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FENTON'S REAGENT EFFECTIVENESS IN THE OXIDATION PROCESS OF METHYLENE BLUE AND METHYLENE VIOLET DYES

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The kinetics of oxidation of methylene blue (MB) and methyl violet (MV) dyes by Fenton's reagent (H_2O_2 + Me^{n+}, where Me^{n+} = Fe^{2+}, Fe^{3+}) has been investigated. Different process parameters have been varied in order to reach relatively fast decoloration of the substrate solution under mild conditions (ambient temperature, small concentrations of the oxidative system, etc.). The kinetics of decoloration was studied using SPEKOL® 1500 UV/Vis spectrophotometer (Analytik Jena AG, Germany) at 585 nm (MV) and 625 nm (MB).

It was shown that depending on the system used, different patterns of kinetic curves were obtained. For the reaction mixture [MV (MB) + H_2O_2 + Fe^{2+}] sharp decrease of optical density was observed at the initial stage of oxidation process – up to 10 minutes. After that the reaction was slowing down – the rate of dye decomposition was 4–10 times lower. At the same time, when Fe^{3+} was used instead of Fe^{2+} ion, more smooth kinetic curves were observed, without obvious two stages. Such effect can be explained in terms of different mechanisms of substrate destruction reaction by hydrogen peroxide in the presence of metal ions with different oxidation state.

The dye decomposition rate is shown to be dependent non-linearly on the pH value and concentration of each component in the system. Additional experiments were carried out to study the influence of compounds of natural origin on the kinetics of MB oxidation. The obtained results demonstrated that the presence of relatively low concentrations of amino acids and carbohydrates could significantly accelerate the reaction.

Optimum ratios of Fenton's reagent components and reaction conditions providing relatively fast dye oxidation were determined for each investigated system.

The obtained results show the prospects of Fenton systems with additives of substances of natural origin for the development of effective wastewater treatment processes.