



Discoloration and mineralization of Direct Orange 39 textile dye in water by atmospheric plasma and ferrous ion

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ABSTRACT

The wastewater generated by the textile industry causes serious problems for ecosystems when discarded without effective treatment. Samples of water contaminated with the Direct Orange 39 dye were treated by plasma discharge generated at atmospheric pressure for 150 min. In this study, the initial concentration of the dye was 1.0 mM with an initial volume of 250 mL. Moreover, iron filings (Fe^{2+}) were used as a catalyst. Reduction of the dye concentration in the samples was possible as a function of treatment time. This was verified by the absorbance spectrum in the UV-vis range. During treatment, every 15 min, we monitored the electric current, voltage, temperature of the water containing the dye, volume, pH, electrical conductivity, absorbance, concentrations of nitrates and nitrites, total organic carbon (TOC), chemical oxygen demand (COD), and the optical emission spectrum of the plasma and determined the dye concentration, discoloration factor, percentage of mineralization, and G_{50} (which expresses the amount of energy required to eliminate 50% of the pollutant), and electrical cost. Results showed that the efficiency of the dye degradation by plasma is a function of treatment time, and we obtained the removal of 50% of the colorant in 34 min and 94.2% in 120 min; additionally, COD was at 98.6%, the TOC was at 98.7%, and the percentage of mineralization was at 98.5% after 150 min of treatment. The maximum concentrations of nitrates and nitrites were 214 and 32 mg/L, respectively, after 150 min. From the optical spectrum of plasma emission, different species were identified (e.g., OH, N_2 , Na, H_α , and H_β). The G_{50} value was 0.825 g/kWh, and the electrical cost calculated for the treatment of 1 m³ of water with this colorant using plasma was \$3.20 after 150 min of treatment.

Keywords: Plasma; Textile dye; Total organic carbon; Chemical oxygen demand; Optical emission spectroscopy

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