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ELECTROFLOTATION OF 2,2-BIS (HYDROXYMETHYL) PROPIONIC ACID FROM AQUEOUS SYSTEMS

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Introduction

The textile industry is the major source of water consumption and wastewater pollution. These wastewaters generated from textile industries are linked to emerging wastewater pollution problems. It contains a mixture of different dyes, auxiliaries, additives, and additional chemicals that were added during textile production processes, causing serious environmental concerns. However, the main problematic pollutants from textile factories in the aquatic environment are dye mixtures.

The direct discharge of dyes in concentrations higher than 1.0 mg/L, treated or not, could increase community complaints and concerns. This is primarily due to the aesthetic problem linked to these dyes, especially for the non-acceptable colors of river water such as red or purple compared to more accepted colors such as green or blue. In addition, textile dyes in high concentrations inhibit sunlight penetration, respiration activities and consequently inhibiting the biological and photosynthesis processes in the aquatic environment.

Furthermore, the presence of these dyes for a long time in watercourses leads to dye accumulation in fishes and other organisms. Some dyes decompose to corresponding hazardous compounds that may also have a negative impact on the aquatic environment. Moreover, azo compound dyes, which are widely used in textile manufacturing and their related products (aromatic amine), can cause allergies, dermatitis, skin irritation, carcinogenic and mutagenic modifications as well as acute and chronic toxicity. Therefore, the treatment of these textile effluents is in demand.

The aim of the study is to evaluate the efficiency of removing simulated systems by elctroflotation methods. The related objectives were to (i) determine the chemical oxygen demand of mixtures that containing direct red dye and one or more types of textile auxiliaries and (ii) comparing these results.

Materials and methods

In this research were used direct red dye 81 (50.0%), 2,2-Bis(hydroxymethyl)propionic acid (98,0%), lignosulfonic acid sodium salt (average M_w~52,000 and M_n~7,000), and diethylene glycol (99.0%).

A rectangular column has been used as electroflotation cell. Its length was 8.5 cm, its width 8.7 cm and its height 17.5 cm. It was provided with two electrodes: carbon anode and a stainless steel cathode. These two electrodes were supplied by a D.C. power supply. The electrodes were placed on the bottom of the cell. COD concentration was measured by potassium dichromate standard method using UV-Vis spectrophotometer T 80+.

Results and conclusions

The electroflotation method is based on the principle of the electrochemical processes of oxygen and hydrogen evolution during electrolysis of waste waters. Finely dispersed gas bubbles raise the surface trapping along with them dispersed particles present in solution. The foam layer obtained (floto sludge) is removed from the surface of the solution by mechanical means.

In this study, electroflotation method is used for four simulated systems with variable concentration auxiliaries (20,0-80,0 mg/L). Results are showed in Table 1.

Table 1. COD of simulated systems by electroflotation; $[DR]_0$=200.0 mg/L, J=0,5 Am^{-2}, electroflotation time=10 min, $V_{work\ solution}$=0.25 L

$[Auxiliaries]_0$, mg/L	Bis-MPA, I	Bis-MPA-DR, II	Bis-MPA-DR-LASS, III	Bis-MPA-DR-LASS-DEgl, IV
20.0	14.4	5.6	6.9	9.4
40.0	15.0	6.9	11.4	14.4
60.0	15.6	8.1	14.4	27.5
80.0	16.3	11.9	16.3	28.8

The emollient agent, Bis-MPA, has several hydrophilic groups than other auxiliary agents and which, respectively, provide more water solubility. This agent has property to prevent the electrofilter removal by the oxygen and hydrogen molecules generated by water hydrolysis. Therefore, with increasing the emollient concentration in the system, COD increases. But when a direct dye with negative charge is added to the system, bis-MPA-DR, the hydrophilic groups (3HO groups) of the emollient interact with the dye molecules, which in turn act as collectors in the electrofloatation system. Thus, COD shrinks almost twice as much as the Bis-MPA system. In the case of the third and fourth systems, the COD value is increased because with the addition of the LASS and DEgl coupling, there is a change in the dimensions and the electrical charge of the dye. As a result, CCO increases with increasing concentration of auxiliaries in the systems studied, because electrolytic gas bubbles interact differently, and the dye loses its collector property of organic matter in the foam layer. The electrofloating process was followed by the activated charcoal adsorption process (KAY-1) for systems whose COD values are greater than 6,9 mgO/L. Adsorption of residual compounds takes place up to admissible rules (CMA). By comparison, the efficiency of coating systems containing direct dyes is 14.0% higher than systems that have active dyes in their composition. At concentrations higher than 200.0 mg/L of dye it is necessary to apply destructive methods, in case of oxidation with Fenton reagent after the electrofloating process.