Treatment and Use of Rural Domestic Wastewater — A Pictorial Handbook

China Agricultural Press

PICTORIAL HANDBOOKS FOR IMPROVING
THE RURAL LIVING ENVIRONMENT

农业农村部规划设计研究院
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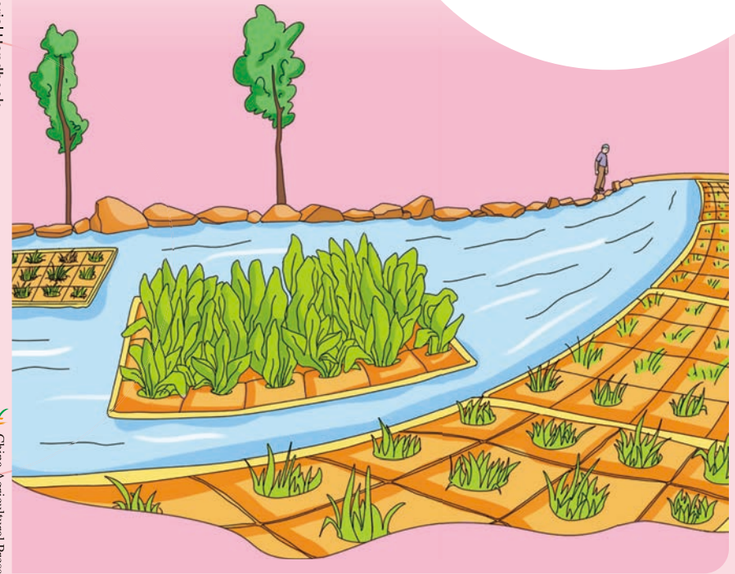

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Treatment and Use of Rural Domestic Wastewater

— A Pictorial Handbook

China Agriculture Press
Beijing

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Foreword

The discharge of rural domestic wastewater in China is about 8 billion tonnes every year. The wastewater contains a considerable amount of organic matter, nitrogen, phosphorus, potassium and pathogens. Most rural areas lack full-featured wastewater collection and treatment facilities. It is common to see wastewater randomly discharged into ditches, rivers and lakes or directly poured on land near households. These practices pollute surface water and groundwater and dangerously affect the health of people.

Rural domestic wastewater treatment is an important part of protecting the rural living environment and is critical to the aims of rural revitalization strategies. In recent years, relevant departments in various regions have responded to the requirements of the central Government and actively promoted the treatment of rural domestic wastewater, achieving positive results. And yet, the treatment of rural household wastewater remains a major shortcoming for improving the rural living environment. To inform and encourage households and local governments of their options for rural domestic wastewater treatment and use, the Academy of Agricultural Planning and Engineering, under the Ministry of Agriculture and Rural Affairs, compiled this *"Treatment and Use of Rural Domestic Wastewater—A Pictorial Handbook"*.

With concise content and comprehensive knowledge presented in a question-and-answer format, this book introduces the characteristics, collection methods, treatment and utilization methods of rural domestic wastewater in detail with pictures and easy-to-understand explanations. It is hoped that the handbook can be taken for reference in technical mode selection and engineering construction for treatment and utilization of rural domestic wastewater.

Feedback on the content of the handbook is welcome.

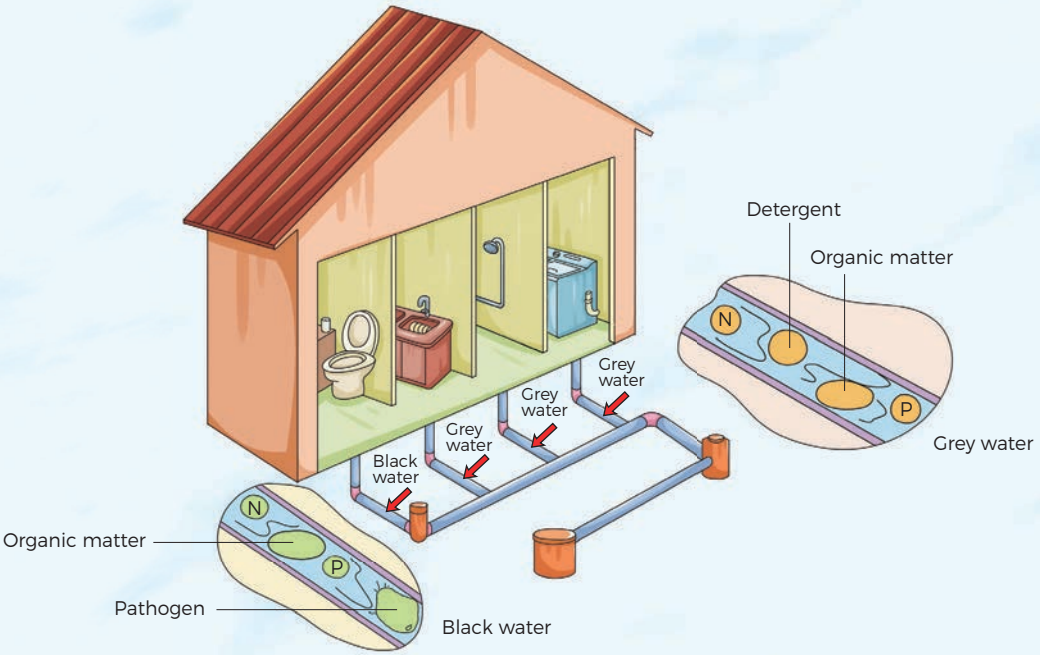
Authors
December 2021

Contents

1
Current situation of rural domestic wastewater treatment in China

1.1 What are the sources of rural domestic wastewater?

There are two main sources of rural domestic wastewater: One is black water that consists of faeces from latrines and accounts for about 30 per cent of the total volume of domestic wastewater. It contains much nitrogen, phosphorus and organic matter. The other is grey water that mainly consists of wastewater produced by rural residents during bathing, washing and cooking, and accounts for about 70 per cent of the total volume of domestic wastewater. Grey water is high in volume and low in organic matter content.



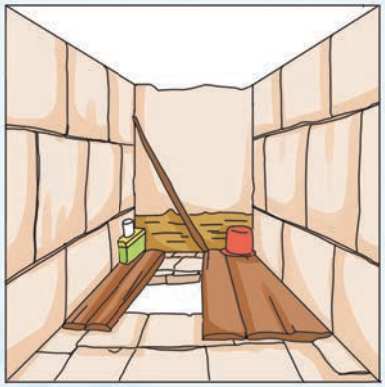
1.2 How much wastewater does the average person produce in rural areas?

Volume of household wastewater in China, per rural resident per day (litres)

Village characteristics	Southern region	Northern region
Good economic condition, households have complete indoor sanitary facility and bathroom	54–150	45–87
Average economic condition, households rely on a sanitary facility	24–72	18–54
No running water, no sanitary bathroom or toilet	12–42	12–24

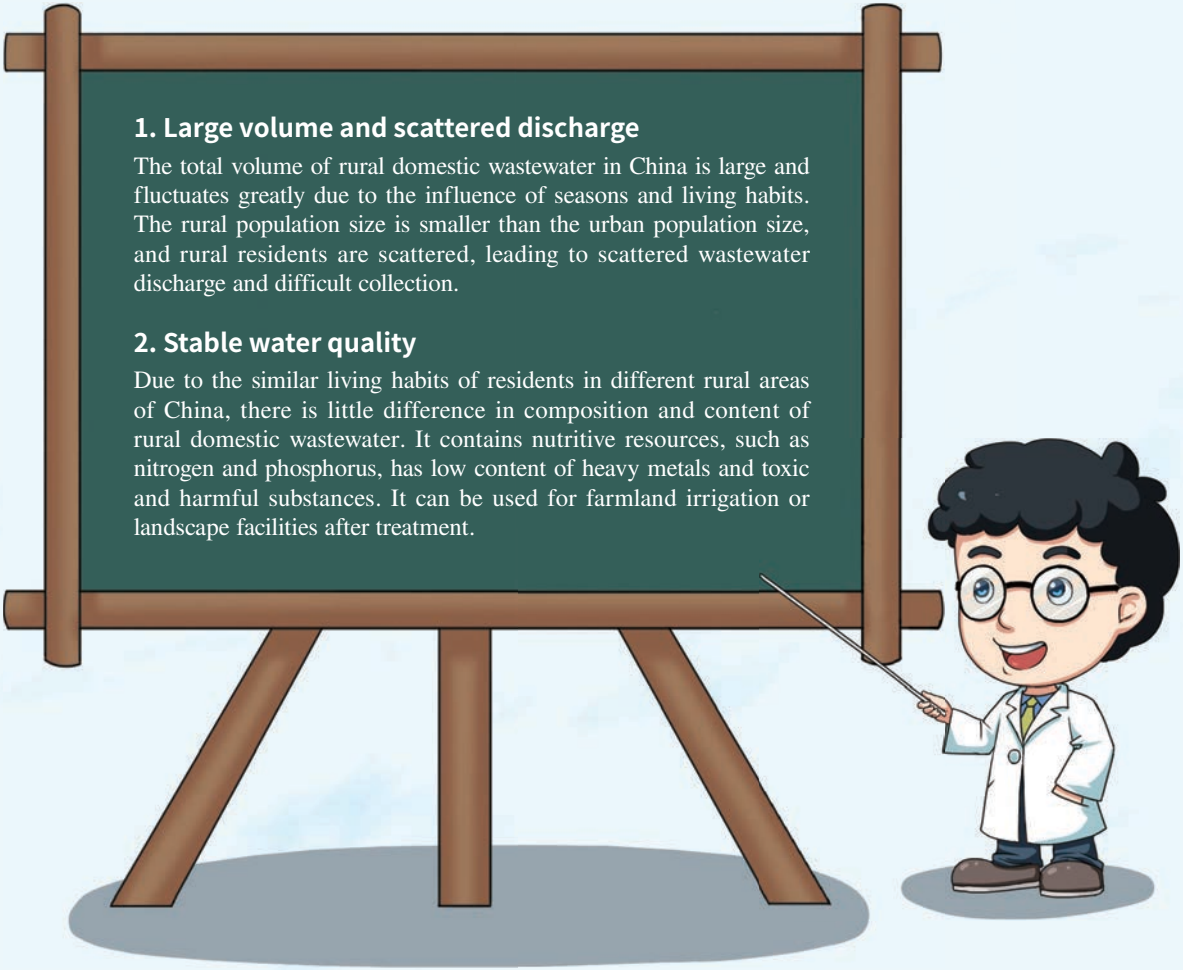
Good economic condition, complete indoor sanitary toilet and bathroom

Average economic condition, sanitary toilet



No running water, no sanitary toilet

1.3 What are the characteristics of rural domestic wastewater?



1. Large volume and scattered discharge

The total volume of rural domestic wastewater in China is large and fluctuates greatly due to the influence of seasons and living habits. The rural population size is smaller than the urban population size, and rural residents are scattered, leading to scattered wastewater discharge and difficult collection.

2. Stable water quality

Due to the similar living habits of residents in different rural areas of China, there is little difference in composition and content of rural domestic wastewater. It contains nutritive resources, such as nitrogen and phosphorus, has low content of heavy metals and toxic and harmful substances. It can be used for farmland irrigation or landscape facilities after treatment.

1.4 What are the requirements for the collection and treatment of rural domestic wastewater?

Ⅰ. Collection and treatment from individual households or combined households

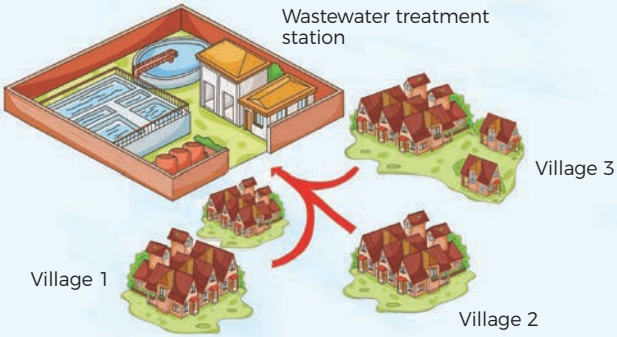
Faeces and other domestic miscellaneous drainage should be collected and treated separately. Toilet waste can be used fertilizers. Other domestic miscellaneous drainage can be treated by ecological and biological methods and used for watering garden plants.

