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FREE RADICALS OF NATURAL WATER AND THEIR INFLUENCE IN CHEMICAL TRANSFORMATION OF DYES

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The importance of the free radicals in natural waters has become a subject of discussion and study not so long ago. Among the products of monoelectonic reduction of the molecular oxygen the *OH* radicals tend to have higher oxidative properties. According to the literature sources, the permanent concentration of OH radicals, the strongest oxidant of the natural waters, is very low ($\approx 10^{-15} - 10^{-17}$M), that is why at the beginning there have been doubts on whether they can have a significant role in the self-purification processes of natural waters [1,2].

The textile industry occupies an important place in the economy of the country, being one of the largest consumers of water. A major problem encountered in the dyeing process is the excess of dye, unfixed on fibers. The discharge of wastewaters into water objects can have negative consequences for aquatic ecosystems. Thus, through experimental research there can be identified main ways of reducing the concentration of textile dyes on the example of red direct dye (RAD) in the presence of free radicals.

The RAD transformations were studied by modeling different systems, ranging from the simplest, RAD-hν, the system RAD-H_2O_2-hν (II), and the last RAD-H_2O_2-Cu^{2+}-hν (III). As a source of radiation the DRT-1000 lamp was used. The emission spectrum of the DRT-1000 lamp contains peaks both in the domains UV and VIS like the spectrum of the RAD dye. Following irradiation of the dye solution its degradation by reducing the solution concentration could pursue.

The research results denote that the RAD is unstable in aqueous solution, so it can be easily removed from natural waters. Presence of H_2O_2 in system contributes to the photochemical formation of free radicals that interact with molecule of the RAD dye. In the presence of Cu(II) ions, the self-purification processes of water with the participation of free radicals arise much faster.

For the all investigated systems the kinetic legalities have been determined, mathematical relationships for determining the rates have been proposed, values of the rate constant and the half-life of the dye have been calculated. In the environmental conditions the RAD dye will be transformed more effectively as a result of indirect photolysis processes than those of direct photolysis. These processes arise more effectively in the presence of Cu(II), which plays the role of catalyst and contributes to the formation of additional quantities of OH radicals. The half-life of RAD is 44 s and shows that RAD has a low degree of persistence in the environment and can be easily removed as a result of photochemical processes of self-purification.

References:

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