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Onsite Wastewater Treatment Systems: Alternative Technologies

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Introduction

A typical Onsite Wastewater Treatment System (OWTS) consists of a septic tank and a soil absorption field that allows treated effluent to infiltrate into the soil. When functioning, these systems are effective at removing pollutants before they enter into the environment.

However, it has been determined that due to geological and hydrological conditions, 2/3 of the U.S. is unsuitable for septic systems (USEPA, 2002). Costly system failures and the release of pollutants may result if a septic system is improperly sited. Fortunately, many alternative technologies have been developed for situations where conventional systems are not appropriate.

Treatment Units

1. Aerobic Treatment Unit

In an Aerobic Treatment Unit (ATU) (Figure 1), wastewater enters a compartment where solids settle and are partially digested by microorganisms. A motor pumps air into the chamber and mixes the liquid, facilitating diffusion of air and supporting aerobic bacteria that further degrade the wastewater. The treated effluent exits the ATU for additional treatment and dispersion through a soil absorption field.

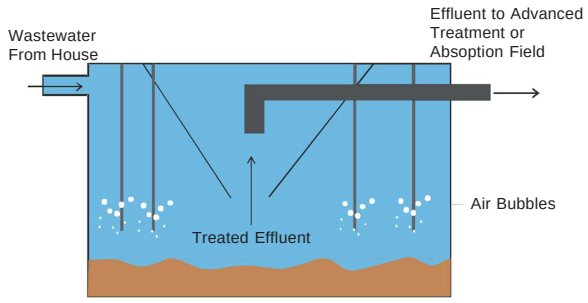

Figure 1. ATU Schematic *(Schematic courtesy of David Berry)*

Advantages: ATUs can reduce the total suspended solids and biochemical oxygen demand. A reduction in suspended solids improves the efficiency and life of the soil absorption field.

Disadvantages: ATUs require electricity and have moving parts, requiring frequent inspection and high equipment replacement costs.

Purchase Cost: The cost of an ATU is between $3,500 and $10,000.

Operation and Maintenance Cost: Operation and maintenance costs average between $500 and $700 per year. This includes the cost of electricity to run the air pump and regular inspection costs.

2. Fixed-Activated Sludge Treatment

Fixed-Activated Sludge Treatment (FAST) systems are similar to aerobic treatment units that fit inside pre-existing septic tanks (Figure 2). The wastewater cycles between the oxygenated FAST system and the septic tank. This recycling action causes microorganisms to convert ammonia and nitrates into nitrogen gas, an inert and abundant atmospheric gas. Because the FAST unit features recycling of effluent, it is more effective than a single-pass ATU at removing ammonia and nitrates.

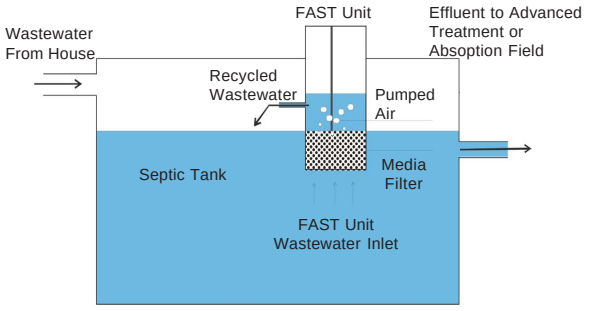

Figure 2. FAST System Schematic *(Schematic courtesy of David Berry)*

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Advantages: The FAST system is particularly efficient at ammonia and nitrate removal.

Disadvantages: The FAST unit uses electricity and requires occasional maintenance of the motor.

Purchase Cost: A FAST unit costs about $5,000. A properly sized septic tank costs about $2,000.

Operation and Maintenance Cost: Typical costs are approximately $300 per year. This amount includes electricity and regular inspection costs.

3. Recirculating Sand Filter

The Recirculating Sand Filter (RSF) utilizes an additional treatment stage beyond the conventional septic system (Figure 3). Effluent from the septic tank is pressurized and sprayed on a volume of sand. Microorganisms break down organic matter and convert ammonia into nitrate as the effluent filters through the sand. When the effluent reaches the under drain, a portion of the water enters the soil absorption field and the rest re-circulates through the septic tank, where the nitrates are converted into nitrogen gas, an inert gas that can be vented to the atmosphere.

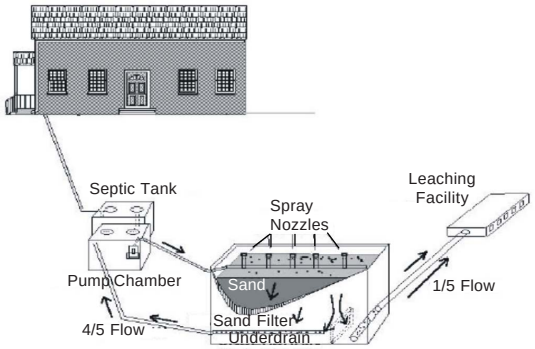

Figure 3. RSF Schematic (Massachusetts DEP, 1997)

Advantages: Recirculating sand filters are extremely efficient at reducing biochemical oxygen demand, total suspended solids, and ammonia and nitrate levels in a relatively small area.

