Does Sawdust Have a Role in Saving Cape Cod's Bays?

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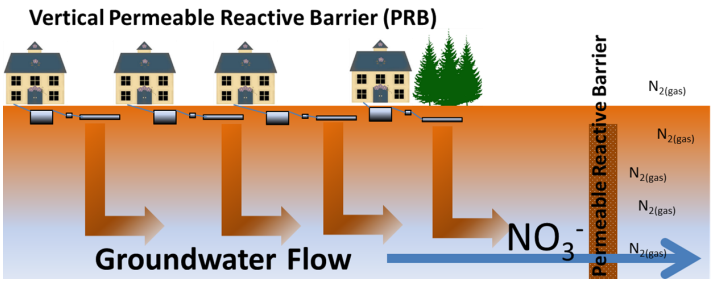
With funding from various sources, staff at the Massachusetts Alternative Septic System Test Center (MASSTC) (operated by the Barnstable County Department of Health and Environment) have been experimenting with a simple technique of layering soil mixed with wood byproduct (sawdust, woodchips) beneath a standard soil treatment area (STA; alternately known as soil absorption system or leaching field) in order to reduce nitrogen loading. The principle is fairly simple. Components of a standard STA generally convert the ammonia-nitrogen in septic tank effluent into nitrate, which is then leached into the groundwater where it can contribute to the over-production of algae and consequent eutrophication of our bays and estuaries. If the percolating nitrate-laden effluent can be first directed through a layer of sawdust matrix and certain conditions are maintained before it reaches the groundwater, then the nitrate can be reduced to harmless nitrogen gas (denitrification) and vented to the atmosphere. The focus of our study has been to research simple and inexpensive ways to produce the sequential conditions necessary to complete the above-described process.

Background

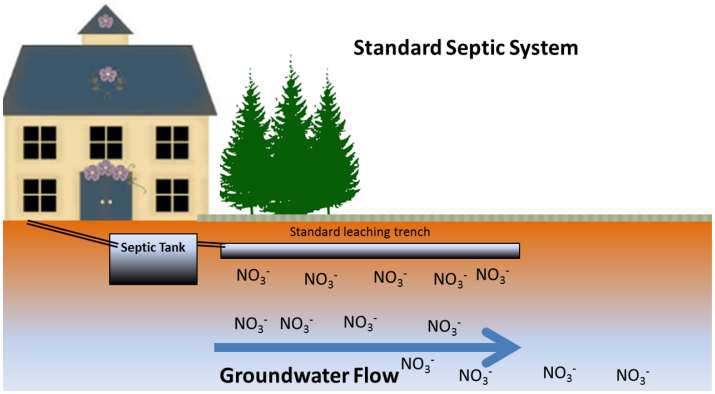
The present study mimics well-known principles (illustrated here) to determine whether various configurations of sawdust in an STA can be used as a carbon source to support denitrification. For example, the Nitrex™ system, a proprietary in-tank system, uses woodchips held in an anoxic condition following advanced treatment, thereby removing a high percentage of nitrate from wastewater. Vertical reactive barriers (alternately called permeable reactive barriers or PRBs) have been used to mitigate nitrate by placing a wall of woodchips as a permeable barrier that extends beneath the water table down-gradient to a groundwater plume containing nitrate. This causes a reduction of nitrate to nitrogen gas as the plume passes through the barrier. The reactive zone containing woodchips provides carbon and the anoxic conditions necessary for denitrification.

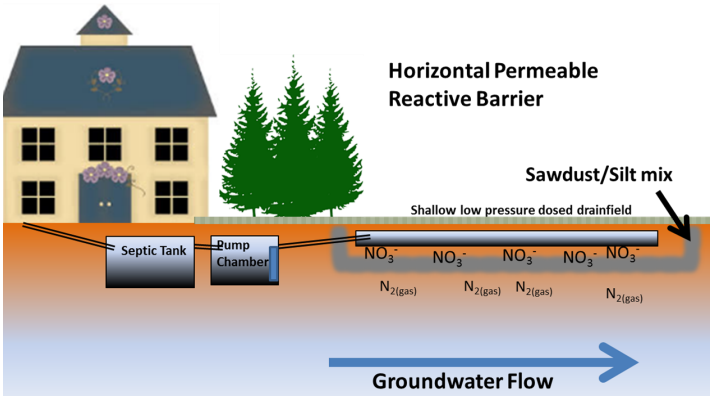


The Florida State Department of Health recently invested millions of dollars in the Florida Onsite Sewage Nitrogen Removal Strategies (FOSNRS) to see if this same principle of using wood byproduct as a carbon source to facilitate denitrification could be incorporated into individual onsite wastewater treatment systems (OWTS). They found greater than 85% removal could be achieved in the STA if it was modified with layers of sawdust. Their configurations, however, still had some complexities that translated to higher costs.

