

Fact Sheet

On-Site Sewage Denitrification Verification Project: Vegetated Recirculating Gravel Filter System



Background

Nitrogen removal from wastewater happens in a two step process.

1. Oxygen loving bacteria convert ammonia to nitrite. Other bacteria then convert nitrite to nitrate. This process is called “nitrification” and the effluent becomes “nitrified”.
2. Under oxygen-free conditions, another type of bacteria converts nitrate to nitrogen gas. This process is called denitrification. Denitrification can only occur in an oxygen-free environment. (Note: The bacteria in these conditions do not need oxygen to survive, but do require a carbon source as food to live.)

After denitrification occurs, nitrogen gas is released into the air. Nitrogen gas makes up most (78%) of the air we breathe, so its release does not cause an environmental concern.

VRGF System

The vegetated recirculating gravel filter (VRGF) system is designed for nitrification to take place in the oxygen rich top layer, and denitrification to take place in the oxygen-free bottom layer.

There are three distinct zones in the vegetated recirculating gravel filter system. Effluent is continually circulated through these zones. Denitrification occurs after a complete circuit is completed and the effluent flows a second time through the first zone of the system.

A diagram of the system and description of the process are on the back.



Photos of the VRGF

Sponsors



To learn more about the project go to
www.doh.wa.gov/CommunityandEnvironment/Shellfish/EPAGrants/Denitrification.aspx

Or contact:
Wastewater Management Section, Office of Shellfish and Water Protection
Phone: 360.236.3330 Email: wastewatertmgmt@doh.wa.gov

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Zone 1 (beginning circuit): The septic tank effluent comes in through a gravelless chamber at the bottom of the filter system, and enters the gravel layer in this anoxic (oxygen-free) zone. Bacteria consume and oxidize organics in the effluent, which travels horizontally across the zone to an outlet pipe leading to the recirculating basin.

Zone 2: The treated effluent from Zone 1 enters the recirculating basin. As the effluent level rises, a float activates a timer to control the pump. The pump sends timed, multiple doses of effluent (60 doses/day) to the filter bed in Zone 3.

Zone 3: In this oxygen-rich zone, wastewater from the recirculating basin is distributed into the root zone of the vegetated bed. The effluent continues to trickle down through a fine gravel layer where oxygen loving bacteria convert ammonia to nitrate. The effluent then flows across a PVC liner and drops down into the uncovered portion of the bottom gravel layer at the inlet end of the filter in Zone 1.

Zone 1 (repeated circuits): The septic tank effluent, containing the carbon required for bacteria in this level to thrive, mixes with the nitrified effluent. The mixed effluent flows horizontally through the anoxic gravel layer, where bacteria convert nitrates to nitrogen gas.

Zone 2 (repeated circuits): The effluent flows back into the recirculating basin to repeat the process. When the recirculating tank fills to a certain level, the denitrified effluent is discharged to the drainfield.

