Kinetic analysis of the adsorption of glyphosate onto palm oil fronds activated carbon

ABSTRACT

Existing techniques for the treatment of pollutants include membrane separation, ion exchange, precipitation, transformation and biosorption. Of all of this technology, biosorption has several positive aspects which include low operating expenses, very efficient detoxification of toxicants at low concentrations, low amount of disposal materials and does not need nutrient requirements as in bacterial-based remediation, the latter of which is limited by the presence of heavy metals and other toxicants. The biosorption of glyphosate on palm oil fronds activated carbon can be an efficient and low-cost tool for remediation of glyphosate. The absorption kinetics data of biosorption isotherm on the biosorption of glyphosate on palm oil fronds activated carbon were analyzed using three models—pseudo-1st, pseudo-2nd and Elovich, and fitted using non-linear regression. The Elovich model was the poorest in fitting the curve based on visual observation followed by the pseudo-1st order. Statistical analysis based on root-mean-square error (RMSE), adjusted coefficient of determination (adjR2), bias factor (BF), accuracy factor (AF), corrected AICc (Akaike Information Criterion), Bayesian Information Criterion (BIC) and Hannan–Quinn information criterion (HQC) that showed that the pseudo-second order model is the best model. Kinetic analysis using the pseudo-second order model at 250 mg/L glyphosate gave a value of equilibrium sorption capacity qe of 94.12 mg g-1 (95% confidence interval from 89.913 to 98.332) and a value of the pseudo-second-order rate constant, k2 of 0.02 (95% confidence interval from 0.012 to 0.023). Further analysis is needed to provide proof for the chemisorption mechanism usually tied to this kinetic.

Keyword: Biosorption; Glyphosate; Kinetics; Palm oil fronds activated carbon; Pseudo-second order