TITLE: ***Photocatalytic degradation of azo dye direct red 23 (DR23) in an aqueous suspension of titanium dioxide***.

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ABSTRACT

The textile industry has a special issue in natural water contamination for generating a large amount of highly colored wastewater due to the presence of some dyes and specially azo dyes. These dyes and their sub-products can represent risks to the human health as well as to the environmental due to the toxicity, non-biodegradability and resistence to the degradation. The aim of this work was to investigate the influence of experimental parameters in the decolorization and degradation of the Direct Red 23 azo dye (DR23), using TiO2 in aqueous suspension under artificial (125 W Hg vapor lamp) and solar radiation. The kinetic behavior was investigated at 30.0℃ under pseudo-first order condition. The concentrations of DR23, TiO2 and pH were varied using two experimental conditions, one exploratory and another one using factorial design 23, both based on experimental data. The largest rate constant at natural pH 6.9 and 30.0℃ was (6.58±0.39)x10-3 min-1 for the exploratory condition, using 1.00x10-4 mol L-1 dye concentration and 1.25 g L-1 of TiO2 and (5.47±0.55)x10-3 min-1 for the experimental design using 1.50x10-4 mol L-1 dye concentration and 1.75 g L-1 of TiO2. The suspension formed by DR23 and TiO2 were stirred for 45 min at 600 rpm in the dark and then, irradiated. The collected samples during 6 h irradiation were filtered (0.22µm) and analysed by UV-Vis spectrophotometry. The CHN elemental analyses of 6 h irradiated samples showed that the total residual carbon was 0.21%, that is, the azo dye was 99.2% degraded for the experimental design and 0.45% for the exploratory one indicatinga degradation of 97.9%. The Q mode factors were determined from the spectral data of the experimental design and showed the formation of five intermediates and one product. The addition of oxidants as persulfate, and chlorate ions and hydrogen peroxide increased the degradation rate constant of DR23. Among these oxidants, the persulfate ion showed to be the most favorable, because 97.6% decolorization performed in 1 min irradiation using 2.50x10-4 mol L-1 concentration. In the presence of chlorate ion 95.9% of the azo dye was also decolorized in 1 min for 50.00x10-4 mol L-1. The H2O2 was the least effective of the three, once to the decolorize 97.8%, it was necessary 120 min irradiation and add

50.00x10-4 mol L-1 of this oxidant. The rate constants of dye decolorization in TiO2 under several experimental conditions were about three times faster under solar radiation than in comparison to the artificial lighting.

Keywords: Photocatalysis; azo dye; titanium dioxide; optimization; factor analysis.