Optimizing nitrate removal in woodchip beds treating aquaculture effluents - DTU Orbit (08/11/2017)

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Nitrate is typically removed from aquaculture effluents using heterotrophic denitrification reactors. Heterotrophic denitrification reactors, however, require a constant input of readily available organic carbon (C) sources which limits their application in many aquaculture systems for practical and/or economic reasons.A potential alternative technology for removing nitrate currently applied for treating surface and drainage water is based on using wood by-products as a carbon source for denitrification. Using lab-scale horizontal-flow woodchip filters, the current study investigated the potential of optimizing woodchip reactors for treating aquaculture effluent. A central composite design (CCD) was applied to assess the effects of simultaneously changing the empty bed contact time (EBCTs of 5.0-15.0 h; corresponding to theoretical hydraulic retention times of 3.3-9.9 h) and bicarbonate (HCO3 -) inlet concentration (0.50-1.59 g HCO3 -/l) on the removal rate of NO3 -N, and additional organic and inorganic nutrients, in effluent deriving from an experimental recirculating aquaculture system (RAS).Volumetric NO3 -N removal rates ranged from 5.20 ± 0.02 to 8.96 ± 0.19 g/m3/day and were enhanced by adding bicarbonate, suggesting that parts of the removal was due to autotrophic denitrification. The highest N removal rate (8.96 ± 0.05 g/m3/day) was achieved at an EBCT and HCO3 - combination of 15 h and 1.59 g HCO3 -/l. Bicarbonate inlet concentration as a single factor had the strongest effect on N removal rates followed by the interaction with EBCT, and EBCT2 (quadratic term). The study thus indicates that woodchip beds may be applied and optimized for removing nitrate from aquaculture effluents. Statement of relevance: This study is a relevant contribution to research in aquaculture as it presents an alternative method for removing nitrates from aquaculture effluents especially for less intensive fish farms. Furthermore, it shows how this method can be optimized to yield higher removal rates of nitrate.

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