Algal Bioremediation of Landfill Leachate Pretreated by Reverse Osmosis

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Landfills are a pervasive by-product of human society, representing the final repository for the majority of anthropogenic wastes. Landfills and the environmental discharges produced from the decomposing wastes must be managed even after closure of the landfill. Current waste treatment strategies for landfill leachates use considerable natural resources and energy capital, but are essential for the preservation of clean water, air, soil and health for future generations. An emerging method for landfill leachate remediation is membrane filtration or reverse osmosis (RO). An experimental two-stage RO system at the closed Alachua County Southwest Landfill reduced electrical conductivity from 16,100 to 1,195 µS/cm and total ammoniacal nitrogen (TAN) from 1,110 to 80 ppm in the first stage and to 73.2 µS/cm and 5.5 ppm, respectively, in the second stage. Reverse osmosis failed to reduce TAN in landfill leachate to meet groundwater cleanup target levels (GCTL) of 2.8 ppm. Algae cultivation was explored as a biological means of TAN reduction. Pairing RO with algal bioremediation may reduce the cost of a two-stage system, by eliminating the second stage. Algal cultivation systems were developed on-site at the landfill and reduced TAN levels of the RO pretreated leachate to below detectable limits (0.1 ppm) within eight days of operation. Growth of algae was modest and reduction in TAN is hypothesized to be mainly from atmospheric volatilization. Elemental analysis of the RO treated landfill leachate revealed phosphorus as a potentially limiting nutrient for algal growth and therefore ammoniacal nitrogen biological assimilation.