Collection and treatment from individual households or combined households

Centralized collection and treatment by villages

Ⅱ. Centralized collection and treatment by villages

Black water should be separated from grey water. Households are encouraged to use black water as fertilizer and to treat grey water by ecological methods, such as fish culture, a constructed wetland or a stabilization pond.



Collection and treatment by urban pipe network

Ⅲ. Collection and treatment by urban pipe network

The collection and treatment of wastewater should be promoted together with rural toilet improvement. Pipelines should be laid reasonably according to the requirements of the urban pipe network, transportation distance and terrain.

2
Technical mode of scattered collection, treatment and use

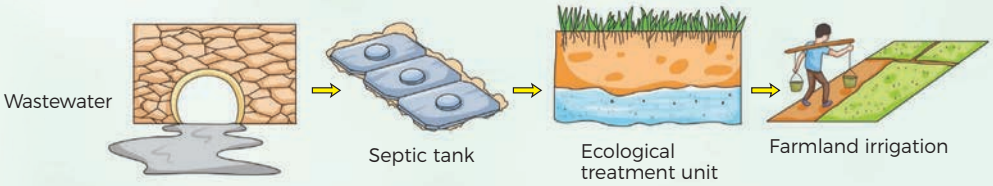
2.1 What is the technical mode of scattered collection, treatment and use?

The technical mode of scattered collection, treatment and use refers to domestic wastewater treatment from individual households or combined households using small wastewater treatment equipment or a natural treatment method. It is applicable to villages with a low population density, a complex terrain and difficulty in organizing a centralized collection of wastewater. The typical implementation methods are scattered treatment in courtyards and centralized treatment at a specific spot in a street.

Technical modes of scattered collection, treatment and use include septic tank plus ecological treatment, septic tank plus biological treatment and the separation of black water and grey water plus ecological treatment.

2.2 How does the septic tank with ecological treatment work?

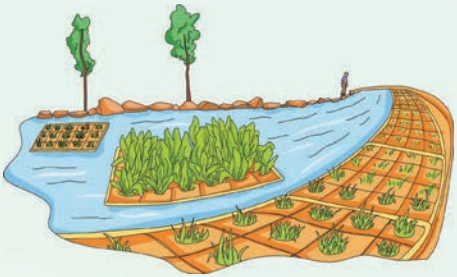
Households with available land can choose to use a septic tank with ecological treatment. Black water and grey water flow into a septic tank or biogas digester. After treatment, they flow into an ecological treatment unit and are purified through the removal of pathogens and the adsorbing, degrading and absorbing of pollutants. Technologies such as constructed wetland, land infiltration and a stabilization pond are ideal as an ecological treatment unit. After proper treatment, domestic wastewater can be used as irrigation water, sanitary water for fish breeding and poultry raising and non-drinking water for urban and rural uses.



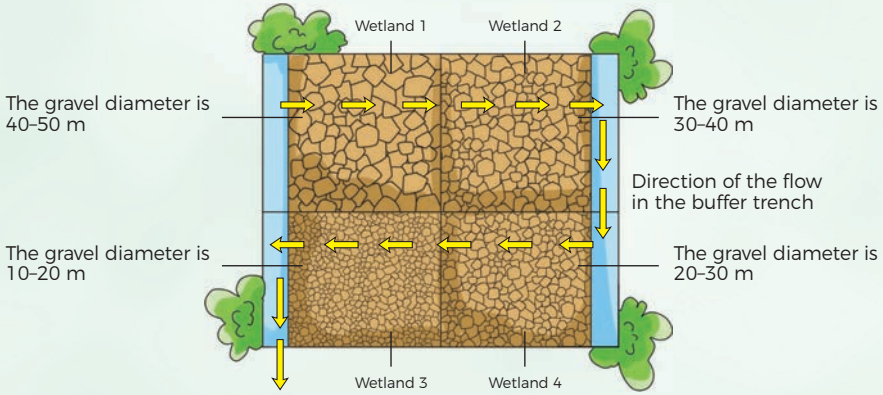
2.3 What is a constructed wetland?

I . Definition

A constructed wetland is a semi-ecological wastewater treatment system created artificially, involving the physical, chemical and biological synergy of soil, artificial media, plants and microorganisms for degrading the pollutants found in wastewater. A constructed wetland requires low investment and has low operating costs and simple maintenance and management. Aquatic plants can thrive in wetlands and thus beautify the environment and help regulate the climate. They are suitable for rural areas with a low population density and a small volume of wastewater. The ratio of wetland area to serviced people is 0.1-4.0 square metres per person.



Constructed wetland.



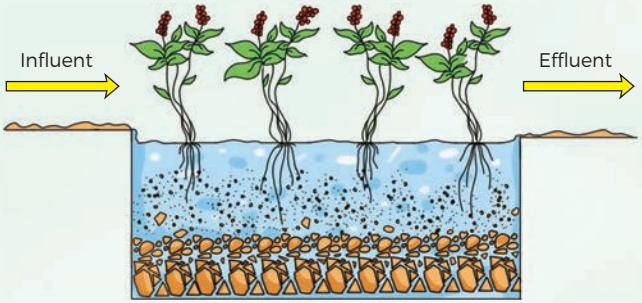
Principle of pollutant removal in a constructed wetland

A constructed wetland can be divided into four parts by gravel size. A constructed wetland at all levels is composed of aquatic plants, gravel beds and substrates, and the thickness of each gravel bed is 500 millimetres. After oxidative decomposition by microorganisms and direct absorption by aquatic plants, wastewater is purified. The yellow arrow indicates the direction of the water flow in the buffer trench.

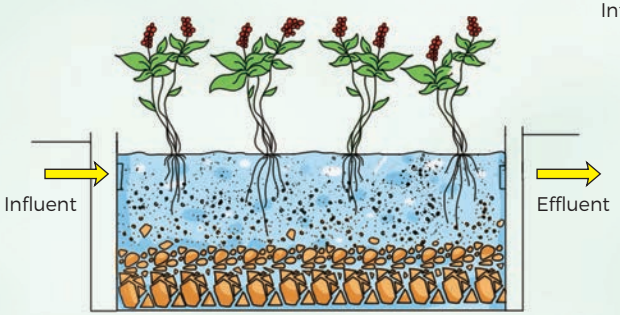
II . Composition

A constructed wetland is composed of wetland ponds, fillers, plants and a water distribution system. It is divided into three types: surface flow wetland, horizontal subsurface flow wetland and vertical subsurface flow wetland. A surface flow wetland requires low investment and has low operating costs for its influent system. But it covers a large area, freezes in winter, breeds mosquitoes and smells bad in summer. A subsurface flow wetland and vertical subsurface flow wetland covers a small area and is sanitary but entails high costs for construction.

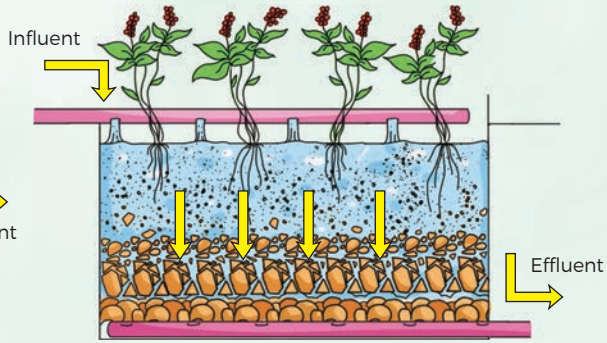
Commonly used fillers are slag, fly ash, vermiculite, zeolite, sand, limestone, blast furnace slag and shale. Broken bricks and tiles and concrete blocks can also be used as filler.



Surface flow wetland



Horizontal subsurface flow wetland



Vertical subsurface flow wetland

III . Key points of construction

① Excavation of soil

Enough soil should be reserved for backfilling, and the surplus soil should be transported to the spoil collection area in one shot.

② Construction of pre-treatment system

Connect to a septic tank.

③ Installation of earth infiltration membrane

The infiltration rate is less than 10^{-6} millimetres per second, and the membrane thickness is greater than 1 millimetre.

④ Laying of water distribution pipeline

Perforated pipes or water distribution (collection) pipes are preferred.

⑤ Filling of matrix materials

If alkaline substrate is used, pre-treatment is required, such as full soaking.

⑥ Backfilling with soil and plant growing

After packing installation, the porosity of wetland should not be lower than 0.3. Plant species can be selected from reed, canna, calamus, cress, rushes or foaming grass.

IV . Notes for maintenance

① To reasonably control the wetland water level, it is necessary to adjust the water level in the dry season, wet season and flood season.

② Before wastewater flows into a constructed wetland, biological treatment is required for reducing the concentration of pollutants.

③ Silt should be removed from a constructed wetland regularly to prevent blockage of the water flow.

2.4 What is soil infiltration?

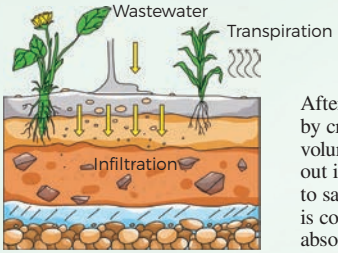
I . Definition

Soil infiltration is a technology that purifies wastewater by using animals, microorganisms, plant roots and soil and the physical and chemical characteristics of soil. This technology requires a vast tract of land but has the advantages of low investment and operating costs and simple management and maintenance. It is mainly used for scattered rural domestic wastewater treatment for individual households or combined households.

II . Types

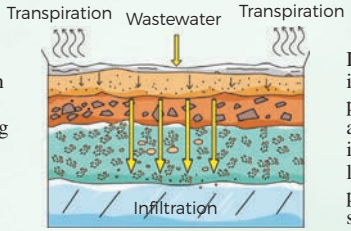
Land infiltration can be divided into four types by wastewater transfer and treatment process: slow infiltration, rapid infiltration, overland flow and subsurface infiltration.

① Slow infiltration



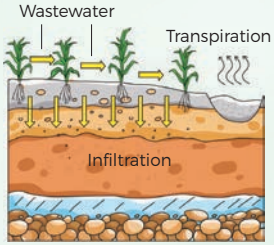
After evaporation, absorption by crops and infiltration, the volume of wastewater flowing out is usually 0. Which is to say that the wastewater is completely purified and absorbed.

② Rapid infiltration



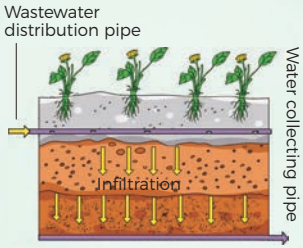
During the process of infiltration into the land, wastewater is purified in physical, chemical and biological actions. Rapid infiltration is suitable for land with good infiltration performance, such as land with sandy soil or gritty soil.

③ Overland flow



Wastewater flows evenly over sloping ground and into the catchment channel at the foot of the slope. The treated water can be reused or discharged into a water body after being collected. Overland flow is suitable for clay or sub-clay with good permeability.

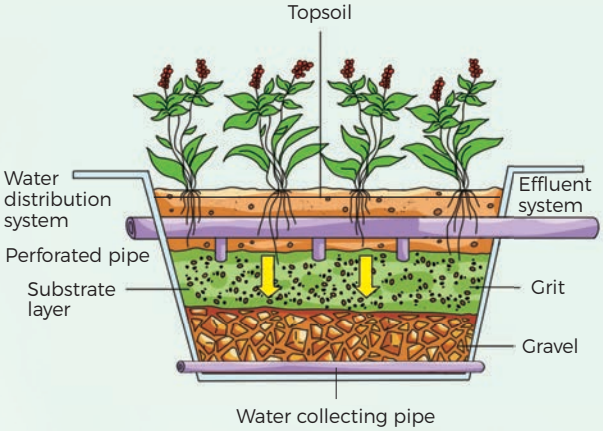
④ Subsurface infiltration



Wastewater is transferred to the permeable soil layer with a certain distance from the land surface through a water distribution pipe. The treatment requirements are met through the processes of precipitation, filtration, adsorption and biodegradation.

