Environmental Engineering and Management Journal

August 2025, Vol. 24, No. 8, 1667-1681
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu
http://doi.org/10.30638/eemj.2025.130

"Gheorghe Asachi" Technical University of Iasi, Romania

ENHANCEMENT OF CHROMIUM ADSORPTION USING POWDERED LEAVES OF *Syzygium cumini*: EVALUATION OF KINETICS, ISOTHERM, AND PREDICTION ANALYSIS

Maedeh Soleimani[1], Milad Mousazadehgavan[2*], Hamzeh Ali Jamali[3], Reza Ghanbari[3]

[1]Department of Environment, Geology, and Natural Resources, Ball State University, Muncie, IN 47306, USA
[2]Faculty of Engineering and Technology, School of Civil Engineering and Built Environment, Liverpool John Moores University (LJMU), Liverpool L3 3AF, UK
[3]Social Determinants of Health Research Center, Research Institute for Prevention of Non-Communicable Diseases, Qazvin University of Medical Sciences, Qazvin, Iran

Abstract

This study explores how chromium interacts with a natural adsorbent made from *Syzygium cumini* leaf powder. Experiments were conducted to evaluate the material's effectiveness removes chromium from water. Using statistical methods, Response Surface Methodology (RSM) and Central Composite Design (CCD), the adsorption process was optimized, achieving a maximum removal efficiency of 98% when the initial chromium concentration was 90 mg/L. As the concentration increased, the removal efficiency declined, reaching its lowest at 200 mg/L. The data best fit the Langmuir adsorption model, and the adsorption process followed a pseudo-second-order kinetic model. A Pareto analysis showed that the amount of *Syzygium cumini* powder had the greatest effect on chromium removal, contributing 21.67%. By optimizing conditions such as dosage of *Syzygium cumini* (29.79 g/L), contact time (118.97 min), chromium concentration (27.74 mg/L), and pH (2.71), we achieved a removal rate of 97.77%, with a 100% probability. These results suggest that *Syzygium cumini* leaf powder is a cost-effective and eco-friendly material for removing chromium from contaminated water, with the potential for reuse in practical applications.

Key words: bio-adsorption, chromium removal, optimization, *Syzygium cumini*

Received: March, 2024; Revised final: November, 2024; Accepted: November, 2024; Published in final edited form: August, 2025

[*] Author to whom all correspondence should be addressed: e-mail: m.mousazadehgavan@2024.ljmu.ac.uk