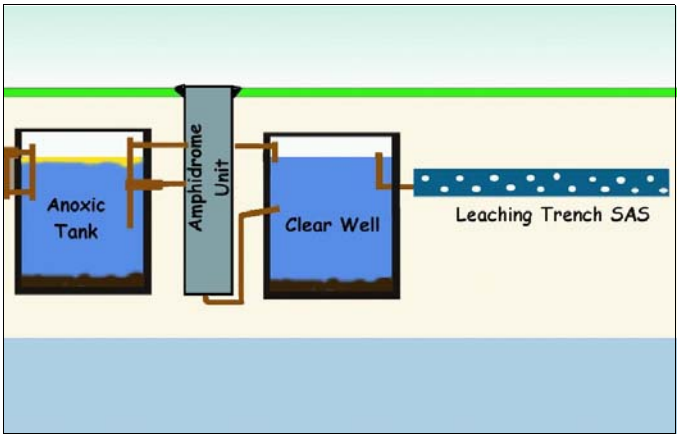
Massachusetts Alternative Septic System Test Center
Technology Fact Sheet -*Interim Findings*

Amphidrome

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:	Amphidrome
Technology Type:	Sequencing batch reactor.
Manufacturer:	F.R. Mahony & Associates, Inc. 273 Weymouth Street Rockland, MA 02370 (781) 982-9300
Contact:	Keith Dobie, President
Company Website:	www.frmahony.com
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:	Nitrogen sensitive areas, suitable for retrofits, use for reduced separation to groundwater and small SAS size.
Testing Period:	Testing started 3/00 and is ongoing. Results shown for 3/00 to 2/01.
Testing loadings:	System loading was 330 gpd, (in 15 doses AM/PM), SAS was 0.74 gallons per sq. ft per day.



Generalized design of Amphidrome System.

Installation of Amphidrome Unit.

Siting Considerations and Installation Notes

The system consists of a septic tank, reactor vessel, and "clear well" or pump chamber. Relative component elevations are critical to proper system performance. Height of the reactor vessel may complicate shallow-to-groundwater installations. Installation requires significant training and/or oversight by manufacturer. Above ground components include a blower with housing (variously sized), and an electrical control with an audio and visual alarm. The control panel contains programmable logic controllers (PLC) that require manufacturer's adjustments. Designer should consider situating the blower to minimize possibility for noise disturbance.

Actual and Manufacturer's Estimated Costs (3-bedroom home) and Labor

Non-Title 5 Components: $8,000 (with clearwell, claim).
Components + Installation: $10,000 more than conventional (claim).
Electrical: $91 per year actual (local rates, annual KWh= 823)
O&M: Quarterly inspection of motors, air flow, 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 and permitting costs vary.
Replacement: Pumps and blowers ($300) have a one-year warranty by Amphidrome?

Theory of Operation

This system directs wastewater back and forth between the septic tank (anoxic tank) and the "clear well," passing it through an aggressively aerated reactor vessel. During this aeration part of the cycle, the effluent is nitrified (ammonium is converted to nitrate). At preset intervals, the air to the reactor vessel is shut off, allowing anoxic conditions to develop, enabling denitrification (*i.e.*, conversion of nitrate to nitrogen gas) to occur. When the wastewater "batch" is adequately treated (cycled a number of times), it is discharged to the Soil Absorption System (SAS) at predetermined intervals.

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

Certification for General Use: No approval in this category. Remedial Use Approval: Amphidrome has approval 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. Provisional Use: No approval in this category, application currently under review. Piloting Approval: Approved for use in nitrogen-sensitive areas. For design flow of less than 2000 GPD, for residential systems up to 660 gpd per acre, for nonresidential systems up to 550 gpd per acre. For systems 2000 gpd or larger approved for 440 gpd per acre.

The company further seeks to demonstrate that the ability to achieve a discharge limit of less than 10 mg/l which will allow construction in any nitrogen sensitive area. In addition, higher hydraulic loading rates are being requested (see the approval letter of June 29, 1995 on DEP Website)

Operation and Maintenance Issues

[This information will be included in the final report findings.]

Explanation of the Graphs

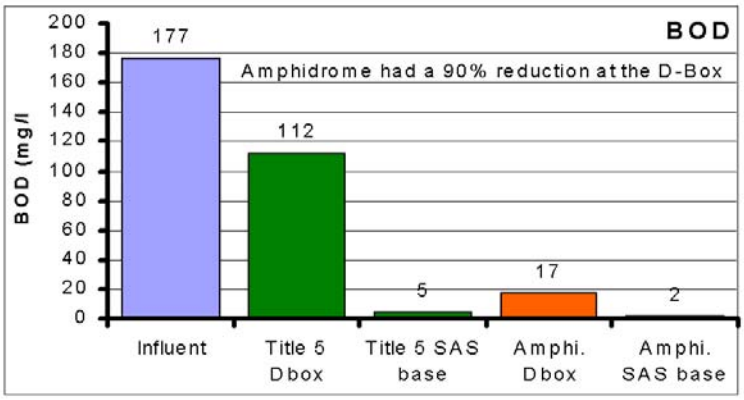
The graphs to the right show the mean of three replicates for each parameter over the testing period, compared to Title 5 performance and influent measured in parallel samples during the same period. Fecal coliform results are expressed as geometric means. In the nitrogen graph, NH4 represents ammonia,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

