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SUPPLEMENTARY MATERIAL TO

Magnetic *Ambrosia artemisiifolia*-based biosorbent for Congo red removal from water: A circular economy approach

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RESULTS AND DISCUSSION

Biosorption kinetics

Table S-I. Kinetic models applied to analyze CR biosorption with Fe_3O_4/MB.[1]

Model	Equation	Plot	Parameter
Pseudo-first-order (PFO)	$\log(Q_e - Q_t) = \log(Q_e) - \frac{k_1}{2.303}t$	$\log(Q_e - Q_t)$ *vs.* t	Q_e, k_1
Pseudo-second-order (PSO)	$\frac{t}{Q_t} = \frac{1}{k_2 Q_e^2} + \frac{t}{Q_e}$	$\frac{t}{Q_t}$ *vs.* t	Q_e, k_2
Elovich	$Q_t = \frac{1}{\beta}\ln(\alpha\beta) + \frac{1}{\beta}\ln(t)$	Q_t *vs.* $\ln(t)$	α, β
Intra-particle diffusion (IPD)	$Q_t = k_3 t^{0.5} + C_{id}$	Q_t *vs.* $t^{0.5}$	k_3

where Q_e and Q_t (mg g^{-1}) are the adsorption capacity's at equilibrium and at time t, k_1 (min^{-1}) and k_2 (, g mg^{-1} min^{-1}) are the rate constant; α (mg g^{-1}) is the initial adsorption rate, β (g mg^{-1}) is related to the extent of surface coverage; k_3 (g mg^{-1} min^{-1}) is intra-particle diffusion rate constant

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Biosorption isotherms

Table S-II. Isotherm models applied to analyze CR biosorption with Fe_3O_4/MB.[2,3]

Model	Equation	Plot	Parameter
Langmuir	$\frac{C_e}{Q_e} = \frac{1}{k_L Q_{\max}} + \frac{C_e}{Q_{\max}}$	$\frac{C_e}{Q_e}$ *vs.* C_e	Q_{max}, k_L
Freundlich	$\log Q_e = \log k_F + \frac{1}{n}\log C_e$	$\log Q_e$ *vs.* $\log C_e$	k_F, n
Temkin	$Q_e = \frac{RT}{b_T}\ln A_T + \frac{RT}{b_T}\ln C_e$	Q_e *vs.* $\ln C_e$	A_T, b_T
Elovich	$\ln\frac{Q_e}{C_e} = \ln K_E Q_m - \frac{Q_e}{Q_m}$	$\ln\frac{Q_e}{C_e}$ *vs.* Q_e	Q_m, K_E
Dubinin-Radushkevich	$\ln Q_e = \ln Q_{D-R} - K_{D-R}\varepsilon^2$ $\varepsilon = RT\ln\left[1+\frac{1}{C_e}\right]$ $E = \left[\frac{1}{\sqrt{2K_{D-R}}}\right]$	$\ln Q_e$ *vs.* ε^2	$Q_{D\text{-}R}$, $K_{D\text{-}R}$

where Q_e (mg g^{-1}) and C_e (mg L^{-1}) are the adsorption capacity at equilibrium and adsorbate equilibrium concentration respectively; k_L (L mg^{-1}) is Langmuir constant; Q_m (mg g^{-1}) is the maximum monolayer adsorption capacity; n and k_F (L g^{-1}) are Freundlich constants related to adsorption and intensity of adsorption driving force or surface heterogeneity, respectively; A_T is Temkin constants (L mg^{-1}), T is the temperature (K), R is the gas constant (8.314 J mol^{-1} K^{-1}); K_E (L g^{-1}) is Elovich equilibrium constant. $Q_{D\text{-}R}$ is the Dubinin-Radushkevich maximum adsorption capacity (mg g^{-1}), $K_{D\text{-}R}$ is the activity coefficient (mol^2 kJ^{-2}), ε is the Polanyi potential, R is the gas constant (8.314 J mol^{-1} K^{-1}), and E is adsorption energy (kJ mol^{-1}).

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