Electronic Supporting Information

Effective removal of lead(II) from wastewater by amine-functionalized magnesium ferrite nanoparticles

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Calculations related to the adsorption.

Adsorption capacity (q).

$$q = ((C_i - C_f)\ V) / m$$

where q is the amount of Pb^{2+} ions (mg) adsorbed onto unit mass of the adsorbent (g) in mg/g; C_i and C_f refer to the concentration of Pb^{2+} aqueous solution before and after adsorption, respectively, in mg/L; V is the volume of Pb^{2+} aqueous solution in L and m is the dry mass of the adsorbent in g.

Removal efficiency.

The removal efficiency is defined as:

$$\text{removal efficiency (\%)} = ((C_i - C_f) / C_i) \times 100$$

Pseudo-first-order kinetics.

The rate law is expressed below:

$$dq_t / d_t = k_1 (q_e - q_t)$$

The integrated form then becomes:

$$\log (q_e - q_t) = \log (q_e) - k_1t/2.303$$

where q_e and q_t refer to the adsorption capacities at equilibrium and time t, respectively, in mg/g and k_1 is the pseudo-first-order rate constant. Plotting the log $(q_e - q_t)$ against t provides the slope and the intercept as $-k_1/2.303$ and log (q_e), respectively.

Pseudo-second-order kinetics.

The rate law is expressed below:

$$dq_t / d_t = k_2 (q_e - q_t)^2$$

The integrated form for the boundary conditions t = 0 to t = t and $q_t = 0$ to $q_t = t$ with rearrangement into the linear form then becomes:

$$t / q_t = 1 / k_2q_e^2 + (1 / q_e)\ t$$

where k_2 is the pseudo-second-order rate constant. Plotting the t / q_t against t provides the slope and the intercept as $(1 / q_e)$ and $1 / k_2q_e^2$, respectively.

Langmuir isotherms.

The equation for Langmuir isotherms model is defined as:

$$q_e = (q_mK_LC_e) / (1 + K_LC_e)$$

The linearized and rearranged form then becomes:

$$C_e / q_e = C_e\ (1 / q_m) + (1 / q_mK_L)$$

where q_m refers to the maximum adsorption capacity in mg/g or mmol/g; C_e is the equilibrium concentration of Pb^{2+} ions remained in the solution in mg/L and K_L is the Langmuir adsorption constant in L/mg or L/mmol. Plotting the C_e / q_e against C_e provides the slope and the intercept as $(1 / q_m)$ and $(1 / q_mK_L)$, respectively.

Freundlich isotherms.

The equation for Freundlich isotherms model is defined as:

$$q_e = K_FC_e^{1/n}$$

The logarithmic form then becomes:

$$\log q_e = 1/n\ (\log C_e) + \log K_F$$

where K_F is the Freundlich adsorption constant in $mg^{1-(1/n)}L^{1/n}/g$ or $mmol^{1-(1/n)}L^{1/n}/g$ and n represents the heterogeneity factor. Plotting the log (q_e) against log C_e provides the slope and the intercept as 1/n and log K_F, respectively.