■Technical Summary

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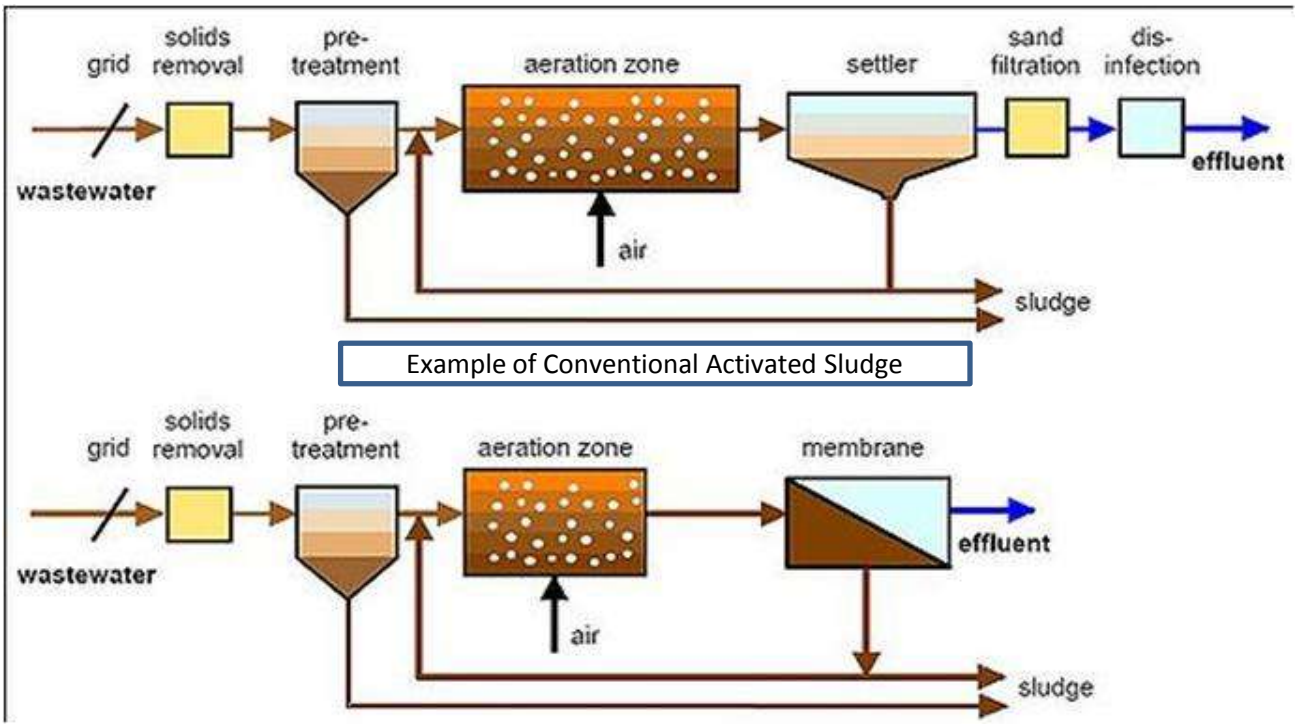
(1) Technical Name: Membrane bio-reactor process

	Items	Contents
Summary	Technical features	The MBR process is a suspended growth activated sludge system that utilises microporous membranes for solid/liquid separation in lieu of secondary clarifiers.
	Merits	Improved Water Quality Option for Wastewater Reuse Reduces Plant Space Requirements Fewer Operational Problems
	Example countries	Japan and many countries over the world
Applicable conditions	Water	Required
	Electricity	Required more than activated sludge processes to operate membrane equipment.
	Suitable locations	Places where water can be reused for industrial water, irregation, and eivironmental ammenities. There must be a river nearby in which the treated water can be discharged. Site procurement and consensus from the surrounding inhabitants must be easy. Sites with an access aisle having good ground condition with few floods.
	Points to remember	Facilities are arranged on a plane; therefore, sites with bad ground conditions should be avoided because the foundation costs will be high.
Technical performance	Sewage Treatment Flow	Initial Sedimentation Pond → Aeration Tank→ Membrane Equipment
	Sludge Treatment	Sludge condensation process is not necessary because of operation within density of range from 1.0 to 1.5 % of activated sludge
	Treatment Performance	Small scaled equipment with a scale of under 3000m^3 of treated water per day in general. (e.g. : Japan) BOD: 5mg/L or below, SS: 5mg/L or below
	Final treatment･ Disposal	Treated water can be recycled except for drinking. Treated water is discharged into rivers. Reusable for irrigation. Sludge is disposed of in landfill sites. Reusable as compost or soil conditioners.
	Daily maintenance	Screen cleaning. Check pumps and valves / Measure water quality of Discharge Keep daily operation log
	Special maintenance	Backwashing of membrane modules Cycle time of backwashing depenses on membrane material.
Cost	Initial cost	Less costly due to smaller scale of plants than the suspended soil method
	Service life	Civil Engineering: 50 years, Machinery and Electricity: 15years, Membrane Module: 5years (e.g. : Japan)
	Running cost	300 JPY per m^3 including sludge treatment cost (e.g. :on experiment in Japan)
Misc.Drainage/Rain water	Miscellaneous drainage	Accepted as part of sewage water.
	Rain water	In the case of a combined sewer system, the amount equivalent to that on a sunny day can be treated up to the secondary treatment, and the excess amount is discharged after the initial treatment.
	Others	Space-saving design allows the upper area to be easily utilized. Desity of activated sludge/MLSS in aeration zone is range of 8000 to 15000 mg/l.



Example of Conventional Activated Sludge

Example of Membrane Bioreactor Process

(2) Technical Name: Suspended solid method (standard activated sludge process)

	Items	Contents
Summary	Technical features	Removal of organic substances using activated sludge (mass of microorganisms) floating in the reactor tank.
	Merits	Quality of the treated water is stabilized. Less space required. Reduction of annoying odors.
	Example countries	In Japan, 72% of the treatment plants exceeding 10000m^3/day capacity utilize the standard activated sludge process, and 68% of those with less than 10,000 m^3/day capacity utilize the oxidation ditch process.
Applicable conditions	Water	Required
	Electricity	Required to operate equipment such as pumps, blowers, valves etc.
	Suitable locations	Places where water can flow naturally by gravity. There must be a river nearby in which the treated water can be discharged. Site procurement and consensus from the surrounding inhabitants must be easy. Sites with an access aisle having good ground condition with few floods.
	Points to remember	Facilities are arranged on a plane; therefore, sites with bad ground conditions should be avoided because the foundation costs will be high.
Technical performance	Sewage Treatment Flow	Initial Sedimentation Pond→ Aeration Tank→ Final Sedimentation Pond→ Contacting Tank
	SludgeTreatment Flow	Sludge Condensation Tank→ Digestion Tank→ Sun-drying Bed (In Japan, incineration is more common than sun-drying)
	Treatment target	Middle/Large scaled equipment with a scale of over 10000m^3 of treated water. (e.g. : Japan)
	Performance	BOD: 15mg/L or below, SS: 40mg/L or below
	Final treatment・Disposal	Treated water can be recycled except for drinking. Treated water is discharged into rivers. Reusable for irrigation. Sludge is disposed of in landfill sites. Reusable as compost or soil conditioners.
	Daily maintenance	Screen cleaning. Check pumps and valves / Measure water quality of Sedimentation Keep daily operation log
	Special maintenance	Based on the density of MLSS, perform desludging or adjust the amount of return sludge.
Cost	Initial cost	26 billion JPY for those with a scale of 100,000m^3/day (e.g. : Japan) (Sludge treatment includes condensation and dehydration)
	Service life	Civil Engineering: 50 years, Machinery and Electricity: 15years(e.g. : Japan)
	Running cost	830 million JPY per year for those with a scale of 100,000m^3/day(e.g. : Japan) (Sludge treatment includes condensation and dehydration)
Misc.Drainage /Rain water	Miscellaneous drainage	Accepted as part of sewage water.
	Rain water	In the case of a combined sewer system, the amount equivalent to that on a sunny day can be treated up to the secondary treatment, and the excess amount is discharged after the initial treatment
	Others	Space-saving design allows the upper area to be easily utilized. <Facility Tour available at> ・Nijino Gesuidoukan in Ariake Koto Ward, Tokyo http://www.nijinogesuidoukan.jp <List of Tokyo Water Reclamation Centers which accept visitors> http://www.gesui.metro.tokyo.jp/odekake/sise_list.htm ・Mikawashima Water Reclamation Center(Exhibit pictures showing the transition of ・Ariake Water Reclamation Center(state of the art facility) <Sewer Culvert Tour> ・Mizuno Yakata in Kuramae Taito Ward, Tokyo http://www.gesui.metro.tokyo.jp/odekake/s_kuramae.htm

