Single-sludge denitrification in recirculating aquaculture systems: effects of pre-fermentation and pH - DTU Orbit (08/11/2017)

Single-sludge denitrification in recirculating aquaculture systems: effects of pre-fermentation and pH

Single-sludge denitrification (DN) reactors in aquaculture use the carbonous solid fish waste produced in the system to reduce the discharged nitrate load. The solid waste is available for denitrifiers when present in soluble, readily biodegradable form, and the transformation is accomplished by bacterial hydrolysis and fermentation. The objective of this study was to quantify the effect of pre-fermentation of solid fish waste on single-sludge DN reactor efficiency. Pre-fermentation times tested were 0 d (no pre-fermentation), 1 d, 5 d, and 10 d, and the efficiency was quantified as the potential DN rate obtained in laboratory assays. Results showed that the highest DN rate was achieved with 1 d pre-fermentation. The volumetric DN rates measured in decreasing order were 23.4 +/- 0.00 mg NO_3-N L-1 h(-1) (1 d), 20.5 +/- 0.35 mg NO_3-N L-1 h(-1) (5 d), 17.0 +/- 0.47 mg NO_3-N L-1 h(-1) (10 d), and 14.2 +/- 0.24 mg NO_3-N L-1 h(-1) (0 d). It was suspected that the poor utilization of soluble COD (sCOD) in the 5 d and 10 d pre-fermentation treatments was due to the low starting pH (pH <7). Subsequently, the experiments were repeated in 0.1 M HEPES buffer (pH = 7.1) and showed a clear correlation between specific DN rate and sCOD content. Overall, the highest increase in potential specific DN rate was achieved by applying pre-fermentation; e.g., from 0 d to 1 d, the increase was 123% and 106% at unadjusted pH and pH 7.1, respectively. An additional 20% increase was achieved at pH 7.1 by prolonging the pre-fermentation time to 5 d.

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