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Study of the Removal Efficiency of Azo-Dyes Using Xanthan as Sequestering Agent

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Abstract : Introduction: The contamination of water with the azo-dye is a problem worldwide as although wastewater contaminate is treated in a municipal sewage system, still contain a considerable amount of dyes. In the present, there are different processes denominated tertiary method in which it is possible to lower the concentration of the dye. One of these methods is by adsorption onto various materials which can be organic or inorganic materials. The xanthan is a biomaterial as removal agents to decrease the dye content in aqueous solution. The Zimm-Bragg model described the experimental isotherms obtained when this biopolymer was used in the removal of textile dyes. Nevertheless, it was not established if a possible correlation between dye structure and removal efficiency exists. In this sense, the principal objective of this report is to propose a qualitative relationship between the structure of three azo-dyes (Congo Red (CR), Methyl Red (MR) and Methyl Orange (MO)) and their removal efficiency from aqueous environment when xanthan are used as dye sequestering agents. Methods: The dyes were subjected to different pH and ionic strength values to obtain the conditions of maximum dye removal. Afterward, these conditions were used to perform the adsorption isotherm as was reported in the previous study in our group. The Zimm-Bragg model was used to describe the experimental data and the parameters of nucleation (Ku) and cooperativity (U) were obtained by optimization using the R statistical software. The spectra from UV-Visible (aqueous solution), Infrared absorption and Raman spectroscopies (dry samples) were obtained from the biopolymer-dye complex. Results: The removal percent with xanthan in each dye are as follows: with CR had 99.98 % when the pH is 12 and ionic strength is 10.12, with MR had 84.79 % when the pH is 9.5 and ionic strength is 43 and finally the MO had 30 % in pH 4 and 72. It can be seen that when xanthan is used to remove the dyes, exists a lower dependence between structure and removal efficiency. This may be due to the different tendency to form aggregates of each dye. This aggregation capacity and the charge of each dye resulting from the pH and ionic strength values of aqueous solutions are key factors in the dye removal. The experimental isotherm of MR was only that adequately described by Zimm-Bragg model. Because with the CR had the 100 % of remove thus is very difficult obtain de experimental isotherm and finally MO had results fluctuating and therefore was impossible get the accurate data. Conclusions: The study of the removal of three dyes with xanthan as dye sequestering agents suggests that aggregation capacity of dyes and the charge resulting from structural characteristics such as molecular weight and functional groups have a relationship with the removal efficiency. Acknowledgements: We are gratefully acknowledged support for this project by Consejo Nacional de Ciencia y Tecnología, México (CONACyT, Grant No. 632694.)

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