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REMOVAL OF HUMIC ACID FROM WATER BY PHYSICO-CHEMICAL METHODS AND ADVANCED OXIDATION PROCESSES AND COUPLED WITH COST ANALYSIS

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Abstract

In this study, various methods for humic acid (HA) removal from water, including physico-chemical methods (adsorption, coagulation-flocculation) and advanced oxidation processes (ozone oxidation, Fenton oxidation and photocatalytic oxidation), were investigated along with a comparative economic analysis. The results showed that adsorption using 2 g/L powdered activated carbon demonstrated promising results with a removal efficiency of 96% at pH 4. Coagulation-flocculation with $FeCl_3$ (40 mg/L) and $Al_2(SO_4)_3$ (40 mg/L) at pH 5 showed HA removal rates of 94% and 93%, respectively, with $FeCl_3$ proving to be more efficient. Fenton oxidation resulted in a removal efficiency of 95% at pH 4, with 60 min of oxidation and optimal doses of 80 mg/L Fe^{2+} and 120 mg/L H_2O_2. Ozone oxidation achieved a lower removal efficiency of 81% at pH 10, and its high cost makes it less favorable. Photocatalytic oxidation with UV-A and UV-C light, combined with 300 mg/L TiO_2 catalyst, exhibited the highest removal efficiency of 99% within 30 minutes. However, its high cost limits its practical application. Cost analysis revealed that physico-chemical methods like adsorption and coagulation-flocculation are not only effective but also economical for HA removal. As a result, while advanced oxidation processes offer high removal efficiency, they come with significant costs. Physico-chemical methods remain viable options for HA removal, providing both efficiency and cost-effectiveness. However, careful consideration of disposal costs for waste materials generated during these processes is essential for a comprehensive cost analysis.

Key words: adsorption, coagulation-flocculation, Fenton oxidation, humic acid, ozone oxidation, photocatalysis

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