

Nitrification of high-strength ammonium landfill leachate with microbial community analysis using (FISH).

Abstract

Nitrification of mature sanitary landfill leachate with high-strength of N-NH_4 (1080–2350 mg L^{-1}) was performed in a 10 L continuous nitrification activated sludge reactor. The nitrification system was acclimatized with synthetic leachate during feed batch operation to avoid substrate inhibition before being fed with actual mature leachate. Successful nitrification was achieved with an approximately complete ammonium removal (99%) and 96% of N-NH_4 conversion to N-NO_3 . The maximum volumetric and specific nitrification rates obtained were 2.56 kg $\text{N-NH}_4 \text{ m}^{-3} \text{ day}^{-1}$ and 0.23 g $\text{N-NH}_4 \text{ g}^{-1}$ volatile suspended solid (VSS) day^{-1} , respectively, at hydraulic retention time (HRT) of 12.7 h and solid retention time of 50 days. Incomplete nitrification was encountered when operating at a higher nitrogen loading rate of 3.14 kg $\text{N-NH}_4 \text{ m}^{-3} \text{ day}^{-1}$. The substrate overloading and nitrifiers competition with heterotrophs were believed to trigger the incomplete nitrification. Fluorescence in situ hybridization (FISH) results supported the syntrophic association between the ammonia-oxidizing bacteria (AOB) and nitrite-oxidizing bacteria. FISH results also revealed the heterotrophs as the dominant and disintegration of some AOB cell aggregates into single cells which further supported the incomplete nitrification phenomenon.

Keyword: Nitrification; High-strength ammonium wastewater; Mature landfill leachate; Biological nitrogen removal; FISH.