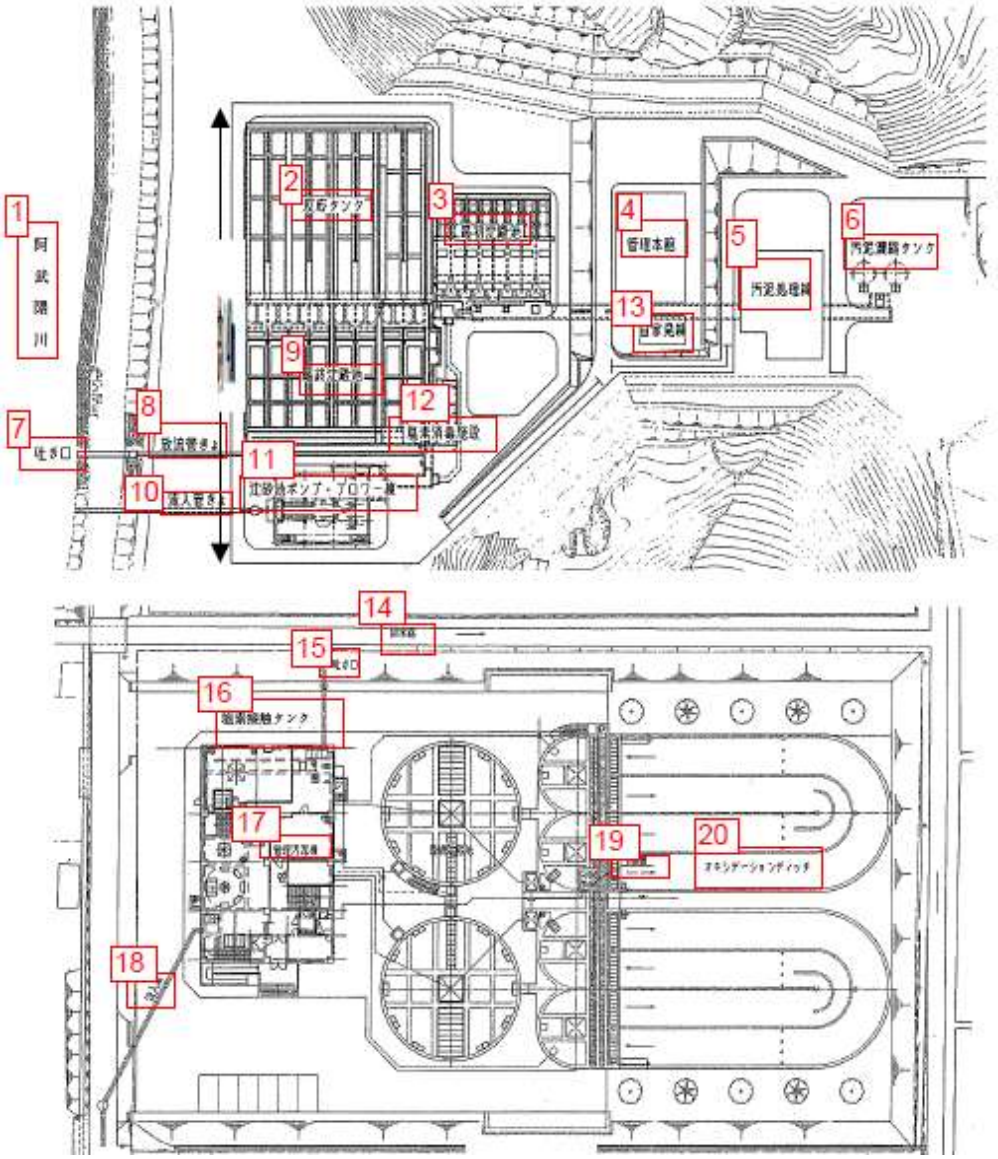


Figure T-1 Sample Configuration of Standard Activated Sludge System(upper) and Oxidation Ditch System(lower)

Reference: "Sewage Facilities Planning・Design Manual and Description-post edition, 2001" Japan Sewage Works Association

1	Abukuma River	11	Grit Chamber Pump・
2	Reactor tank	12	Chlorination Device
3	Initial Sedimentaion	13	Private Power
4	Administration office	14	Drainage Canal
5	Sludge treatment	15	Outlet
6	Sludge Concentration	16	Chlorine Contacting
7	Outlet	17	Final Sedimentation
8	Outlet Pipe	18	Inlet Beam
9	Final Sedimentation	19	Distribution
10	Inlet Pipe	20	Oxydation Ditch

(3) Technical Name: Bio-film method(high-rate trickle filter process)

	Items	Contents
Summary	Technical features	Removing organic substances by using the bio-film on the surface of a filter made from crushed stone.
	Merits	Maintenance is easier and is more flexible to fluctuations when compared to the standard activated sludge process. Odor is a concern.
	Example	Japan(Many were constructed before the 40th year of the Showa Era.)
Applicable conditions	Water	Required
	Electricity	Rotary sprinkler rotates spraying sewage water when a hydraulic head pressure of 50 to 100cm is applied.
	Suitable locations	Same as that of the standard activated sludge process.
	Points to remember	Due to concerns of odor or flies, it is preferred to be located away from urban areas.(can be reduced by circulating treated water) Water levels vary greatly from facility to facility compared to those using the standard activated sludge process.
Technical performance	Sewage Treatment Flow	Initial Sedimentation Pond→Trickle Filter→ Final Sedimentation Pond→ Contiguous Tank
	Sludge Treatment Flow	Sludge Condensation Tank→ Digestion Tank→ Sun-drying Bed
	Treatment target	No limitations
	Performance	BOD: 60mg/L or below, SS: 120mg/L or below
	Final treatment･ Disposal	Treated water can be recycled except for drinking. Treated water is reusable for irregation. Sludge is disposed of in landfill sites.
	Daily maintenance	Screen cleaning Check pumps and valves Measure water quality Keep daily operation log
	Special maintenance	Check the rotary sprinkler
Cost	Initial cost	Less costly than the standard activated sludge process.
	Service life	Civil engineering: 50 years, Machinery and Electricity: 15years
	Running cost	Less costly than standard activated sludge process
Misc.Drainage/ Rain water	Misc. Drainage	Treatable as part of sewage water.
	Rain water	IIn the case of a combined sewer system, the amount equivalent to that on a sunny day can be treated up to the secondary treatment, and the excess amount is discharged after the initial treatment.
	Others	<Facility Tour available at> Jonan Water Reclamation Center in Takasaki Yuzawa Water Quality Management Center in Shibukawa Monokikizawa Water Quality Management Center in Shibukawa etc.

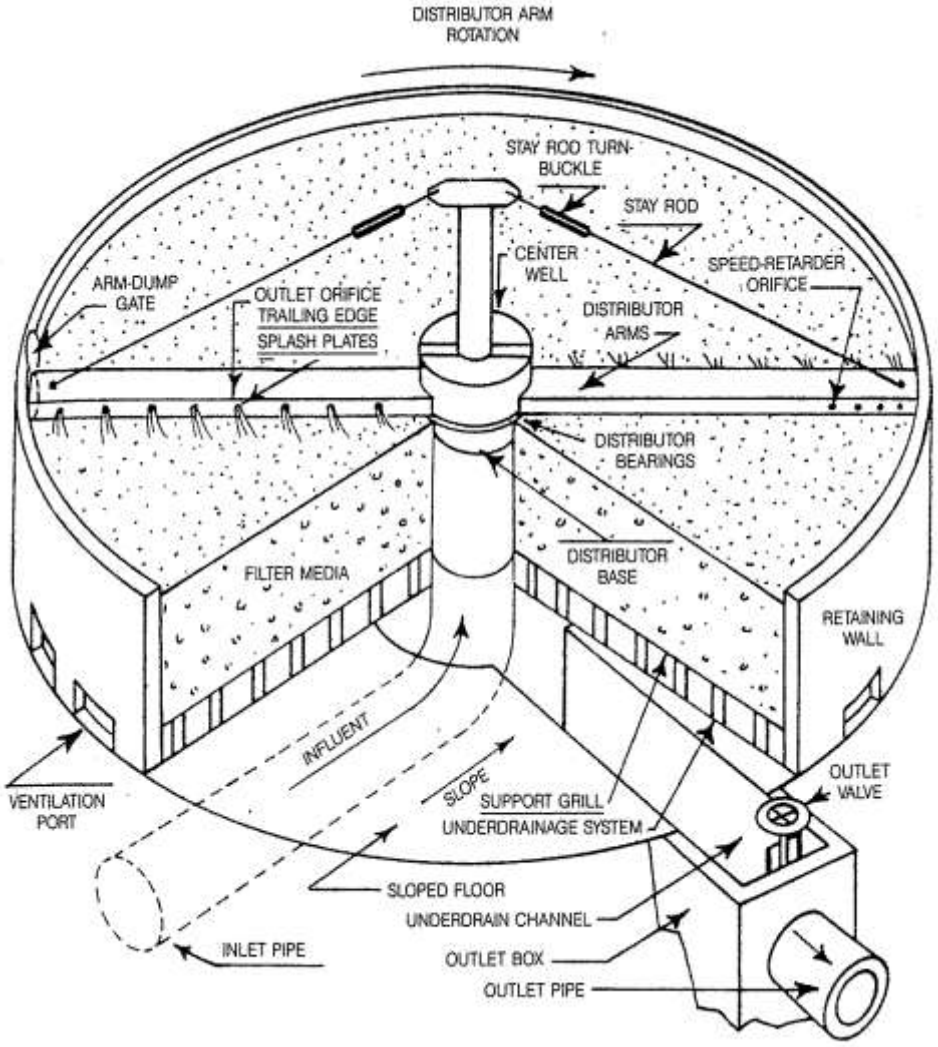
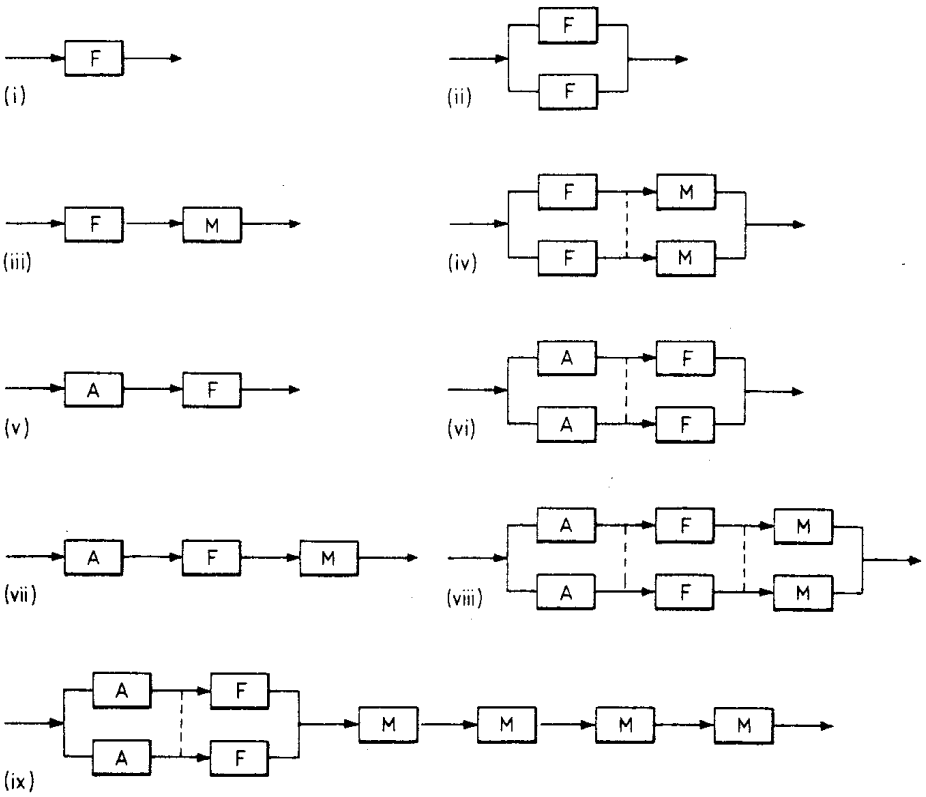


