ELECTROCHEMICAL TREATMENT OF DYE DISSOLUTIONS OBTAINED FROM THE MIXTURE OF HYDROLYZED BIFUNCTIONAL REACTIVE DYES

ABSTRACT

The intervention of man in the environment is causing a rapid and intense environmental deterioration that can be observed in the exhaustion of natural resources. The investigation of potent and practical treatments to decolorize and degrade the colored textile wastewater**,** represents today a problem of wide interest for the textile industry due to the environmental impact this entails.

In this Doctoral Thesis the degradation of the three reactive dyestuffs that make up the Tricromia Procion HEXL is studied: Procion Yellow HEXL, Procion Crimson HEXL and Procion Navy HEXL. This type of dyes have as reactive group two monochlorotriazine groups and as chromophore group (group responsible for color) have two azo groups (-N=N-).

The discoloration and mineralization of these dyes are studied by applying the oxidation-reduction electrochemical treatment to 125mA/cm^2 in a filter-press cell using a stainless steel cathode (Cr 18-19% and Ni 8.5-9%) , and as anode, an antimony-doped Ti / SnO_2 type DSA electrode and small amounts of platinum (Ti / SnO_2-Sb-Pt) are used. The DSA electrodes stand out, among other things, for presenting a greater overpotential of oxygen production. This process is the one that previous research has shown to be the one with the best results.

The degree of decolorization / mineralization is evaluated by Total Organic Carbon (TOC), Total Nitrogen (TN) and Chemical Oxygen Demand (COD), data that also allow us to know Average Oxidation State (AOS) at the end of each as well as information on the efficiency in each case through the Carbon Oxidation State (COS), State of Average Oxidation (EOP), Instantaneous Currente Efficiency (ICE) and Average Current Efficiency (ACE).

The kinetics of discoloration and the evolution of the generated intermediates have been studied through measurements of High Resolution Liquid Chromatography (HPLC). The comparison of the spectra obtained through UV-Visible Spectroscopy and FTIR allows us to follow the discoloration from the initial and final state of the solutions after the electrolysis. The stability of the Ti / SnO_2-Sb-Pt DSA electrode in this type of process is also evaluated.

The main objective is to obtain discolored water with organic matter contents significantly lower than the initial values and also to study the possibility of reuse of these purified waste water in subsequent dyeing processes with the consequent saving of water and electrolyte.

In this first part of the work we studied the electrochemical treatment for the degradation of these bifunctional azo reactive dyes using solutions with the hydrolyzed dyes in which the main characteristics of the residual baths of dyeing by depletion of

cotton fibers were simulated. Initially, a solution containing only the Procion Yellow dye was studied, with the aim of evaluating the degradation and discoloration obtained from a single dye. In the second part we studied the behavior of a solution containing the mixture of the three hydrolyzed dyes of the Tricromia Procion HEXL in a concentration similar to those of a real effluent, in both cases Na_2SO_4 is used as electrolyte.

Next, we study the degradation and electrochemical behavior of baths containing dyes**:** Procion Yellow HEXL, Procion Crimson HEXL and Procion Navy HEXL after dyeing cotton fabrics. Laboratory dyes are made with each of the three dyes separately and also with a mixture of the three dyes, subsequently the waters resulting from these dye baths are subjected to an electrochemical oxidation-reduction treatment at 125mA/cm^2 in a filter-press cell.

Once the oxidation-reduction electrochemical treatment at 125mA/cm^2 in a sewage filter cell from bifunctional reactive azo dye dyebaths, in particular those belonging to the Tricromia Procion HEXL is effective to achieve a significant reduction of COD and TOC**,** as well as the discoloration of the treated solutions, proceed to study and to verify that these treated waters can be reused in later dyes obtaining acceptable values of equalization in the dyed tissues. We have also studied degradation and discoloration in successive reuses.

We perform a color equalization study of the cotton fabrics tinted with the dyes of the Tricromia Procion HEXL**,** using solutions with different proportions of distilled water and recovery water and verify the equalization of the same, the data that we obtain from this study indicate us that good results are obtained from mixtures of 70% recovery water and 30% water. This model of bath is the one that we have used to carry out afterwards four electrolysis and five consecutive dyes, reusing in each tincture the water from the bath of the previous that contains the hydrolyzed dyes which have not reacted with the fiber and which will undergo an oxidation-reduction treatment in a press filter cell without separation of compartments.

The color differences obtained in the fabrics dyed in the four reuses are below the maximum limit of acceptance of color differences in the textile industry**,** which is one unit ($DE_{CMC(2:1)} \leq 1$).

Subsequently we study the degradation and mineralization of the bath resulting from the dyeing of cotton fabrics at the laboratory level with a mixture of the colorants**:** Procion Yellow HEXL, Procion Crimson HEXL and Procion Navy HEXL**,** using NaCl as electrolyte by subjecting these baths to a treatment Oxide-reduction electrochemical at 125mA/cm2 in a filter-press cell.

In all cases a decrease of COD, TOC and TN is obtained, AOS and COS data indicate that the oxidation state of Carbon in all solutions increases, the ACE and COS results show that the process takes place in a way efficient. The discoloration kinetics of all processes correspond to pseudo-first order, UV-Visible spectroscopy reveals that the bands corresponding to the chromophore group of the dyes are eliminated.

Studies indicate that this treatment of successive dyes and discolorations could be a viable alternative in the purification of actual textile effluents containing this type of dyes.

The re-use of dyebaths for discolored reactive dyes by electrochemical methods is a interesting process from an environmental point of view due to the consequent saving of water and electrolyte (up to 70%), this also avoids the discharge of textile effluents with a high salt content in the environment.