Disadvantages: Frequent inspection and maintenance is required to ensure proper functioning.

Purchase Cost: The costs of an RSF are variable, depending upon the cost of the sand media. An estimate is between $10,000 and $15,000.

Operation and Maintenance Cost: $200 to $300 per year, including electricity. The system must be inspected and occasionally the top layer of sand must be removed for optimal performance.

4. Trickling Filter

In trickling filters (Figure 4), also known as fixed-film reactors, microorganisms typically grow on a specially designed synthetic material, such as a plastic polymer, instead of being carried with the liquid, as in a typical septic system.

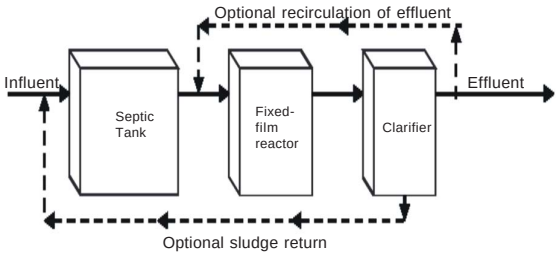

Figure 4. Trickling Filter Schematic (Massachusetts DEP, 1997)

Advantages: Trickling filters can handle surges of flow to the system without losing the microbial community responsible for effluent treatment. They are extremely effective at reducing biochemical oxygen demand.

Disadvantages: Trickling filters must be used as an advanced treatment in conjunction with the septic tank.

Purchase Cost: Equipment is about $9,000 including installation.

Operation and Maintenance Cost: Approximately $200 to $300 per year. The unit must be inspected regularly by a professional.

5. Sequencing Batch Reactor

The sequencing batch reactor (SBR) is particularly successful at the removal of nitrate, phosphorus, and ammonia. The design principle consists of a series of processes that occur in sequence in a single underground unit (Figure 5). During the treatment cycle no additional influent is allowed to enter the unit.

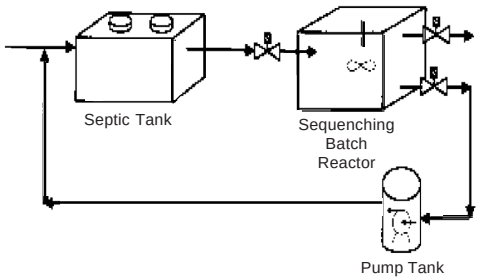

Figure 5. SBR Schematic (City of Austin, 2001)

Advantages: Efficient removal of nitrate, phosphorus, and ammonia.

Disadvantages: This technology requires professional operation and maintenance, so a contract with a licensed company is highly recommended.

Purchase Cost: The cost of equipment and installation is about $8,500 to $12,000

Operation and Maintenance Cost: Yearly maintenance costs are on average $250 to $400. This includes electricity, inspections, and pumping.

Soil Absorption Systems

1. Mound System

Mound systems (Figure 6) are so prevalent they are not considered an "alternative" technology. They are appropriate for areas with a high water table or shallow bedrock. A septic tank or alternative system first treats the wastewater. The liquid then flows into a storage compartment, where it is pumped up to a leach field within a soil mound a few feet above grade. The mound provides an adequate volume of unsaturated soil to treat the wastewater that exits the perforated pipe network in the leach field. The cost of a mound system is highly variable, depending in large part on the cost of the transport of the appropriate soil mixture to the construction site.

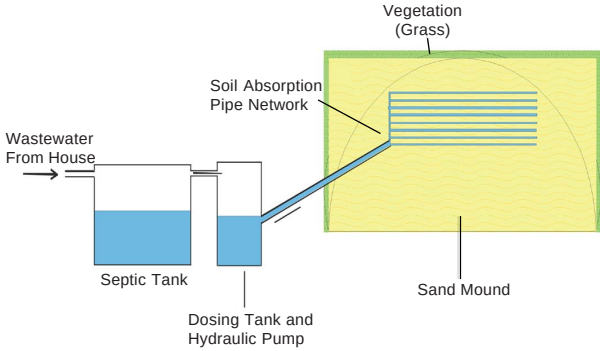

Figure 6. Mound System Schematic *(Schematic courtesy of David Berry)*

Advantages: The mound system performs well in areas with high water tables or shallow bedrock.

Disadvantages: Installation is expensive and the mound can be visually and physically obtrusive.

Purchase Cost: A mound system costs approximately $25,000 to install.

Operation and Maintenance Cost: About $100 per year. This cost includes electricity and regular inspections.

