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# Heterogeneous Fenton-like oxidation of crystal violet using an iron loaded ZSM-5 zeolite

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**ABSTRACT**

The heterogeneous Fenton-like oxidation of a cationic triphenylmethane dye, crystal violet (CV), dissolved in water was investigated using an iron-loaded ZSM-5 zeolite catalyst. The catalyst was characterized by powder X-ray diffraction patterns, Fourier Transform infrared spectroscopy (FTIR), scanning electron microscope, analysis, and nitrogen adsorption-Brunauer-Emmet-Teller ($N_2$-BET) studies. The effects of temperature, solution pH, $H_2O_2$ amount, catalyst amount, and initial dye concentration were investigated using the heterogeneous Fenton-like oxidation of an aqueous CV. The increase in the concentration of $H_2O_2$ from 3 to 7.5 mM enhanced the decolorization. Whereas increasing the $H_2O_2$ amount from 7.5 to 10 mM led to a decrease in the color removal from 94.1 to 85.5%. An acidic pH of 3.5 was favorable for the decolorization of the dye. The decolorization of the dye decreased with the increase in the initial concentration of CV. Doubling the amount of the catalyst enhanced the decolorization from 94.1 to 99.6% while the chemical oxygen demand (COD) removal changed from 50 to 58.8%. The increase in temperature positively affected the decolorization and the COD reduction of the dye. The stability of the catalyst was maintained even after using the catalyst for three cycles, and a small iron leaching was also proof of the stability of the catalyst. The initial color removal rate of the CV was described as $-r_{CV,o} = 7.3\, e^{-14.7/RT}\, C_{CV,o}^{0.7}\, C_{H_2O_2,0}$ where $R = 8.314$ J/mol K and $C_{CV,o}$ and $C_{H_2O_2,0}$ were in mol/dm$^3$.

*Keywords:* Advanced oxidation process; Heterogeneous Fenton-like oxidation; Crystal violet; Iron-loaded ZSM-5 Zeolite catalyst

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