Figure T-2 Trickle Filter process

Source: "Operation of Municipal Wastewater Treatment Plants Volume II: Liquid Processes – Sixth Edition", Water Environmental Federation (WEF)

(4) Technical Name: Wastewater Stabilization Pond

	Items	Contents
Summary	Technical features	The easiest treatment method utilizing natural processes.
	Merits	Although it requires a large area, power is not needed when using natural processes.
	Example countries	There are no examples in Japan, but it is employed in many countries.
Appl	Water	Not required
	Electricity	Basically power is not required within treatment plants, but pumps are required in some cases for discharging.
	Suitable locations	Largest area is required among the treatment methods. In rapidly urbanized areas, it is preferred to arrange sites for construction well in advance because site procurement will become harder along with the surging land prices. Irregularly shaped sites can be modified by the shape of the ponds.
	Points to remember	Due to the odor, it is preferred that Anaerobic Ponds to be located 1000m away, and Facultative Ponds 500m away from the residential area.
Technical performance	Sewage Treatment Flow	There are various combinations of Anaerobic Ponds→ Facultative Ponds→ Maturation Ponds
	Sludge Treatment Flow	Daily sludge treatment is not necessary, but desludging is required once every 5 to 10 years.
	Treatment target	Not suitable for treating large amounts of sewage water because it requires bigger space.
	Performance	BOD removal rate: 94%, removal rate of fecal coliform bacterium: 99.95%
	Final treatment・ Disposal	Treated water can be recycled for irrigation. Sludge is concentrated, digested, sun-dried and disposed of as landfill.
	Daily maintenance	Remove floating substances and waterweeds; remove weeds on the edge of the pond.
	Special maintenance	----
Cost	Initial cost	Less costly compared to the standard activated sludge or high-rate trickle filter processes.(except for land expenses)
	Service life	50 years
	Running cost	Less costly compared to standard activated sludge high-rate trickle filter processes.
Misc.Drainage/ Rain water	Misc. Drainage	Treatable as part of sewer water.
	Rain water	Few examples of wastewater stabilization pond utilization for combined processes.
	Others	Cities where urbanization is not easily predictable, treatment methods can be changed according to the development situation. No examples in Japan.



A: Anaerobic Pond F: Facultative Pond M: Maturation Pond

Figure T-3 Combinations of Wastewater Stabilization Pond Process

Table T-1 Removal Rate per combination of Wastewater Stabilization Ponds

ons	BOD (%)			Bacteria		
	12ºC	20 ºC	25 ºC	12 ºC	20 ºC	25 ºC
Anaerobic Pond						
A	45	62	70	60	86	93
A + F	80	88	90	96	99.5	99.2
A + F + M	86	92	94	99	99.975	99.95
+ M + M	94	95	95+	99.95	99.9996	99.99999
Facultative Pond						
F	75	80	84	91	97	98
F + M	86	90	93	98.2	99.94	99.98
+ M	93	95	95+	99.9	99.998	99.99993

A: Anaerobic Pond (2 days) F: Facultative Pond (7 - 15 days) M: Maturation Pond (5 days after Facultative Pond)

Note) Ordinary household sewages

Source: J. P. Arthur, "(World Bank Technical Paper No. 7) Notes on the Design and Operation of Waste Stabilization Ponds in Warm Climates of Developing Countries", November 1983

Table T-2 Detention period & Site space required to achieve the water emission standard.

Combinations	Detention period (days)			Water	Square measure (ha)			Required
	12℃	20℃	25℃	Unit	12℃	20℃	25℃	(kw)
A + F + M	29.7	18.8	13	10	2.2	1.6	1.1	-
				25	5.5	4	2.6	-
				50	10.7	7.7	5.1	-
				100	20.9	15.1	10.1	-
				250	50.8	36.5	24.3	-
F + M	48.9	25.4	17.6	10	3.9	2	1.4	-
				25	9.5	4.9	3.5	-
				50	18.5	9.4	6.8	-
				100	36.4	18.5	13.3	-
				250	88.2	44.9	32.2	-
				10	2.6	1.8	1.3	25
				25	6.3	4.3	3.2	63

A: Anaerobic Pond F: Facultative Pond M: Maturation Pond

Water emission standard: BOD_5 25mg/l, Coliform Bacteria Count 5,000/100ml

Assumed conditions:

Water consumption volume	130 lpcd
Sewage conversion ratio	80 %
Daily BOD loading amount per person	40 gpcd
Water depth	A (4.0 m), F (1.8 m), M (1.5 m)
Detention period	M (5 days)
Coliform Bacteria in sewage water	2×10^7/100 ml

Source: J. P. Arthur, "(World Bank Technical Paper No. 7)
Notes on the Design and Operation of Waste Stabilization Ponds
in Warm Climates of Developing Countries", November 1983

(5) Technical Name: Untreated Discharge

	Items	Contents
Summary	Technical features	Apply sedimentary sand, screening or precipitation treatment of sewage water before discharging into the ocean.
	Merits	Except for implementing precipitation treatment, sewage/sludge treatments are not required.
	Example	The Philippines(Manila) No examples in Japan.
Applicable conditions	Water	Not required
	Electricity	Power is used for precipitation treatment or pumping.
	Suitable locations	Places facing the open sea without public beaches.
	Points to remember	It is necessary to check the diffusion and effect by implementing marine contamination analysis based on the tidal current investigation. Sea outfall is prohibited in the Mediterranean Sea.
Technical performance	Sewage Treatment Flow	Screen→ (Sedimentation Pond)→(Pumping)
	Sludge Treatment Flow	----
	Treatment target	No limitations
	Performance	Same as crude sewage without precipitation treatment.
	Final treatment・ Disposal	----
	Daily maintenance	Screen cleaning. Check the equipment.
	Special maintenance	A diver must be used to inspect the sea outfall pipes.
Cost	Initial cost	----
	Service life	----
	Running cost	----
Misc.Drainage/ Rain water	Misc. Drainage	Treatable as part of sewage water.
	Rain water	Few examples of direct discharge among combined systems.
	Others	----

(6) Technical Name: Sewage Treatment Tank

	Items	Contents
Summary	Technical features	Treating drainage water from houses, apartment complexes, housing complexes or commercial facilities within the site. Performance can be arranged based on the drainage standards. Planning through operation can be achieved within a short period of time.
	Merits	Planning through operation can be achieved within a short period of time. Sewer culvert works are mitigated, leading to a reduction of construction cost. Damage from earthquakes can be minimized.
	Example countries	Indonesia, Romania, South Korea, China, Australia etc. (Applicable to the regions in the West where Septic Tank + Ground Treatment)
Applicable conditions	Water	Required
	Electricity	Basically required but can be substituted by installing a natural depuration system.
	Suitable locations	----
	Points to remember	A consistent system from cultivating human resources for designing, construction, maintenance and sludge treatment that are appropriate to each building usage.
Technical performance	Night soil treatment flow	Drainage water ⇒ Initial treatment ⇒ Secondary treatment ⇒ Tertiary treatment ⇒ Sterilization⇒ Discharge (Advanced treatments can be set in if necessary)
	Treatment target	Depending on the equipment scale.
	Performance	General Value(ordinary treatment) e.g. BOD :(90,60,30),20,15,10,5mg/L or below, COD :30,20,10 mg/L or below , T-N::20,15,10 or below , T-P :1,0.5 mg/L or below
	Final treatment･ Disposal	Treatment and disposal of excessive sludge are required.
	Daily maintenance	Contact a special maintenance provider in case of abnormal noise, vibration or odor.
	Special maintenance	Periodical maintenance(individual residences: once every 4 months, middle/large sized buildings: once every 1 to 2 weeks), Cleaning(desludging), legal inspection (once a year)
Cost	Initial cost	Vary from individual residences to middle/large-sized buildings. (See TECHNOLOGIES on WEPA's website)
	Service life	Building frames: FRP(Fiber Reinforced Plastic),DCPD(Decyclo Pentadiene)will last over 30 years
	Running cost	Same as the initial cost.
Misc.Drainage/ Rain water	Misc. Drainage	In general, night-soil and other misc. drainage are treated altogether. Night-soil can be treated alone (Misc. drainage water is discharged without treatment)
	Rain water	Rainwater is drained into a separate line. Hazardous substances are treated separately.
	Others	Exporting sewage treatment tanks manufactured in a factory involves enormous costs. Local production or cast-in-place constructions are necessary. <Contact for Facility Tour> Japan Education Center of Environmental Sanitation(Sumida Ward, Tokyo) http://www.jeces.or.jp/

