Septage Management

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Fact Sheet

Introduction

The 1990 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. It was also calculated that approximately 5.5 billion gallons of septage are generated each year.

"Septage" is the liquid and solid material pumped from a septic tank, cesspool, or other primary treatment source. A septic tank will usually retain 60 to 70% of the solids, oil, and grease that enter it. The scum accumulates on top and the sludge settles at the bottom, comprising 20 to 50% of the total septic tank volume when pumped.

Many types of septage exist; however, the focus of this fact sheet will be limited to domestic septage. Treatment and disposal of domestic septage is governed by the U.S. Code of Federal Regulations (40 CFR) Part 503. However, municipalities also establish local regulations for septage handling, treatment, and disposal in addition to the federal and state regulations.

Facilities for septage treatment and disposal can be privately or publicly owned. Larger municipalities are capable of managing the whole process from handling and treatment to disposal. 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, while in some cases, pretreatment may not be necessary.

Septage Characteristics

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

Septage is highly variable and organic, with significant levels of grease, grit, hair, and debris. Septage has an offensive odor and appearance, a tendency to foam upon agitation, and a resistance to settling and dewatering. It is also a host for many disease-causing viruses, bacteria, and parasites. These characteristics make septage require special handling and treatment. However, the polymers and chemical conditioners available today have considerably reduced these requirements.

Table 1: Characteristics of Septage–Conventional Parameters

Parameter	Concentration	
	Minimum	Maximum
Total solids	1,132	130,475
Total volatile solids	353	71,402
Total suspended solids	310	93,378
Volatile suspended solids	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.

Adapted from: U.S. Environmental Protection Agency (1994)

It is important to know the characteristics and the amount of septage in order to handle and dispose of it properly. This information is also useful for design purposes and determining typical design values for treatment and disposal. Table 2 on page 2 shows the sources of septage.

Septage Management Options

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

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A Technical Overview

and treatment at independent septage treatment plants. Listed below are some of the various options for each of these three approaches, which will be discussed in detail in the sections to come.

Land Application

- Surface application
- Subsurface incorporation
- Burial

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

Treatment at Independent Septage Treatment Plants

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

Selecting the appropriate septage management option depends not only on technical issues, but particularly on 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.

However, some limitations to certain management options of untreated septage are the lack of available sites or potential odor and pathogen problems, which can be reduced by pretreating and stabilizing the septage before it is applied to the land.

Table 2: Sources of Septage

Description	*Removal Pump-out Rate*	*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, solids, 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, inorganics, odor, and variable BOD
Grease traps	Weeks to months	Oil, grease, BOD, viscous solids, and odor

BOD = biochemical oxygen demand

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Stabilization

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. However, there is a possibility of odors.

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

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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. The disadvantages of land application are the need for a holding facility during periods of frozen or saturated soil and the need for a relatively large, remote land area.

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.

Before it is applied to the land, septage can be stabilized, dewatered, or both; and under certain conditions, it can be applied to the land without any pretreatment. The options for land application of septage are described below.

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 use 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.

Treatment at Wastewater Treatment Plants

A convenient and attractive option for septage treatment would be at a wastewater treatment plant. 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. However, the disadvantages are the potential for upset processes if the septage addition is not properly controlled and the increased requirements for handling and disposing of residuals. The three main approaches to treating septage at a wastewater treatment plant are discussed in the following section.

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

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due to the very simple receiving station design. However, there is a potential for grit and debris to accumulate in the sewer and for odor problems near the manhole.

To Plant Headworks

Septage is 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 is handled as a 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 is 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.

Treatment at Independent Septage Treatment Plants

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. The advantage of using these treatment plants is that they provide a regional solution to septage management. The disadvantages are that capital and operation and maintenance costs may be high and that skilled operators may be required.

These facilities vary from stabilization lagoons to sophisticated 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 use lime to provide both conditioning and stabilization before the septage is dewatered. The liquid residual can be discharged to a privately owned treatment works or it can undergo further treatment and then be discharged. Septage solids can be sent to a landfill, composted, applied to the land, or incinerated.

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.

Septage is resistant to dewatering, thus the need for conditioning chemicals is high and varies among different loads. A combination of lime and ferric chloride has been successfully used, as well as 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.

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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For more information on septage management or a list of other fact sheets, contact the NSFC at West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064. Phone: (800) 624-8301 or (304) 293-4191. Fax: (304) 293-3161. World Wide Web site: http://www.nsfc.wvu.edu.

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