Name(s)	Project Number
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Project Title

Low Cost Removal of Organic Nitrogen and Nitrate from Bovine Sewage Using Physical and Biological Methods

Abstract

Objectives/Goals
At dairies in California and around the world, bovine sewage is discharged to the ground or to percolation ponds resulting in nitrate contamination in groundwater. I investigated low-cost physical and biological means of reducing total nitrogen (TKN + nitrate) from bovine sewage to reduce the potential for nitrate contamination.

Methods/Materials
Bottle point adsorption batch experiments were conducted to measure equilibrium adsorption capacity of TKN, ammonia, and COD onto cotton fabric and crushed tumbleweeds. Two controls of filtered bovine sewage with no solid were also prepared. Packed bed columns were also set up to test the dynamic adsorption pollutant removal characteristics of cotton, tumbleweed, and chopped palm fronds. I set up columns of coarse, washed sand and measured a physical property of salt solution (specific conductance, EC) in the effluent "breaking through" a packed, porous column. I generated several breakthrough curves with high reproducibility.
   I also set up packed columns of clayey-sand and silty sand to determine the dynamic flow properties of TKN, COD, ammonia, and nitrate in aerated bovine sewage through the media, to determine the dynamic removal characteristics of each pollutant.

Results
The cotton column had favorable adsorption characteristics for TKN, COD, and nitrate. Palm fronds and crushed tumbleweeds proved unsuccessful in dynamic adsorption columns because their effluents had much color (tannins) which show up in the COD analysis. In the bottle point tests, cotton removed TKN up to 6.43 mg/g cotton, but cotton showed no removal of COD. In our second batch aeration, we again showed significant reduction of TKN, COD, and BOD, and I generated nitrate at 6 mg/L -N. My clayey-sand column had significant removal of TKN, COD and BOD, but nitrate removal was inconclusive. In the silty-sand column, I was more successful passing sewage through it, and achieved significant removal of TKN, COD, BOD, and nitrate.

Conclusions/Discussion
Cotton fabric and simple aeration of bovine sewage can be effective, low-cost means of reducing total nitrogen (organic nitrogen and ammonia) and other pollutants (BOD and COD) before the sewage is released to a percolation pond. Creating anoxic conditions and the addition of a modest amount of sugar can stimulate the anaerobic bacteria to remove nitrate as the aerated sewage percolates through a silty sand.

Summary Statement

I investigated low cost physical and biological means of lowering total nitrogen in bovine sewage in order to prevent nitrate pollution.

Help Received

My mentor, Dr. Tom Browne, was very helpful in guiding my knowledge of TKN and BOD analysis. I used the Chem Lab at Victor Valley College, Babcock did analytical measurements.