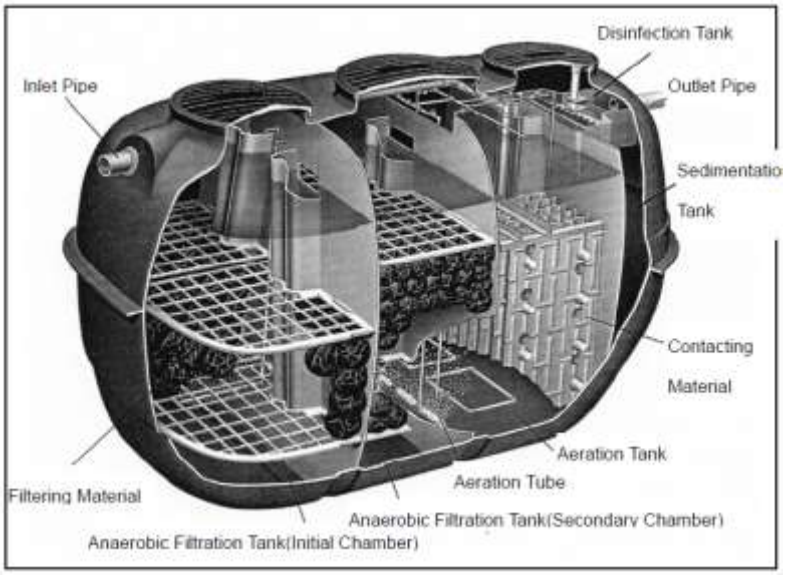


Figure T-4 Section view of Anaerobic Filter-bed Aeration

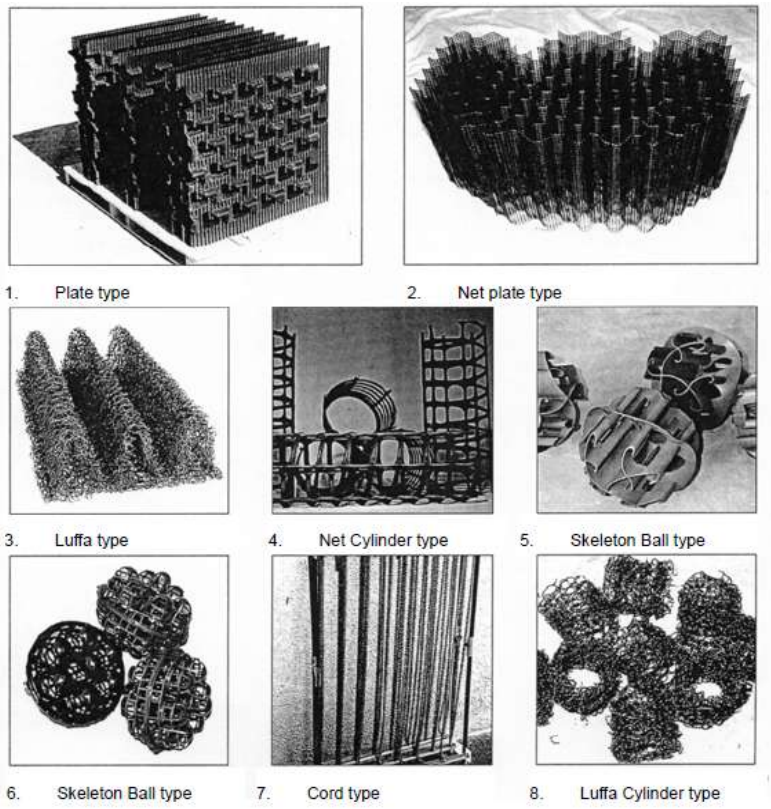


Figure T-5 Product samples of contacting or filtering materials

(7) Technical Name: Compost

	Items	Contents
Summary	Technical features	Mixing and agitating night-soil with cedar chips or sawdust to treat and reduce the amount through evaporation and aerobic fermentation.
	Merits	Water is not required for toilet/night-soil treatment. It can be introduced at a low cost by operating manually instead of using mechanical agitation.
	Example countries	Japan
Applicable conditions	Water	Not required
	Electricity	Required for mixing and agitating but it can be substituted by manual operation.
	Suitable locations	Equipment for dehydration is required in humid regions.
	Points to remember	Do not use chemicals for cleaning.
Technical performance	Night soil treatment flow	Toilet→ Compost Tank→ Evaporation・Residues
	Treatment target	Approx. 50 times/day(depending on the equipment scale)
	Performance	General Value(ordinary treatment); Design Value BOD around 10mg/L
	Final treatment・Disposal	Treated /disposed as Soil Conditioner or Industrial Waste.
	Daily maintenance	Screen cleaning. Check pumps and valves / Measure water quality of Sedimentation Pond Keep daily operation log
	Special maintenance	Equipment inspection. Change compost materials.
Cost	Initial cost	Equipment 3,200,000 JPY(spec: 50times/day)(Japan)
	Service life	–
	Running cost	Japan(approx. 100,000JPY/year)
Misc.Drainage/ Rain water	Misc. Drainage	Non treatable
	Rain water	Rainwater cannot be treated with this technology. Some measures must be taken to prevent rainwater from flowing into the equipment.
	Others	<Sample facilities (Tokyo metropolitan regions) > Shimin Kenko no Mori (Citizen's Forest for Health) in Aso Ward, Kawasaki Akiruno-shi Water Purification Plant, Tokyo Koiwa Shobu-en in Edogawa Ward, Tokyo Okinoshima Park in Tateyama, Chiba

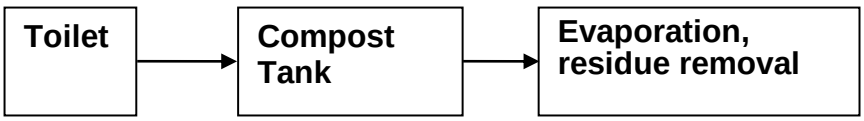


Figure T-6 Treatment flow

Figure T-7 Toilet appearance

Figure T-8 Inside

Figure T-9 Compost Tank

(8) Technical Name: Latrine for Night-soil Separation

	Items	Contents
Summary	Technical features	Separating night-soil for recycling. Setting 2 pits with openings in the ground in parallel, and install toilet bowls on them. Use the pits alternately at an interval of approx. 6 months. Urine is separated for removal to be used as liquid fertilizer. When the pit is full, promote composting within the tank.
	Merits	There is no need for concern about groundwater contamination. Less odor and fly
	Example countries	More examples in Asian countries such as North Vietnam.
Applicable conditions	Water	Not required
	Electricity	Not required
	Suitable locations	Places with environments for fermentation and dehydration.
	Points to remember	The idea of turning night-soil into compost must be accepted. Provide thorough instruction on generation and utilization methods of liquid fertilizer or compost. In regions where people have the custom of washing their buttocks with water after defecation, the water must be prevented from entering the pit. In regions with the custom of wiping with paper, the paper used for wiping must be collected and treated separately. It is hard to ensure the utilization method. Management of compost generation is required.
Technical performance	Night-soil Treatment Flow	(1) Toilet Bowl→ (2) Pit→ (3)Composting Adjust the water (dehydration) by throwing ashes into the pit after defecation. It is effective to promote dehydration with the solar heat. Use one of the tanks for around 6 months, and when it's full, cover it with ashes until bacteria compost it(around 6 months)
	Treatment target	Depending on the tank capacity.
	Performance	Susceptible to climate conditions.
	Final treatment･ Disposal	Urine is utilized for liquid fertilizer. Solid waste is utilized for compost or soil conditioner after implementing degradation treatment for around 6 months.
	Daily maintenance	Save ashes to throw in the pit. In the case of a toilet bowl or hole being prepared for each pit, be sure to seal the filled up one to keep them from being used.
	Special maintenance	Check the progress of composting.
Cost	Initial cost	Reasonable
	Service life	-
	Running cost	Reasonable
Misc. Drainage/ Rain water	Misc. Drainage	Non treatable
	Rain water	-
	Others	No examples in Japan