2. Subsurface Drip System

Drip systems (Figure 7) feature small diameter plastic piping with effluent emitters. The piping network runs through a system of shallow trenches. Effluent is pumped intermittently to the pipes for slow infiltration into the soil.

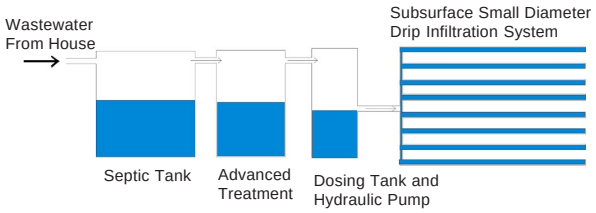

Figure 7. Drip System Schematic *(Schematic courtesy of David Berry)*

Advantages: Drip irrigation is ideal in hilly, rocky conditions where there is little space for soil absorption. It also avoids mound necessity.

Disadvantages: It is important that the effluent has been filtered of solids that could potentially clog the piping. The effluent should be treated to an advanced level so that it is safe for shallow land application.

Purchase Cost: Approximately $15,000 including the pumps, valves, and control units.

Operation and Maintenance Cost: The annual fee for an operation and maintenance contract is approximately $500. This covers inspections and regular maintenance. Electricity usage will add a small additional cost.

3. Peat Field

A peat leach field, which is usually in a contained unit, is very similar in design to a conventional leach field. The main difference is that effluent drips through a layer of peat before entering the soil. This has been shown to improve the quality of effluent by reducing total solids and nitrate levels. Because peat is a natural substance, the composition of it is extremely variable. Peat that is to be used for onsite treatment must have certain characteristics to make it an efficient filter, such as proper moisture content and preparation.

Advantages: Peat is relatively simple to install and maintain, and delivers a high quality effluent.

Disadvantages: It is important that the system be built correctly and with the right materials because if improperly installed peat systems may clog.

Purchase Cost: Installation of the peat field is approximately $10,000.

Operation and Maintenance Cost: About $100 per year for electricity and for pump maintenance.

Conclusion

Many of these technologies are considered to be experimental in New Jersey at this time. Therefore, a New Jersey Department of Environmental Protection (NJDEP) Treatment Works approval is required. Contact NJDEP at 609-292-0407 for more information

For More Information

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U.S. Environmental Protection Agency
http://cfpub.epa.gov/owm/septic/home.cfm and
www.epa.gov/etv/verifications/vcenter9-3.html

NSF International
www.nsf.org/business/wastewater_treatment/index.asp?program=WastewaterTreatmentUnits

A Compendium of Information on Alternative Onsite Septic System Technology in Massachusetts
www.state.nj.us/dep/dwq/pdf/compend.pdf

References

City of Austin Onsite Wastewater Treatment and Disposal Fact Sheets. 2001. Austin, Texas. *www.ci.austin.tx.us/wri/fact.htm*.

Massachusetts Department of Environmental Protection (DEP). 1997. *A Compendium of Information on Alternative Onsite Septic System Technology in Massachusetts. www.state.nj.us/dep/dwq/pdf/compend.pdf*.

U.S. Environmental Protection Agency (USEPA). 2002. Manual: *Onsite Wastewater Treatment Systems Manual*. EPA/625/R-00/008. Office of Research and Development. Cincinnati, OH.

A Partial List of New Jersey Suppliers and Installers

(The inclusion of these companies does not indicate an endorsement by Rutgers University; it is merely provided as a reference tool.)

A-L Septic Services
Vineland, NJ
Phone: (856) 691-3433

Aquapoint, Inc.
New Bedford, MA
Phone: (508) 998-7577 x17

Arthur Stanley Septic
Burlington, NJ
Phone: (609) 386-9814

Ashco-A-Corporation
Morgantown, WV
Phone: (304) 291-0808

Bio-Microbics, Inc.
Shawnee, KS
Phone: (800) 753-3278

Central Jersey Septic Inc.
Old Bridge, NJ
Phone: (732) 525-0040

Cromaglass Corporation
Williamsport, PA
Phone: (570) 326-3396

Ewing Septic Systems
Cape May, NJ
Phone: (609) 884-3312

F.R. Mahony & Assoc., Inc.
Rockland, MA
Phone: (781) 982-9300

L.J. Rusciani Assoc., Inc.
Berlin, NJ
Phone: (609) 767-2323

Manchester Septic Tank Co.
Freehold, NJ
Phone: (732) 761-9540

Montville Septic Service
Boonton, NJ
Phone: (973) 334-4800

Septic Restoration Systems
Sparta, NJ
Phone: (973) 729-8549

Septic System Services
Wharton, NJ
Phone: (973) 361-0181

South Jersey Bio-Septic Supply Co.
Elmer, NJ
Phone: (856) 358-4771

Sweetrose Septic Corp.
Andover, NJ
Phone: (973) 347-3878

Tri-County Septic Service
Newton, NJ
Phone: (973) 579-2751

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