

Use of Denitrifying Bioretention Systems to Control Non-Point Sources of Nitrogen

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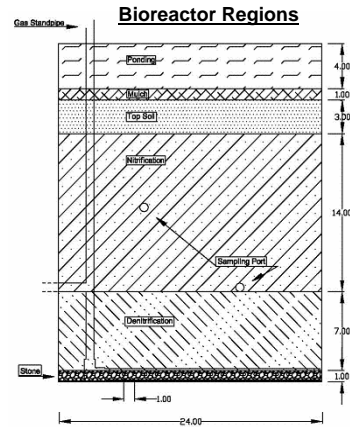
Research Objectives

This research focuses on the use of bioretention systems to control non-point sources of nitrogen. Two bioretention units are being investigated, one utilizing heterotrophic denitrification and the other utilizing autotrophic denitrification. The main objective is to compare and contrast these two systems and evaluate their effectiveness at being a robust, efficient and reliable system that can achieve low effluent nitrogen levels.

Reactor Configuration

Five distinct regions:

- Ponding: maintains hydraulic loading
- Top Soil and Mulch
- Nitrification: aerobic sand layer
- Denitrification
 - Autotrophic: sulfur and oyster shell mix
 - Heterotrophic: hardwood chips and sand mix
- Stone



Simulated Rain Events

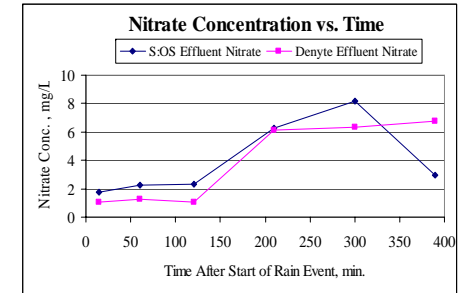
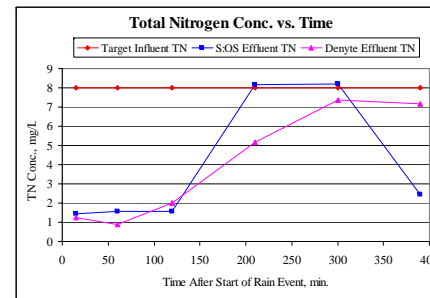
Application Rate	4 ml/sec
Application Duration	6 hrs
Total Applied Volume	86.4 L (22.8 gal)

Feed Composition	
NO ₃ ⁻ -N	2 mg/L as N
NH ₄ ⁺ -N	2 mg/L as N
Organic N	4 mg/L as N
PO ₄ ⁻²	0.6 mg/L as P

Application Rate and duration were based on the following:

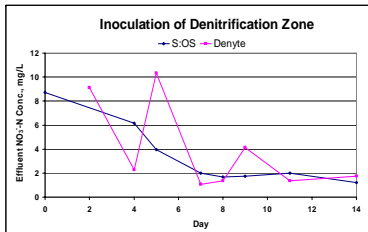
- Average storm total of 0.6 inches
- Average storm duration of 6 hours
- Bioreactor area is 5% of drainage area

Results: Simulated Rain Event #1



Reactor Inoculation

- Inoculated using supernatant from Belchertown, MA WWTP
- After approximately 14 days for denitrification zone and 30 days for nitrification zone steady removal observed



Sample	pH	COD (mg/L)	Alkalinity (mg/L as CaCO ₃)	TSS (mg/L)
Avg. Influent	6.8	47.5	< 20	0.4
Avg. S:OS Effluent	7.7	48.8	74.0	0.8
Avg. Denyte Effluent	6.8	78.7	187.3	9.3

Future Plans

- Optimize reactors in laboratory setting
- Conduct simulated rain events under laboratory conditions
- Move bioreactors to field site to obtain real life performance
 - Field site located at a dairy farm in Connecticut



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