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The Process Science of the SeptiTech, Inc. System:

Summary

SeptiTech™ uses an enhanced recirculating biological trickling filter system in a treatment process that is optimized to remove a high percentage of BOD, TSS, and nitrogen from wastewater through aerobic and anaerobic degradation. The SeptiTech processor is added to a conventional system between the septic tank and final soil absorption system.

Initially, raw wastewater passes through a 1,500 gallon baffled septic tank, where a portion of the solids and grease are separated out. Wastewater moves from the septic tank into the reservoir of the processing tank beneath the trickling filter. The SeptiTech treatment process uses unique characteristics of a patented filter media to construct a trickling filter in which the treatment occurs in the mixed-liquor as it passes though the filter. The filter consists of a bed of highly permeable hydrophobic media situated over a reservoir into which the percolate drains. Within the reservoir is a pump that distributes a combination of percolate and newly added wastewater from the baffled septic tank to the top of the media.

The SeptiTech Residential models use polystyrene hydrophobic bead filter media, which occupy the upper portion of the treatment unit. Due to the hydrophobic nature of the media, microbes present in the wastewater do not strongly attach to the media, but are rather entrained within the wastewater as it flows by gravity through the media. In this suspended state, the microbes use and transform the nutrients and organic materials provided by the constant supply of fresh wastewater to form new cell mass. The open spaces within the media allow air to freely pass through, providing ample oxygen to support the microorganisms. The percolate from the filtering process drains into the reservoir for further recirculation (approximately 70 times/day) or discharge. Several times per day, a portion of the wastewater in the reservoir is pumped back to the septic tank where denitrification occurs. Nitrification of the ammonium in the wastewater occurs in the liquor as it passes through the media.

The timing and sequence of the recirculation of wastewater in the lower collection reservoir, as well as the recirculation of a portion of the waste back to the septic tank, is controlled by a programmable logic controller (PLC). The PLC also controls the discharge to the leaching system. A more specific description of the process is provided below.

How the Standard SeptiTech System works:

Step 1

Wastewater is discharged from the home or business to a partitioned septic tank where solids settle and begin to undergo anaerobic decomposition. The decanted effluent flows to the SeptiTech processor tank for treatment.

Step 2

Wastewater from the septic tank enters the processor and collects in a reservoir at the base of the tank where it mixes with treated water. Wastewater is pumped up to the treatment area above the reservoir where outside air is passively drawn into the wastewater stream. Oxygenated wastewater is uniformly sprayed over the media by low-pressure spray nozzles. The media consists of polystyrene beads that provide a hydrophobic surface and an exceptionally high treatment area to wastewater volume ratio. The microbes residing in the pore spaces of the filter beads break down pollutants in the wastewater as it migrates downward through the media and back into the reservoir below. The wastewater can be circulated through the filter media 70 or more times in a 24-hour period by the recirculation pump.

A programmable micro-logic controller (PLC) activates the recirculation and discharge pumps through a program that self adjusts these operations based on actual wastewater flow into the processor (as monitored by the PLC). The processor constantly evaluates the water usage and meters out the effluent discharge to the soil absorption system in equal doses over a 24-hour period (a dosing schedule can be customized to the project specification).

SeptiTech processors are sized based on the projected design flow with additional capacity to accommodate wastewater surges (morning and evening flows, special events, etc). Under surge conditions, the PLC senses the increased flow into the system and adjusts the treatment process to gradually accommodate the accumulated surge flow while maintaining treatment effectiveness. If the PLC senses reduced flow, it will ratchet the system down, and after several days enter "sleep mode" during which the processor only operates long enough to maintain the microbe culture.

SeptiTech processing starts automatically with any wastewater input. The recirculation system then remains in operation, continuing to automatically reset as necessary, as long as wastewater is discharged into the processor or until all the accumulated surge flow has been discharged.

Microbes have a short life cycle, flourishing and dying within a few hours. Due to the unique physical characteristics of SeptiTech's patented media, the wastewater and microbes do not wet or strongly adhere to the media surfaces, thereby reducing the potential for the media clogging. Instead of being stationary, the microbes migrate along with the wastewater increasing their degradation effectiveness. Dead microbes are flushed through the media with the wastewater and drain into the reservoir at the base of the processor tank. A "pump-back" system periodically pumps them back to the septic tank for additional anaerobic digestion (denitrification). As such, sludge and flock do not accumulate and the processor does not require pumping.

