Supplementary Materials: Influence of pH and Contaminant Redox Form on the Competitive Removal of Arsenic and Antimony from Aqueous Media by Coagulation

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3. Results and Discussion

**Table S1.** Major speciation of trivalent (As(III) and Sb(III)) and pentavalent (As(V) and Sb(V)) species at various pH conditions obtained using Visual MINTEQ.

|  |  |  |
| --- | --- | --- |
| Contaminant | pH | Major Speciation |
| As(III) | 0–9.22 | H3AsO3 |
| 9.22–13.4 | H2AsO3‾ |
| >13.4 | HAsO32− |
| Sb(III) | 0–2 | Sb(OH)2+ |
| 2–10.4 | Sb(OH)3 |
| >10.4 | Sb(OH)4‾ |
| As(V) | 0–2.2 | H3AsO4 |
| 2.2–6.97 | H2AsO4‾ |
| 6.97–11.53 | HAsO42− |
| >11.53 | AsO43− |
| Sb(V) | 0–2.7 | Sb(OH)5 |
| >2.7 | Sb(OH)6‾ |

**Table S2.** Single solute system showing change in pH after ferric chloride (FC) coagulation in the absence and presence of As and Sb species.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial pH | Change in pH Observed in the Single Solute System | | | | |
| **FC Only** | **As(III)** | **Sb(III)** | **As(V)** | **Sb(V)** |
| 4 | 4.25 | 4.02 | 4.3 | 4.28 | 3.78 |
| 5 | 5.33 | 4.83 | 4.99 | 5.57 | 4.82 |
| 6 | 5.81 | 5.56 | 5.91 | 5.44 | 5.3 |
| 7 | 6.24 | 6.95 | 6.87 | 6.71 | 6.61 |
| 8 | 7.27 | 6.94 | 7.02 | 7.64 | 7.66 |
| 9 | 8.41 | 8.58 | 8.54 | 9 | 8.59 |
| 10 | 9.71 | 9.55 | 9.68 | 10.08 | 9.8 |

**Table S3.** Binary system showing change in pH after FC coagulation in the presence of As and Sb species in binary mode.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial pH | Change in pH Observed in the Binary System | | | |
| **As(III)/Sb(III)** | **As(III)/Sb(V)** | **As(V)/Sb(III)** | **As(V)/Sb(V)** |
| 4 | 4.26 | 3.79 | 4.27 | 4.11 |
| 5 | 4.96 | 5.09 | 5.28 | 4.94 |
| 6 | 6 | 6.03 | 6.19 | 5.76 |
| 7 | 6.43 | 6.68 | 6.85 | 6.24 |
| 8 | 6.88 | 7.36 | 7.53 | 6.84 |
| 9 | 8.42 | 8.58 | 8.69 | 8.61 |

**Table S4.** Quaternary system showing change in pH after FC coagulation in the presence of As and Sb species in the multicomponent environment.

|  |  |
| --- | --- |
| Initial pH | Change in pH Observed in the Quaternary System |
| 4 | 3.74 |
| 5 | 4.81 |
| 6 | 5.54 |
| 7 | 6.23 |
| 8 | 6.57 |
| 9 | 8.02 |
| 10 | 9.95 |



**Figure S1.** Speciation of Fe(III) species derived from Visual MINTEQ.

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**Figure S2.** Single solute system of As and Sb showing Fe solubility behavior at pH 7, 0.1 mM FC dose and varying initial concentration (0–10 mg/L).