III . Example of construction

For the subsurface infiltration system, as an example, an open channel should be dug first. The bottom of the channel should be filled with gravel or grit, and perforated pipes should be laid above the gravel layer. Then the perforated pipes should be buried by grit, and finally, the topsoil should be covered. Perforated pipes should be buried 50 centimetres below the land surface. Subsurface infiltration ditches are also feasible for water distribution.



IV . Operation management

Harvest plants in time

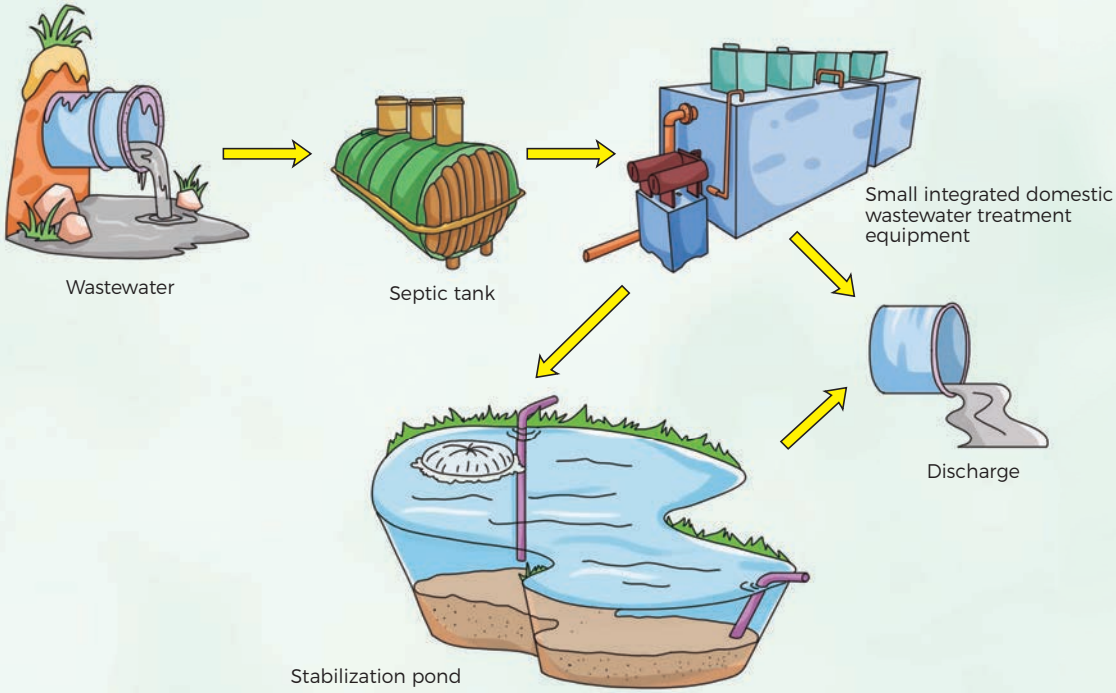
Reap plants in time to remove pollutants adsorbed by them.

Check whether the soil is soaked in water

Check whether the topsoil is soaked in water. If so, it means that there is blockage or excessive hydraulic load.

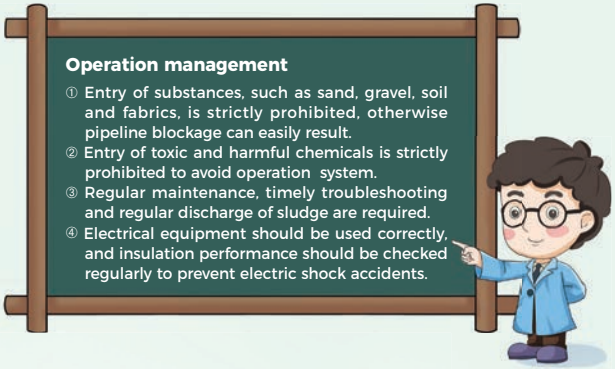
2.5 How does the septic tank with biological treatment work?

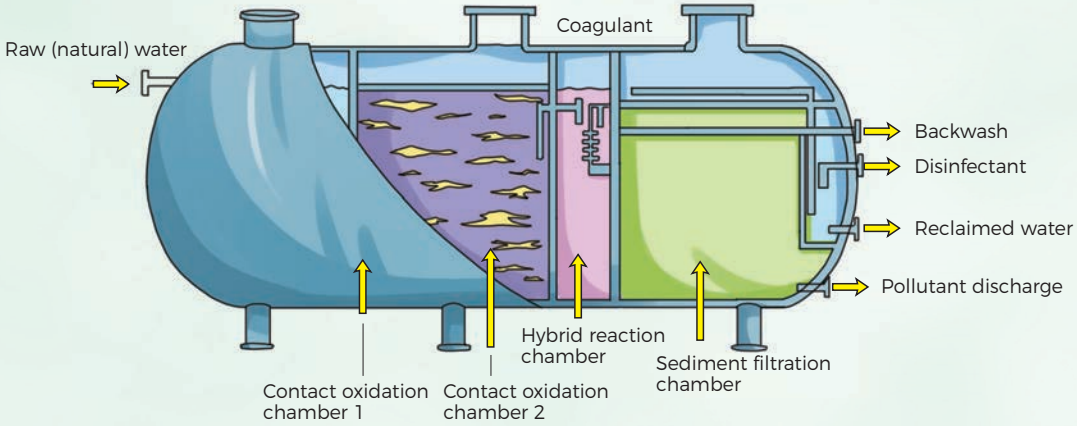
For households that have no available land or areas that require a high quality of discharged wastewater, the mode of septic tank with biological treatment can be used to treat wastewater. Small integrated domestic wastewater treatment equipment can be used as the biological treatment unit. The treated wastewater can be directly discharged or discharged after treatment through a connected ecological treatment unit, such as a stabilization pond. Properly treated domestic wastewater can be used as irrigation water and sanitary water for fish breeding and poultry raising. This mode is characterized as having good treatment effect and requiring only a small area. But it also requires regular maintenance and management.



2.6 What is small integrated domestic wastewater treatment equipment?

Small integrated domestic wastewater treatment equipment is mainly promoted and used in areas where no drainage pipe network is available and wastewater cannot be treated by a centralized treatment facility. The process mainly involves removal of suspended solids, biochemical treatment and precipitation. Processes such as anaerobic filter, contact oxidation, membrane separation and fluidized bed can be used for biochemical treatment. The treated domestic wastewater is further treated in a precipitation tank, constructed wetland or stabilization pond. The chemical oxygen demand and total nitrogen of the effluent complies with the standard of Class 1(B)[Integrated Wastewater Discharge Standard(GB 8978—1996)]. The equipment is characterized by convenient use, high degree of specialization and mature and stable technology.



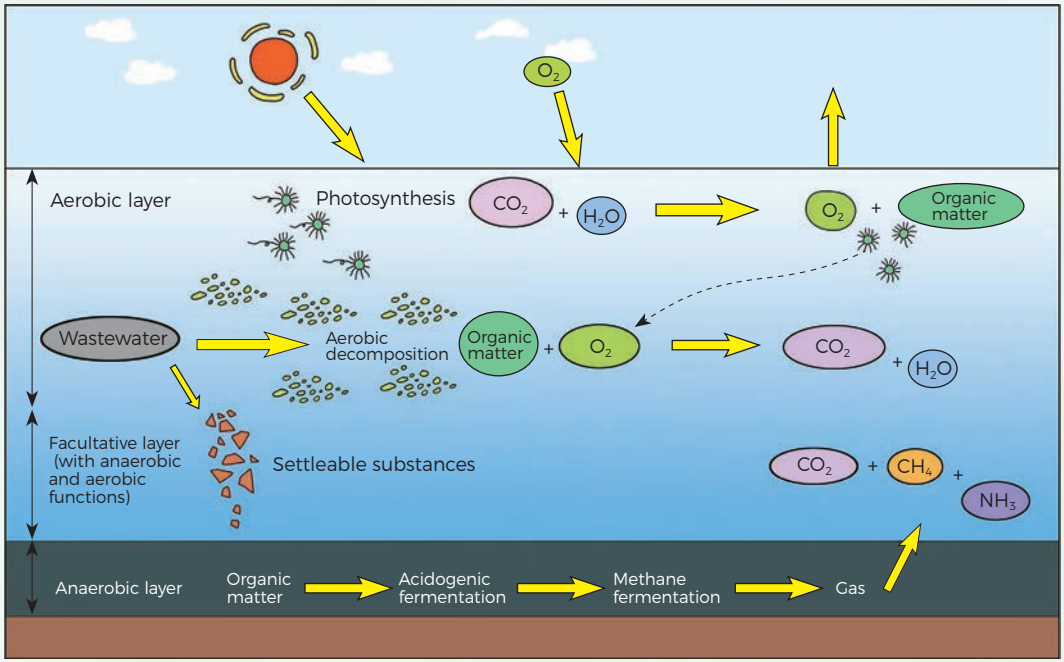


Structure of small integrated domestic wastewater treatment equipment

2.7 What is a stabilization pond?

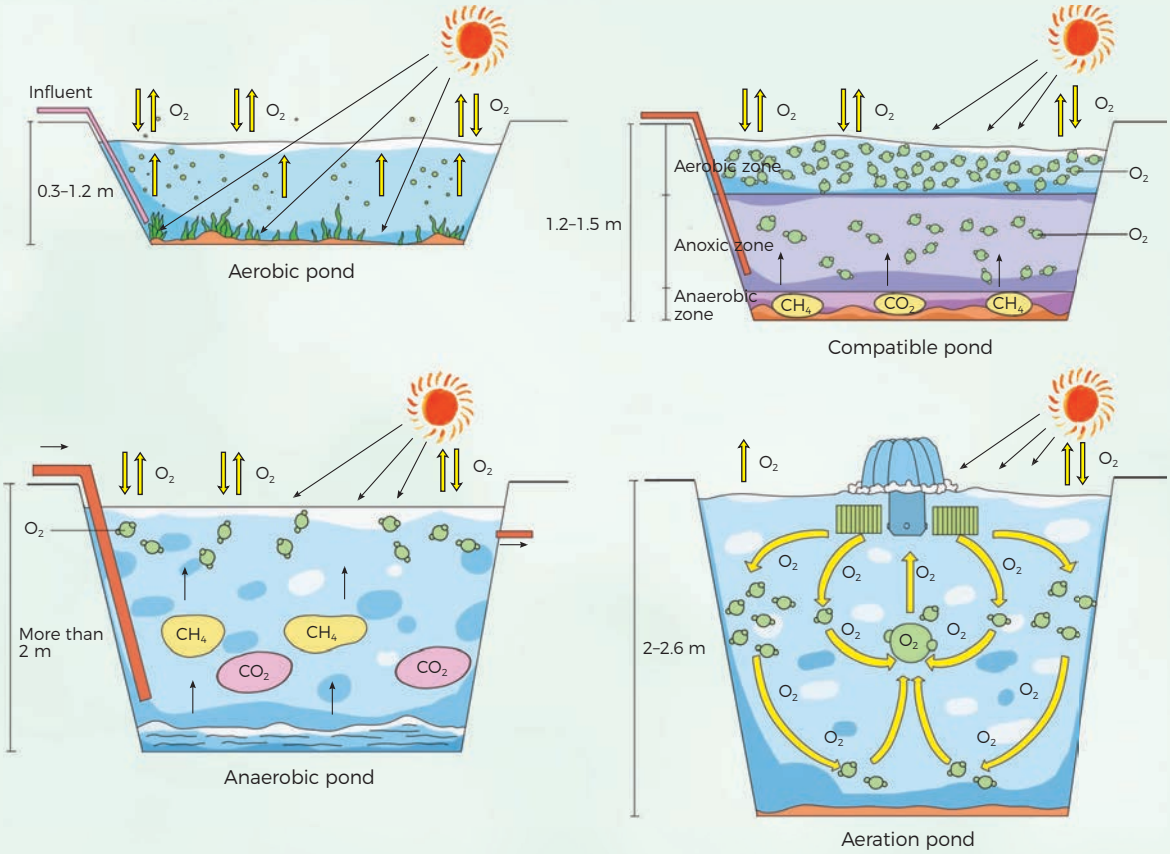
I. Definition

A stabilization pond, also known as an oxidation pond or a biological pond, is a biological treatment facility that uses the natural purification capacity of water body to treat wastewater. Pollutants can be removed by dilution, precipitation, flocculation, microorganisms, the absorption function of algae and other actions. Having a simple structure and requiring low investment and a large area, a stabilization pond can be constructed from an existing water storage pond in rural areas. It is suitable for arid and semi-arid areas and rural areas short of funds but rich in land resources. The ratio of construction area to serviced people is 0.8–1.6 square metres per person.



