OXIDATIVE DESTRUCTION OF METHYL VIOLET DYE BY FENTON AND RUFF SYSTEMS

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The efforts of many scientists all over the world are aimed at studying ways of polluted water purification. One of the most widely used are chemical methods, mainly based on oxidative reactions. Hydrogen peroxide in combination with Fe^{2+} (Fenton system) or Fe^{3+} ions (Ruff system) generate hydroxyl radicals which are effective oxidants for wastewater decontamination. The goal of this work was investigation of Fenton and Ruff systems effectiveness in the reaction of methyl violet dye decolorization.

The kinetics of methyl violet (MV) dye oxidative decolorization was studied by spectrophotometric method. UV/Vis spectra were received on a single-beam spectrophotometer SPECOL 2000 (Analytik Jena, Germany) at 23±2 °C in a 10 mm-thick cuvette. The pH = 3.0 was adjusted by the addition of sulfuric acid solution.

It was shown that for both components of Fenton system the initial rate of the reaction (W_0, $mol \cdot l^{-1} \cdot s^{-1}$) and the substrate conversion (S, %) change nonlinearly. The higher H_2O_2 concentration the higher the substrate conversion, while for Fe^{2+} the opposite dependence is observed. The highest MV conversion values were obtained for stoichiometric ratio $[Fe^{2+}]_0/[H_2O_2]_0$, and $[H_2O_2]_0 > [Fe^{2+}]_0$. The Ruff system was shown to be less effective for substrate solution decolorization. The values of W_0 were ~10 times lower compared to Fenton reagent at the same conditions.

It was established that the efficiency of both systems could be varied by the addition of the substances of natural origin such as ascorbic acid, fructose, cysteine. Depending the concentration of the additive in the system both acceleration and slowing down of the reaction could be observed. For Fenton system the additives in concentrations that are one-fold less than the concentration of components provide an increase in the MV conversion compared to a mixture without additives over a shorter period. At the same time, the increase of additive concentration results in decrease of W_0 and substrate conversion. The most effective additive in MV discoloration process is ascorbic acid.

The influence of ascorbic acid additives at the MV oxidative decolorization by Ruff system was studied. The results show that the presence of ascorbic acid in the concentrations of $1 \cdot 10^{-5}$–$6 \cdot 10^{-4}$ M ($[MV]_0 = 1.6 \cdot 10^{-5}$ M, $[Fe^{3+}]/[H_2O_2] = 1/3$) results in rise of W_0 and increase of $S_{30\ min}$. At higher additive concentrations gradual decrease of these parameters is observed.

The obtained results can be used to regulate the efficiency of the Fenton and Fenton-like systems to develop environmentally friendly and relatively inexpensive technologies for oxidative degradation of water pollutants.