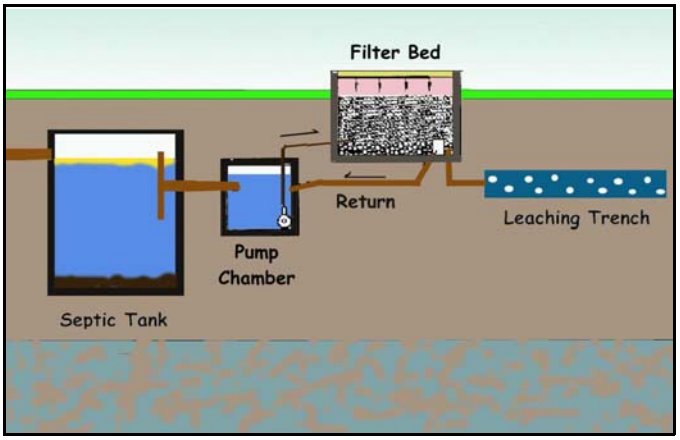
Massachusetts Alternative Septic System Test Center *Recirculating Sand Filter*
Technology Fact Sheet - *Interim Findings*

The Massachusetts Alternative Septic System Test Center is a collaborative project of the Buzzards Bay Project National Estuary Program, Massachusetts Office of Coastal Zone Management, Massachusetts Department of Environmental Protection, Barnstable County Department of Health and the Environment, and UMass Dartmouth School for Marine Science and Technology. The Test Center was established in recognition of the need in Massachusetts for cost-effective wastewater disposal systems suitable for sites with limited space, poor soils, high groundwater elevations, or where advanced pollutant removal is required. Its mission is twofold. First, to evaluate the performance and operation costs of new and innovative wastewater disposal technologies in a carefully controlled and unbiased manner, and provide this information to regulators and consumers. Second, to assist vendors in getting their technologies more quickly approved for use in Massachusetts, and at a lesser cost.

Technology Name:	Recirculating Sand Filter.
Technology Type:	Recirculating Sand Filter- Return design for nitrogen removal.
Manufacturer:	Non-proprietary, many manufacturers
Contact:	Massachusetts DEP
Company Website:	Not applicable.
Performance & Permitting info at MA DEP and BCHED Websites:	www.state.ma.us/dep/brp/wwm/t5pubs.htm#it www.barnstablecountyhealth.org/AlternativeWebpage/
Testing Objectives:	Evaluate nitrogen removal.
Testing Period:	Testing began 2/00 and is ongoing. Results shown for 2/00 to 3/01.
Test Loadings:	System loading was 330 gpd, (in 15 doses AM/PM), SAS was 0.74 gallons per sq. ft per day.



Generalized design of a Recirculating Sand Filter.

Sand Filter Bed during installation.

Sand filter bed after 6 months.

Siting Considerations and Installation Notes

RSF systems generally consist of a septic tank, sand filter and pump chamber, although some variations do not require a separate pump chamber. Systems vary widely in design characteristics. Care should be taken in selection of filter media. Provide free access to the recirculation valve or box. Clean-out sweeps are recommended for pressure distribution laterals atop the sand filter. Designer should consider inspection and maintenance access for all critical components. Designer should consult Massachusetts Guidelines for Recirculating Sand Filters. Designers specifying open-access filter beds should consider placement of filter component where occasional odors will not be a nuisance. Designers specifying covered filter beds should consider the difficulties that a cover may present if the media surface must be serviced. Above ground components include a portion of the filter and an electrical control panel with a visual and audible alarm. Dosing to the filter is controlled by a timer in the control panel. Event counters and run-time meters are recommended for all pumps. At the Test Center, only two RSF replicates were installed. One RSF was covered with wood chips, the other with insulated plywood. In Massachusetts, the RSF flows to an SAS, but no SAS were used or evaluated in this study.

