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Rice Husk Derived Engineered Biochar for Glyphosate Removal in Aqueous Media

HERATH, I., VITHANAGE, M., KUMARATHILAKA, P., BANDARA, T., JAYAWARDHANA, Y., MAYAKADUWA, S. & WICKRAMASINGHE, S.

Chemical and Environmental Systems Modeling Research Group, National Institute of Fundamental Studies, Hantana Road, Kandy 20000, Sri Lanka

The presence of glyphosate in waters at elevated concentrations has received much attention worldwide in the recent decade, due to its detrimental consequences on the surrounding ecosystem as well as human beings (Bradberry et al. 2004). Hence, the remediation of glyphosate contaminated waters is an urgent necessity. Carbon-rich solid substrates such as biochars (BCs) have been recognized as an alternative and economically viable strategy to remove various inorganic and organic contaminants present in wastewaters. The activation of BC surface via steam activation is capable of enhancing the adsorption capacity of the BC (Rajapaksha et al. 2014). The main objective of the present study was to investigate the potential of a steam-activated BC derived from rice husk to remove glyphosate from aqueous solution. The BC was produced from risk husk under slow pyrolysis conditions at 700 ºC with steam activation in a furnace. Batch adsorption and isotherm experiments were carried out to evaluate the effects of pH, reaction time and glyphosate loading on the adsorption process. Three kinetics models including the Pseudo-first order, Pseudo-second order and Elovich were applied to evaluate the behavior of adsorption kinetics, whereas the Langmuir and Freundlich isotherm models were applied to determine the equilibrium parameters on the adsorption capacity of the BC. Results showed that a maximum sorption of glyphosate (82.0%) occurs at pH 4 and the adsorption capacity is decreased significantly with increasing pH. The Freundlich model fitted best the equilibrium isotherm data suggesting a physisorption that triggers via a multilayer sorption mechanism on heterogeneous and amorphous surfaces of BC. The kinetics of the adsorption process were described by the Pseudo-first order model with an adsorption capacity of 31.6 mg/g indicating that the adsorption of glyphosate onto the BC would be more inclined towards physisorption mechanisms depending on the initial concentration of glyphosate. Porous diffusion and π-π electron donor-acceptor interaction were the main mechanisms responsible for the adsorption process. Overall results demonstrated that this steam activated rice husk BC is highly effective in removing glyphosate in aqueous solution.

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