EVALUATION OF AN EFFLUENT TREATMENT STRATEGY TO CONTROL NITROGEN FROM A RECIRCULATING AQUACULTURE FACILITY

by

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Thesis submitted to the Faculty of
Virginia Polytechnic Institute and State University
In partial fulfillment of the requirements for the degree of

Master of Science

In

Environmental Engineering

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October 4, 2001
Blacksburg, Virginia

Keywords: aquaculture, denitrification, fermentation, nitrite accumulation

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ABSTRACT

The ability of a self-contained denitrification system, using fermentation products from waste fish solids, to maintain reliable performance was studied. Denitrification performance was described kinetically and stoichiometrically under different initial nitrate-nitrogen and soluble organic carbon to nitrate-nitrogen ratios. Characterization of soluble organic carbon (measured as soluble chemical oxygen demand, sCOD) indicated that volatile fatty acids (VFA) were generated during the fermentation of the waste fish solids. The results from batch experiments showed that over the range of initial nitrate concentrations studied, complete denitrification was achieved within 6 hrs. sCOD, nitrite, and nitrate profiles across several batch experiments showed that transient nitrite accumulations occurred, but the maximum measured concentrations never completely inhibited nitrate removal. The results suggested that the rate of denitrification was influenced by the initial sCOD to nitrate-nitrogen ratio when transient nitrite concentrations remained below 20 mg/L. However, when nitrite-nitrogen exceeded 25 mg/L, the rate of denitrification was negatively correlated with the maximum measured nitrite-nitrogen concentration. The stoichiometric carbon requirement was not correlated

to any parameters believed to influence carbon consumption. After complete denitrification was achieved residual sCOD was still measured, which could not be identified as VFAs. Batch aerobic treatment of denitrified effluent resulted in a 60 to 70 % removal of the residual sCOD when allowed to react for 8 days. It was further determined that the residual sCOD exerted an oxygen of 5.81 on g COD/g C. Additional studies were conducted to maximize sCOD production during fermentation. Increasing the fermentation temperature from 28 ^{o}C to 40 ^{o}C facilitated a 36 % increase in the specific sCOD production rate (g sCOD/ g fish solids applied). In addition to sCOD production, ammonia production increased 20 % when the fermentation was conducted at the elevated temperature. An analysis comparing the cost of methanol addition to support denitrification to the cost associated with fermenting waste fish solids indicated that supplementing fermentation products with methanol resulted in the least costly strategy for promoting denitrification of an aquaculture waste stream.