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Nitrifying trickling filters and denitrifying bioreactors for nitrogen management of high-strength anaerobic digestion effluent

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Abstract

The treatment of high-strength anaerobic digester effluent in laboratory-scale trickling filters for nitrification and then anaerobic filters for denitrification is reported. Five media types were investigated in the trickling filters: biochar, granular activated carbon (GAC), zeolite, Pall rings, and gravel. Three media were tested in five denitrifying filters: sand (S), bamboo wood chips (B), eucalyptus wood chips (E), bamboo with sand (B+S), and eucalyptus with sand (E+S). The different wood chips served as a supplemental electron donor for denitrification. From six months of operation, biochar, GAC, zeolite, Pall rings, and gravel media had turbidity (NTU) removal efficiencies of 90, 91, 77, 74, and 74%, respectively, and ammonia removal efficiencies of 83, 87, 85, 30, and 80%, respectively, which was primarily by nitrification to nitrate. For the anaerobic filters, S, B, B+S, E, and E+S had nitrate removal efficiencies of 30, 66, 53, 35, and 35%, and turbidity removal efficiencies of 88, 89, 84, 89, and 88%, respectively. Biochar and bamboo were selected as the best combination treatment. Based on an average initial influent of 600 mg NH_3-N L^{-1}, 50 mg NO_3-N L^{-1}, and 980 NTU, the biochar filter's effluent would be 97 mg NH_3-N L^{-1}, 475 mg NO_3-N L^{-1}, and 120 NTU. The bamboo filter's final effluent would be 82

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