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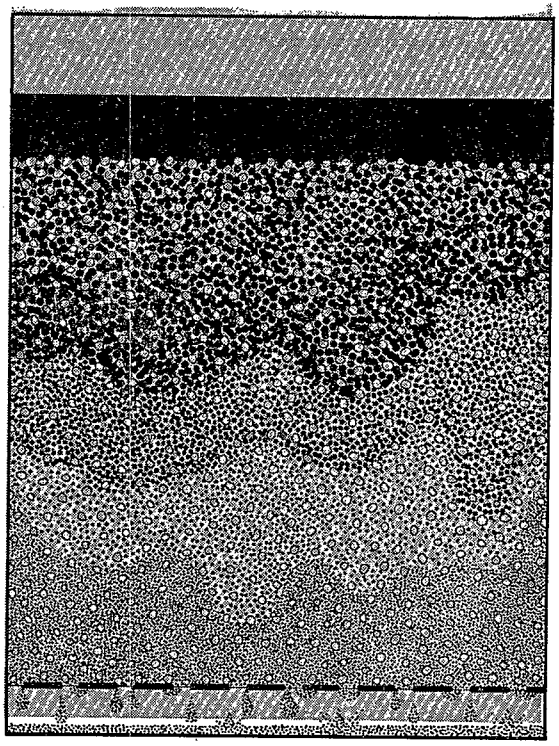
An Emerging Technology

Intermittent Sand Filtration

A Process Assessment



Intermittent Sand Filtratic

Introduction

A goal of wastewater treatment processes is to produce an environmentally acceptable effluent at the lowest possible cost. The task of choosing a process which fulfills this goal can be challenging when the volume of wastewater is small. For example, treatment of wastewater from a sparsely populated community at a central facility may be inappropriate due to the high cost of construction, operation, and maintenance of long sewer lines, numerous manholes, and lift stations. Where only small wastewater volumes are generated, on-site treatment is a possible cost-effective solution. One such system - capable of effective treatment of wastewater from residences and small commercial establishments at a reasonable cost - is the Intermittent Sand Filter (ISF).

This brochure discusses the technology of the ISF system and addresses design, performance, operation and maintenance, and cost aspects of the process.

In an ISF system, the effluent from a septic tank or an aerobic unit receives additional treatment through periodic application to a filter. ISFs can be used to upgrade existing wastewater facilities such as lagoons or replace failed soil absorption systems (SAS). The ISF system can also be a low cost alternative when site, soil, or other conditions restrict the use of SASs.

Technology

The ISF relies primarily on biological and physical processes to remove wastewater contaminants. The effluent can then be discharged in an environmentally sound manner. A simplified flow schematic of the ISF process is shown in Figure 1.

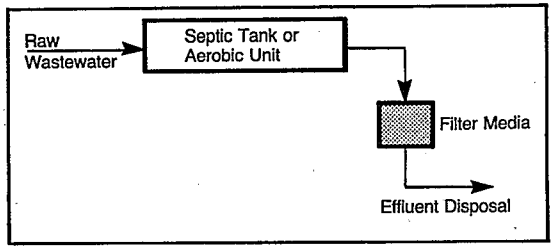


Figure 1 ISF Process Flow Schematic

with 24 to 36 inches of media so that a "clogged" top layer can be removed several times before total bed replacement is necessary.

Compliance with local health regulations may necessitate disinfection of the filter effluent prior to discharge to surface water. Local codes may stipulate the distance that an ISF must be separated from potable water supplies (usually 100 feet).

Performance

Under normal operating conditions, ISFs will produce high quality effluents with respect to BOD_5 and suspended solids. The BOD_5 concentration of an ISF effluent is generally less than 10 mg/l, except during filter startup and maturation. The mean concentration of suspended solids in ISF effluents is usually less than 15 mg/l. A properly functioning ISF will have an organic mat on the filter surface where microorganisms "treat" the organics in the wastewater. As the age and density of the mat increases, treatment improves due to greater retention time. However, too thick a mat results in filter clogging.

