

Spectroscopic on-Line monitoring and stopped-flow kinetic analysis of dye degradation by laccase/mediator systems

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Abstract

The laccase catalyzed transformation of the acid dye Indigo Carmine (CI Acid Blue 74) was studied using various redox mediators: violuric acid (VIO), 2,2,6,6-tetramethyl-1-piperidinyloxy (TEMPO), 1-hydroxybenzotriazole (HOBT), and 2,2-azinobis-(3-ethylbenzothiazoline-6-disulfonic acid diammonium salt (ABTS). Inline UV/Vis and IR spectroscopy was employed to monitor the decolorization in real-time during batch decolorization. ABTS was the most effective mediator followed by TEMPO. Stopped flow kinetics was employed to study the initial phase of dye degradation in more detail. While the batch decolorization experiments suggested zero-order rate laws for dye transformation at an early stage, the more accurate stopped-flow kinetic experiments revealed that the rate laws for the initial phase were actually more complicated. Different pH optima for dye decolorization were found for the laccase catalyzed reaction (pH 3.5) and for the oxidation brought about by the isolated ABTS radical cation (pH 6.7).