Engineering a Biological Filter System for Freshwater Denitrification for Use in Agricultural Applications, Phase I

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Inorganic nitrogen pollution typically caused by farming fertilizer runoff affects the environment in four major ways: increasing the acidity of freshwater ecosystems, stimulating the eutrophication of aquatic ecosystems, subsequently reducing available oxygen available for aqueous organisms, and inducing adverse effects in organisms such as humans that ingest water with high nitrate levels (Camargo and Alonso, 2006). The study's purpose was to engineer a biological nitrate reducing filter that doesn't release bacteria into the environment. Pseudomonas stutzeri, a bacillus bacteria, was sealed in a nitrate permeable filter constructed of .45 micron filter paper and/or dialysis tubing. The biological filter then was placed inside a 3D printed secondary filter. This device was placed in an open container of known value nitrate solution. Nitrate levels (mg/L) were measured for 24-72 hours using a nitrate probe. Water samples were taken from the experimental setup and placed on prepared nutrient agar plates to check for P. stutzeri leaving the filters.The mixed media filter achieved a 19.72% nitrate level reduction while the average of all filters was a 14.14% reduction. A t-test showed the results to be statistically significant. Colony growth on the Petri dishes was noted. Morphology staining revealed coccus shaped bacteria from one trial and some bacillus shaped bacteria in another trial. It was concluded that the device does reduce nitrate levels but further testing is needed to determine whether the bacterial filter keeps the P. stutzeri from escaping.

Awards Won: