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Decentralized Systems Technology Fact Sheet
Septage Treatment/Disposal

DESCRIPTION

In 1990 the U.S. Department of Commerce, Census Bureau, estimated that the number of housing units with septic tanks or cesspools in the U.S. was 24.6 million and approximately 5.5 billion gallons of septage were being generated each year. "Septage" is the liquid and solid material pumped from a septic tank, cesspool, or other primary treatment source. Scum accumulates on the surface while the sludge settles at the bottom, comprising 20 to 50% of the total septic tank volume when pumped. A septic tank will usually retain 60 to 70% of the solids, oil, and grease that passes through the system.

Septage is classified according to the environment in which it is generated. This fact sheet will focus solely on domestic septage. Treatment and disposal of domestic septage is governed by the U.S. Code of Federal Regulations (40 CFR) Part 503. Municipalities can also establish local regulations for septage handling, treatment, and disposal in addition to the federal and state regulations.

There are several approaches to septage treatment and disposal which include private or public ownership. Larger municipalities are capable of managing the whole process from handling and treatment to disposal, while other municipalities opt to use privately owned facilities that alleviate some of the responsibilities of operating a facility. Land disposal of septage after adequate treatment is also a popular option.

Septage characteristics

Factors that affect the physical characteristics of septage are: climate, user habits, septic tank size, design, and pumping frequency, water supply characteristics, piping material, and the use of water-conservation fixtures, garbage disposals, household chemicals, and water softeners. Table 1 lists the characteristics and limits of domestic septage.

TABLE 1 CHARACTERISTICS OF SEPTAGE CONVENTIONAL PARAMETERS

	Concentration	
Parameter	**Minimum**	**Maximum**
Total solids	1,132	130,475
Total volatile solids	353	71,402
Total suspended solids	310	93,378
Volatile suspended	95	51,500
Biochemical oxygen demand	440	78,600
Chemical oxygen demand	1,500	703,000
Total Kjeldahl nitrogen	66	1,060
Ammonia nitrogen	3	116
Total phosphorus	20	760
Alkalinity	522	4,190
Grease	208	23,368
pH	1.5	12.6
Total coliform	10^7/100 mL	10^9/100 mL
Fecal coliform	10^6/100 mL	10^8/100 mL

Note: The measurements above are in mg/L unless otherwise indicted.

Source: U.S. EPA, 1994.

TABLE 2 SOURCES OF SEPTAGE

Description Rate	Removal Pump-out	Characteristics
Septic tank	2-6 years, but can vary with location local ordinances	Concentrated BOD, solids, nutrients, variable toxics (such as metals), inorganics (sand), odor, pathogens, oil, and grease
Cesspool	2-10 years	Concentrated BOD, solids, nutrients, variable toxics, inorganics, sometimes high grit, odor, pathogens, oil, and grease
Privies/portable toilets	1 week to months	Variable BOD, soilds, inorganics, odor, pathogens, and some chemicals
Aerobic tanks	Months to 1 year	Variable BOD, inorganics, odor, pathogens, and concentrated solids
Holding tanks (septic tank with no drain-field, typically a local requirement	Days to weeks	Variable BOD, solids, inorganics, odor, and pathogens, similar to raw wastewater solids
Dry pits (associated with septic fields)	2-6 years	Variable BOD, solids, inorganics, and odor
Miscellaneous May Exhibit Characteristics of Septage		
Private wastewater treatment plants	Variable	Septic tank
Boat pump-out station	Variable	Portable toilets
Grit traps	Variable	Oil, grease, solids, inorganics, odor, and variable BOD
Grease traps	Weeks to months	Oil, grease, BOD, viscous solids, and odor

Source: Septage Handling Task Force (1997), copyright Water Environment Federation, used with permission.

APPLICABILITY

Septage is highly variable and organic, with significant levels of grease, grit, hair, and debris. The liquids and solids pumped from a septic tank or cesspool have an offensive odor and appearance, a tendency to foam upon agitation, and a resistance to settling and dewatering. Septage is also a host for many disease-causing viruses, bacteria, and parasites. As a result, septage requires special handling and treatment. However, the polymers and chemical conditioners available today have considerably reduced these requirements.

The handling and disposal of septage are based on the characteristics and volume of septic waste. Knowldege of this information is also useful for design purposes and determining typical design values for treatment and disposal. Table 2 summarizes the sources of septage.

ADVANTAGES AND DISADVANTAGES

Advantages

The advantage of using treatment plants is that they provide regional solutions to septage management.

Disadvantages

- May need a holding facility during periods of frozen or saturated soil.
- Need a relatively large, remote land area for the setup of the septic system.
- Capital and operation and maintenance costs tend to be high.
- Skilled operators may be required.
- Some limitations to certain management options of untreated septage include lack of available sites and potential odor and pathogen problems. These problems can be reduced by pretreating and stabilizing the septage before it is applied to the land.
- Septage treated at a wastewater treatment facility has the potential to upset processes if th septage addition is not properly

controlled, and increased requirements for handling and disposing of residuals.

