Abstract

Wastewater production in North America alone is estimated at 85 cubic kilometers per year. This wastewater is subsequently treated by a variety of biological and physical processes. This thesis examines two novel treatment processes, one biological and one physical in nature, namely, Rotating Algae Biofilm Reactor treatment and expanded shale augmented coagulation-flocculation.

Rotating algae biofilm reactors (RABRs) were compared with suspended-growth open pond lagoon reactors for removal of nutrients and suspended solids in petrochemical wastewater. RABR treatment demonstrated a statistically significant increase in removal of nutrients and suspended solids, and increase in biomass productivity, compared to the open pond lagoon treatment. These trends translate to a greater potential for the production of biomass-based fuels, feed, and fertilizer as value-added products. This study is the first demonstration of the cultivation of mixed culture microalgae on petroleum refining wastewater for the dual purposes of treatment and biomass production.

A blend of expanded shale, a low-cost ceramic derived from the concrete industry, and an industry standard coagulant, ferric sulfate, was demonstrated as feasible, novel, low-cost coagulant. The optimum blend concentration for turbidity removal, 0.1 g/L expanded shale and 0.01 g/L ferric sulfate, removed 84.7% and 91% of turbidity and suspended solids, respectively. This blend outperformed the ferric sulfate only treatment, demonstrating expanded shale as an effective additive to traditional coagulation-flocculation systems.