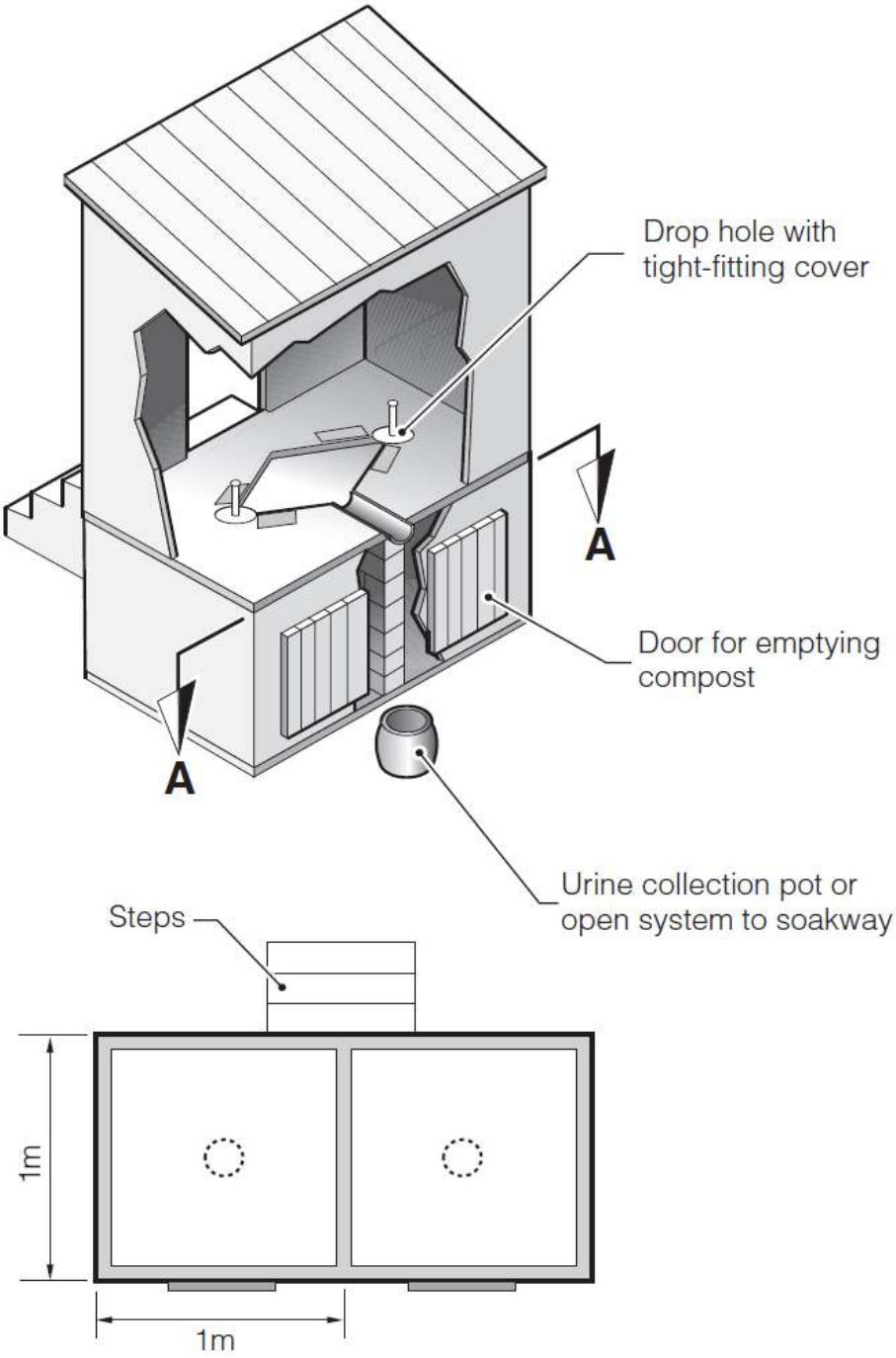


Figure T-10 Example of Latrine for Night-soil Separation

Source: Excreta disposal in emergencies/Loughborough University

(9) Technical Name: Ground Treatment

	Items	Contents
Summary	Technical features	After treatment in an Anaerobic Digester Tank, the treated water passes through the spray tube buried underground so that it is soaked in the ground and treated by microbes.
	Merits	Due to its simple structure, it is hard to break and the maintenance is comparatively easy. It can be utilized in regions without electricity by using foot pumps.
	Example countries	Japan
Applicable conditions	Water	Required(Approx. 250cc of cleaning water per use)
	Electricity	Required for operating electric pumps.(Not required when using a foot pump)
	Suitable locations	Places where the ground is suitable for night-soil treatment and space for installing ground treatment equipment is available. Not suitable to regions with heavy rainfall. There is also a concern that the equipment may become unserviceable due to snow or freezing.
	Points to remember	Measures must be taken to prevent sewage water or sludge from leaking out of the system. Soil replacement or desludging is required in the long run.
Technical performance	Night-soil Treatment Flow	Toilet→ Anaerobic Treatment→ Spray Tube→ Cleaning Water Recycling
	Treatment target	Approx. 160times /day (depending on the facility scale)
	Performance	General Value(ordinary treatment); Design Value BOD around 10mg/L
	Final treatment･ Disposal	Sludge (Night-soil Treatment Facilities)
	Daily maintenance	Checking tube blockage or maintenance does not require advanced skills.
	Special maintenance	Check the operation conditions.
Cost	Initial cost	Equipment 4,210,000JPY (spec: approx. 160 times/day)
	Service life	-
	Running cost	Japan (approx. 20,000JPY/year)
Misc.Drainage/ Rain water	Misc. Drainage	Although it depends on the drain load, it is basically non-treatable.
	Rain water	Because rainwater cannot be treated with this method, measures must be taken to prevent large amounts of rainwater from entering the soil treatment equipments.
	Others	<Contact for Facility Tour> Reinforce Co., Ltd.(Kamakura-shi, Kanagawa) http://www.reinforce.co.jp/