Step 3

After completing the prescribed treatment process in the processor, the treated water is time dosed to the disposal field to insure small frequent dosing of the field and proper absorption by the soil. In addition,

pressurized delivery to the field allows placement of the disposal trenches all in one area or in several mini-disposal areas on the same lot.

Step 4

Finally, SeptiTech disposal trenches lie nearer to the surface of the ground than in a standard leachfield to enable the action of soil microbes to further polish the effluent.

In addition to our standard biological trickling filter processor, SeptiTech systems can provide enhanced pathogen destruction and can further reduce total nitrogen through the use of complimentary U.V. oxidation and denitrification processes, respectively.

U.V. oxidation

Typical residential wastewater carries fecal coliform at a concentration of 10^7 to 10^9 colonies per 100 milliliters (col/100 ml) of wastewater[1]. Standard SeptiTech processors reduce this concentration by over 99.99 % resulting in effluent concentrations typically ranging from less than 10 to 1,000 col/100 ml. In certain applications (e.g., close proximity to surface water, water supply wells, irrigation disposal, etc...) a further reduction of *bacteria and viruses* is desired.

Due to the clarity of the effluent from the SeptiTech processor, U.V. oxidation technology can be used to destroy the majority of the pathogens remaining. This technology is currently installed in over 40 SeptiTech systems along the Maine coast and on several coastal islands. Fecal coliform concentrations typically range from non-detectable to 0.5 col/100 ml and average 0.1 col/100 ml. Actual concentrations depend on variations in wastewater strength and clarity. To produce a more consistently low coliform concentration (less than 0.05 col/100 ml), SeptiTech has developed an enhanced U.V. oxidation process that is less dependent on effluent clarity. This technology is being used in several commercial systems.

Denitrification

SeptiTech's standard aerobic pretreatment system typically reduces total nitrogen concentrations by 20 to 30%. For critical resource areas that exhibit a high degree of sensitivity to the effects of nitrogen loading, SeptiTech has developed a denitrification process to further enhance total nitrogen removal during pretreatment. The SeptiTech denitrification systems have been proven to remove a larger percentage of total nitrogen by combining the nitrifying capabilities of our aerobic biological trickling filter system with an enhanced denitrification procedure.

The SeptiTech nitrogen reduction technology first nitrifies wastewater by the SeptiTech aerobic trickling filter process. Nitrification of the ammonium (NH_4) in the wastewater occurs in the processor as it passes through the media. Nitrified wastewater is then passed into an anoxic (>2 mg/l dissolved oxygen) environment where a culture of anaerobic bacteria satisfies their need for oxygen by chemically stripping the oxygen off other compounds, such as NO_3. To promote denitrification within the anoxic environment, SeptiTech has developed zones of submerged media with the required conditions of temperature,

[1]Design Manual - Onsite Wastewater Treatment and Disposal Systems, Environmental Protection Agency, Washington, D.C. 1980.

alkalinity, and BOD levels. Similar to the aerobic process, the denitrification process is self-adjusting based on demand and controlled by the PLC to provide consistent results.

SeptiTech's nitrogen reduction technology has completed a full year of verification testing under the US EPA Environmental Technologies Initiative Source Water Protection Program. This testing was designed to verify nutrient reduction of the SeptiTech treatment technology and was being conducted by the Barnstable County Department of Health at the Massachusetts Septic System Test Center in Bourne, Massachusetts. During the testing, the SeptiTech system was being loaded with influent wastewater from a sanitary sewer at the design hydraulic rate of 440 gpd. SeptiTech's nitrogen reduction capability was measured by constituents that demand oxygen for treatment (BOD and CBOD), and nitrogen species (TKN, NH_4, NO_2, and NO_3). Operational characteristics such as labor to perform maintenance, maintenance tasks, durability of the hardware, noise and odor production were also monitored

The Testing was completed in August of 2002. Results have not yet been released by NSF, (National Small Flows) for public dissemination, however NSF has sent us unofficial results that indicated the yearly average for CBOD was 5.0, TSS was 2.4 and total nitrogen compounds of 14. A table with typical testing results is provided as a part of this binder.