DESIGN CRITERIA

Surface application

Septage can be applied to the land as a fertilizer and soil conditioner. Application rates depend on the slope, soil type, depth of application, drainage class, and hydraulic loading. Septage must not be applied before or during rainfall or on frozen ground. Thus, an interim storage facility is needed. Some states require septage to be disinfected before application.

- Spray Irrigation-pretreated (e.g., screened) septage is pumped at 80 to 100 psi through nozzles and sprayed directly onto the land. Spray irrigation can be used on steep or rough land and minimizes disturbances to the soil by trucks. It is important to consider the wind patterns and the site location when using spray irrigation because of the offensive odors associated with septage.

- Ridge and Furrow Irrigation-this is used for relatively level land, with slopes no greater than 0.5 to 1.5%. In this disposal method, pretreated septage is applied directly to furrows or to row crops that will not be directly consumed by humans.

- Hauler Truck Spreading-septage is applied to the soil directly from a hauler truck that uses a splash plate to improve distribution. The same truck that pumps out the septic tank can be used for transporting and disposing the septage.

- Farm Tractor and Wagon Spreading-liquid septage or septage solids are transferred to farm equipment for spreading. This allows for application of liquid or solid septage. However, if the septage was not lime stabilized, then the septage must be incorporated into the soil within 6 hours.

Subsurface Incorporation

Subsurface incorporation places untreated septage just below the soil surface, reducing odors and health risks while fertilizing and conditioning the soil. Septage can only be applied to slopes less than 8%, and the soil depth to seasonal high water table must be at least 20 inches (or as mandated by local regulations). A holding facility is required during periods of wet or frozen ground. To prevent soil compaction and allow sufficient infiltration, equipment must not be driven over the site until 1 to 2 weeks after application.

- Plow and Furrow Cover-typically, a moldboard plow is used with furrow wheels and coulters. The coulter blade slits the ground ahead of a plow. Liquid septage is discharged from a tank into a narrow furrow about 15 to 20 cm deep and is then covered by a second plow.

- Subsurface Injection-liquid septage is injected in a narrow cavity created by a tillage tool. The opening is about 10 to 15 cm below the surface. Some equipment uses a forced closure of the injection swath.

Burial

Septage burial includes disposal in holding lagoons, trenches, and sanitary landfills. There is a high odor potential during septage application until a final cover is placed on top. It is essential to select an appropriate site for disposal not only to control odors, but to avoid groundwater pollution.

- Holding Lagoons- these disposal lagoons are a maximum of 6 feet deep, with septage placed in small incremental lifts of 15 to 30 cm and no infiltration. Multiple lagoons are loaded in sequential order for optimum drying. To decrease odors, the lagoon inlet pipe can be placed below liquid level.

- Trenches-multiple trenches are filled sequentially with septage in small lifts of 15 to 20 cm for optimum drying. Each trench is then covered with soil (2 feet), and new trenches are opened. Another option is to

leave a filled trench uncovered to enable some solids to settle and liquids to evaporate and leach out. The solids, along with some bottom and sidewall material, are removed and the trench can be reused.

- Sanitary Landfills- the primary problems that need to be considered when septage is added to a sanitary landfill are the production of leachate, treatment, and odor. Therefore, septage must not be disposed of in landfills with areas that have over 90 cm of rainfall, landfills that do not have leachate prevention and control facilities, or those not having isolated underlying rock. Each area that is filled with septage should be covered with 15 cm of soil each day and 2 feet of final cover within 1 week after the placement of the final lift. In general, sanitary landfills are not cost-effective disposal options for septage.

Septage is resistant to dewatering and as a result conditioning chemicals are used. The amount of chemical used is based on the load and its characteristics. A combination of lime and ferric chloride has been successfully used, along with certain polymers. Septage treatment plants also use other processes to dewater conditioned septage such as screw presses, plate and frame presses, belt presses, rotary vacuum filters, gravity and vacuum-assisted drying beds, and sand drying beds.

Another feasible option for septage treatment facilities is composting in locations where bulking agents are available and the humus product is needed as a soil conditioner. If the necessary bulking agents are not accessible, this method can be expensive. For this reason, it is preferable to dewater septage before composting.

OPERATION AND MAINTENANCE

The three basic alternatives for septage treatment and disposal are land application, treatment at wastewater treatment plants, and treatment at independent septage treatment plants.

Treatment at independent septage treatment plants

- Stabilization lagoon.
- Chlorine oxidation.
- Aerobic digestion.
- Anaerobic digestion.
- Biological and chemical treatment.
- Conditioning and stabilization.
- Composting

Treatment at wastewater treatment plants

- Addition to upstream sewer manhole.
- Addition to plant headworks.
- Addition to sludge handling process.
- Addition to both liquid stream and sludge handling processes.

Land application

- Surface application.
- Subsurface incorporation.
- Burial.

Selecting the appropriate septage management option depends on technical issues and regulatory requirements. Some of the factors that influence the process of selection include: land availability and site conditions, buffer zone requirements, hauling distance, fuel costs, labor costs, costs of disposal, and other legal and regulatory requirements.