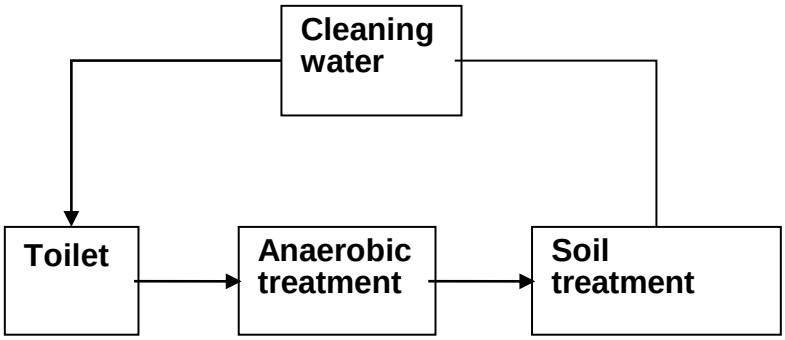


Figure T-11 Treatment Flow

Figure T-12 Ground Treatment Tank

Figure T-13 Ground Treatment Tank

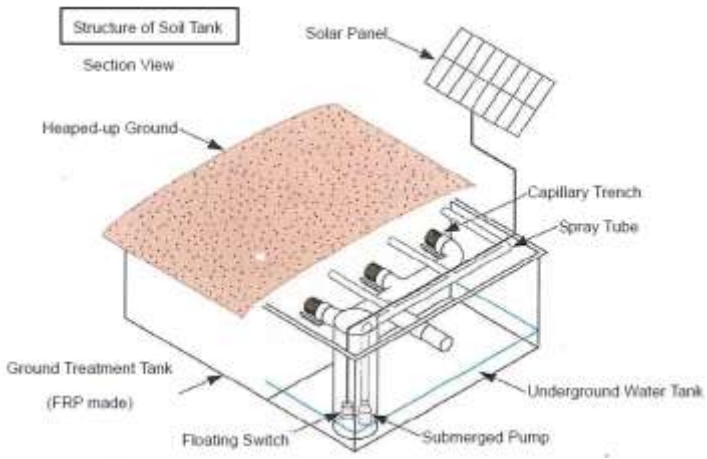


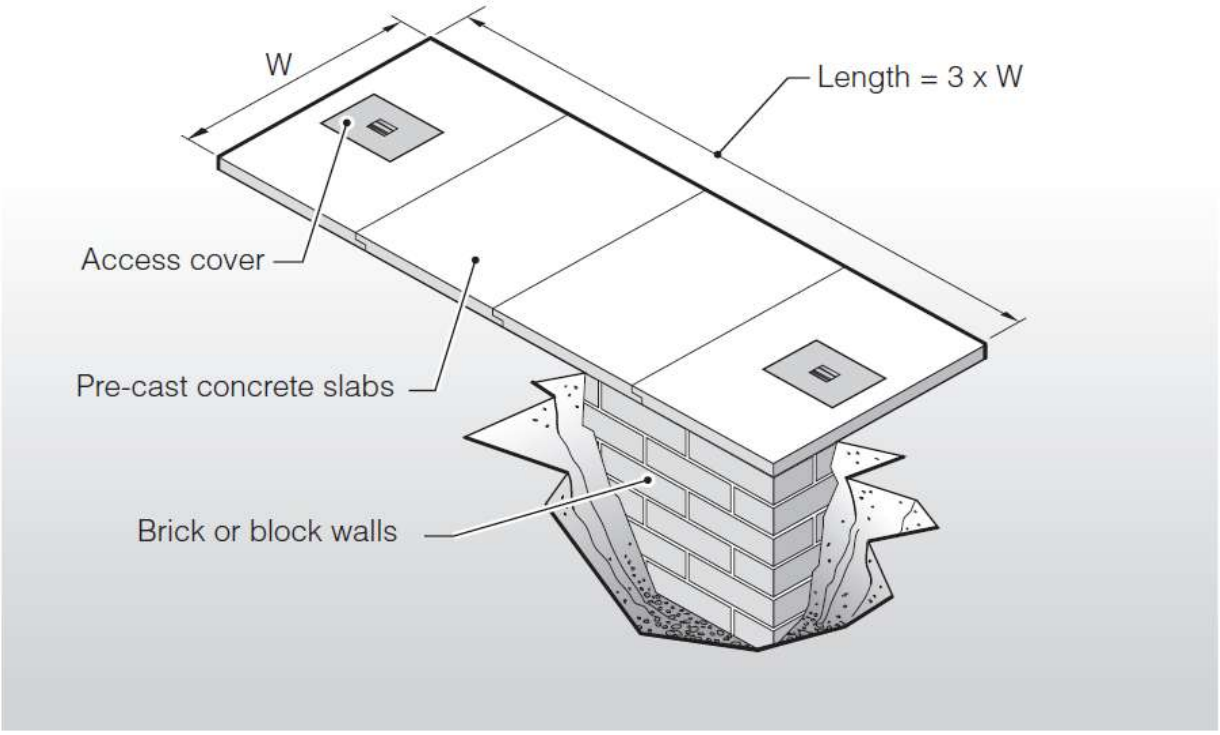
Figure T-14 Ground Tank

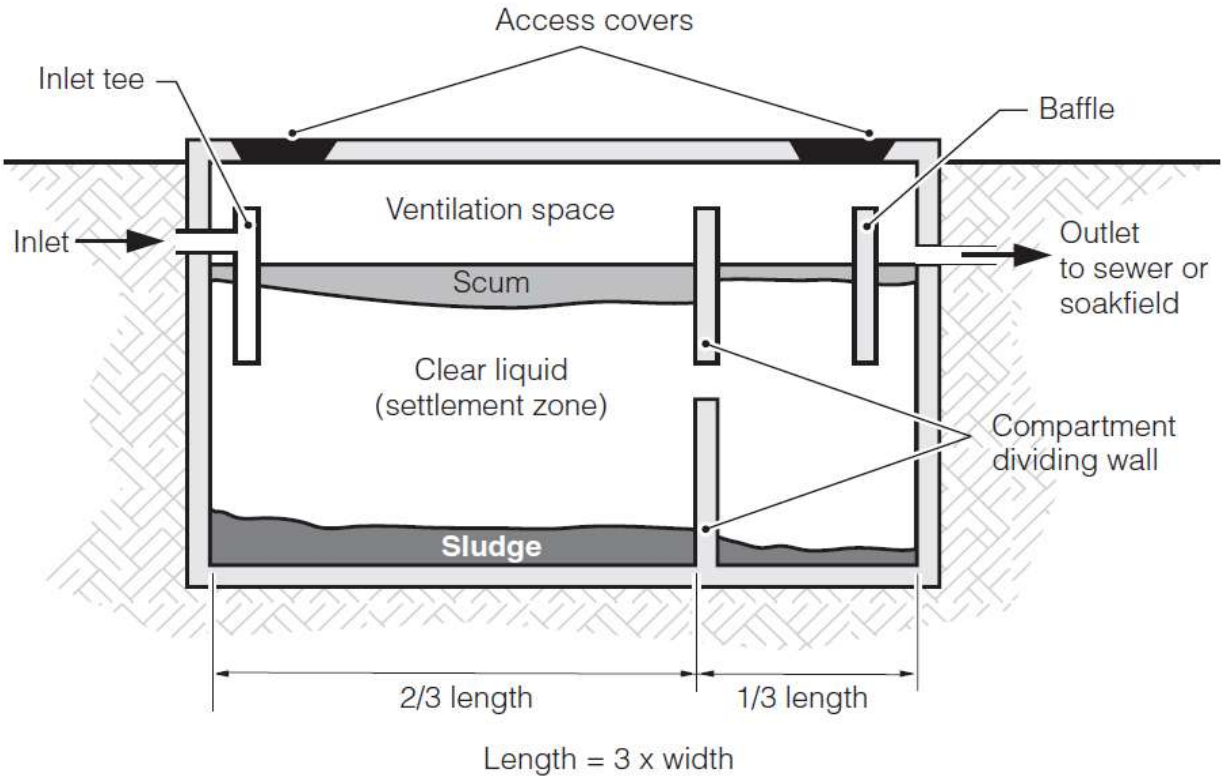
(10) Technical Name: Septic Tank(Decomposing Tank)

	Items	Contents
Summary	Technical features	Night-soil flushed with cleaning water is treated for a period of 1 to 3 days in a tank buried underground. Treated water is discharged or allowed to seep underground. The main purpose is to remove solid substances by precipitation. Therefore, sludge will accumulate at the bottom of the tank. Oil contents float to the surface to create scum. Sludge and scum must be removed accordingly. Quality of the treated water is bad due to anaerobic treatment. It is not safe from a microbiological viewpoint.
	Merits	Flush toilets create a comparatively cozy space. Generation of odor or flies can be suppressed though it is influenced by maintenance conditions. Misc. Drainage can be treated simultaneously.
	Example countries	Developing countries in general
Applicable conditions	Water	Water sufficient to flush excretory substances into the decomposing tank is necessary.
	Electricity	Not required
	Suitable locations	Places where treated water can be discharged or seep underground. It must be placed at least 30m away from water well sources.
	Points to remember	It should not be used widely without sanitary considerations, because it can lead to contamination of surrounding waters unless managed adequately.
Technical performance	Night-soil Treatment Flow	Toilet bowl→ Decomposing tank(Removing solid substances)→ Discharge or Underground seepage
	Treatment target	Depending on the equipment scale
	Performance	―
	Final treatment・Disposal	Removal and disposal of sludge and scum are necessary.
	Daily maintenance	―
	Special maintenance	・Removal and disposal of sludge and scum are necessary.(Sludge and scum must be removed when sludge accumulates to 1/2 to 1/3 of the effective water depth between the liquid surface and the bottom) A vacuum truck is preferred for sludge removal. However, it must be done manually in case vacuum trucks are not available. In that case, special attention must be paid for diseases resulting from excrement. Sludge should not be totally washed off nor disinfected. Digestion by anaerobic bacteria will continue by leaving a small amount of sludge in the tank.
Cost	Initial cost	Africa (approx. 12,700JPY/person) Asia (approx. 11,400 JPY/person) Latin America・Caribbean countries (approx. 17,600 JPY/person)
	Service life	Depending on septic tank materials.
	Running cost	Water bill, removal fee of sludge and scum.
Misc.Drainage/ Rain water	Misc. Drainage	Treatable but water contamination due to increased water discharge will be a concern.
	Rain water	Non-treatable
	Others	No examples in Japan

Figure T-15 Septic Tank

Source：Excreta disposal in emergencies / Loughborough University





(11) Technical Name: Pit Latrine

	Items	Contents
Summary	Technical features	Penetrating fluid in urine through the walls or bottom of the pit to the ground. Residual sludge is accumulated in the tank. Solid substances will be reduced by anaerobic digestion.
	Merits	It can be used for a long time and is hard to break. The equipment can be installed at a comparatively low cost. Periodical cleaning of the upper buildings and slabs as well as ventilation is needed to minimize odor creation. The number of flies can be reduced by covering the opening of the ventilation pipe with a net and making the upper building dark. It is easy to understand how to use.
	Example countries	Developing countries in general
Applicable conditions	Water	Not required (except for Flush Latrine)
	Electricity	Not required
	Suitable locations	Places where the ground can be dug with low groundwater level in regions free from flooding. In the case of utilizing Pour flush toilets, water for flushing must be ensured.
	Points to remember	Mosquito emergence is unavoidable. Rain water may flow in and cause the toilets to overflow. Underground water may be contaminated. When a pit becomes full, a new toilet needs to be facilitated. It must be located more than 18m away from any water source.
Technical performance	Night-soil Treatment Flow	Toilet bowl→ Pit→ Fluid goes to the soak field. Solid substances are accumulated.
	Treatment	Depending on the equipment scale
	Performance	―
	Final treatment・ Disposal	When a pit becomes full, cover up with soil and leave for around 2 years. To use the same tank continuously, sludge must be removed. This is not the original usage.
	Daily maintenance	If the upper structure has a door, keep it closed to improve airflow, as well as make it dark to prevent fly emergence. Opening for air inlet must not be closed. Check the anti-fly net set to the upper end of the ventilation pipe. Remove cobwebs in the ventilation pipe.
	Special maintenance	Trap management(Pour flush latrine) Removal and disposal of the sludge as required.
Cost	Initial cost	Pit latrine (approx. 4,300JPY/person)(Countries in Africa) Pit latrine with improved ventilation(approx. 6,300 JPY/person) (Countries in Africa) Pour flush latrine (approx. 10,000JPY/person) (Countries in Africa)
	Service life	(Around 2 years)
	Running cost	―
	(cost per person(JPY))	―
Misc.Drainage/ Rain water	Misc. Drainage	Non-treatable
	Rain water	―
	Others	No examples in Japan

