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EFFICIENT REMOVAL OF TOXIC FOOD DYES WITH AN ENVIRONMENTAL-FRIENDLY CROSSLINKED POLYMER

Iolanda-Veronica Ganea[1,2], Alexandrina Nan[2], Călin Baciu[1]

[1]Faculty of Environmental Science and Engineering, "Babeș-Bolyai" University, 30 Fântânele, 400294 Cluj-Napoca, ganea.yolanda@yahoo.com, calin.baciu@ubbcluj.ro, Romania
[2]National Institute for Research and Development of Isotopic and Molecular Technologies, 67-103 Donat, 400293 Cluj-Napoca, alexandrina.nan@itim-cj.ro, Romania

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Introduction

The terms "food coloring" or "color additives" refer to dyes or chemicals that create color when added to food or drinks. Food coloring is used in both industrial and residential food preparation. Globally, it is now well-known that the environmental damage caused by synthetic dyes has become a major problem. Tartrazine (E102, Yellow 5, Acid Yellow 23) is a yellow synthetic azo dye and the fourth-most used coloring dye in food technology, medicines, cosmetics, and textiles. Recent research has shown that tartrazine can cause several adverse effects on human health, such as asthma, allergies, anaphylactic shocks, liver/kidney disorders or even induce cancer. Therefore, treating tartrazine-containing wastewater prior to its release in the environment is an essential requirement.

The current study presents the synthesis of a new environmental-friendly crosslinked polymer and its application for tartrazine adsorption from aqueous solutions. The material was characterized by Scanning Electron Microscopy (SEM) and Fourier-Transform Infrared Spectroscopy (FTIR), and tartrazine was determined by UV-VIS Spectroscopy. The effects of initial tartrazine concentration and contact time on the adsorption process were evaluated. Promising results were obtained regarding the removal efficiency of tartrazine from the investigated aqueous solutions.

Materials and methods

The crosslinked polymer (CP) preparation followed "green synthesis methods" and did not involve the use of catalysts. The synthesis optimization involved the variation of the reagents' ratio (1:1, 1:2 and 2:1). Batch adsorption tests were performed on 4 different tartrazine concentrations (10, 100, 250 and 500 mg L^{-1}) and 9 contact times (5, 15, 30, 45, 60, 90, 120, 150 and 180 minutes). Several equilibrium isotherms and two kinetic models were applied to describe the tartrazine adsorption mechanism.

Results and conclusions

The experimental data show that tartrazine removal efficiency was up to 100% under all investigated conditions (Figure 1). As can be seen, no significant differences appear in the adsorption efficiency of the 3 crosslinked polymer ratios

tested. However, a slight increase is noticed in the case of CP 1:2 at 100 mg L^{-1} and 250 mg L^{-1}.
Tartrazine adsorption on the new material generally varied between 99.42-100% efficiency. Moreover, the experiments proved that for the tested operational and environmental conditions, contact time does not influence the tartrazine removal efficiency of the polymer. Linear regression was applied to check which equilibrium isotherm fitted best the material's adsorption mechanism. Results showed that Langmuir isotherm registered the best fitting (R^2 = 0.999).

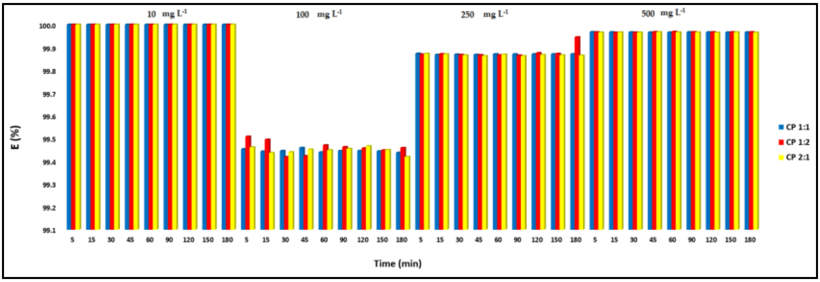

Fig. 1. The effect of tartrazine initial concentration and contact time on the adsorption efficiency of the crosslinked polymer

To sum up, the new crosslinked polymer was prepared under environmental-friendly synthesis conditions. The obtained material displayed excellent adsorption properties, making it suitable for environmental applications in the treatment of tartrazine and other azo dyes contaminated effluents.

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