II. Types

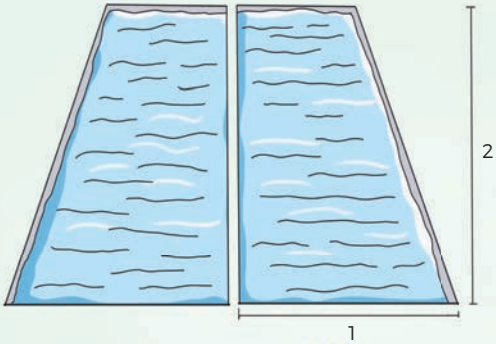
A stabilization pond is generally classified into five types: aerobic pond, facultative pond, anaerobic pond, aeration pond and ecological pond. If the concentration of pollutants in the influent is low, generally an aerobic pond or an ecological pond is used. If the concentration of pollutants in the influent is high, an anaerobic pond or aeration pond should be used. If the wastewater quality is between either of those levels, then generally a facultative pond should be used.



III . Key points of construction

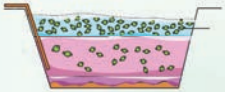
Before flowing into a stabilization pond, wastewater should be pre-treated by bio-contact oxidation in a septic tank or an anaerobic or aerobic pond to ensure that the treatment effect meets the design requirements. Wastewater flowing into a stabilization pond should comply with the Class III standard specified in the Integrated Wastewater Discharge Standard. A stabilization pond should be seepage-proof and kept as far as possible away from residential areas. During operation, the leakage and biological growth in water should be checked regularly.

There should be two stabilization ponds at the least. The retention duration is 7–180 days, and the length to width ratio of ponds is 2:1.

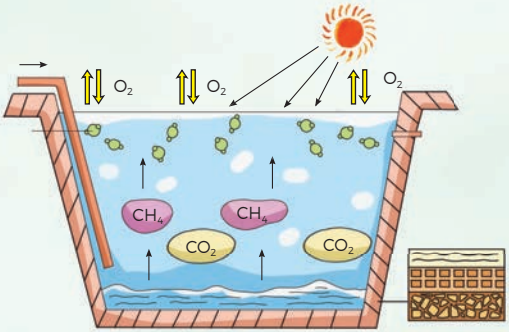


Household

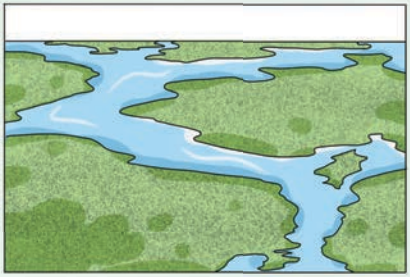
Away from residential areas



Stabilization pond



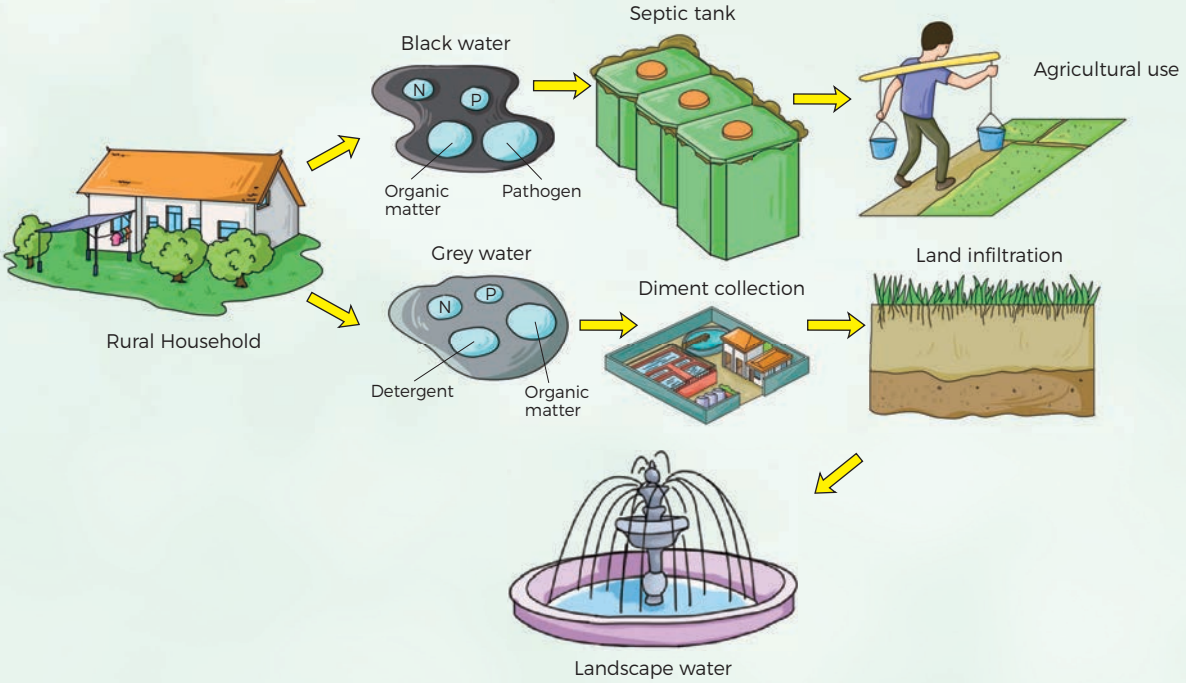
Plastic membrane
Geomembrane
Compacted clay



Excessive algae affect water quality

2.8 How does the separation of black water and grey water with ecological treatment work?

For households that need black water for agricultural use, the mode of separation of black water and grey water with ecological treatment can be used to treat the wastewater. Black water is collected and discharged into a septic tank or a biogas digester and can be used for agriculture after treatment. After precipitation treatment, collected grey water flows to a constructed wetland or land infiltration system. After proper treatment, the wastewater can be directly discharged or used as landscape water.



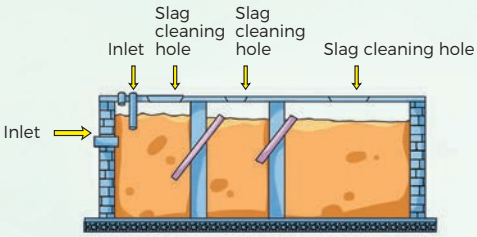
2.9 What is a septic tank?

I. Definition

A septic tank is a treatment facility that removes suspended solids, organic matter and pathogens in faecal sewage or other domestic wastewater by precipitation and anaerobic microbial fermentation.
A septic tank has the advantages of simple structure, easy construction, low investment, low operating costs, good sanitation and simple maintenance and management.
It is suitable for primary treatment of rural wastewater, especially for pre-treatment of faeces from toilets or transformed from pit latrines.

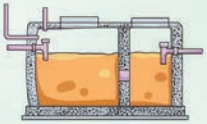
II. Types

Nowadays, a three-section and double-container septic tank is widely used. According to building materials and structures, it can be divided into brick, cast-in-situ or precast concrete, fibre-reinforced plastic and plastic (polyethylene or polyvinyl chloride) types.

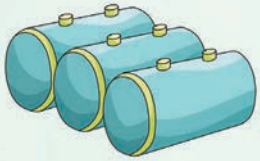


Three-section septic tank


Brick septic tank


Cast-in-situ or precast concrete septic tank


Dual-container septic tank


Fibre-reinforced plastic septic tank

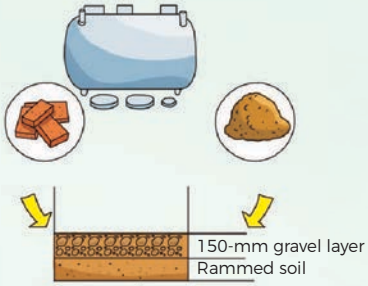

Plastic (polyethylene or polyvinyl chloride) septic tank

III . Key points of construction

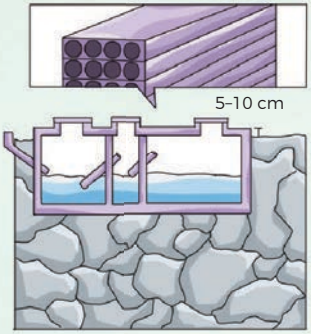
(1) Design: The design should be undertaken by a engineers and technicians and based on the Water Supply and Drainage Design Manual as well as the Technical Specification of Wastewater Engineering for Town and Village (CJJ 124–2008).

(2) Construction: The construction mainly involves pit digging, foundation treatment, pool construction and soil covering.

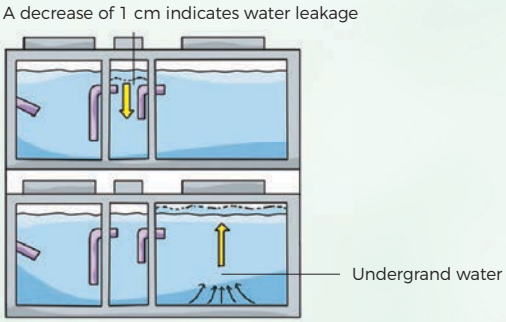
Pit digging



Foundation treatment

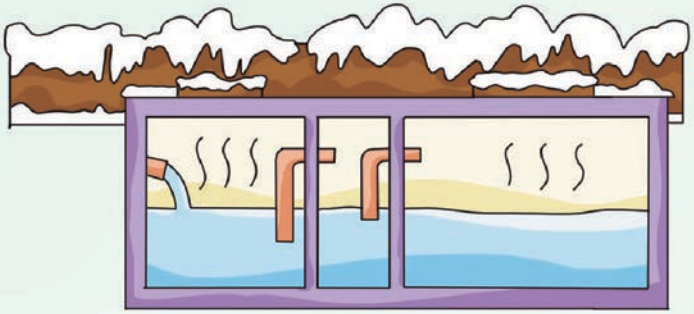


Pool construction

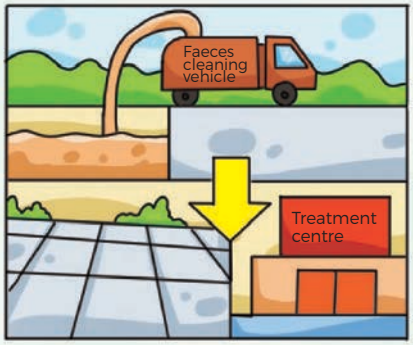


Earth covering

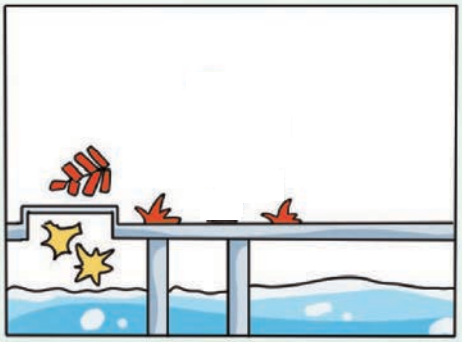
(3) Operation and management: The daily maintenance and inspection of a septic tank involves water quantity control, leakage prevention, deodorization, cleaning of grid waste and cleaning of tank slag – all of which should be undertaken by professionals. To prevent biogas produced by faeces fermentation from exploding, do not allow flames or smoke by the pool when cleaning the slag or taking faecal sewage. After checking or cleaning the pool slag, cover the hole to avoid harm to people and animals.