An ISF having clean sand can remove up to 50% of a waste stream's phosphorus. Phosphorus removal by a mature filter is low, and additional treatment processes are necessary if discharge permits require reduced phosphorus concentrations. Removal of nitrogen is dependent on wastewater type, filter loading rates, ambient temperature, and other meteorological conditions.

ISFs can also significantly reduce the concentrations of wastewater fecal and total coliforms and fecal streptococci bacteria. ISF performance will be a direct result of the system's design, operation, and maintenance.

Operation and Maintenance

A properly designed ISF will require a minimum of time spent on operation and maintenance (O & M). Table 2 presents the major requirements and suggested scheduling of O & M activities to obtain optimum treatment efficiency. O & M requirements for ISFs are not overly complicated, and many can

Item	Buried
Pretreatment	
Septic Tank	Inspect at 1 to 2 year intervals, pump solids if necessary (usually once every 3 to 5 years)
Aerobic Unit	Inspect at 4 to 6 month intervals, pump solids every 8 to 12 months
Dosing Chamber	
Pumps and Controls	Check every year
Timer Sequence	Check and adjust every 6 months
Appurtenances	Check every 6 months
Filter Media	
Raking	None
Replacement	None
Miscellaneous	

Table 2 ISF Operation and Maintenance Activities

be performed by an informed homeowner. Service of pumps, electrical equipment, and pretreatment units should, however, be performed by experienced maintenance personnel. Communities may wish to consider establishing a community-run or contract maintenance program, thereby relieving the homeowner of direct involvement in maintenance activities.

One of the most important O & M activities for an ISF system is the periodic pumping of solids that accumulate in the pretreatment unit. Properly scheduled, pumping reduces the possibility that materials such as oils, grease, and scum will overflow and clog the filter surface. This is especially critical for buried ISFs, since the filter media is inaccessible for maintenance.

Open	Recirculating
ame	Same
ame	Same
heck every 3 months	Check every 3 months
heck and adjust every 3 months	Check and adjust every 3 months
heck every 3 months	Check every 3 months
3 inches deep when ponding occurs	To 3 inches deep when ponding occurs
eplace top 1 to 4" of sand when onded more than 12" deep, eptic tank fed filters are rested pproximately 6 to 9 months hile an alternate unit operates, erobic unit fed filters can mediately be returned to ervice	Skim sand if heavy incrustations occur, add new sand when bed depth falls below 24"
eed as required, maintain istribution device, protect filter gainst ice sheeting, check high ater alarm	Weed as required, maintain distribution device, protect filter against ice sheeting

Costs

The expenses incurred in constructing ISFs are a function of local labor and material costs and are greatly influenced by the land acquisition and filter media costs. Approximate costs (1982 dollars) for construction of three types of ISFs are as follows:

Buried: $2400 to $4500

Open: $3900 (average)

Recirculating: $3500 (average)

These examples assume a four bedroom house having a 1,000-gallon septic tank and a design flow of 600 gallons/day. The costs include $300 to $600 to reflect the costs of the septic tank. An aerobic pretreatment unit will increase the system's cost by $600 to $3600. Annual O & M costs range from $30 if pretreatment is a septic tank to $500 if

Recirculating: Recirculating filters are open filters that treat a mixture of the pretreatment unit effluent and recycled filter effluent. This filter depends on biological activity for treatment, as do buried or open filters. When the system is operating properly, odors from the recirculation tank and open filter are usually not objectionable since septic tank effluent is mixed with aerobic effluent returning from the filter.

Design

Treatment of domestic wastewater prior to filtration is usually provided by a septic tank or aerobic unit. Large wastewater volumes can be pretreated in lagoons.

