Supporting Information

Novel synthesis of clay supported amorphous aluminum nanocomposite and its application in removal of hexa-valent Chromium from aqueous solutions

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Cr(VI) sorption was studied as a function of increasing sorbent amount (constant volume-25ml) to optimize the amount of B-Al nanocomposite for further sorption experiments. As shown in fig. S1, as amount of B-Al composite increased, sorption capacity decreased drastically which was due to complete removal (>99%) by 15 mg of the composite. Hence the amount of B-Al to be used for further sorption experiments was decided to be 15 mg.

![Fig. S1- Effect of solid to solution ratio on Cr(VI) removal](image-url)
**Fig. S2** - Calibration curve used to determine Cr(VI) concentration using UV-Vis spectrophotometer using 1,5- diphenylcarbazide complexing agent.
Adsorption Isotherms

To evaluate the interactions between sorbate and sorbent at equilibrium and to get the maximum sorption capacity, isotherm is generally used. There are two most widely used isotherms i.e. Langmuir and Freundlich adsorption isotherms. Langmuir represents the
monolayer sorption with equilibrium distribution of metal ions between the solid and liquid phases. The basic principle of Langmuir isotherm is that every adsorption site is identical and energetically equivalent [1, 2]. On the other hand, Freundlich assumes heterogeneous adsorbent surface. It represents an initial surface adsorption followed by a condensation effect resulting from strong adsorbate-adsorbate interaction [2, 3]. The linearized equations are as follows-

**Langmuir adsorption isotherm**

\[
\frac{C_e}{q_e} = \frac{1}{q_m K_L} + \frac{C_e}{q_m}
\]

**Freundlich adsorption isotherm**

\[
\ln q_e = \ln K_F + \frac{1}{n} \ln C_e
\]

where \(C_e\) (mg/L) is the equilibrium concentration, \(q_e\) (mg/g) is the sorption capacity equilibrium, \(q_m\) (mg/g) and \(K_L\) (L/mg) are Langmuir constants related to maximum sorption capacity and energy of adsorption, respectively. \(K_F\) (mg/g)(L/mg)^1/n is the Freundlich adsorption constant and 1/n is a measure of the adsorption intensity.

**Temkin adsorption isotherm**

Temkin isotherm model assumes that the heat of sorption of solute in a layer decreases linearly with the blocking of the surface due to sorbent-solute interactions where sorption is characterized by uniform binding energy distribution [2]. The linearized form of Temkin isotherm is as follows-

\[
q_e = \frac{RT}{b} \ln K_T + \frac{RT}{b} \ln C_e
\]

where \(b\) (kJ/mol) is a constant related to heat of sorption, \(K_T\) (L/ g) is the Temkin isotherm constant, \(R\) (0.00813 kJ/mol–K) is the gas constant, and \(T\) (K) is temperature.
DKR adsorption isotherm

In other reported isotherms, DKR isotherm is used to determine apparent energy of adsorption. This equation works where adsorption process follows a pore filling mechanism [4-6]. The linear form of DKR isotherm equation is as following-

\[ \ln q_e = \ln X_m - \beta \varepsilon^2 \]

Where \( \varepsilon \) is the Polanyi potential, which is equal to-

\[ \varepsilon = RT \ln(1 + \frac{1}{C_e}) \]

Where \( X_m \) is the maximum sorption capacity, \( \beta \) is the activity coefficient related to mean sorption energy, \( R \) is the gas constant (kJ/kmol- K).

The mean energy of sorption (E) can be determined using following equation-

\[ E = \frac{1}{\sqrt{2\beta}} \]
### Reported literature and our study

<table>
<thead>
<tr>
<th>Adsorbent</th>
<th>Conditions</th>
<th>$Q_{\text{max}}$</th>
<th>Second order rate constant, $k_2$ (g mg$^{-1}$ h$^{-1}$)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-Al nanocomposite</td>
<td>pH = 6.4</td>
<td>49.5 mg/g</td>
<td>6.12</td>
<td>This work</td>
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<tr>
<td></td>
<td>T = 25 °C</td>
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<tr>
<td></td>
<td>$C_0$ = 10 mg/L</td>
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<tr>
<td></td>
<td>$m/V$ = 0.6 g/L</td>
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<tr>
<td>Magnetic magnetite (Fe3O4)</td>
<td>pH = 2</td>
<td>20.16 mg/g</td>
<td>0.17</td>
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<tr>
<td></td>
<td>T = 25 °C</td>
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<tr>
<td></td>
<td>$C_0$ = 25 mg/L</td>
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<td>$m/V$ = 1 g/L</td>
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<td>Organoclay</td>
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<td>14.64 mg/g</td>
<td>0.166</td>
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<td>T = 23 °C</td>
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<td></td>
<td>$C_0$ = 50 mg/L</td>
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<tr>
<td>Material/Composition</td>
<td>pH</td>
<td>Temperature</td>
<td>Initial Concentration</td>
<td>Adsorption Capacity</td>
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<tr>
<td>Aluminum magnesium mixed hydroxide</td>
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<td>30 °C</td>
<td>100 mg/L</td>
<td>109.6 mg/g</td>
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<td>Layered double hydroxides on γ-Al2O3</td>
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<td>100 mg/L</td>
<td>20.04 mg/g</td>
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<tr>
<td>Titanium oxide-Ag composite</td>
<td>2</td>
<td>25 °C</td>
<td>40 mg/L</td>
<td>25.7 mg/g</td>
</tr>
</tbody>
</table>


