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Fenton Sludge's Catalytic Ability with Synergistic Effects During Reuse for Landfill Leachate Treatment

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Abstract : Advanced oxidation processes (AOPs) based on Fenton are versatile options for treating complex wastewaters containing refractory compounds. However, the classical Fenton process (CFP) has limitations, such as high sludge production and reagent dosage, which limit its broad use and result in secondary contamination. As a result, long-term solutions are required for process intensification and the removal of these impediments. This study shows that Fenton sludge could serve as a catalyst in the Fe^{3+}/Fe^{2+} reductive pathway, allowing non-regenerated sludge to be reused for complex wastewater treatment, such as landfill leachate treatment, even in the absence of Fenton's reagents. Experiments with and without pH adjustments in stages I and II demonstrated that an acidic pH is desirable. Humic compounds in leachate could improve the cycle of Fe^{3+}/Fe^{2+} under optimal conditions, and the chemical oxygen demand (COD) removal efficiency was 22±2% and 62±2%% in stages I and II, respectively. Furthermore, excellent total suspended solids (TSS) removal (> 95%) and color removal (> 80%) were obtained in stage II. The processes underlying synergistic (oxidation/coagulation/adsorption) effects were addressed. The design of the experiment (DOE) is growing increasingly popular and has thus been implemented in the chemical, water, and environmental domains. The relevance of the statistical model for the desired response was validated using the explicitly stated optimal conditions. The operational factors, characteristics of reused sludge, toxicity analysis, cost calculation, and future research objectives were also discussed. Reusing non-regenerated Fenton sludge, according to the study's findings, can minimize hazardous solid toxic emissions and total treatment costs.

Keywords : advanced oxidation processes, catalysis, Fe^{3+}/Fe^{2+} cycle, fenton sludge
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