Filter media particle sizes can strongly influence final effluent quality. Media that is too coarse allows wastewater to pass rapidly through the filter which results in insufficient detention time for biological decomposition. Fine media limits the quantity of wastewater filtered and may cause premature clogging. The most effective filter media particle size is different for each type of ISF.

Each type of ISF requires a different method and rate of wastewater application. Wastewater characteristics also influence the loading rate. In general, the higher the organic strength of the waste, the lower will be the recommended loading rate.

Typically recommended filter media particle sizes and loading rates for the three different types of ISFs are shown in Table 1.

A filter bed depth of 9 to 12 inches is sufficient to treat most wastewaters. Additional depth of filter media will not appreciably improve effluent quality; however, it is recommended that ISFs be supplied

ISF Type	Filter Media Particle Size (millimeters)	Wastewater Application Rate (gallons/day/square foot)	Method of Wastewater Application
Buried	.25 - 1.0	<1.5	Flooded 2 to 4 times daily
Open	0.35 - 1.00	2-5 for septic tank effluent 5-10 for aerobic effluent	Flooded to 2 inches more than 4 times daily
Recirculating	1.0 - 1.5	3 to 5	Dosed periodically

Table 1 Typical ISF Design Parameters

Raw wastewater first receives preliminary treatment in a septic tank or aerobic unit. The effluent is then periodically applied to a bed of granular material. During its passage through the filter, the wastewater is treated further by biological and physical processes. Sand is the common choice as filter media because of its low cost and availability.

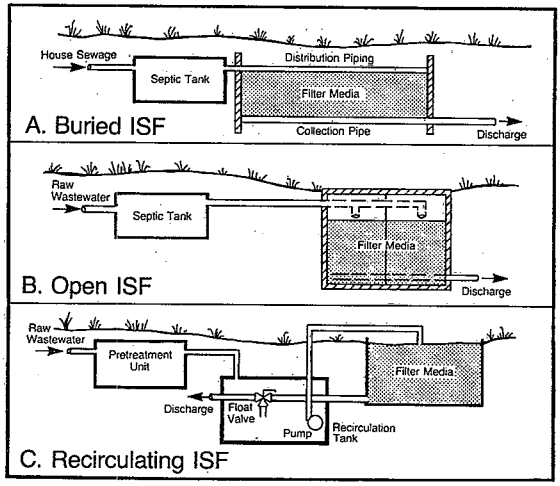


Figure 2 Three Types of ISFs

Three types of ISFs are illustrated in Figure 2 and described as follows:

Buried: Pretreated wastewater is distributed through a network of pipes laid above the filter. Perforated piping beneath the filter collects and conveys the effluent for surface disposal. Buried ISFs are best suited for single-family residences and small commercial establishments.

Open: Wastewater from either aerobic treatment or a septic tank is applied to the filter surface by a distribution pipe. A buried concrete box structure is often used to contain the filter media and can be operated with or without a cover depending on the climate. When septic tank treatment precedes an open ISF, two independent filters may be required to allow for recovery periods. Open filters, sometimes referred to as "free access" ISFs, can handle larger wastewater volumes than buried ISFs and can also be used as small community, cluster, and commercial systems.

pretreatment is an aerobic system requiring pumping plus a recirculating pump and final disinfection.

Implementation

Several factors should be assessed prior to the construction of an ISF system. Local jurisdictions should be consulted to determine the acceptable methods of effluent disposal. ISF effluent can be discharged to surface waters, subsurface to ground water, or to land. As with any wastewater treatment system, it will be necessary to determine the need for Federal or State discharge permits for the specific application.

Careful planning may allow for the implementation of ISF systems in situations where lot size and topography may limit disposal by other processes. A lot of .25 acres is usually large enough for installation of an ISF. Topography is rarely restrictive for ISF construction, but wastewater may be conveyed to a nearby site where an ISF system can be installed. However, where the topography of individual lots is not amenable to standard construction of an ISF, special designs such as filter trenches often overcome the problem.

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