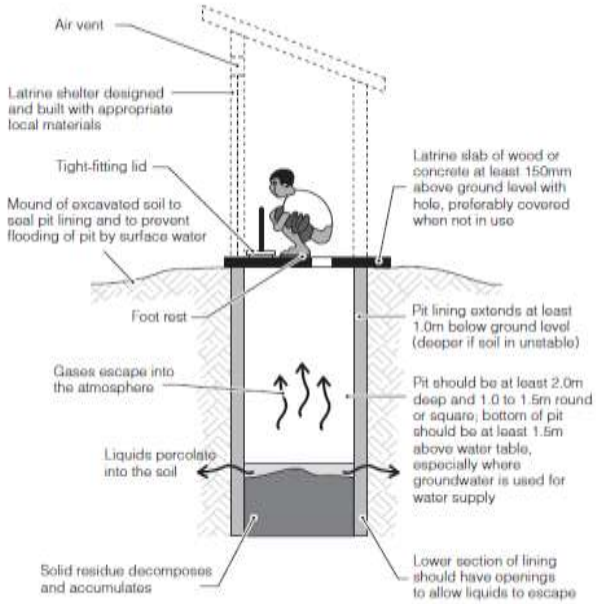


Figure T-16 Pit Latrine

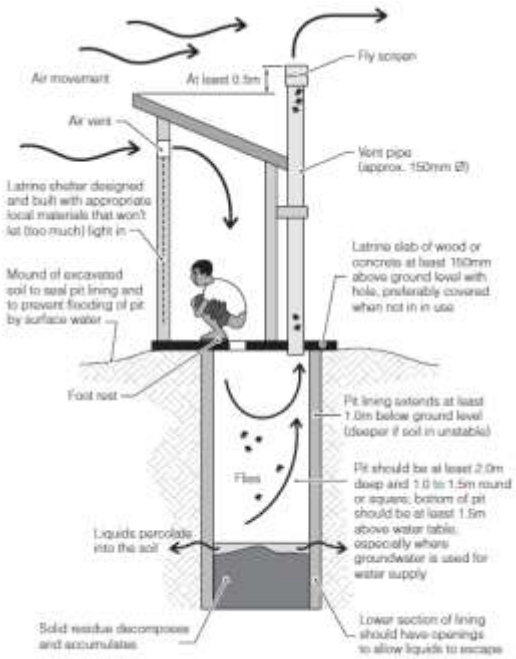


Figure T-17 Pit Latrine with Improved Ventilation

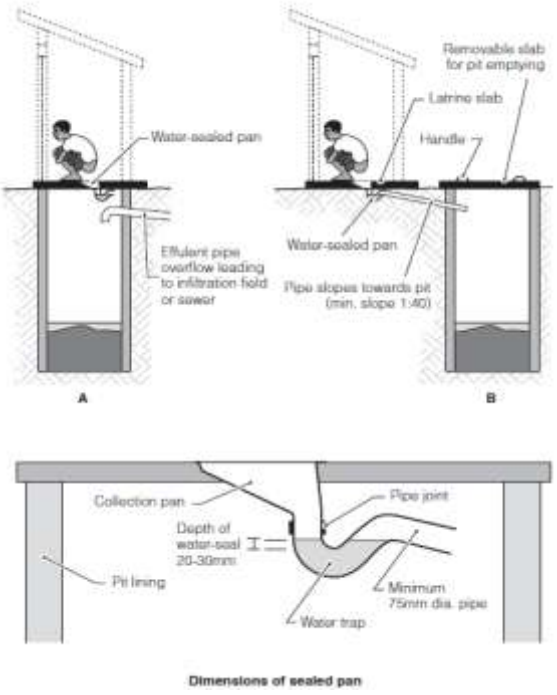


Figure T-18 Pour Flush Latrine

Source：Excreta disposal in emergencies / Loughborough University

(12) Technical Name: Vault Toilet

	Items	Contents
Summary	Technical features	Consisting of toilet bowl, piping, pit and ventilation device. Stored night-soil must be removed periodically. Tank capacity is for 2 to 3 months. Flush down system using a small amount of water (Simplified Flush Toilet) is available.
	Merits	Because night-soil is not mixed with water, it can be pooled effectively.
	Example countries	Japan, China, South Korea
Applicable conditions	Water	Not required
	Electricity	Not required
	Suitable locations	In regions where a sewage system is not established. Collection･Treatment systems must be established.
	Points to remember	Measures to prevent odor and unsanitary insects must be taken.
Technical performance	Night-soil Treatment Flow	Toilet bowl→ Dropping down by gravity→ Storage→ Collection
	Treatment target	―
	Performance	―
	Final treatment･ Disposal	Night-soil Treatment Facilities, Sewage System
	Daily maintenance	―
	Special maintenance	Regular vacuuming
Cost	Initial cost	Depending on the material of the pit.
	Service life	―
	Running cost	Vacuuming costs
Misc.Drainage/ Rain water	Misc. Drainage	Non-treatable
	Rain water	Consider the ground level
	Others	

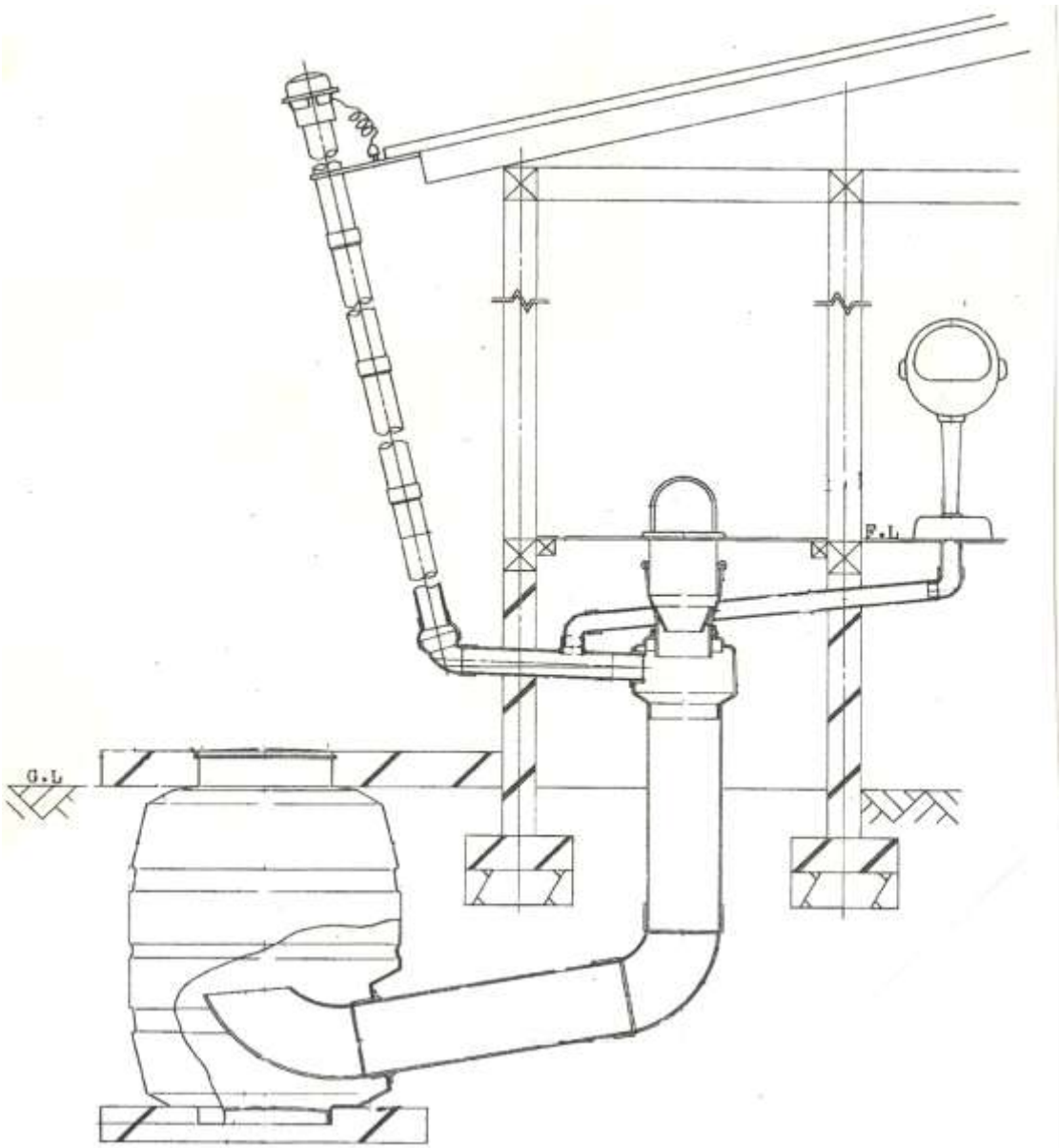


Figure T-19 Schematic View of Vault Toilet

(13) Technical Name: Night Soil Collection Equipment (Vacuum Pumping Truck)

	Items	Contents
Summary	Technical features	Vehicles with tank and vacuum equipment for collection and transportation of night-soil. Reduce the pressure inside the tank with a vacuum pump so that the night-soil is directly aspirated into the tank through a hose using the pressure difference. There is a vacuum dumper type that has greater suction. Discharging is accomplished by opening the hatch.
	Merits	Efficient removal･transportation
	Example countries	Japan, China, South Korea, Indonesia, Vietnam
Applicable conditions	Water	―
	Electricity	―
	Suitable locations	Vehicle maintenance system must be established.
	Points to remember	―
Technical performance	Night-soil Treatment Flow	Pit→ Vacuum Equipment→ Storage Tank→ Transportation
	Treatment target	Tank Capacity: 1.8－10m3, Vacuum Power: 700mmHg
	Performance	―
	Final treatment･ Disposal	Night-soil Treatment Facilities
	Daily maintenance	Clean the inside of the tank and replace the e ngine oil.
	Special maintenance	Maintenance of the vacuuming equipment.
Cost	Initial cost	4 ton truck: approx. 7million JPY
	Service life	Around 7 years.
	Running cost	―
Misc.Drainage/ Rain water	Misc. Drainage	―
	Rain water	―
	Others	―

Figure T-20 Vacuum Truck

Figure T-21 Vacuum Dumper Truck

(14) Technical Name: Night-soil Treatment Facilities
((i)Anaerobic digestion system, (ii)Aerobic digestion system, (iii)Standard denitrification system)

	Items	Contents
Summary	Technical features	Facilities where night-soil and sludge stored in pits or individual wastewater treatment units are collected and treated altogether. ((i)Take out biogas using anaerobic microbes and utilize it for heating the digestion tank. (ii)Decompose organic substances using aerobic microbes. (iii)Facilities where night-soil and sludge stored in pits or individual wastewater treatment units are collected and treated altogether. Nitrogen is removed using nitrification bacteria and denitrifying bacteria.)
	Merits	Efficient treatment of highly concentrated liquid waste is available. Effective utilization of Biogas.
	Example countries	Japan
Applicable conditions	Water	Water of 10 to 20 times is required for dilution.
	Electricity	40 to 60kWh/m3
	Suitable locations	Collection system must be established. Water volume of 10 to 20 times of waste is required for dilution. ((i)Anaerobic Digestion: Regions with high temperature)
	Points to remember	Plant Installation space and advanced maintenance technique will be required.
Technical performance	Night-soil Treatment Flow	Acceptance→ Pre-treatment→((i)Anaerobic digestion (ii)Aerobic digestion (iii)Bio denitrification treatment)→Secondary treatment→ Discharge(Excess sludge: Concentration→ Dehydration→(Drying))
	Treatment target	―
	Performance	General Value (ordinary treatment); Treated water quality: BOD20mg/L or below, SS70mg/L (in case activated sludge treatment is executed as Secondary Treatment.) ((iii)Standard Denitrification System: T-N60mg/L or below)
	Final treatment･ Disposal	Sludge: Composting, Incineration
	Daily maintenance	Resident operation management(Device control, Data management, water quality management etc.)
	Special maintenance	Regular inspection of the equipment.
Cost	Initial cost	1 to 2 billion JPY for those with a scale of 100m3/day (e.g. : Japan)
	Service life	Civil Engineering: 30 years, Machinery and Electricity: 10 years
	Running cost	37 to 73 million JPY for those with a scale of 100m3/day(e.g.: Japan)
Misc.Drainage/ Rain water	Misc. Drainage	Non-treatable
	Rain water	Consider the ground level.