Treatment at Independent Septage Treatment Plants

Independent septage treatment plants use such processes as chlorine oxidation, aerobic digestion, anaerobic digestion, and biological and chemical

treatment. Many septage treatment plants also use lime to provide both conditioning and stabilization before the septage is dewatered. The liquid residual can be discharged to a privately owned treatment facility or undergo further treatment and then be discharged. Septage solids are then sent to either a landfill, composted, applied to the land, or incinerated.

When suitable land is unavailable and wastewater treatment facilities are too distant or do not have adequate capacity, independent septage treatment plants can be of use. Such treatment plants have been designed exclusively for treating septage and have many unit processes to handle both the liquid and solid portions of septage.

Stabilization is a treatment method that decreases odors, the levels of disease-causing organisms, and the potential for putrefaction of septage. Pretreatment/stabilization is achieved by physical, chemical, or biological processes. Some methods of stabilizing septage are discussed below.

Alkali (Lime) Stabilization

Lime or other alkaline material is added to liquid septage to raise the pH to 12.0 for a minimum of 30 minutes. Although there is a lot of variation in septage characteristics and lime requirements, mixing is not very difficult, and approximately 20 to 25 pounds of lime are used for every 1,000 gallons of septage. The three main stabilization approaches before land application are to add lime slurry: 1) to the pumper truck before the septage is pumped, 2) to the pumper truck while the septage is being pumped, or 3) to a tank that is storing septage that was discharged from a pumper truck. The septage and lime may sometimes be mixed by a coarse bubble diffuser system located in the tank or truck. In some states, it is prohibited to use hauler trucks for the stabilization process. A separate storage tank is necessary for lime and septage mixing. This is beneficial because a separate holding tank allows for more uniform mixing and easier sampling, monitoring, and control.

Aerobic Digestion

Septage is aerated for 15 to 20 days in an open tank to achieve biological reduction in organic solids and odor potential. The time requirements increase with lower temperatures. Normally, this is not a cost-effective option.

Anaerobic Digestion

Septage is retained for 15 to 30 days in an enclosed vessel to achieve biological reduction of organic solids. Anaerobic digestion is generally not used except for co-treatment with sewage sludge. However, one advantage is that anaerobic digestion generates methane gas, which can be used for digester heating or other purposes.

Composting

Liquid septage or septage solids are mixed with a bulking agent (e.g., wood chips, sawdust) and aerated mechanically or by turning. Biological activity generates temperatures that are sufficiently high to destroy pathogens. The composting process converts septage into a stable, humus material that can be used as a soil amendment. This process tends to create odors that can be a problem if not handled properly.

After the septage is stabilized, it is then sent for further treatment or disposal, which is described in the sections that follow.

Land application

Land application of septage is currently the most commonly used disposal method in the U.S. It is relatively simple and cost-effective, uses low energy, and recycles organic material and nutrients to the land.

With proper management, domestic septage is a resource containing nutrients that can condition the soil and decrease the reliance on chemical fertilizers for agriculture. Septage management maximizes these benefits of septage while protecting public health and the environment.

Land application includes spreading septage from septage hauler trucks, specially designed land application vehicles, or tank wagons onto sites using spray irrigation, ridge and furrow irrigation, and overland flow.

Treatment at Wastewater Treatment Plants

A convenient and attractive option for septage treatment is performing the treatment at a wastewater treatment facility. The constituents of septage are similar to domestic sewage, even though septage is stronger and more concentrated. The advantages of treating septage at wastewater treatment plants are that many plants are capable of handling some septage and that it centralizes waste treatment operations. The four main approaches to treating septage at a wastewater treatment plant are:

To Upstream Sewer Manhole

When septage is added to a sewer upstream of the wastewater treatment plant, substantial dilution of septage occurs prior to it reaching the wastewater treatment plant. This method is only feasible with large sewers and treatment plants. It is economical due to the very simple receiving station design. However, there is the potential for grit and debris to accumulate in the sewer and for odor problems near the manhole.

To Plant Headworks

Septage can be added to sewage immediately upstream of the screening and grit removal processes. This method, like the one mentioned above, is economical because of the very simple receiving station design. It also allows the wastewater treatment plant staff to have control of the septage discharge.

To Sludge Handling Process

Septage can also be handled as sludge and processed with wastewater treatment plant sludge after pretreatment in the receiving station. This method reduces the loading to liquid stream processes, and it eliminates the potential for affecting effluent quality. However, there could be an adverse effect on the sludge treatment processes, such as dewatering. Adding septage to the sludge handling process may also cause clogging of the pipes and increase wear on the pumps if the septage is not screened and degritted in the receiving station.

To Both Liquid Stream and Sludge Handling Processes

Septage can also be pretreated to separate liquid and solid fractions, which are then processed accordingly. This provides more concentrated sludge for processing and reduces the organic loading to liquid stream processes and the hydraulic loading to sludge processes. Increased operations are required for septage pretreatment at the receiving station.

COST

Cost considerations cannot be generalized because of the wide range of options available for septage management. The cost of a septage management system is dependent on the treatment and disposal method used and the regulatory requirements of a particular area.

Administrators of a septage management program should be aware of disposal options and the cost involved. The median cost of disposal (or tipping fee) typically ranges from 3 to 6 cents per gallon.

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