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Oxidation of azodye Direct Black 22 by Fenton and photo-Fenton processes

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Abstract

The direct black 22 (DB) (C.I. 35435) azodye oxidation with use of the Fenton reagent and the photo-Fenton system (Fenton reagent under irradiation with UV light) was studied. The dye oxidation proceeds through with the formation of hydroxyl radicals upon the catalytic decomposition of hydrogen peroxide in the presence of Fe^{2+} ions. The kinetics of DB molecules oxidation using various oxidants (UV-light, hydrogen peroxide, Fenton reagent ($Fe^{2+}+H_2O_2$), and the photo-Fenton process ($UV/Fe^{2+}+H_2O_2$)) are considered. The dye concentration was determined by the spectrophotometric method. Investigation of the kinetics of DB oxidation was carried out under pseudo-first order conditions. The rate constant and the initial rate DB molecules oxidation values are calculated for different variants of its oxidation. The highest oxidation rate is observed when the UV light/Fenton reagent is implemented. The effect of hydrogen peroxide concentration on the efficiency of DB oxidation was studied. An increase the hydrogen peroxide concentration of leads to a significant increase the efficiency of the process, which is associated with the formation of more hydroxyl radicals during the decomposition of hydrogen peroxide when irradiated with UV-light. When comparing the oxidation of the DB with hydrogen peroxide and Fenton's reagent under irradiation with UV light, the efficiency of the process is increased by 43%. Much of the DB molecules are oxidized when treated with Fenton's reagent in 20 minutes of the process at a hydrogen peroxide concentration of 0.15 mg/l. It is shown, that when the concentration of iron ions in the solution is increased, the degree of decolorization of the DB solution passes through a maximum, which is due to the rapid oxidation of Fe^{2+} and the formation of iron-containing sludge.

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