Actual and Estimated Costs (3-bedroom home) and Labor

Non-Title 5 Components: $2,800. (Test Center estimate).
Components + Installation: $4,800 more than conventional.
Electrical: $100 per year actual (local rates, KWh= 909).
O&M: Quarterly inspection of motors, effluent and sludge. A service contract is required in Massachusetts (Approximately $400 per year minimum, but varies). Septic tank pumping averages $60 per year.
Other Costs: Quarterly effluent quality monitoring is required for some permits ($300 or more annually). Design permitting costs vary with site.
Replacement: Pumps ($300) generally have 1-year manufacturer's warranty, sand filter ($500) expected to last 30 years.

Theory of Operation

This technology is a trickling filter using passage over variously-textured sand on which an active community of bacteria develops to achieve the nitrification of septic tank effluent (the conversion of ammonium to nitrate). After passing through the filter (sometimes at the bottom of the filter), the flow is split to return a portion of the nitrified effluent back to the anoxic "recirculation tank" or pump chamber for denitrification (conversion of nitrate to nitrogen gas). Some additional pollution removal likely occurs in the SAS.

Certification for General Use: Title 5 requires utilization of an RSF or "equivalent alternative technology" in nitrogen sensitive areas that are limited to 440 gpd. For residential systems less than 2000 gpd an RSF can be installed to treat and dispose of up to 550 gpd per acre where the allowable density for residential use is limited to 440 gpd per acre for a conventional Title 5 system. RSFs or equivalent alternative technologies are required for all systems with design flows of 2000 gpd or greater in nitrogen sensitive areas. Remedial Use: RSFs are approved in remedial situations where a system is failed, failing or nonconforming where relief is sought to construct an SAS within two feet (or three feet for percolation rates exceeding two minutes per inch) of the high groundwater elevation, to construct an SAS reduced in size by up to 50 percent or in areas where at least 2 feet of suitable material is available beneath the SAS.

Permitting and Use in Massachusetts (***as of June 2001)***

Operation and Maintenance Issues:
This information will be included in the final report findings.

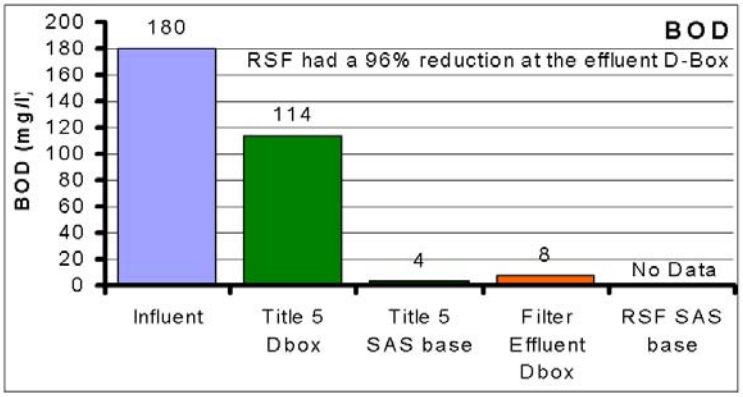
Explanation of the Graphs
The graphs to the right show the mean of two replicates for each parameter over the testing period, compared to Title 5 (three replicates) performance and influent measured in parallel samples during the same period. Fecal coliform results are expressed as geometric means. In the nitrogen graph, NH4 represents ammonia, NOx represents nitrate + nitrite, DON is dissolved organic nitrogen, and PON is particulate organic nitrogen. Total nitrogen is the sum of these four parameters.

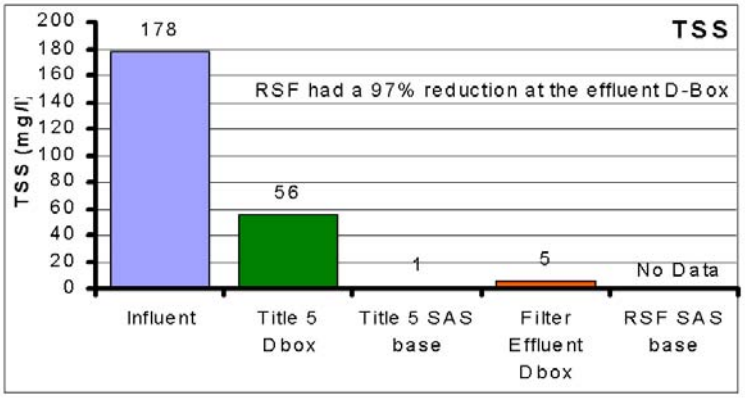
The RSFs tested did not employ a SAS. The one replicate where wood chips covered sand filter (area=96 ft2) was presumed to receive enough rainwater to dilute the effluent 3% based on local rainfall and sand filter dosage. The bar labeled RSF "filter effluent D-Box" in the nitrogen graph accounted for this modest dilution in the one replicate. Results shown for biological oxygen demand (BOD), total suspended solids (TSS), and fecal coliforms were not adjusted for dilution by precipitation, because the adjustment was negligible in evaluating overall performance. **The "RSF effluent" values reported here is not comparable to the Title 5 SAS base data because no SAS was employed for the RSF systems as would normally be installed in Massachusetts.**

