

Onsite wastewater treatment systems

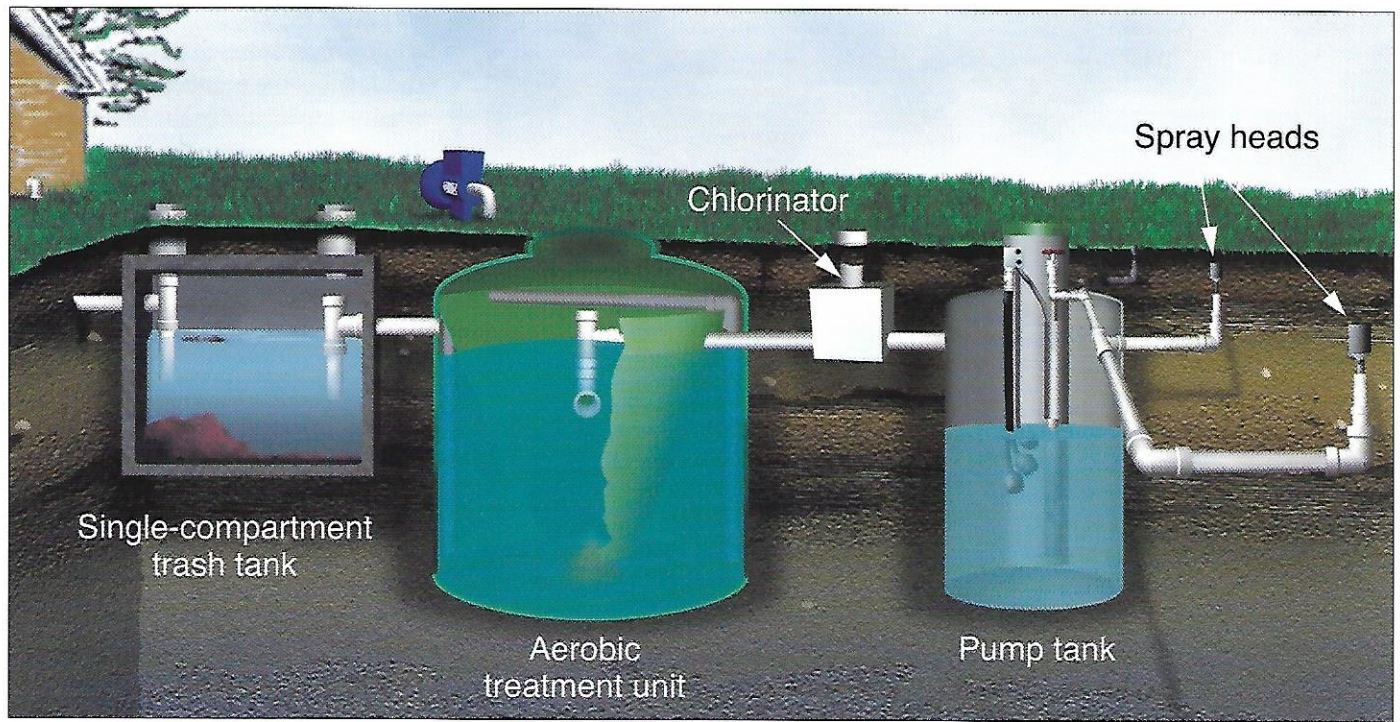


Figure 1: An onsite wastewater treatment system using an aerobic treatment unit.

Aerobic treatment unit

Bruce Lesikar

Professor and Extension Agricultural Engineer
The Texas A&M System

Aerobic treatment units treat wastewater for homes and small businesses using the same process, only scaled down, as our municipal wastewater treatment systems use. They remove 85 to 98 percent of the organic matter and solids from the wastewater, producing effluent as clean as that from municipal wastewater treatment plants, and cleaner than that from conventional septic tanks.

Aerobic treatment units, which are certified as Class I aerobic systems, treat wastewater well enough to be used in conjunction with spray systems, which distribute treated wastewater over lawns. They are the most common way to treat wastewater for spray dispersal systems.

The aerobic treatment process includes four main components that work together to purify wastewater:

- ✓ A pretreatment tank, generally referred to as the “trash tank” because it removes materials that microorganisms (microbes) cannot degrade.
- ✓ An aeration chamber, where aerobic microbes decompose waste in the water. An aeration system consists of an air pump, piping, and diffusers that force air into the aeration chamber.

