Electronic Supplementary Material (ESI) for Environmental Science: Water Research & Technology.

Supplemetary information

Immobilization of hydrous iron oxides into porous alginate beads for arsenic removal from water

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Table S1. Langmuir and Freundlich isotherm parameters for As(III) and As(V) adsorption onto HIO-P-alginate beads

	As(III)	As(V)
Langmuir Isotherm		
q_m [mg/g]	47.3	30.0
b [L/mg]	0.023	0.038
R^2	0.985	0.995
Fruendlich Isotherm		
K_f [(mg/g)·(L/mg)$^{1/n}$]	5.02	4.80
n	2.84	3.45
R^2	0.997	0.990

Langmuir and Freundlich isotherm equations are expressed as follows:[S1]

$$q_e = \frac{q_m b C_e}{(1 + bC_e)} \tag{S1}$$

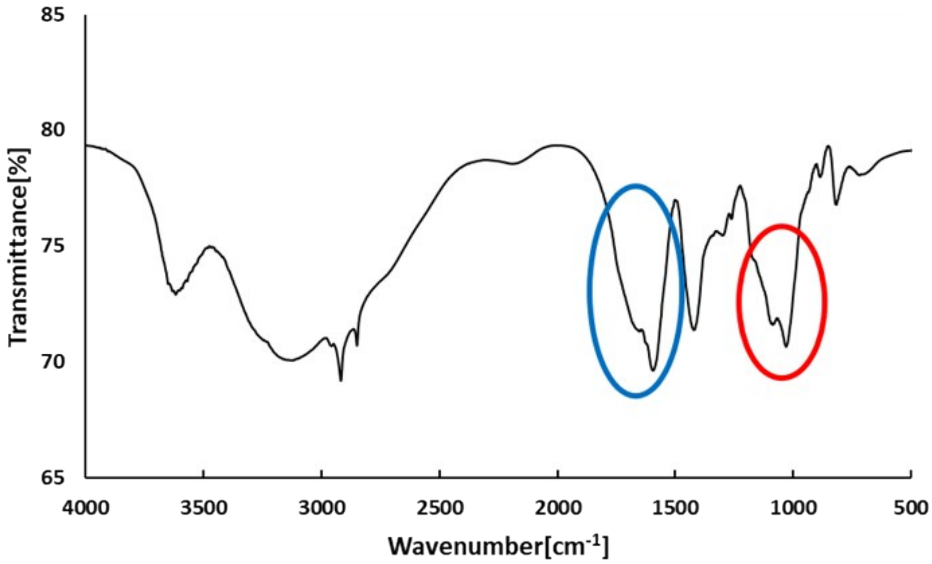
$$q_e = K_f {C_e}^{1/n} \tag{S2}$$

where C_e and q_e are the equilibrium concentrations of an adsorbate in liquid (water) and solid phases, respectively; q_m and b are Langmuir isotherm constants related to the maximum monolayer adsorption capacity of the adsorbent and the strength of adsorption, respectively; K_f and n are Freundlich constants related to adsorption capacity and heterogeneity respectively. Equation (S1) and (S2) can be linearized as follows:

