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Development of an Engineered Drainage Tile for Nitrogen Management

The Chesapeake Bay is in ecological danger due to eutrophication. Eutrophication is the result of excess nutrients such as nitrogen and phosphorus, which causes oxygen depletion in receiving water bodies and threatens aquatic life. Agriculture is a contributing factor to the increased level of nitrates, as nitrogen and phosphorus are main ingredients in fertilizers used to promote crop yields. Because fertilizers are a major culprit, treatment of agricultural runoff at the source (fields) is relevant in improving the water quality in the Chesapeake, especially in locations like Lancaster County with large agricultural presences that feed into the bay. Many studies have shown that sulfur and limestone can be paired in order to achieve denitrification in context to wastewater and drinking water treatment. *Thiobacillus denitrificans,* bacteria known to respire under anaerobic conditions by converting reactive nitrogen (nitrates) into atmospheric nitrogen, is the optimal microorganism to thrive in this anaerobic and sulfur-rich environment. The objective of this project is to demonstrate the capacity of an engineered drainage tile to continuously remove nitrates, thus improving water quality. A modified tile drainage simulation was built, where the tile was surrounded by a layer of elemental sulfur and limestone. Three different models were used: two systems using different sizes of limestone pieces and one control. From these models, influent and effluent were tested for levels of nitrate, sulfate, and pH in order to estimate nitrate removal as well as biological activity inside the reactor.