- ✓ The air pump, located near the aerobic tank, compresses air to flow into the aeration chamber. The diffuser forces the air into the water, dividing the air into bubbles that float to the surface. The oxygen in the air bubbles goes into the water for the microbes, while the rising bubbles mix the wastewater.
- ✓ A settling chamber, commonly called a clarifier, which provides a place for the microbes that have treated the wastewater to settle out of the water.
- ✓ A final treatment and dispersal component, which distributes the

wastewater into the soil for reuse. Aerobic treatment units usually disperse wastewater via a spray field, which includes a disinfection component for removing disease-causing microorganisms, a pump tank for dosing water, and distribution heads for spreading the water over the ground.

For more information on the disinfection, pump tank, and spray distribution components, see Extension publication L-5303, "Spray Distribution System," L-5346, "Pump Tank," and L-5344, "Tablet Chlorination."

Aerobic treatment units can be built from concrete, fiberglass, or plastic. These materials are durable and can be used across the state.

Concrete tanks are heavier and require larger equipment to carry them to the site, which can require additional installation practices during wet periods. Some manufacturers' products incorporate the trash tank, aeration chamber, clarifier, and pump tank into a single structure; others include in one structure only the trash tank, aeration chamber, and clarifier.

The main advantage to having the components in one structure is that the system can be delivered preassembled. The installer must dig only one hole with a level bottom, reducing preparation time for installation.

Fiberglass, plastic, and single-process concrete tanks are light enough to be carried to the installation site by a backhoe. They generally have an aeration chamber and clarifier in one structure. A separate trash tank and pump tank accompany the aeration chamber and clarifier.

All tank types can meet your wastewater management needs. But the systems must be installed according to manufacturer specifications. They also must be watertight to prevent groundwater from entering the system and overloading the treatment unit and final treatment and dispersal area. A spray field distributing more water than usual during wet

times of the year may indicate that the system is not watertight.

Treatment

The aerobic treatment unit components—pretreatment tank, aeration chamber, air pump, and settling chamber—work together to treat the water to a high quality. In the system, wastewater first enters the pretreatment tank or trash trap, which removes plastic objects and other solids that float or settle. Then it enters an aeration chamber, where oxygen supplied by an air pump allows aerobic organisms to live.

Treatment in the aeration chamber is a biological process in which microbes eat the waste and their bodies transform it into nonpolluting material. The microbes change dissolved and solid pollutants into cell mass, nondegradable material, and gases such as carbon dioxide.

It is important to maintain an active population of microbes in the system to break down solids. A variety of aerobic microorganisms living together in a mixed state can decompose many kinds of materials.

Treated wastewater moves from the aeration chamber into a settling chamber or clarifier. The clarifier allows the cell mass and nondegradable materials to settle from the water before it leaves the treatment system. The separation of microbial cells from treated effluent is an important part of the process.

Aerobic treatment processes greatly lower biochemical oxygen demand (BOD), a common measure of pollution, as well as reduce the suspended solids that do not settle to the bottom of the clarifier. This process also removes some of the nitrogen and reduces the number of disease-causing organisms in the waste.

Design

To select an aerobic unit, first determine the amount of daily wastewater flow from the home or small business. Then choose a Class I aerobic treatment unit that can handle the amount of flow.

The Texas Commission on Environmental Quality maintains a list of Class I aerobic treatment units approved for sale in Texas. The approved units are listed by company, model number, their rated treatment capacity, and whether or not they require a trash tank in the treatment system. Choose a Class I aerobic unit with a rated treatment capacity of more than the amount of flow expected from the residence.

The size of aerobic treatment component chosen for a home is determined by the rate of daily wastewater flow expected from that home. The rate is based on the home's square footage or number of bedrooms, whichever is larger (Table 1).

A different sizing factor was used previously, when aerobic treatment units were first built. Later, Texas set a

Table 1. Sizing of wastewater aerobic treatment units for single-family residence of various sizes.

Number of bedrooms	Square footage of house	Texas minimum unit capacity (gal/day)	Traditional unit capacity (gal/day)
1 or 2	less than 1,501	400	450
3	less than 2,501	400	600
4	less than 3,501	480	750
5	less than 4,501	600	900
6	less than 5,501	720	1,050
7	less than 7,001	840	1,200
8	less than 8,501	960	1,350
9	less than 10,001	1,080	1,500

different minimum unit capacity sizing, after the development of water-saving fixtures.

However, the sizing for water-conserving fixtures addressed only the amount of water leaving the home, not the strength of the water. Therefore, many treatment systems are overloaded organically (too much waste), resulting in the need for the sludge to be removed from the systems more often.

Most residential aerobic systems can treat 500 gallons a day. This approach to choosing a system assumes that the wastewater includes an amount of organic matter common for homes; it may be inadequate for certain businesses.

The NSF International Standard 40 rating protocol that establishes the manufacturers' capacity rating does not apply to facilities that are not single-family residences.

Therefore, the size of systems for restaurants and other facilities with strong wastes should be calculated by using both the quantity and organic strength of the facility's wastewater. Base the system size on the greater of these two factors.

Sometimes an aerobic treatment system can meet the minimum state requirement for gallons of wastewater treated per day, but its capacity per hour may be too small for a family's normal activities.

For instance, if a system can handle only 60 gallons per hour (1 gallon per minute), and a normal clothes washer uses 30 to 40 gallons at a time, the residents may have to curtail other water-using activities when doing laundry.

To alleviate that problem, a flow equalization tank may be placed between the trash tank and the aeration chamber. The tank would hold the wastewater and send it to the aerobic unit at a rate it could handle.

A flow equalization tank can be used at facilities with variable wastewater flows or large water-using devices, or in homes where the residents

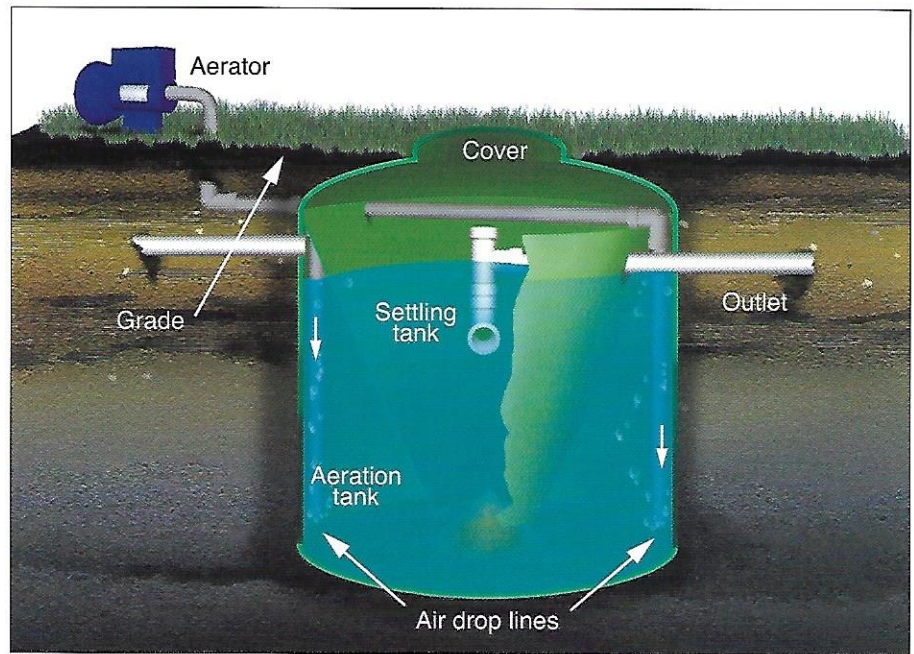


Figure 2: An aerobic treatment unit.

do not want their wastewater treatment system to dictate their lifestyle.

Aerobic treatment units, marketed in Texas as Class I aerobic treatment units, must be tested and certified according to NSF International Standard 40 policies for wastewater treatment devices. Aerobic treatment units that pass the tests are approved for sale as Class I units.

How to keep it working

To remain effective, aerobic treatment unit components need regular maintenance. Poorly maintained systems may not produce water as clean as desired.

For the best care for an aerobic treatment unit, follow the manufacturer's recommendations. Use these general guidelines as a basis for maintaining your system:

- ✓ Monitor the trash tank to determine the amount of solids accumulating in the tank. Have the tank pumped on a schedule similar to a septic tank pumping interval of every 2 to 3 years.
- ✓ Periodically remove the solids in the aeration chamber. Solids form a blanket on the bottom of the clarifier and float in the aera-

tion chamber. Use the "30 minute settle-ability" test to determine when the aerobic treatment unit needs to be pumped.