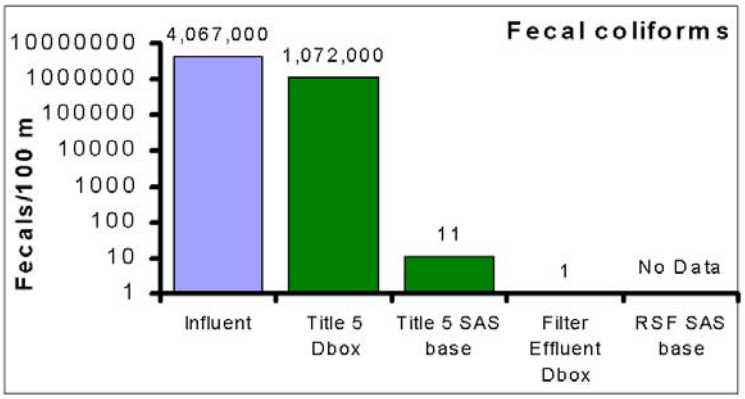
Summary of Interim Findings
This technology meets secondary treatment (*i.e.*, TSS and BOD less than or equal to 30 mg per liter) to allow for the reduced separation to groundwater, or reduced soil absorption system size. BOD and TSS concentrations at the base of the SAS for this technology and the Title 5 system are similar. This system was not tested at the Test Center for seasonal or intermittent use or for high hydraulic loading conditions.

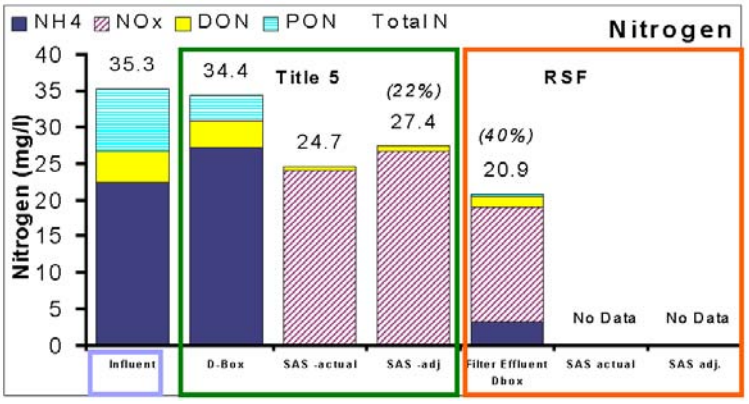
This RSF technology provides additional nitrogen removal capability beyond a conventional Title 5 system for use in nitrogen sensitive areas. The RSF must meet a regulatory effluent discharge concentration of 25 mg/l and a minimum 40 percent removal of influent total nitrogen. All systems with a design flow of 2000 gpd or greater in nitrogen sensitive areas must include an RSF or equivalent alternative technology and limit the discharge to no more than 440 gpd per acre. For design flows less than 2000 gpd a discharge credit of up to 550 gpd per acre is allowed with this technology." Because some nitrogen removal may occur in an SAS, actual nitrogen removal capacity of RSF systems may exceed the 40% removal shown.

The Technical Review Committee does not recommend adoption of nitrogen loading ratings for this technology until the two-year testing period is complete. Differences in nitrogen removal among technologies tested are not necessarily significant. System performance may vary with soil types and other factors. The Buzzards Bay Project will recommend nitrogen loading rates for this technology for planning purposes and watershed loading evaluations at a later date.









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