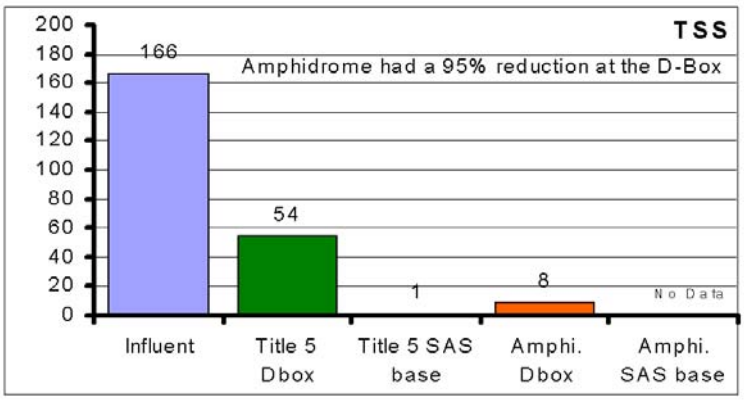
Soil absorption system samples include wastewater disposal system effluent and precipitation. The recharge of precipitation to groundwater is estimated to be between 8 percent-16 percent of effluent discharge based on local rainfall, estimated groundwater recharge rates, SAS size and dosage rates. For all technologies, an interim dilution rate of 10 percent was employed based on precipitation and theoretical and measured dosage rates at the Test Center. The results for nitrogen removal include this estimated dilution factor (note bars labeled "SAS adj.") 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. This interim approach, is being compared to specific conductivity, chlorides, and bromide tracer to better refine this estimate, and develop system specific dilution factors. **Thus, the "SAS adjusted" values reported here for nitrogen discharge to groundwater should be considered preliminary.**

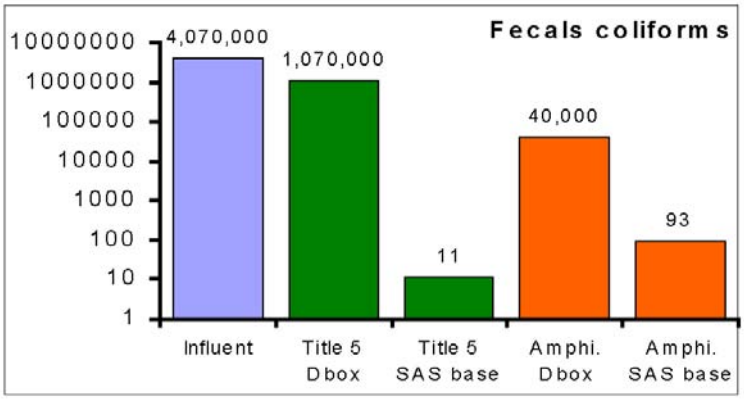
Summary of Interim Findings

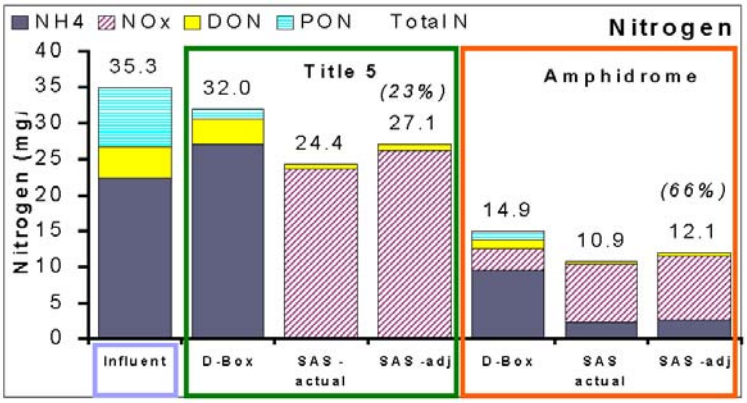
This technology exceeds secondary treatment (*i.e.*, TSS and BOD less than or equal to 30 mg per liter) to allow for the reduced separation to groundwater, or reduced soil absorption system size. BOD and TSS concentrations at the base of the SAS for this technology and the Title 5 system are similar. This technology discharged below 19 mg/l TN to allow for use in nitrogen sensitive areas with design flow of 660 gpd. At the SAS base, this system was estimated to remove 64 percent of nitrogen inputs compared to 19 percent for a Title 5 system during the same period. This system was not tested at the Test Center for seasonal or intermittent use or for high hydraulic loading conditions.

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. Nitrogen removal performance may vary with soil types and other site differences. 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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