- ✓ Check the air pump to make sure the air flow rate entering the aeration chamber is constant. Clean the air filter, screen, or vent on the air pump inlet to remove dust and fibers. Look for air leaks in the other components of the aeration system. Check the effluent mixing in the aeration chamber to make sure the air is being distributed properly. The dissolved oxygen concentration in the aeration tank must be more than 1 milligram per liter, preferably 2 milligrams per liter. A dissolved-oxygen meter or test kit can determine the oxygen concentration in the water. When the air flow is reduced, less oxygen is available for the microbes.
- ✓ Keep electricity going to the aerobic treatment unit. It needs a continuous supply of power for the aeration system. The aerobic microbes need the air from the aeration system to survive.
- ✓ Maintain the spray heads in the system. If they are broken,

- replace them with the same type and model as the original. Do not change the spray head locations. Also, do not place a vegetable garden in the spray field.
- ✓ If an alarm sounds, call your maintenance provider. Also, reduce nonessential water use in the home until the system is fixed. Alarms may indicate a high-water or low-air-pressure condition. A high-water condition may be caused by a plugged distribution head or filters, broken pump, excessive water use, or broken fixtures. Low air pressure may be caused by a broken air pump, broken air lines, or a low water level in the aeration chamber.
 - ✓ Maintain a landscape cover in the spray field. The grass and plants there will use the water and nutrients being dispersed by the system.
 - ✓ Most disinfection systems use chlorine tablets to disinfect the treated water. You must add chlorine to the chlorinator. Be careful when handling chlorine, because chlorine gas can burn your lungs. Disinfection is important; without it, untreated wastewater will be sprayed onto the ground.

- ✓ If the wastewater smells bad when it is being distributed, ask the maintenance provider to evaluate all system components. If they are working properly, evaluate your habits in the home. You may be overloading the system with too much organic matter. For example, you may be pouring too much fat and grease down the drain, grinding too much food in the garbage disposal, or sending too many paper products into the wastewater system.

Another problem could be that products toxic to the aerobic microbes are being sent into the system. For example, sending too many cleaning products down the drain can kill the microbes. Also, overloading water to the system, such as when fixtures leak or too much laundry is washed on a single day, dilutes the microbes' food source.

Sending too little waste into the system also can affect it. Microbes need a steady source of organic matter. Homes with periodic usage, such as lake houses with weekend visits, will have problems maintaining a good population of microbes to treat the wastewater. Also, if you leave home for a couple of weeks, their

population in the system could drop for lack of food.

For example, vacationing for 2 weeks lowers the microbial population by reducing the food supply entering the system. Returning home and washing 10 loads of laundry can flush out what population is left with all the laundry water. After a period of low system activity, the microbial population needs time to rebuild so it can function well.

The NSF Standard 40 program provides a way for homeowners to make sure their units can be serviced. Those who cannot find a local maintenance provider can contact the manufacturing company for help in locating one. If the manufacturer does not respond, the homeowner can contact the testing and certification group that tested the unit for help in working with the manufacturer to find a maintenance provider.

Generally, aerobic treatment units are used in conjunction with spray fields that disperse treated wastewater over lawns. To minimize the risk of human exposure to disease-causing microorganisms, it is important that the aerobic treatment unit works properly.

The Onsite Wastewater Treatment Systems series of publications is a result of collaborative efforts of various agencies, organizations and funding sources. We would like to acknowledge the following collaborators:

Texas State Soil and Water Conservation Board	USEPA 319(h) Program
Texas On-Site Wastewater Treatment Research Council	Texas AgriLife Extension Service
Texas Commission on Environmental Quality	Texas AgriLife Research
Consortium of Institutes for Decentralized Wastewater Treatment	USDA Natural Resources Conservation Service

All publications in the On-Site Wastewater Treatment Systems series can be downloaded from the World Wide Web at: <http://AgriLifeExtension.tamu.edu>.

Produced by AgriLife Communications, The Texas A&M System
 Extension publications can be found on the Web at: <http://AgriLifeBookstore.org>.
 Visit Texas AgriLife Extension Service at <http://AgriLifeExtension.tamu.edu>.

Educational programs of the Texas AgriLife Extension Service are open to all people without regard to race, color, sex, disability, religion, age, or national origin.