Junior Science Communications
Faculty of Applied Sciences, UiTM Shah Alam
https://journal.uitm.edu.my/ojs/index.php/JSC

E-ISSN 2637-0689
Vol 42 2024

Colloquium on Applied Sciences 2024
19-21 January 2024, Faculty of Applied Sciences, UiTM Shah Alam, Malaysia

Removal of Congo Red from Aqueous Solution Using Banana Peel Ash as An Adsorbent

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Structured Abstract

Background: Congo Red dye is a synthetic dye widely used in the textile, apparel, printing, paint, and chemical industries due to its resistance to fading and intense colour. However, releasing this dye into water presents substantial risks to both the environment and human health. Additionally, the improper disposal of agricultural waste, such as banana peels, can contribute to environmental pollution and climate change. This study utilized banana peel waste to synthesize mesoporous silica nanoparticles (MSN). The purpose of this study is to investigate the potential of the synthesized mesoporous silica as an adsorbent to remove Congo Red dye in an aqueous solution.

Methods: Silica was extracted from banana peel ash using the sol-gel method. Silica was modified into mesoporous silica nanoparticles (MSN) using CTAB and NH_4OH. An adsorption study was conducted to study the effect of initial dye concentration and adsorbent dosage. For the effect of initial dye concentration, varying concentrations of Congo Red dye solutions were mixed with 0.01 g of adsorbent. As for adsorbent dosage, different amount of adsorbent was added into 10 ppm of Congo Red dye solutions. The sample solutions from both experiments were analysed using UV-Vis Spectroscopy at wavelength 497 nm.

Results: Silica was successfully extracted from banana peel and then produced into mesoporous silica nanoparticles (MSN). The results from the study of the effect of initial dye concentrations show that as dye concentration increases, the percentage removal of Congo Red dye decreases. In the study of the effect of adsorbent dosage, percentage removal increases as the amount of adsorbent increases. However, as the adsorbent dosage is raised, the removal percentage decreases. The maximum percentage removal of Congo Red dye is 98.00% which is at optimum initial dye concentration and adsorbent dosage of 2 ppm and 0.03 g, respectively.

Conclusion: In conclusion, banana peels have promising characteristics that can be used to produce adsorbent in removing contaminants from water, hence contributing to the decrease of environmental pollution. The synthesized mesoporous silica nanoparticles (MSN) from banana peels have proven to be successful in removing Congo Red dye from an aqueous solution.

Keywords: Adsorption, Congo Red, Banana Peel, Mesoporous Silica Nanoparticles

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