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Preparation, characterization and catalytic performance of paper mill sludge and municipal wastewater treatment sludge-based catalysts for Fenton-like oxidation of Rhodamine B

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ABSTRACT

In this study, sludge-derived Fenton-like catalysts, namely potentially low cost, were successfully synthesized through a unique and original method, which was used to oxidative degradate Rhodamine B (RhB) as heterogeneous Fenton-like Fe/C catalysts. Two types of sludge sources were used as sludge-derived support carbon: paper mill sludge and municipal wastewater treatment sludge. This unique preparation method converted pyrolyzed sludge into a porous carbon-based carrier material by chemical activation and then used an iron loading impregnation method to synthesize the Fenton-like Fe/C catalyst. The prepared two types of catalysts including paper mill sludge-derived char-supported iron catalyst and municipal sewage sludge-derived char-supported iron catalyst were characterized in terms of Fourier transform infrared spectroscopy, X-ray diffraction, scanning electron microscopy and N_2-adsorption/desorption. Compared with sludge-derived Fe/C catalyst without activation, both the PMSC-Fe and the MSSC-Fe catalyst exhibited much better catalytic performance in degrading RhB. Both PMSC-Fe and MSSC-Fe exhibited excellent catalytic stability and almost seldom Fe-ion leaching. A correlation could be found between surface area and RhB degradation, suggesting that surface area of the catalyst is an important factor for the catalytic performance. Two different sources of sludge also showed discrepancy in catalytic performance of RhB degradation, which is perhaps due to the different properties of the initial sewage sludge. The catalyst of PMSC-Fe and MSSC-Fe both has an excellent long-term stability. Possible degradation mechanism of RhB induced by sludge-derived Fe-C/H_2O_2 system is proposed.

Keywords: Heterogeneous catalyst; Sewage sludge-based catalyst; Fenton like; Rhodamine B

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