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Adsorptive removal of cadmium from electroplating wastewater using hybrid composite of thiol-grafted seed gum of *Tamarindus indica* and Teff hay biocarbon

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Abstract

This study examined the methods for preparing biocarbon from Teff hay (TBC) and thiol-grafted seed gum of *Tamarindus indica* (TH@TI-TBC) with the purpose of removing cadmium (Cd) from polluted electroplating waste water. To improve biocarbon adsorption, seed gum and thiol were added in a two-step combination. At a pH of 5.5, the most effective Cd adsorption was seen with TH@TI-TBC (261.47 mg g^{-1}). While comparing to the Freundlich and Temkin models, the Langmuir and pseudo-second-order kinetic models found to be the best fit to the obtained adsorption data. After being treated with electroplating wastewater having $30 \text{ mg}^{-1}\text{L}$ of cadmium, TH@TI-TBC was able to remove up to 89% of the Cd, proving its effectiveness in dealing with adsorptive removal of Cd. Experimental studies and computational analyses revealed that electrostatic interaction and surface complexation were the principal underlying processes for Cd removal by TH@TI-TBC. In addition, an innovative material that can transform the waste into a product for environmental remediation must be developed using the vast amounts of Teff hay that are generated as agro-residue. So, this work proved that TH@TI-TBC can be made from Teff hay biocarbon could be a potential candidate for removing Cd from industrial wastewater.

Keywords: Teff hay biocarbon; seed gum; thiol modification; cadmium; adsorption; electroplating wastewater

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