Removal Arsenate by Layered Double Hydroxides (LDH) from Aqueous Solutions

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Arsenate is anionic type contaminant that commonly found in surface and ground water. It is toxic to human beings and other living organisms, creates serious environmental problems throughout the world. Therefore, reducing arsenate concentrations in aquatic environments is an important work that we must to do. Removing arsenate by adsorption method is the simplest and most direct approach. Layered Double Hydroxides (LDHs) are a potential adsorbent for arsenate removal because of the large specific surface area and high anion exchange capacities. Thus, the adsorption of arsenate by MgAl-NO_3−-LDH from aqueous solutions has been investigated in this study.

Table 1. Mg-Al ratio and structure formula of samples: (a) 2:1, (b) 3:1, (c) 4:1 MgAl-NO_3-LDH

Sample	x_{cal}[a]	x_{exp}[b]	Structural formula
2:1LDH	0.33	0.33	$[Mg^{2+}_{0.67}Al^{3+}_{0.33}(OH)_2]^{0.33+}(NO_3)^-_{0.29}(CO_3)^{2-}_{0.02}$
3:1LDH	0.25	0.26	$[Mg^{2+}_{0.74}Al^{3+}_{0.26}(OH)_2]^{0.26+}(NO_3)^-_{0.24}(CO_3)^{2-}_{0.01}$
4:1LDH	0.20	0.21	$[Mg^{2+}_{0.79}Al^{3+}_{0.21}(OH)_2]^{0.21+}(NO_3)^-_{0.20}(CO_3)^{2-}_{0.01}$

[a] x_{cal} is the molar ratio of Al^{3+} to total cations in initial solutions; $x_{cal} = ([Al^{3+}] / ([Mg^{2+}] + [Al^{3+}])$.
[b] x_{exp} is the measured molar of Al^{3+} to total cations ratios in the samples.

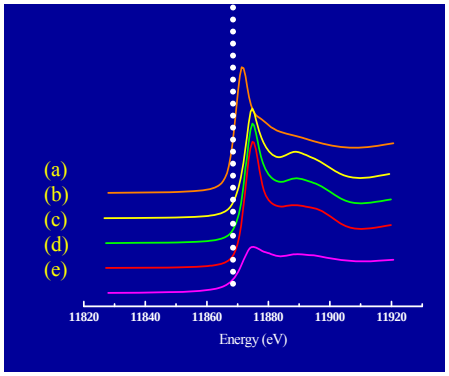
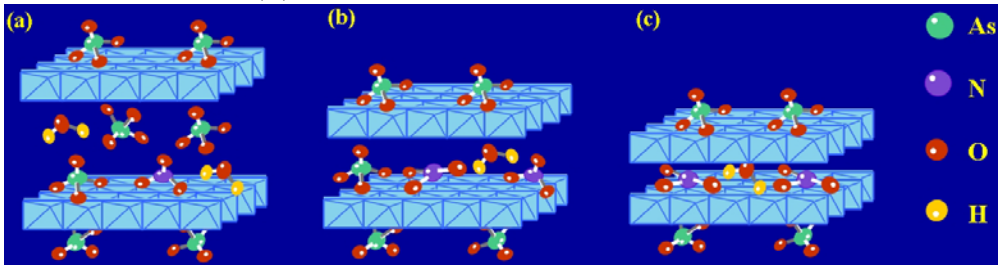


Figure 1. The XANES spectra of (a) reference As(III), As(V) sorbed with (b)2:1 LDH, (c) 3:1 LDH, and (d) 4:1 LDH, and reference As(V).



LDH: (a) 2:1LDH, (b) 3:1LDH, (c) 4:1LDH

From XANES analysis, arsenate sorbed on LDH of three different ratios showed that the peak in the 11875 eV of XANES spectra was the characteristics of As (V) XANES, indicating that As (V) is the dominant species (Fig. 1). Which means the charge of As (V) can not be reduced after reacting with LDH.

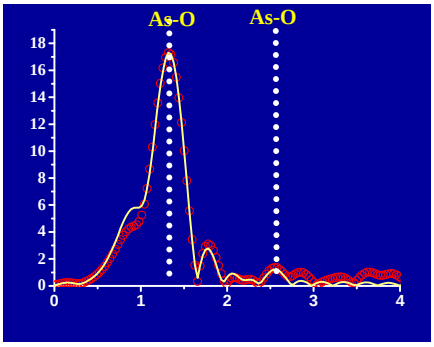


Figure 2. RSF profile of the χ functions of EXAFS signal for arsenate sorbed on 2:1 MgAl-LDH at 298 K. Solid line and open circles represent fit data and experiment data, respectively.

The first shell of As(V)-O that As(V) sorbed on 2:1 MgAl LDH were simulated with that extracted from $AlAsO_4$. The peaks of As-Al and As-Mg could not simulated in RSF profile, indicated the As (V) sorption mechanism reacted with MgAl-LDH was ion exchange (Fig. 3)

According to XANES and EXAFS analysis describes that ion exchange was the major adsorption mechanism on LDH-arsenate sorption behavior. The consistency in arsenate sorption at excellent sorption potential, cheaper and environment friendly makes it be a potential sorbent for arsenate removal.