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Applicability of Graphite–Copper Electrode System for Electrolytical Removal of Rhodamine-B dye in Textile Effluents

H.P.R.T. Priyankara*, U.A.D. Jayasinghe and H.L.K. Sanjaya

Department of Limnology and Water Technology,
Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Sri Lanka

** priyankara029fw@fmst.ruh.ac.lk*

Industrialization around the world increases wastewater discharge, causing environmental issues with great concern. Wastewater treatment and management is the major problem in the textile industry. Although there are many traditional methods to remove color from wastewater, the electrochemical process could be a promising alternative for efficient and eco-friendly treatment. In this study, Rhodamine B (Rh-B) dye was used as a model textile dye to determine the optimum conditions in the electrolytical removal with electrochemical cell. In the presence of the chlorinated electrolyte, the efficacy of the dye degradation is described by the electro-oxidation that leads to the generation of strong oxidizing chlorine active species besides the graphite anode. On the copper cathode, reduction of water activates as the cathodic reaction. The effect of concentration of electrolyte (NaCl), pH, current density, temperature, Rh-B dye concentration and contact time on the degradation of dye were examined by assessing the color removal efficiency, Chemical Oxygen Demand (COD) under the optimized conditions. It was observed that highest color removal efficiencies were reached at 30 ^{0}C, pH 7.0 at the 0.075 M NaCl concentration, 80 mA cm^{-2} current density. And these optimized conditions were suitable for below 100 ppm of Rh-B dye concentration. The 91.62±0.14% color removal efficiency after 60 minutes of electrolysis for 50 ppm dye solution and 77.07±0.15% of color removal efficiency after 90 minutes for 100 ppm dye were achieved at the optimal conditions. After 180 minutes of experiment, 52.70±4.42% and 50.65±2.13% of COD removal efficiencies were achieved for 50 ppm and 100 ppm of Rh-B dye respectively. Under the optimized conditions, the percentage weight loss values of graphite (0.97±0.01%) and copper (0.94±0.73%) electrodes were obtained for 50 ppm dye treatment. The electro-oxidation was found to be highly effective in the treatment of textile effluents containing Rh-B dye, without forming any sludge.

Keywords: Electro-oxidation, Colour removal, Wastewater treatment, Electrochemical process