	Others	Requiring high running cost ((ii)Reasonable compared to anaerobic system) <Examples in Japan> <Standard Denitrification System> ・Ashikaga City Tobu Clean Center, Tochigi prefecture, 175 kiloliter/day, Date of completion: March, 1993 80 Yamakawa-cho Ashikaga-shi 0284-41-5740 ・Ota City Second Clean Center, Gunma prefecture, 120 kiloliter/day, Date of completion: March, 1995 (1296-1 Takabayashi Higashi-cho, Ota-shi 0276-38-0420) ・Washimiya Eisei Kumiai Night-soil Treatment Plant, Kurihashi, Saitama prefecture, 53 kiloliter/day, Date of completion: March, 1995 (2525 Happo Oaza Washimiya-cho, Kita Katsushika-gun, 0480-58-1309) ・Kisai-cho Clean Center, Night-soil Treatment Plant 75kiloliter/day, Date of completion: March, 1991 (1790 Oaza Mouchi, Kazo-shi Saitama pref. 0480-61-3671) ・Chiba City Clean Center 173kiloliter/day, Date of completion: August, 1995 (893 Murata-cho Chuo-ku Chiba-shi, 043-261-2256) ・Futtsu City Clean Center 68kiloliter/day, Date of completion: March, 1997 (12-1 Shintomi Futtsu City, 0439-88-1350) ＜Others＞ ST(Septic Tank) Sludge adaptive High-load Filtration System ・Kumagaya City Night-soil Treatment System 42 Kiloliter/day, Year of completion: 2005 ・Hanyu City Night-soil Treatment Plant 60 kiloliter/ day, Year of completion: 2005 High load Treatment System ・Futtsu City Clean Center 35 kiloliter/day, Year of completion: 2005

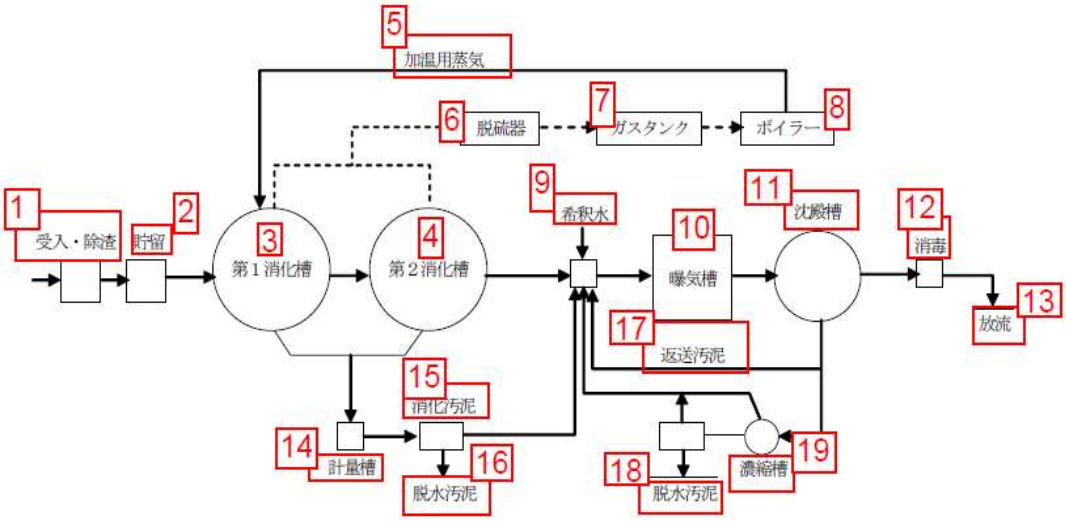


Figure T-22 Anaerobic Digestion Treatment System

1	Inlet ・Residue Removal	11	Sedimentation Tank
2	Storage	12	Disinfection Tank
3	Initial Digestion Tank	13	Discharge
4	Secondary Digestion Tank	14	Measuring Tank
5	Steam for heating	15	Digested sludge
6	Desulfurizer	16	Dehydrated Sludge
7	Gas tank	17	Returned Sludge
8	Boiler	18	Dehydrated Sludge
9	Dilution Water	19	Concentration Tank
10	Aeration Tank		

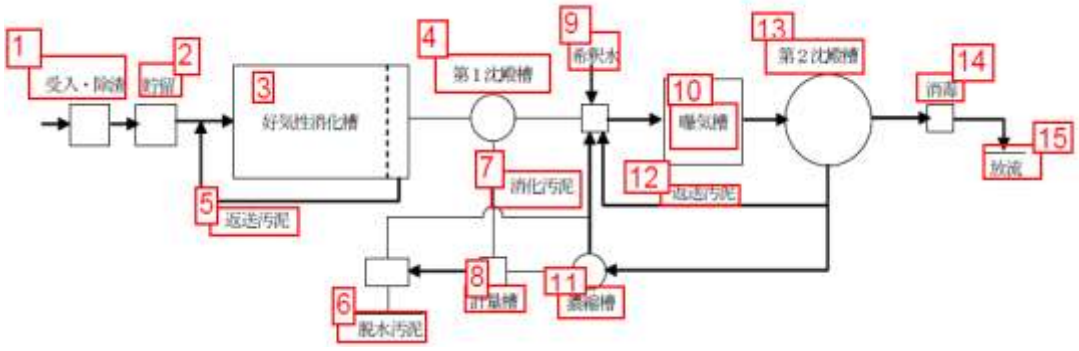


Figure T-23 Aerobic Digestion Treatment

1	Inlet ・Residue Removal	9	Dilution Water
2	Storage	10	Aeration Tank
3	Aerobic digestion tank	11	Concentration Tank
4	Initial Sedimentation Tank	12	Returned Sludge
5	Returned Sludge	13	Secondary Sedimentation Tank
6	Dehydrated Sludge	14	Disinfection Tank
7	Digested Sludge	15	Discharge
8	Measuring Tank		

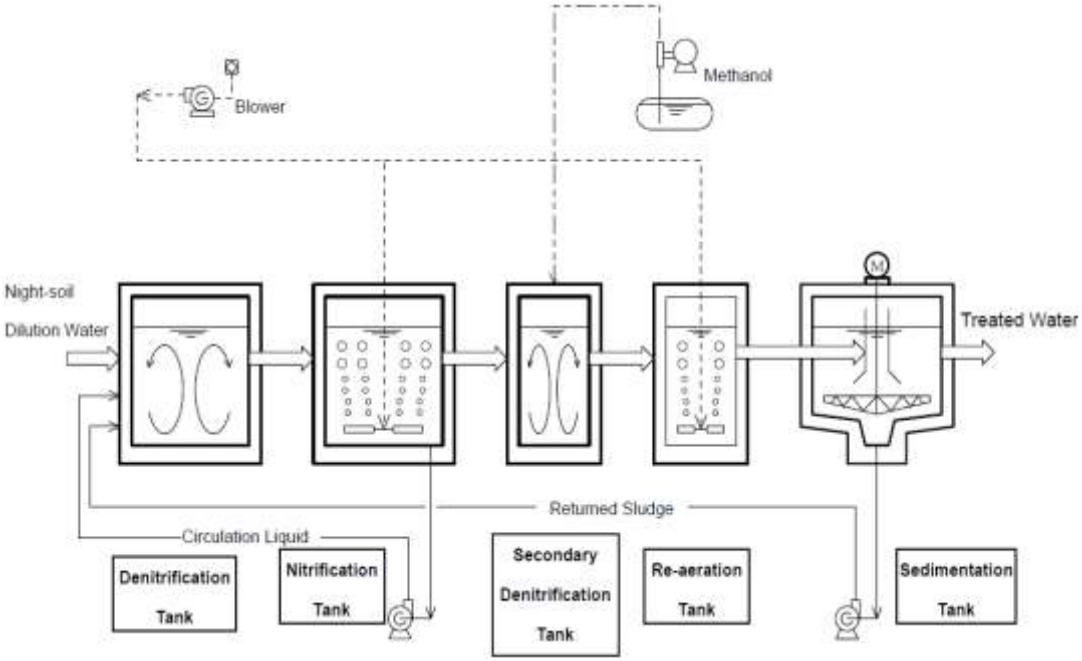


Figure T-24 Standard Denitrification Treatment System