Clean with hot water in winter



Faeces can be pumped out for centralized treatment

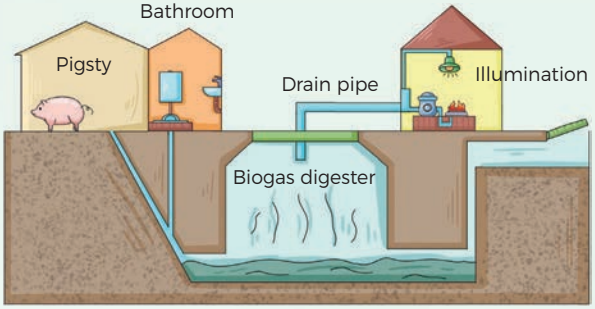


Do not throw firecrackers, cigarette butts, etc. into septic tank

2.10 What is a biogas digester?

I. Definition

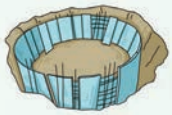
A biogas digester is a wastewater treatment facility that decomposes organic matter in domestic wastewater by turning it into methane, carbon dioxide and water through the use of anaerobic microorganisms under anaerobic conditions.
It is suitable for the treatment of rural wastewater for individual households or combined households. If there are industries such as livestock and poultry breeding or vegetable and fruit planting, biogas utilization modes suitable for different industrial structures can be selected.



II. Types

Biogas digesters are categorized as brick, reinforced concrete and fibre-reinforced plastic biogas digesters according to the building materials and structure used. Or they are categorized as underground, semi-buried and above-ground, based on where it is located. Generally, households use an underground biogas digester.


Brick biogas digester


Reinforced concrete biogas digester


Fibre-reinforced plastic biogas digester

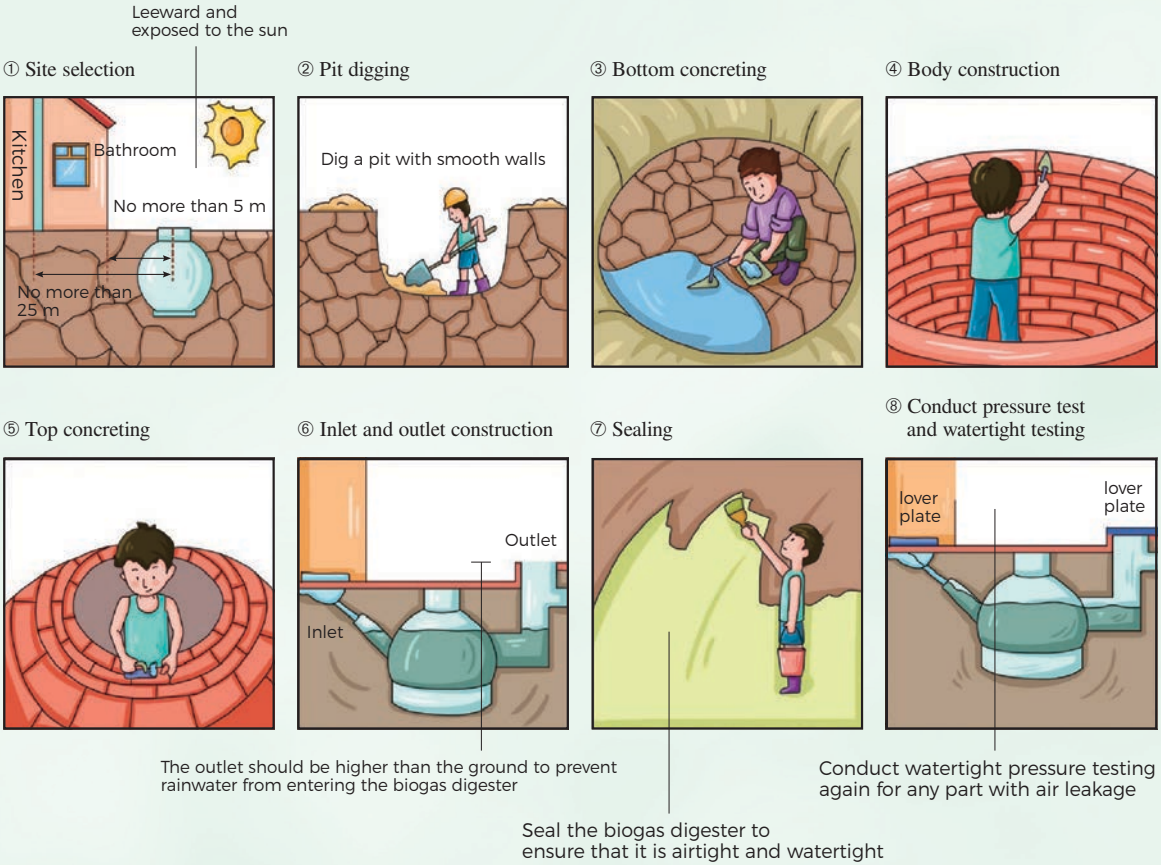

Underground biogas digester


Semi-buried biogas digester

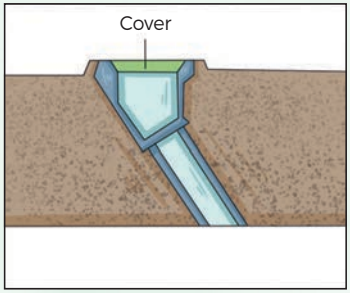

Above-ground biogas digester

Ⅲ. Key points of construction

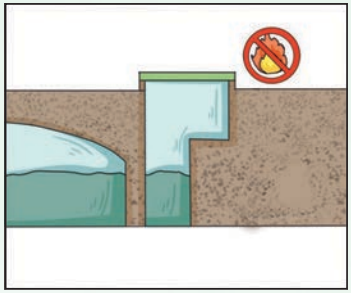
(1) Design: The design of a biogas digester involves eight steps: site selection, pit digging, bottom concreting, body construction, top concreting, inlet and outlet construction, sealing, and pressure and watertight testing. On-site guidance of professional technicians is required for the construction.



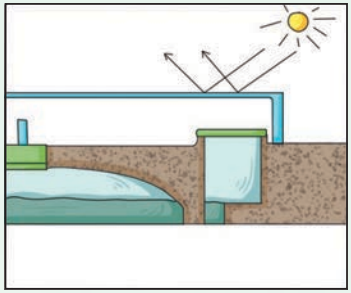
(2) Operation management and maintenance



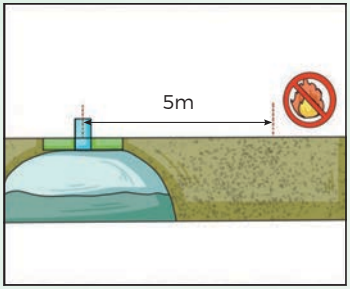
The inlet of biogas digester must be covered to avoid injuries and death of people and animals.



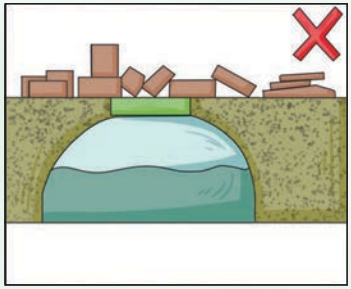
To avoid fire, do not ignite any flammable item (cigarettes) near the outlet or gas pipe of the biogas digester.



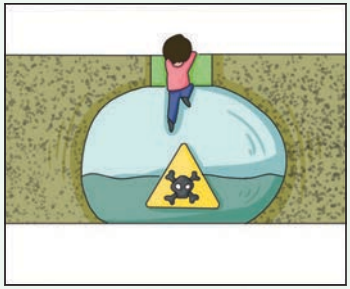
Outdoor pipelines should be protected from sunlight to avoid air leakage caused by weathering and ageing.



It is strictly forbidden to make a fire within a 5-metre radius of the biogas digester.



Heavy items (such as bricks and stones) and inflammable and explosive materials (such as woodpile or haystack) cannot be stored in or around the biogas digester.



It is strictly forbidden to work in the biogas digester without safety protection measures.

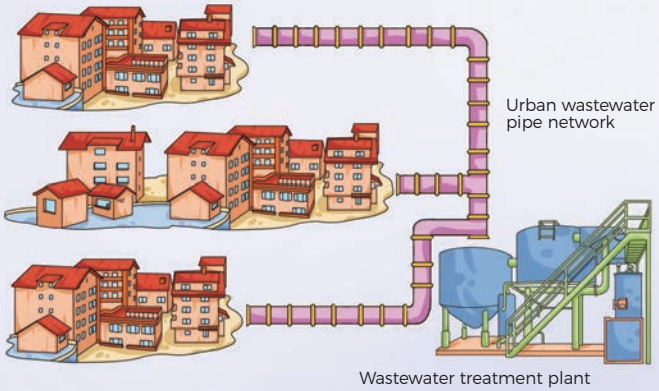
3
Technical mode of centralized collection, treatment and use

3.1 What is the technical mode of centralized collection, treatment and use?

For villages with a centralized populated area and conditions for laying a pipe network in all or part of those areas, the mode of centralized treatment and utilization of domestic wastewater should be adopted. This model is widely used for rural domestic wastewater treatment in China. Generally, the wastewater of a village is collected and transferred to a nearby rural domestic wastewater treatment facility for treatment.

For rural areas with better economic conditions in the suburbs of cities and towns, if the domestic wastewater can be directly discharged by urban sewage pipes, an urban sewage pipe network can be chosen for unified and centralized treatment. This mode can reduce the construction investment. Villages have no responsibility for operation and management and do not bear any of the operating costs. They can enjoy long-term benefits brought about by a one-time investment.

Collect and transport rural domestic wastewater to wastewater treatment facilities

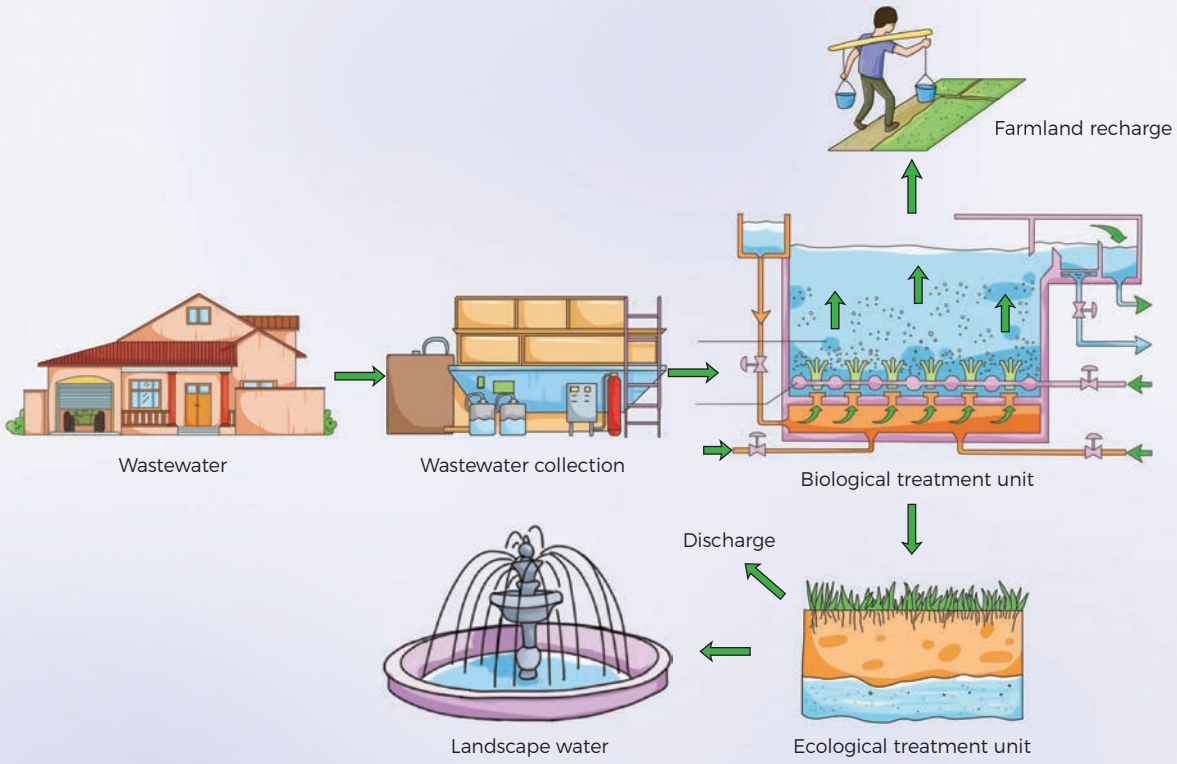


Incorporate rural domestic wastewater into urban wastewater pipe network

3.2 What biological treatment technologies can be used?

Centralized treatment mainly depends on biological treatment methods, including the biomembrane method and activated sludge method. For the biomembrane method, a biological contact oxidation pond can be used. For the activated sludge method, the traditional activated sludge process and an oxidation ditch can be used.

