Supplementary data

Table S1. Adsorptin kinetic, isotherm and thermodynamic models.

Model	Equation	Parameters
PFO	$\ln(q_e - q_t) = \ln q_e - k_1 t$	q_t: amount of adsorbate adsorbed at time (mg/L) q_e: equilibrium adsorption capacity (mg/g) k_1: pesudo-first-order rate constant (1/min) t: time (min)
PSO	$\dfrac{t}{q_t} = \dfrac{1}{k_2 \cdot q_e 2} + \dfrac{t}{q_e}$	k_2: pseudo-second-order-rate constant (L/mg • min)
Intra particle diffusion (ID)	$q_t = k_{id} t^{1/2} + C$	kid: Intraparticle diffusion rate constant (mg/g·h$^{0.5}$)
Langmuir	$\dfrac{1}{q_e} = \dfrac{1}{q_m K_L} \dfrac{1}{C_e} + \dfrac{1}{q_m}$ $R_L = \dfrac{1}{1 + K_L C_0}$	q_m: maximum adsorption capacity (mg/g) K_L: Langmuir constant (L/mg) C_e: equilibrium adsorbate conceration in solution (mg/L) C_0: initial adsorbate concetration in solution (mg/L) R_L: separation factor
Freundlich	$\ln q_e = \ln K_F + (\dfrac{1}{n}) \ln C_e$	K_F: Freundlich constant (mg/g(L/mg)$^{1/n}$) n: heterogeneity factor
Temkin	$q_e = B \ln K_T + B \ln C_e$	K_T: Temkin equilibrium binding constant (L/mg) B: Temkin constant (J/mol)
Gibbs Free Energy	$\triangle G° = \triangle H° - T \triangle S°$	$\triangle G°$: Gibbs free energy change (kJ/mol) $\triangle H°$: enthalpy change (J/mol) $\triangle S°$: entropy change (J/mol • K)