COLOR REDUCTION IN TEXTILE EFFLUENTS BY MEMBRANES

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Abstract **- In this study, the efficiency of polymeric membranes in terms of reductions in color and chemical oxygen demand (COD) in textile industry effluents was investigated. Effluents containing different mixtures of dyes, taken from different processing stages, and some pure dyes in aqueous solution were used. Five membranes were used, three commercial ones produced by Osmonics (two nanofiltration M1 and NF-HL and one reverse osmosis SG) and two ultrafiltration (UF) membranes prepared in the laboratory using PES (polyethersulfone) named T1 and T2. Each membrane, due to its particular chemical nature and molecular weight cut-off (MWCO), had distinct values for permeate flux, and color, conductivity and COD reductions. After stabilization, the permeate flux varied from 20 to 71 L/h/m^2 and the dye retention from 81 to 100%. For aqueous solutions containing pure dyes, the permeate flux varied from 57 to 119 L/h/m^2, depending on the temperature used in the process. Membrane M1 showed a good performance; when considering the values for permeate flux (66 L/h/m^2) and color reduction (99.3%).**

Keywords - textile **effluent, dye, polymeric membrane.**

I. INTRODUCTION

The textile industry can be considered as one of the greatest consumers of water, due to the high consumption at different stages of the production process, it being necessary to adequately treat large quantities of effluents before their discharge to the environment. Some of these effluents are colored, despite containing only small amounts of dyes. These dyes are toxic and, in most cases, are not biodegradable or their biodegradation is difficult and they resist well physico-chemical treatment methods.

The presence of inorganic dyes in the effluents is the main reason for their non biodegradability and their removal from these effluents has been recently studied using biotechnological processes, adsorption, hydrolysis and, more recently, through nanofiltration or reverse osmosis microporous membranes, with removals of between 95 and 100% being achieved (Noël *et al*., 2000; Cho *et al*., 1999; Xu *et al.,* 1999).

With the popularization of membrane processes, such as reverse osmosis and nanofiltration, in various application areas, the cost of industrial units has been reduced, making viable their use in processes which were previously economically unviable.

The removal of dyes from textile industry effluent, along with the removal of other contaminants in effluents from other industries, opens the possibility for water reuse. Depending on the treatment used and its efficiency in terms of reducing color, turbidity and chemical oxygen demand (COD), the water can be entirely or partially reused for the same process from which it originated or in other processes which use less clean water, such as for equipment cleaning or gardening.

The possibility for reuse has gained the attention of the industrial sector due to the imminent possibility for large consumers to be charged for water, even when they carry out their own collection. Considering the large volume of water consumed by the textile industries, there is a need to invest in adequate treatment technologies with a view to reuse, given the risk of becoming less competitive should a water charging system be implemented.

This study aimed to test ultrafiltration, nanofiltration and reverse osmosis polymeric membranes in the treatment of different effluents containing a mixture of dyes and of solutions containing a pure dye. The permeate flux, color reduction, turbidity and COD were evaluated.

II. MATERIALS AND METHODS

A. Membranes

Five membranes were used, three commercial ones produced by Osmonics (two nanofiltration M1 and NF-HL and one reverse osmosis SG) and two prepared in the laboratory from PES (polyethersulfone) named T1 and T2. These latter two were prepared from an 18% homogeneous solution of PES, with additions of PVP at 1% (T1) and 2% (T2) in N'N'dimethylformamide. The solution was spread over the polyester-polypropylene (Viledon Filter – Carl Freudenberg) support and coagulated in water at a temperature of 20-22^{o}C.

Analytical Methods

The soluble COD was determined according to a method of the "American Public Health Association – Standard Methods for the Examination of Water and Wastewater" (APHA, 1995) Method 5220 D. The conductivity was measured directly with a conductivimeter at ambient temperature and expressed in mS/cm (Tecnopen). The color was determined spectrophotometrically at 420nm (Shimadzu, model UV mini 1240) and