The treated wastewater can be used for urban and rural non-drinking water uses, such as landscape water, irrigation water, sanitary water for fish breeding and poultry raising or directly discharged into a water body.

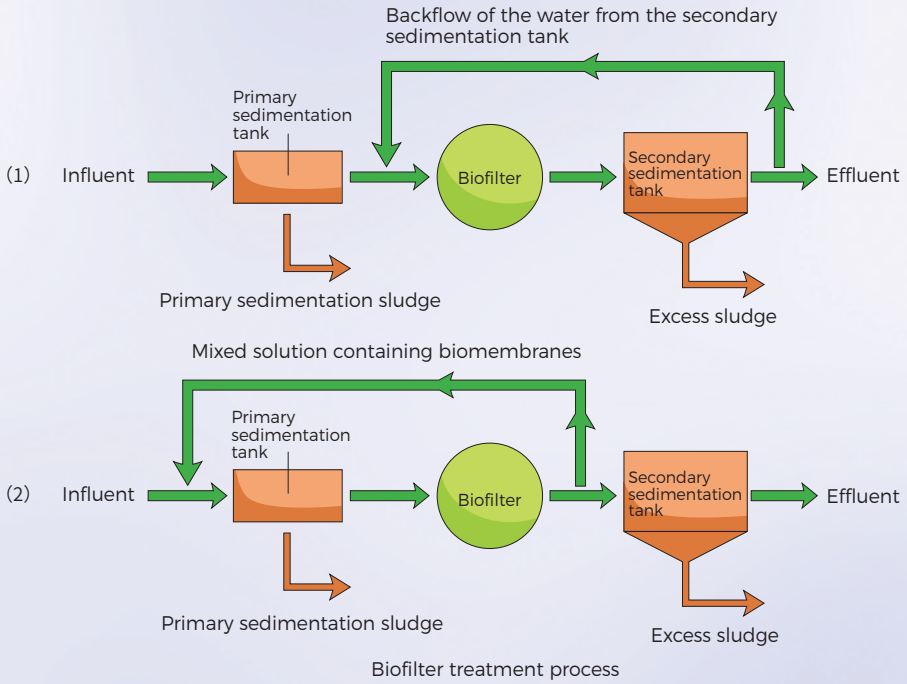


3.3 What is a biofilter?

Ⅰ. Definition

A biofilter is composed of a tank, filter materials, a water distribution device and a drainage system. With the granular materials filled in the filter as a carrier, a large number of biomembranes grow on the surface of the filter materials during aeration in the filter. Wastewater can be treated by strong oxidation and decomposition of high-concentration active microorganisms in the biomembranes. It is necessary to build a secondary sedimentation tank to remove the excess sludge.

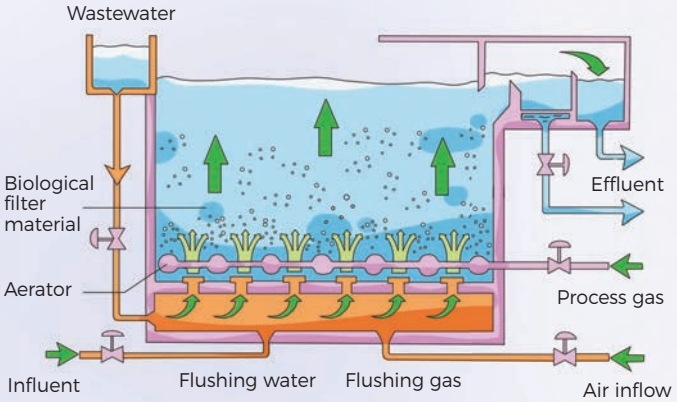
With the advantages of a small area and stable treatment effect, biofilters are suitable for wastewater treatment in villages or small and medium-sized settlements, especially for villages with high annual average temperatures, small land area, steep slopes and large fluctuations of water quality and quantity.



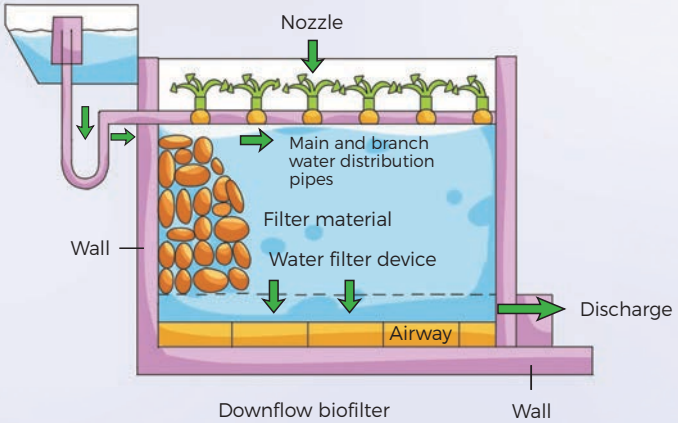
Biofilter treatment process

Ⅱ. Types

A biofilter can be either an ordinary biofilter or a high-capacity biofilter. An ordinary biofilter has a low load and occupies a large area, and it tends to be less popular in China nowadays. A high-load biofilter involves backflow of treated water, and the biochemical oxygen demand (BOD) of influent is less than 200 milligrams per litre, which improves the water quantity and BOD load and solves the problems of needing a large area and frequent blockage. A high-load biofilter can be categorized as a carbon oxidation biofilter, a nitrification biofilter and a denitrification biofilter, according to the pollutants removed. Or it can be categorized as an upward flow, downward flow, lateral flow or backflow biofilter, according to the direction of water flow.

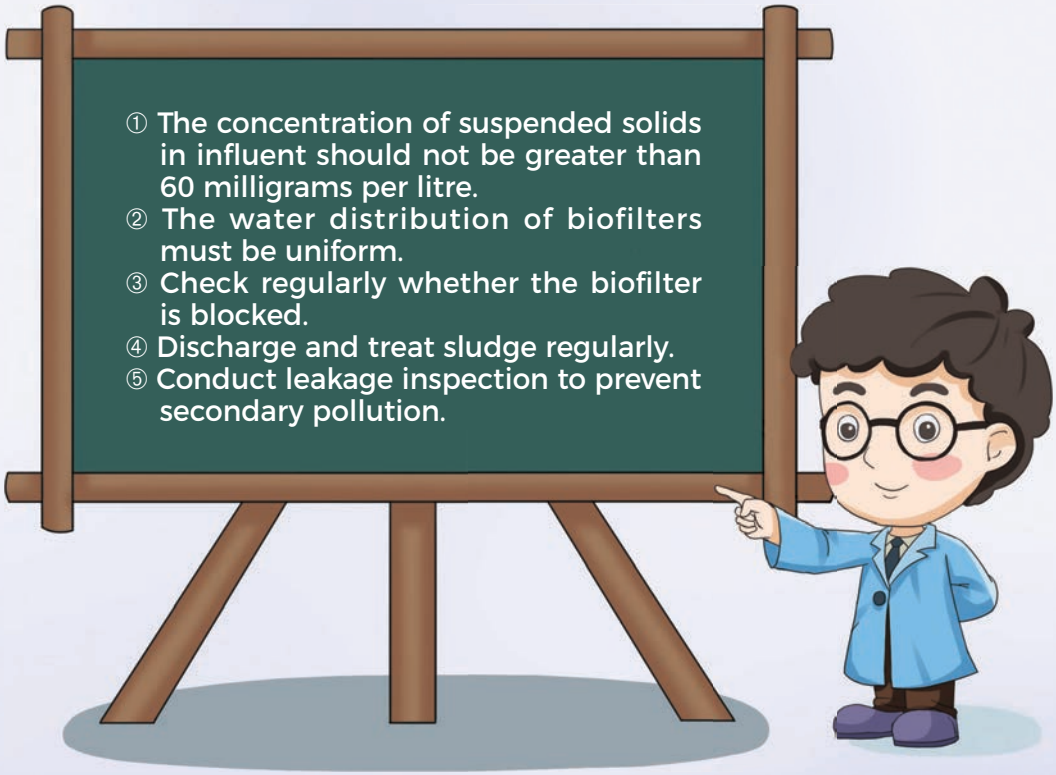


Up-flow biofilter



Downflow biofilter

III . Key points of construction



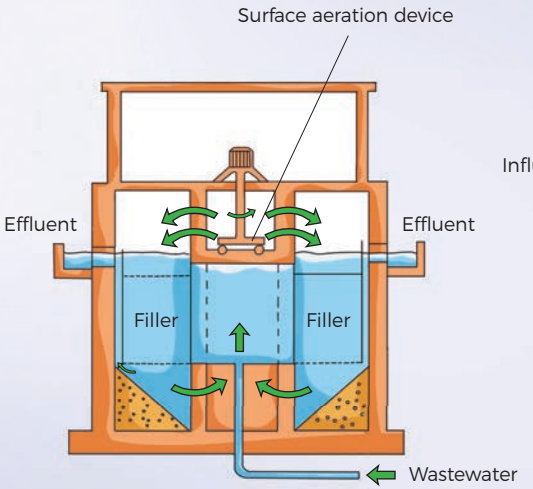
3.4 What is a biological contact oxidation pond?

Ⅰ. Definition

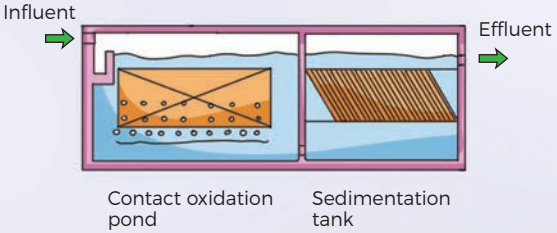
A biological contact oxidation pond is filled with fillers. Wastewater submerges and passes through the fillers at a certain flow rate. In the process of contacting with oxygen, wastewater and fillers, the organic matter in the wastewater is removed through the metabolism of the microorganisms on biomembranes. The biological contact oxidation pond is mainly composed of the tank body, filler, aeration device, water inlet and outlet device and sludge discharge pipeline. This technology can be used for decentralized and centralized rural domestic wastewater treatment.

(1) Advantages: ① wide application range, simple structure and requires only a small area; ② highly reliable and stable treatment system; ③ simple operation and low power consumption; and ④ operating intermittently.

(2) Disadvantages: ① poor controllability of the system and limited capacity; ② high construction costs and difficult to replace filler.



