



# Intermittent Sand Filters

Project funded by the U.S. Environmental Protection Agency under Assistance Agreement No. CX824652

## What is an intermittent sand filter?

Sand filter systems have been used for wastewater treatment in the U.S. since the late 1800s. They are a viable alternative to conventional methods when soil conditions are not conducive for proper treatment and disposal of wastewater through percolative beds/trenches. Sand filters can be used in sites that have shallow soil cover, inadequate permeability, high groundwater, and limited land area.

An assessment conducted by the U.S. Environmental Protection Agency of intermittent sand filter (ISF) systems in

the sand filter, treatment is accomplished through physical and chemical means, but mainly by microorganisms attached to the filter media. The treated wastewater is collected in underdrains at the bottom of the sand filter and is then transported to a line for further treatment or disposal. (See Figure 1.)

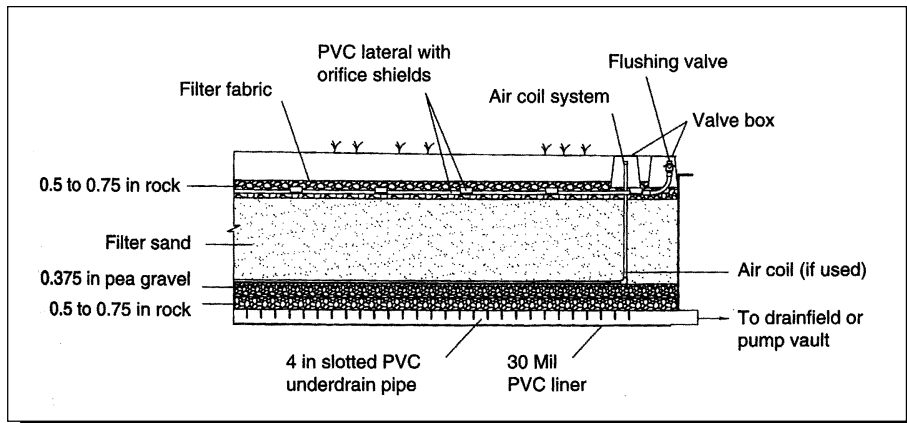
ISFs are designed such that the pre-treated wastewater passes through the sand filter bed once.

## Common Types of ISFs

### Gravity Discharge ISFs

One variety of buried ISFs, the gravity discharge ISF, is usually located on a hillside

with the long axis perpendicular to the slope to minimize the excavation required. Because the effluent leaving the sand filter flows out by gravity, the bottom of the sand filter must be several feet higher than the drainfield area. To achieve that difference in elevations, a sand filter may be constructed partially above ground.



**Figure 1: Typical Cross Section of an Intermittent Sand Filter**

Source: Orenco Systems, Inc., Sutherlin, Oregon (1998), used with permission

1985 revealed that sand filters are a low-cost, mechanically simple alternative. More recently, sand filter systems have been serving subdivisions, mobile home parks, rural schools, small communities, and other generators of small wastewater flows.

In ISFs, wastewater is applied in intermittent doses to a bed of sand or other suitable media. The wastewater first receives primary treatment in a septic tank or an aerobic treatment unit, and then is pumped from a screened vault in the septic tank or separate dosing tank to the sand bed where it is evenly distributed over the top of the sand filter bed. As the wastewater passes through

### Pumped Discharge ISFs

Another type of buried sand filter, the pumped discharge sand filter, is usually sited on level ground, but its location in relation to the drainfield is not critical since a pump located within the sand filter bed allows effluent to be pumped to a drainfield at any location or elevation. Discharge piping goes over—not through—the sand filter liner, so the integrity of the liner is protected.

### Bottomless ISFs

A third type of buried sand filter has no impermeable liner and does not discharge to a drainfield, but rather directly to the soil below the sand.

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## What are the advantages and disadvantages of using ISFs?

