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SUPPLEMENTARY MATERIAL TO

Biosorptive removal of cobalt (II) ion from wastewater using pomegranate peel activated carbon as biosorbent

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Adsorption capacity was calculated using the Eq. S-1[6,9]

$$q_e = \frac{C_i - C_e}{W} V \quad \text{(S-1)}$$

q_e denotes the amount of Co(II) ions adsorbed at equilibrium per unit mass of the adsorbent (mg g^{-1})

C_i represents the initial concentration of cobalt (II) ion (mg L^{-1})

C_e represents the final concentration of cobalt (II) ions (mg L^{-1})

V represents the volume of the solution (ml)

W represents the mass of PPAC (adsorbent) (g)

Cobalt metal ion removal efficiency (R) was calculated using Eq. S-2[7]

$$R\ (\%) = \frac{C_i - C_e}{C_i} \times 100 \quad \text{(S-2)}$$

ISOTHERM AND KINETIC MODEL

Langmuir Isotherm Model (linear form)[6]

$$\frac{C_e}{q_e} = \frac{1}{q_m \cdot K_L} + \frac{C_e}{q_m} \quad \text{(S-3)}$$

q_m denotes the maximum adsorption capacity (mg g^{-1})

K_L represents the empirical constant corresponding to the affinity of the binding sites and the adsorption energy (L mg^{-1})

Langmuir Isotherm Model (Non linear form)[13]

$$q_e = \frac{q_m K_L C_e}{1 + K_L C_e} \quad \text{(S-4a)}$$

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Separation Factor[13,30]

$$R_{\mathrm{L}} = \frac{1}{1+K_{\mathrm{L}}C_{\mathrm{i}}} \qquad \text{(S-4b)}$$

R_L = Separation factor, which gives the information whether the adsorption is favourable or not. R_L ranging between 0 and 1 represents the feasibility of adsorption process.

Freundlich Isotherm Model (Linear form)[6]

$$\log q_{\mathrm{e}} = \log K_{\mathrm{f}} + \frac{1}{n}\log C_{\mathrm{e}} \qquad \text{(S-5)}$$

K_f = Freundlich constant related to adsorption capacity (mg g^{-1})

n = adsorption density parameter relating the degree of surface heterogeneity

Freundlich Isotherm Model (Nonlinear form)[13]

$$q_{\mathrm{e}} = K_{\mathrm{f}}C_{\mathrm{e}}^{\frac{1}{n}} \qquad \text{(S-6)}$$

Temkin Isotherm Model (Linear form)[24]

$$q_{\mathrm{e}} = BlnA + BlnC_{\mathrm{e}} \qquad \text{(S-7)}$$

A= Temkin constant (L g^{-1})

Temkin Isotherm Model (Non-linear form)[24]

$$q_{\mathrm{e}} = BlnAC_{e} \qquad \text{(S-8a)}$$

B refers to the heat of adsorption, which is defined below

$$B = \frac{RT}{b} \qquad \text{(S-8b)}$$

b is the Temkin constant (J mol^{-1}).

KINETIC STUDY

Pseudo first order model[27]

$$\ln(q_{\mathrm{e}} - q_{\mathrm{t}}) = \ln(q_{\mathrm{e}}) - K_1\, t \qquad \text{(S-9)}$$

q_t = capacity of adsorption at a particular time 't' (mg g^{-1})

K_1 = pseudo first order rate constant (min^{-1})

Pseudo second order model[30]

$$\frac{t}{q_{\mathrm{t}}} = \frac{1}{K_2\, q^2{}_{\mathrm{e}}} + \frac{t}{q_{\mathrm{e}}} \qquad \text{(S-10)}$$

K_2 = pseudo second-order rate constant (g mg^{-1}min^{-1})

Intra particle diffusion model[6,27]

$$q_{\mathrm{t}} = K_{int}\, t^{0.5} \qquad \text{(S-11)}$$

K_{int} = intra particle diffusion rate constant (mg g^{-1} min$^{-1/2}$)

Thermodynamic parameters were obtained from the following equation[32]

$$lnK_{\mathrm{d}} = \frac{-\Delta H}{RT} + \frac{\Delta S}{R} \quad \text{(S-12)}$$

$$K_{\mathrm{d}} = \frac{q_{\mathrm{e}}}{C_{\mathrm{e}}} \quad \text{(S-13)}$$

$$\Delta G = \Delta H - T\Delta S \quad \text{(S-14)}$$

K_{d} = distribution coefficient (L g^{-1})
ΔG = Gibbs free energy (kJ mol^{-1})
ΔH= change in enthalpy (kJ mol^{-1})
ΔS= change in entropy (kJ mol^{-1} K^{-1})

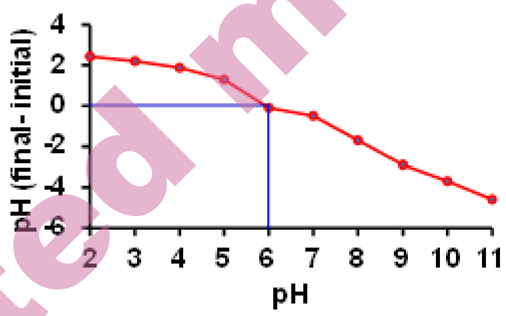

Fig. S1. Point of zero charge on PPAC using NaCl of 0.01 mol/L.