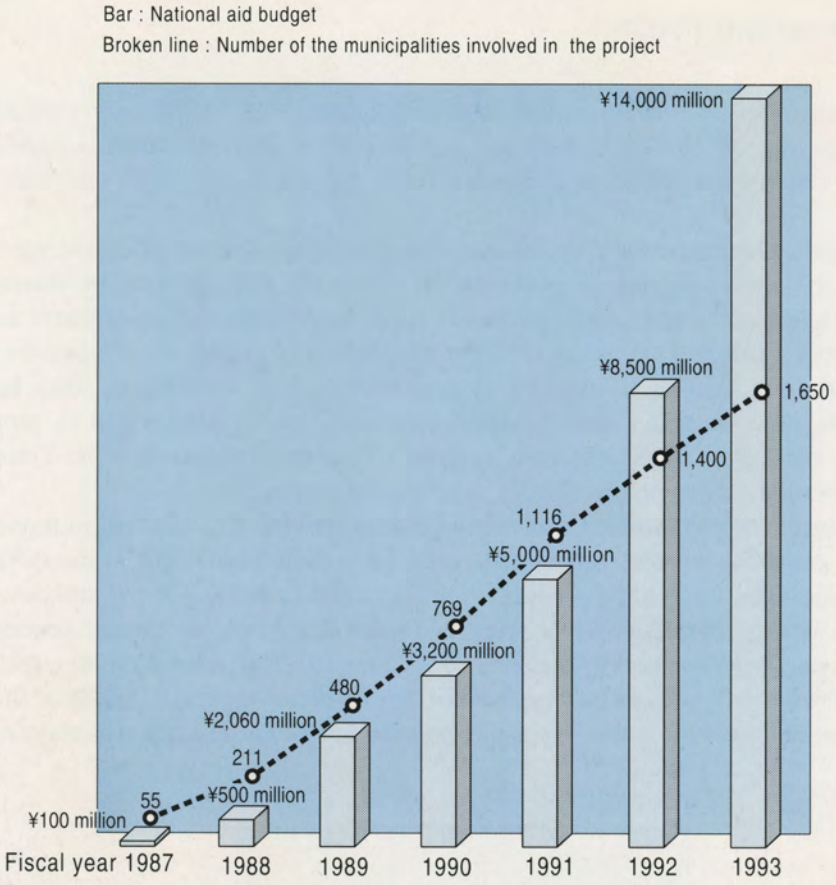


Figure 12 Trends in the Gappei-shori Johkasou Installation Promotive Project

As the need to install more flush toilets and treat domestic wastewater continues to grow in localities, the budget of the government and the number of municipalities which promote this project are also growing.

This project, inaugurated in fiscal year 1987 with ¥100 million from the national treasury and involving 55 municipalities, expanded to ¥5,000 million in government funding and more than 1,100 municipalities by the fiscal year 1991 as shown in Figure 12. This suggests that the gappei-shori johkasou system has established itself as an important way to cope with water pollution problems through domestic wastewater in municipalities. For the fiscal year 1993, government funding is expected to reach ¥14,000 million, with municipalities expected to reach 1,650.

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JOUKASOU SYSTEM FOR TREATMENT OF DOMESTIC WASTEWATER