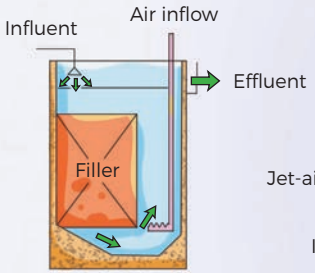
Biological contact oxidation pond



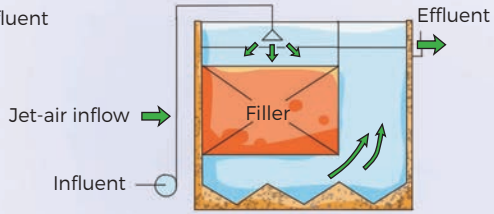
Wastewater treatment process of biological contact oxidation ponds

II. Types

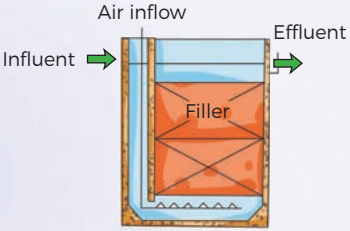
According to the position of the aeration device, a biological contact oxidation pond is categorized as split-flow or direct-flow.



Split-flow type
(supplies oxygen by blast aeration)



Split-flow type
(supplies oxygen by jet aeration)



Direct-flow type
(supplies oxygen by blast aeration)

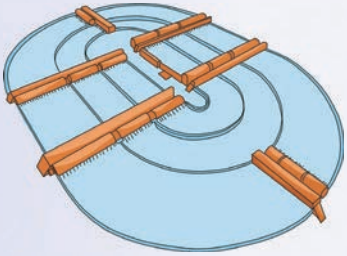
III. Key points of construction Biological contact oxidation pond

① The design is based on the average volume of wastewater. Calculate the filler volume according to the volumetric loading rate.
② The effective retention duration of wastewater in the contact oxidation pond should not be less than two hours.
③ Control the BOD_5 concentration of wastewater entering the contact oxidation pond at 100–300 milligrams per litre. When the BOD_5 concentration is higher than 300 milligrams per litre, dilution with the backflow treated water can be considered.
④ The total height of filler layers is generally 3 metres. The height of each layer depends on the filler type. Generally, a single layer should not be higher than 1.5 metres.
⑤ Maintain the dissolved oxygen at 2.5–3.5 milligrams per litre and the gas-water ratio at (15–20) : 1.
⑥ To ensure uniform water and gas distribution, the volume of each biological contact oxidation pond should be within 25 cubic metres.

3.5 What is an oxidation ditch?

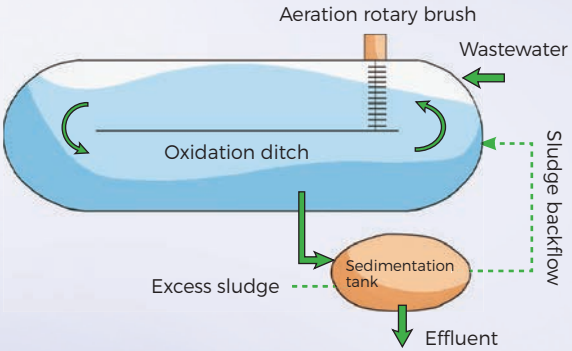
I . Definition

An oxidation ditch uses a continuous annular reaction tank as the biological reaction tank. Wastewater can be purified when the mixed liquid of wastewater and activated sludge continuously circulates in a closed aeration channel. The facility has the advantages of simple structure, equipment, management or maintenance and low investment. But it occupies a large area and uses a considerable amount of electricity. It is suitable for treating wastewater with a high concentration of pollutants.



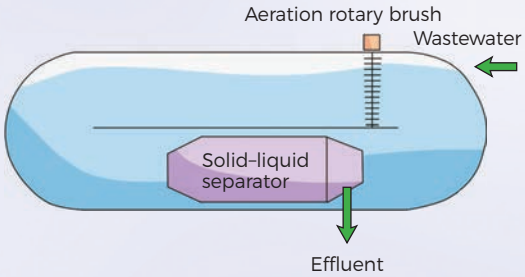
Oxidation ditch

II . Types



Passever oxidation ditch

The ditch is runway shaped. It is equipped with one or more rotary brushes that push the water to circulate and aerate in the ditch.



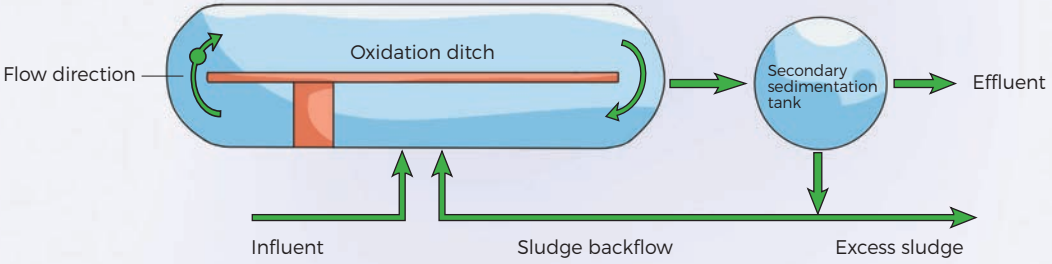
Integrated oxidation ditch

A sedimentation tank and an oxidation ditch are built in the same structure, and the pump-free backflow is realized by using hydrodynamic force, thus saving on the cost.

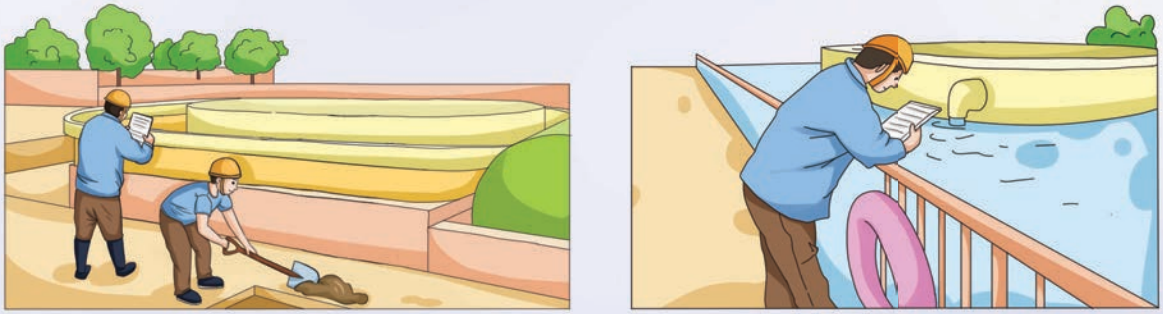
III . Key points of construction

(1) Design: A ditch, aeration equipment, water inlet and outlet device, diversion and mixing equipment, a secondary sedimentation tank, an electrical and control system need to be constructed. Design parameters should be determined according to the results of test data or determined with reference to the results of similar projects when test data are not available.

(2) Construction: Select a professional construction team for construction and installation.



Oxidation ditch process flow



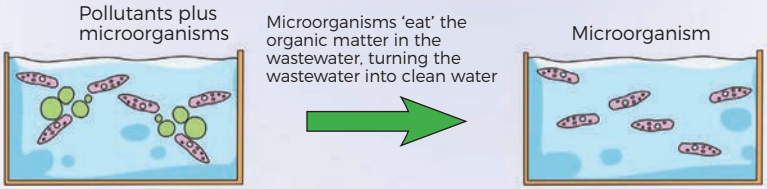
Regular inspection and maintenance

3.6 What is the activated sludge method?

I. Definition

The activated sludge method is a method of decomposing and removing organic pollutants in wastewater by introducing air into the water, continuously cultivating the wastewater and various microbial groups and then utilizing the coagulation, adsorption and oxidation effect of the activated sludge. It is a general name for the biological method of wastewater treatment by using microorganisms suspended in water.

The activated sludge method has strong adaptability to different properties of wastewater and entails low construction costs. It is suitable for treatment of wastewater with high organic matter content. However, there are some problems, such as poor operation stability, sludge bulking and loss, and an unsatisfactory separation effect.

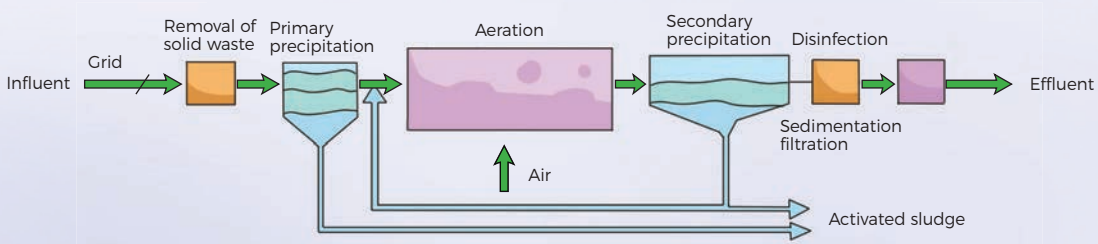


Principle of pollutant removal by activated sludge method

II. Types

The traditional activated sludge method involves sedimentation, filtration, aeration and secondary sedimentation processes. Aeration tanks and secondary sedimentation tanks are the main devices.

The method involves what are known as the AO process, the AAO (A^2O) process, the SBR(Sequencing batch reactor activated sludge process) process and an oxidation ditch.



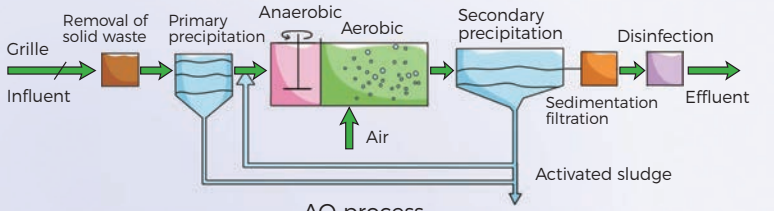
Process flow of the traditional activated sludge

(1) The anaerobic–aerobic, or AO, process removes nitrogen and phosphorus [in the anaerobic (A) section] and decomposes organic matter in the water [in the aerobic (O) section]. The system is simple and entails low operating costs and a small area. The process is suitable for wastewater treatment under general conditions.

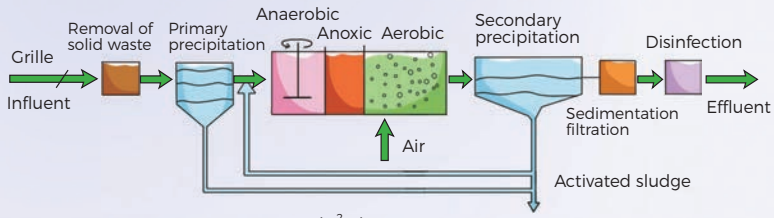
(2) AAO (or A^2O) refers to the anaerobic–anoxic–aerobic process, which can remove nitrogen and phosphorus simultaneously. The total wastewater retention time is short and the operating costs are low. The process is suitable for secondary or tertiary wastewater treatment and reclaimed water reuse.

(3) The sequencing batch reactor activated sludge process, or SBR, integrates a regulating tank, aeration tank and sedimentation tank and does not require a sludge backflow system. This process has the advantages of easy operation, low investment and stable effect. The process minimizes sludge bulking, has high-impact load resistance and can remove nitrogen and phosphorus. It is suitable for domestic wastewater treatment of small and medium-sized rural areas with a developed economy, limited land resources, great changes in wastewater volume and a requirement for high-quality effluent.

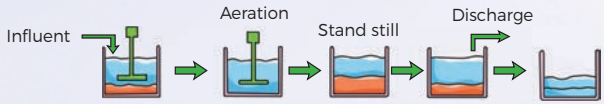
(4) See section 3.5 of this chapter for the explanation of an oxidation ditch.