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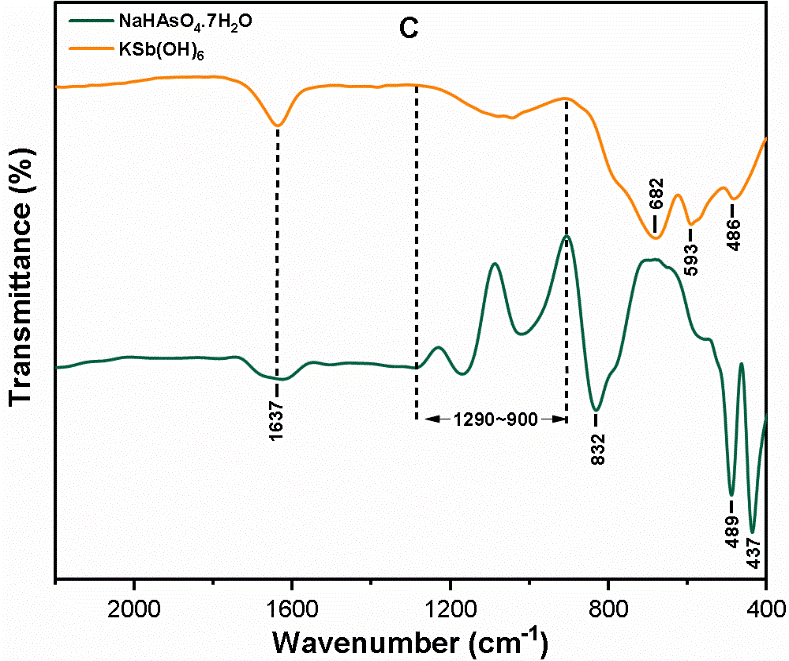
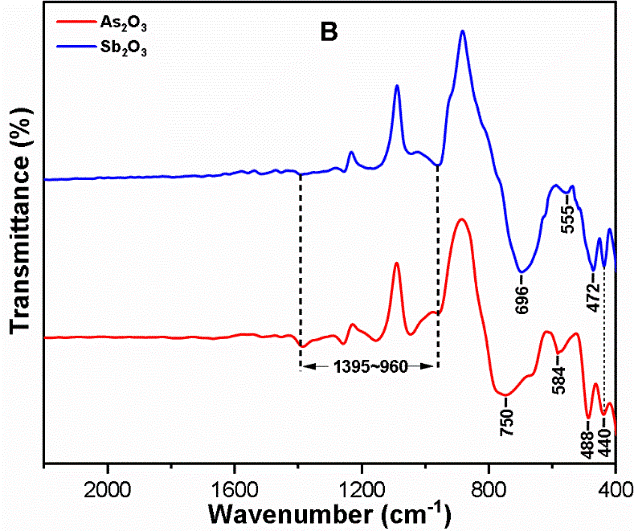
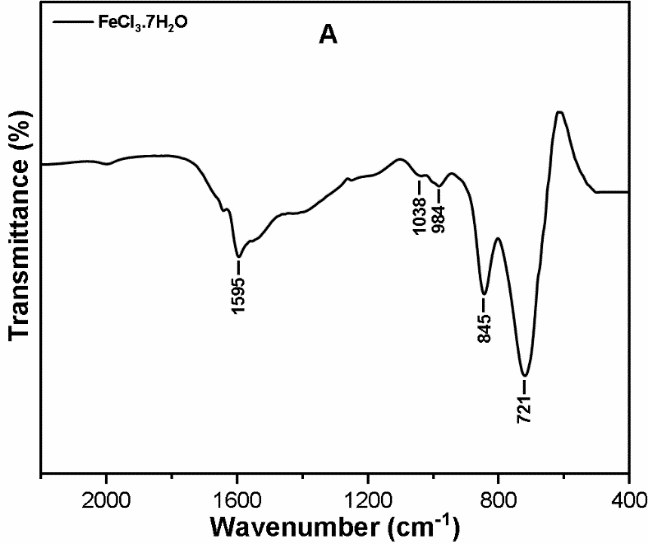
**Figure S3.** Binary system of As and Sb showing Fe solubility behavior at pH 7, 0.1 mM FC dose and varying initial As-Sb concentration (0–10 mg/L of each specie) respectively.

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**Figure S4.** Quaternary system of As and Sb showing Fe solubility behavior at pH 7, 0.1 mM FC dose and varying initial As-Sb concentration (0–10 mg/L of each species) respectively.

3.1. Fourier Transform Infrared Spectroscopy (FT-IR) of Chemicals

The FT-IR analysis of pristine chemicals was recorded to expound the bond formation of various heavy metal species as shown in Figure S4. The main peak at 721 cm−1 in the figure S4A, ascribed to the Fe-O stretching vibrations [1]. In Figure S4B, the IR spectra of pure Sb(III) showed three peaks in the wavenumber 472, 555 and 696 cm−1 corresponded to the stretching vibration of Sb(III)-O bond [2]. While in the case of two main peaks at 584 and 750 were attributed to the As(III)-O stretching vibration [3]. Three main peaks in the Figure S4C for pure Sb(V) were observed at 486,593 and 682 cm−1 which ascribed to the Sb(V)-O stretching vibration [2], moreover the broad peak at 832 cm−1 confirms the presence of As(V)-O stretching vibration [3].



**Figure S5.** FT-IR Spectra of pristine (**A**) FC, (**B, C**) Sb(III,V) and; (**B,C**)As(III,V) Species

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