

Fixed-bed adsorption of crystal violet dye on four activated carbon adsorbents: Felt-Ox, Luffa-Ox, MSC-Ox and F400

Batuhan Mulla¹, Kyriacos Ioannou¹, Ioannis Ioannidis², Ioannis Pashalidis², Nikolaos Kostoglou^{3,4}, Claus Rebholz¹

¹Department of Mechanical and Manufacturing Engineering, University of Cyprus, 2109 Nicosia, Cyprus

²Department of Chemistry, University of Cyprus, 2109 Nicosia, Cyprus

³ Institute of Geoenergy, Foundation for Research and Technology – Hellas, 73100 Chania, Greece

⁴ Department of Materials Science, Montanuniversität Leoben, 8700 Leoben, Austria

Περίληψη

The widespread use and improper disposal of crystal violet (CV) dye into aquatic environments have raised serious environmental concerns, as this dye is non-biodegradable, toxic and poses harmful effects on both human health and ecosystems [1]. Therefore, developing efficient removal strategies to prevent its accumulation in the environment is essential. Activated carbons, owing to their high surface area and pore volume, can be used as highly effective adsorbents for treating contaminated water [2]. Among various approaches, the fixed-bed adsorption method enables continuous treatment of large volumes of contaminated water using a constant amount of adsorbent, offering advantages such as operational simplicity and scalability [3].

This study investigates the use of oxidized activated carbon fibers (Felt-Ox) for the removal of CV dye through the fixed-bed adsorption method. The performance of Felt-Ox was compared with three other activated carbon-based adsorbents (MSC-Ox, F400 and Luffa-Ox). Characterization of the carbon adsorbents was carried out for their nanopore structure, surface morphology and surface chemistry. Additionally, the maximum CV adsorption capacity of the adsorbents was determined by fitting the experimental breakthrough data to the Yan model. Moreover, the effect of adsorbent mass in CV removal was also examined. The results revealed that the Felt-Ox material exhibited the highest maximum adsorption capacity (19.6 mg/g) among all the tested adsorbents.

Βιβλιογραφία

[1] M. Boulahbal, M.A. Malouki, M. Canle, Z. Redouane-Salah, S. Devanesan, M. S. AlSalhi, M. Berkani, Chemosphere 306 (2022) 135516

[2] F. Hassan, M. A. Sabri, H. Fazal, A. Hafeez, N. Shezad, M. Hussain, Journal of Analytical and Applied Pyrolysis, 145 (2020) 104715.

[3] P. Rajandran, N. Masngut, N. H. A. Manas, N. I. W. Azelee, S. F. Z. M. Fuzi, M, A, H, Bunyamin, International Journal of Environmental Science and Technology 22 (2025) 3943