Our Research

After an extensive review of the FOSNRS data and discussions with the investigators that conducted it, plus a review of other related publically funded projects, MASSTC staff sought to adapt those same techniques to Cape Cod's predominantly sandy geological landscape. There were some fundamental changes that were necessary as revealed by a series of soil column experiments (small simulated STAs); however, these indicated changes seemed feasible.





An added benefit of the shallow leachfields used in all designs is the ability to support lush lawn growth, thus avoiding the need for fertilizer or additional water.

The demise of many oak trees on Cape Cod due to damage inflicted by the crypt gall wasp may result in the increased availability of sawdust that can be used in all of the denitrification designs being tested.

The placement and testing of full-scale systems at MASSTC are currently underway using two modifications of the Florida designs mentioned, as well as one that mimics experiments conducted in the early 1990's by University of Waterloo Professor Will Robertson. The latter effort, illustrated above, introduces the same basic principle as the vertical reactive barrier, but places the barrier in a horizontal configuration directly below the leaching component to intercept the nitrate-laden percolate (a standard septic system configuration is also illustrated above for comparison).

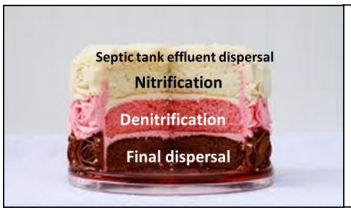
We are working with researchers in Florida, Rhode Island and Suffolk County, New York in the hopes of developing a non-proprietary design that optimizes nitrogen removal in an STA. The goal is to have total excavations (STA and sawdust-soil layer) not exceed four feet. The one complexity of our designs is the requirement of a low-pressure dosed (LPD) septic tank effluent distribution system, which is needed to disperse the septic tank effluent evenly across the STA using a pump and small diameter (one-inch) pipe. Alternately, a drip dispersal unit could be used at an increased expense.

The preliminary first year results from our designs are promising, suggesting that at least 50% and up to 90% nitrogen removal occurred in the first year of the test. We will be watching closely as winter ensues and biological systems tend to exhibit a slowdown in their performance due to cold weather. Testing of these designs will continue for a period of at least two years at MASSTC.

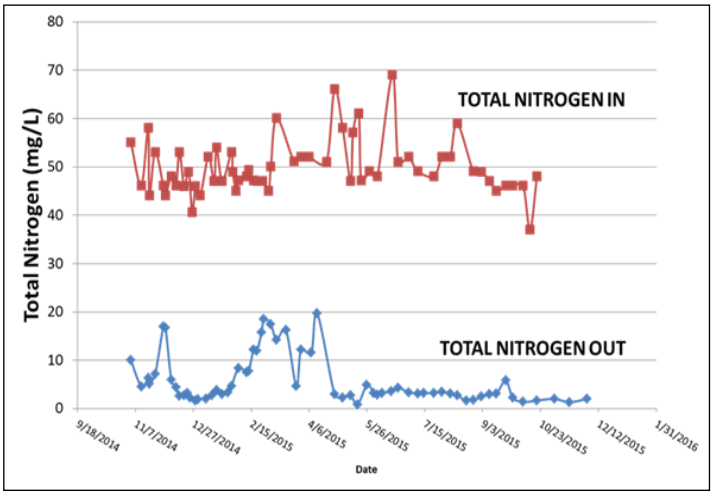
Although the full-scale systems at MASSTC are tested using real wastewater from residential housing and at full design capacity, the final step will be to monitor their performance in actual homeowner situations. Recently, the Barnstable County Department of Health and Environment partnered with the Buzzards Bay Coalition, the University of Rhode Island and Florida investigators in a proposal to the US EPA that combines home testing, data validation, design manual compilation and investigation of permitting issues and regulatory agency concerns.

Cautiously Optimistic

While initial small-scale and large-scale experiments look promising, there are still a number of aspects of our system design that need to be validated. The team of experts contributing to this project includes top practitioners in the field of onsite septic systems. One investigator, Damann Anderson, is a lead researcher from FOSNRS study who is presently working with the Suffolk County effort to validate the layering strategy. We are also actively collaborating with The Laboratory of Soil Ecology and Microbiology (LSEM) and The New England Onsite Wastewater Training Center (NEOWTC) at the University of Rhode Island. The LSEM, under the guidance of lead scientist Jose Amador, has conducted landmark research on the impacts of climate change on OWTS performance. George Loomis, the Director of the NEOWTC, has been instrumental in completing design guidance documents for non-proprietary OWTS technologies that have been accepted by Massachusetts, Vermont, and Rhode Island; a skill that will prove invaluable for maneuvering through regulatory codes and policy.



*The concepts detailed here could be described as a **layer cake,** where septic tank effluent passes sequentially through a layer for nitrification, denitrification and then final dispersal.*



Results from one of the three designs being tested at the Massachusetts Alternative Septic System Test Center

For more information on this project and the various research efforts, contact:

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