

Full-scale trials of external nitrification on plastic media nitrifying trickling filter

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Abstract

The full-scale single-stage tertiary nitrifying trickling filter (NTF) at the Citrusdal Wastewater Treatment Plant provides for external nitrification of unclarified effluent from the facultative aerobic lagoon in order to meet standard effluent ammonia concentration requirements. The apparent ammonia nitrification rate (ApANR, gN/m^2 media surface-d) of the NTF was sensitive to particulate organic loading rates which were predominantly in the form of algae, and the soluble COD removal rates increased under cold climates. Installation of forced-air ventilation fans improved the nitrification efficiency from 15% to 43%. An increase in hydraulic loading rate (HLR) by effluent recirculation significantly improved the ApANR, eradicated filter flies and decreased the prevalence of worms. Maximum ApANR of $\sim 1.0 \text{ gN/m}^2\text{-d}$ was achieved yielding an ammonia-removal efficiency of approximately 71%. Profile samples collected along the NTF media depth indicated poor media wetting at low HLR resulting in low ApANR ($< 0.5 \text{ gN/m}^2\text{-d}$). Also during the cold and rainy winter period, poor biofilm activity and prevalence of motile algae were observed, and under low hydraulic loading rates and warmer temperatures, a dominance of filter flies and fly larvae were observed. In contrast, in controlled laboratory studies, ApANRs up to $1.72 \text{ gN/m}^2\text{-d}$ (22.1 mgN/l removal) were attained, which, in conformity with full-scale, was also found to be sensitive to hydraulic loading conditions.

Keywords: external nitrification, nitrifying trickling filter, unclarified secondary effluent, full-scale, apparent nitrification rates, plastic media