Effective treatment of palm oil mill effluent using FeSO4.7H2O waste from titanium oxide industry: Coagulation adsorption isotherm and kinetics studies

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Abstract

Palm oil mill effluent (POME) is a highly polluted industrial wastewater that may cause detrimental environmental pollution if discharged directly due to its biochemical oxygen demand (BOD) and chemical oxygen demand (COD) concentrations. In the present study, the performance of FeSO4.7H2O waste from titanium oxide industry was investigated in removing BOD, COD, and total suspended solids (TSS) from POME. Jar tests were conducted with varying coagulant doses (1–5 g L−1), pH (2–10), and temperature (40–80 °C) as a function of treatment time ranging from 5 to 90 min. Results show that the FeSO4.7H2O waste can remove about 70% COD, over 80% BOD, and over 85% TSS in a single stage coagulation treatment. The coagulation adsorption mechanisms for the removal of COD, BOD, and TSS from POME were investigated based on Brunauer–Emmett–Teller (BET), Freundlich, and Langmuir isotherm models. The removal of COD, BOD, and TSS from POME was best described by the Freundlich isotherm model, indicating that coagulation adsorption occurred in a multilayer formation with non-uniform distribution of adsorbed particles. The coagulation adsorption kinetics studies revealed that the removal of COD, BOD, and TSS from POME using FeSO4.7H2O waste followed the second-order-kinetics modeling. Our findings suggest that the FeSO4.7H2O waste has the potential to be utilized as a coagulant for treating POME in compliance with the standard discharge limits.