KINETIC REGULARITIES AND THE MECHANISMS OF THE OXIDATION OF SOME REACTIVE DYES IN PHOTO-FENTON SYSTEM

Dr. Isac-Gutul Tatiana[1], Dr. Tutovan Elena[1], Spivacenco Eugen[2] Master Student

[1]Moldova State University, [2]Customs Service of the Republic of Moldova, Moldova

The formal kinetics of decolouration of the reactive industrial dyes - Reactive Orange 16 and Reactive Blue in systems of the type S – H_2O_2 – hν, S – Fe^{2+}- H_2O_2 – hν, S – Fe^{2+}- H_2O_2 – hν-AAS (in weak acid medium) has been studied. Mercury-deuterium high-voltage lamp «ДРТ – 1000» as a source of UV has been used. There have been defined optimal concentration conditions of the decolouration of the dyes in the systems used. Addition of an oxidizer and a catalyst increases the decolouration effect in the cases of both dyes. The rate of the decolouration in the S – Fe^{2+}- H_2O_2 – hν systems as a function of the concentrations of the substances has been determined:

$$W_1=\chi_1[Fe^{2+}]^{0,4}[H_2O_2]^{0,4}[RO\ 16]^{0,9}$$

$$W_2=\chi_2[Fe^{2+}]^{0,5}[H_2O_2]^{0,3}[RA]^{0,5}$$

According to the results that has been obtained we concluded that the mechanisms in the systems mentioned are considered to be ion-radicalic, there have been proposed the schemes of the oxidation processes. The first step is the decomposition of the light-sensitive dye, but the second step is the generation of OH-radicals in the systems used, which are the main particles involved in the dye oxidation:

$$1.\ S + h\nu \rightarrow S^*\ \text{(leuco-form dye)}$$

$$2.\ H_2O_2 + h\nu \rightarrow 2\ OH^{\cdot}$$

$$3.\ S + OH^{\cdot} \rightarrow P$$

$$4.\ OH^{\cdot} + H_2O_2 \rightarrow HO_2^{\cdot} + H_2O.$$

The decolouration degrees in these systems increase in the following order:

$$S – h\nu\ <\ S – H_2O_2 – h\nu <\ S – Fe^{2+} - H_2O_2 – h\nu$$

COD (chemical oxygen demand) and general degree of mineralization of these dyes have been determined by two similar methods, both based on the dichromate oxidability. It has been found that ability of H_2O_2 is enough for waste water treatment from colorants, but for the elimination of surfactants it's necessary to use the Photo-Fenton system. Also there has been established the oxidation degree in the mixed systems containing 4 reactive dyes after COD value in the mentioned systems. Good results of oxidation in range of MPC (maximum permissible concentration) are achieved in this work both for systems $S – H_2O_2 – UV$ and $S – Fe^{2+} - H_2O_2 – UV$ not for in $S – Fe^{2+} - H_2O_2 – UV$- AAS. Mineralization degree measures achieve values up to 97%. According to the rezults obtaned in the Photo-Fenton system, the oxidation of these dyes in water solutions at the acid pH can be used for the pretreatment of the waste waters from the textile industry.

There have been detected the mane products of the oxidation in the systems examined by FTIR spectroscopy and HPLC chromatography methods. The main product of the oxidation in the $S – H_2O_2 – UV$ systems are: sodium butyrate, methacrylic acid, 3-octanone, catethol, 2-methyl-1-nitro-propane, 4-hidroxy-3-hexanone, 2-dimethyl-2-hexanol, sulfoxide.