AO process



AAO (A^2O) process



SBR process

III . Key points of construction

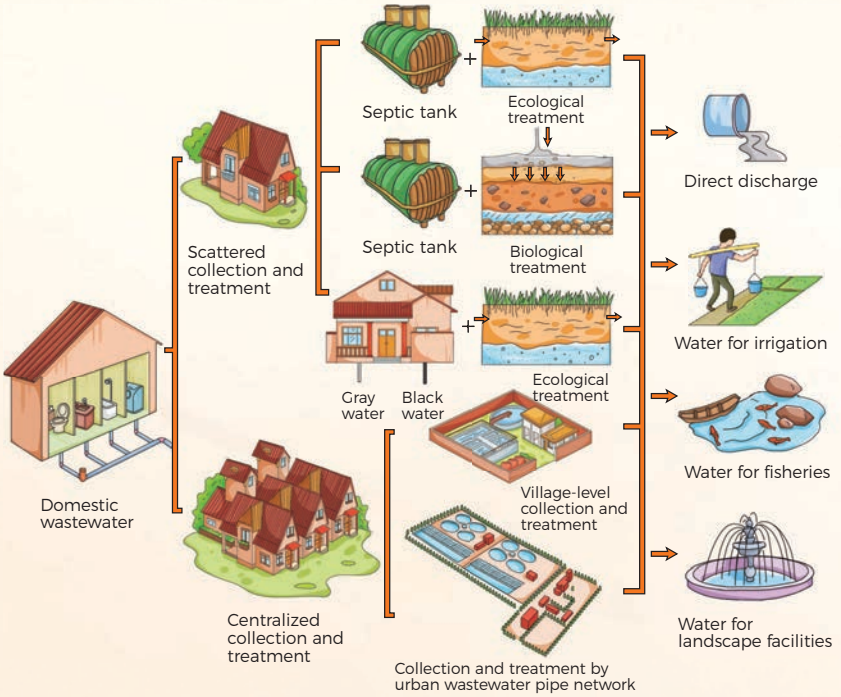
Operating conditions

Temperature: 10–50℃; pH 6–9. It requires an adequate oxygen supply. The wastewater must contain enough soluble and degradable organic matter. The activated sludge is suspended in the tank and keeps a certain concentration in the aeration tank.

4
Management of rural domestic wastewater treatment facilities

4.1 What requirements should be met for rural domestic wastewater discharge?

Rural domestic wastewater can be used for irrigation water, fisheries, landscape facilities or directly discharged into a water body after the scattered or centralized collection and treatment and further treatment by wetlands or soil. The effluent quality should meet relevant standards.



Rural wastewater discharge standards of all provinces (municipalities directly under the central Government and autonomous regions) and the Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant (GB18918—2002)

Standards for Irrigation Water Quality (GB 5084—2005)

Fishery Water Quality Standard (GB 11607—1989)

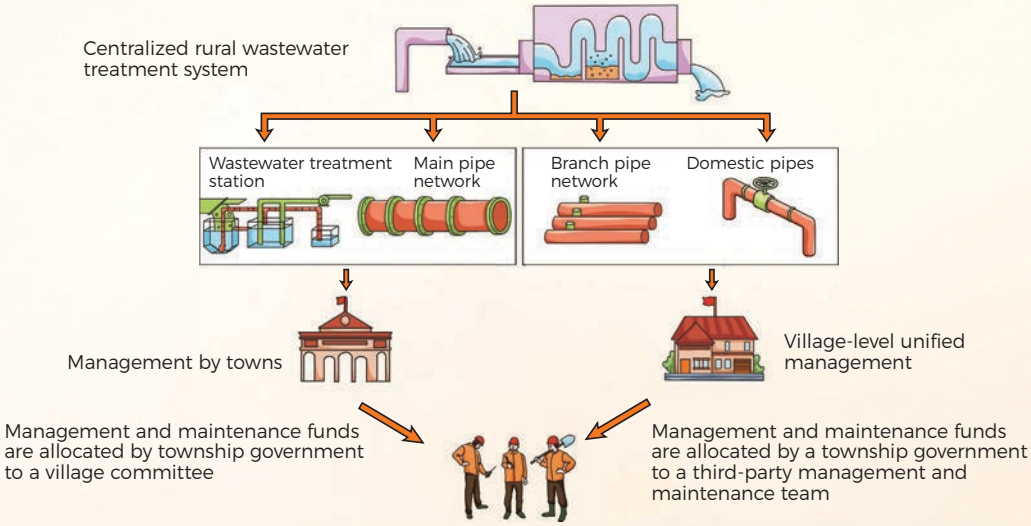
Reuse of Urban Recycling Water – Water Quality Standard for Scenic Environment Use (GB/T 18921—2019)

4.2 What are the management and maintenance modes of a rural domestic wastewater treatment facility?

Ⅰ. Management and maintenance of facilities for centralized collection, treatment and use

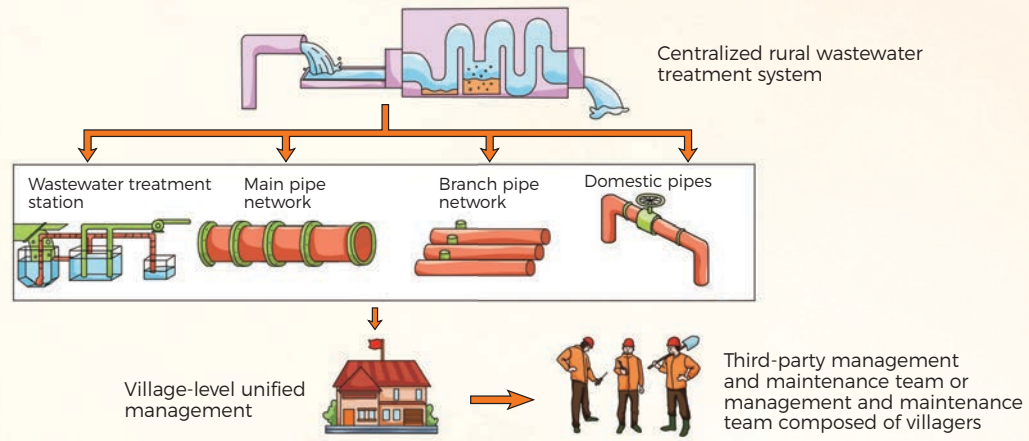
(1) The mode of joint management by towns and villages is applicable to villages without any integrated and unified management of public facilities.

The rural wastewater treatment system mainly comprises treatment stations, a main pipe network, a branch pipe network and domestic pipes. The treatment facilities, such as the treatment stations and the main pipe network, are under town management: The town government entrusts third-party professional management and maintenance teams to implement unified management and maintenance. The treatment facilities, such as the branch pipe network and household pipes, can be under village management: Village committees organize management and maintenance teams or entrust third-party professional management and maintenance teams to implement management and maintenance.



Mode of joint management by towns and villages

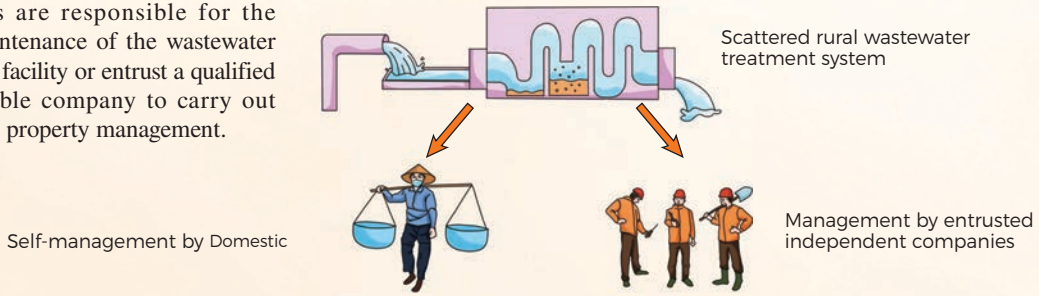
(2) The mode of self-management by village committee is suitable for villages with integrated and unified management of public facilities. Village committees are responsible for the management. And the management and maintenance of a rural wastewater facility is subject to integrated and unified management of rural public facilities. Villagers set up management and maintenance teams or entrust a qualified and capable company to carry out long-term property management.



Mode of self-management by village committee

II . Management and maintenance of facilities for scattered collection, treatment and use

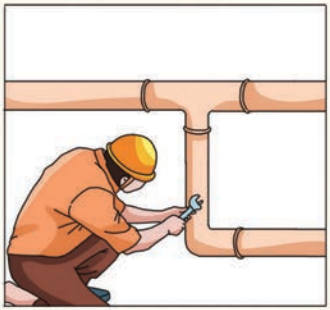
Villagers are responsible for the daily maintenance of the wastewater treatment facility or entrust a qualified and capable company to carry out long-term property management.



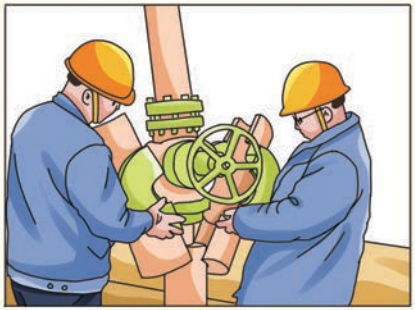
4.3 How should the rural domestic wastewater collection pipe network be maintained?

The daily maintenance of the pipe network mainly involves the removal of waste and sludge in the pipe network; the dredging of pipes; the maintenance of pumps, valves and flowmeters in pumping stations; and the cleaning of the grilles.

Regularly check and maintain the wastewater collection system, and dredge the system immediately if silt or blockage is found.

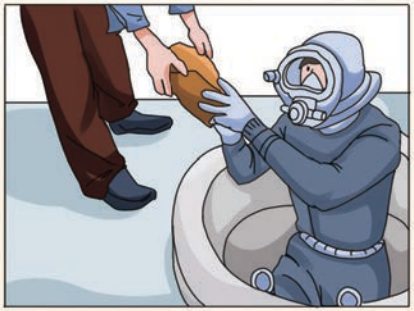


Regularly check pipeline joints and bends for leakage and damage.



Regularly maintain the lifting pumps, valves and flowmeters.

Regularly clean the anti-blocking funnel above a kitchen sewer and the hair filter in the bathroom.



Regularly check and clean inspection wells, conduct safety inspection before going down wells, and take measures to eliminate harmful gases in time.

4.4 What are safety matters in the operation and management of wastewater treatment facilities?

Ⅰ. Establishment of a safety education system

Regular and systematic safety education should be conducted for new operators and managers.

Ⅱ. Smoking or open flames prohibited

Smoking or open flames should be strictly prohibited in the daily operation and management of a treatment centre, and a sign of "smoking or open flames prohibited" should be set at a conspicuous position. When hot work is necessary, safety measures must be taken.

Ⅲ. Protection devices

Wastewater treatment facilities should be equipped with anti-electric shock devices and anti-static devices. Power must be cut off during maintenance, and signs that maintenance is in process should be hung.

Anti-static devices must be available

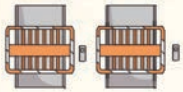
Anti-electric shock devices for high-voltage power equipment must be available

Ⅳ. Safety protection

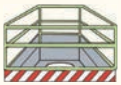
In daily operation and management, safety helmets, safety belts and safety nets should be used. Protection measures should be applied at staircase entrances and exits, elevator entrances, reserved holes, entrances and exits and five surrounding areas. Care must be maintained at all times regarding slipping or falling prevention during work at high places and on rainy or snowy days.

Staircase entrances and exits, elevator entrances, reserved holes, entrances and exits

Stairway protection



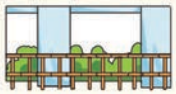
Elevator entrance protection



Reserved hole protection

Entrance and exit protection

Five surrounding areas

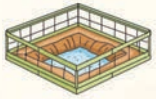


Protection of the areas around each floor

Roof protection

Stair side protection

Protection of the areas around roofs



Protection of the areas around pits, ditches and grooves

Ⅴ. Protection against poisonous substances

Avoid entering facilities with toxic and harmful gases. If it is necessary to enter such a facility, safety measures must be taken. Protective and lifesaving gear and related articles should be provided at conspicuous positions. Emergency response procedures and plans for fire, explosion, toxic and harmful gas leakage, natural disasters and other unexpected events should be developed.

Protective and lifesaving equipment and related articles should be provided at conspicuous positions