### Advantages

- ISFs produce a high quality effluent that can be used for drip irrigation or can be surface discharged after disinfection.
- Drainfields can be small and shallow.
- ISFs have low energy requirements.
- ISFs are easily accessible for monitoring and do not require skilled personnel to operate.
- No chemicals are required.
- If sand is not feasible, other suitable media could be substituted that may be found locally.
- Construction costs for ISFs are moderately low, and the labor is mostly manual.
- The treatment capacity can be expanded through modular design.
- ISFs can be installed to blend into the surrounding landscape.
- The soil cover prevents odors.

### Disadvantages

- The land area required may be a limiting factor.
- Regular (but minimal) maintenance is required.
- Odor problems could result from open filter configurations and may require buffer zones from inhabited areas.
- If appropriate filter media are not available locally, costs could be higher.
- Clogging of the filter media is possible.
- ISFs could be sensitive to extremely cold temperatures.
- ISFs may require an NPDES Permit when the effluent is surface discharged.

## What determines the performance of an ISF?

ISFs produce a high quality effluent by removing a very high percentage of the contaminants. The performance of an ISF depends on how biodegradable the wastewater is, the environmental factors within the filter, and the design of the filter. The most important environmental factors that determine the effectiveness of treatment are media re-aeration and temperature. Re-aeration makes oxygen available for the aerobic decomposition of the wastewater. Temperature directly affects the rate of microbial growth, chemical reactions, and other factors that contribute to the stabilization of wastewater within the ISF.

Several process design parameters that affect the performance of ISFs are the degree the wastewater was pretreated prior to going through the sand filter, media size and depth, the hydraulic loading rate, and dosing techniques and frequency.

Although physical, chemical, and biological processes are all at work to some degree in an ISF, the biological processes play the most important role since bacteria are the primary workers in sand filters.

## Are ISFs easy to operate and maintain?

ISFs require annual maintenance, although the complexity of maintenance is generally minimal. Buried sand filters used for residential application can perform for an extended period of time.

The majority of operation and maintenance involves monitoring the influent and effluent and checking the dosing equipment periodically.

Pumps and controls should be checked every 3 months, and the septic tank or aerobic unit should be checked for sludge and scum buildup and pumped as needed. Control panels with programmable timers and hour and event meters simplify troubleshooting and diagnosis.

## What is the cost of an ISF?

The cost of ISFs depends on the labor, materials, site, capacity of the system, and characteristics of the wastewater. For a single-family home, the main construction costs, primarily for labor and materials, generally run from \$7,000 to \$10,000 where installers have experience with sand filters. Energy costs mostly involve the pumping of wastewater onto the filter and run between 3 and 6 cents per day. Consequently, the energy costs of sand filters are lower than most other small community processes except for lagoons.

## How do I stay informed about ISF technology?

For more information on ISFs or a list of other fact sheets, contact the National Small Flows Clearinghouse (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.nsf.wvu.edu>.

The NSFC provides free and low-cost informational services and products to help homeowners and small communities address their wastewater needs. Also, information about manufacturers, consultants, regulations, and facilities can be obtained from the NSFC's databases.

## References

- Anderson, D. L.; R. L. Siegrist; and R. J. Otis. 1985. "Technology Assessment of Intermittent Sand Filters." U.S. Environmental Protection Agency (EPA). Municipal Environmental Research Laboratory. Cincinnati, Ohio.
- Crites, R. and G. Tchobanoglous. 1998. *Small and Decentralized Wastewater Management Systems*. The McGraw-Hill Companies. New York, New York.
- Sievers, D. M. 1998. "Pressurized Intermittent Sand Filter With Shallow Disposal Field for a Single Residence in Boone County, Missouri." On-Site Wastewater Treatment: Proceedings of the Eighth International Symposium on Individual and Small Community Sewage Systems. Orlando, Florida.
- U.S. Environmental Protection Agency. 1980. *Design Manual: Onsite Wastewater Treatment and Disposal Systems*. EPA Office of Water. EPA Office of Research & Development. Cincinnati, Ohio. EPA 625/1-80-012.
- . 1992. *Manual: Wastewater Treatment/Disposal for Small Communities*. EPA Office of Research & Development. EPA Office of Water. Washington, D.C. EPA/625/R-92/005.

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