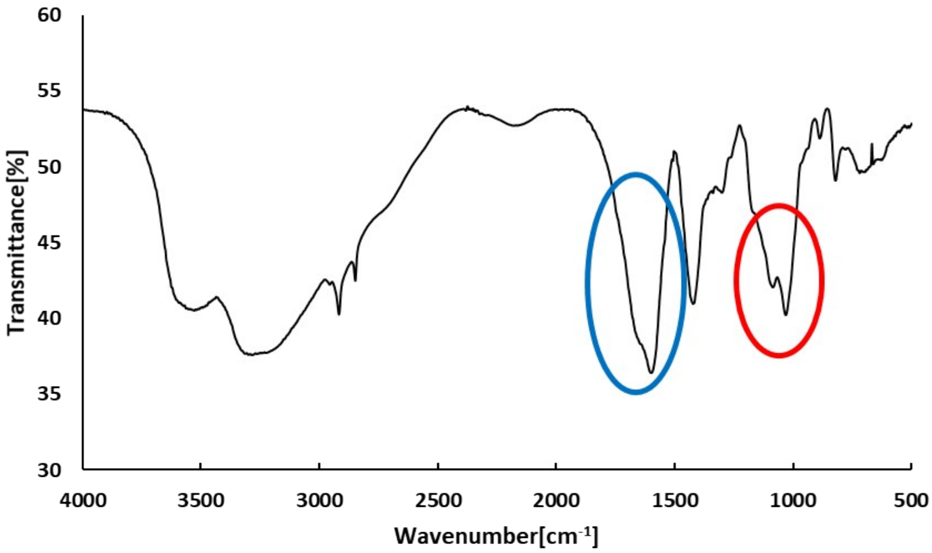
$$C_e/q_e = 1/bq_{e,max} + C_e/q_{e,max} \qquad \text{(S3)}$$

$$C_e/q_e = 1/bq_{e,max} + C_e/q_{e,max} \qquad \text{(S4)}$$

As shown in Table S1, the q_m and K_f values obtained from Langmuir and Freundlich isotherm equations were higher for As(III) than As(V). This indicates that the adsorption capacity for As(III) of the HIO-P-alginate beads prepared in this study was higher than that for As(V). The *b* value of the Langmuir isotherm was greater for As(V), meaning the adsorption of As(V) toward the HIO-P-alginate beads was stronger than that of As(III). The Freundlich parameter *n* was greater than 1, indicating favorable nature of adsorption by the HIO-P-alginate beads under the investigated conditions.[S2, S3]



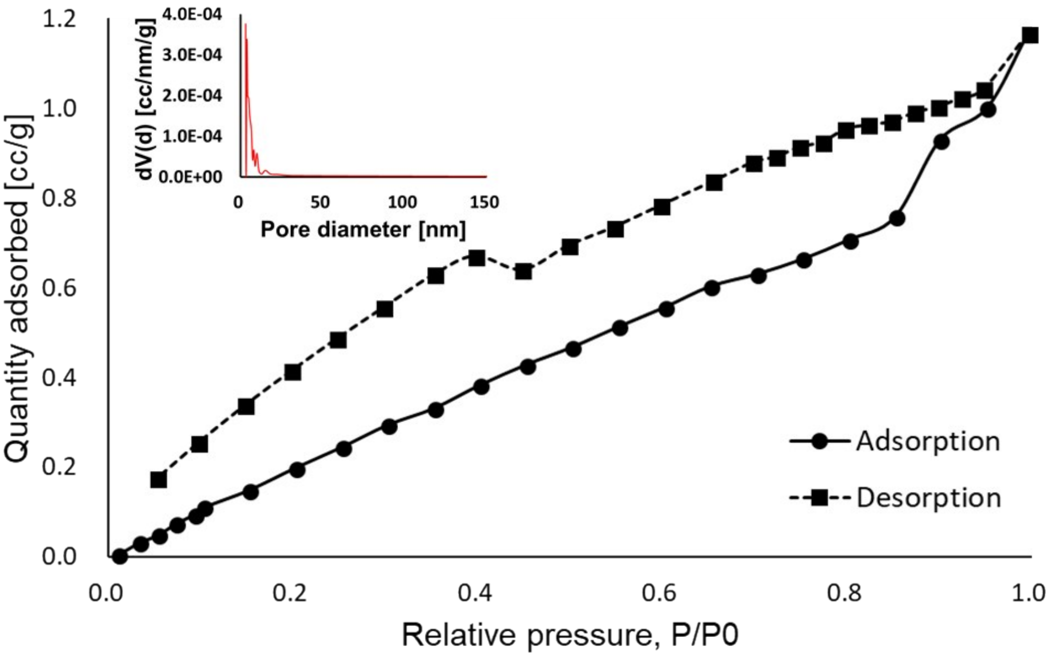
(a)



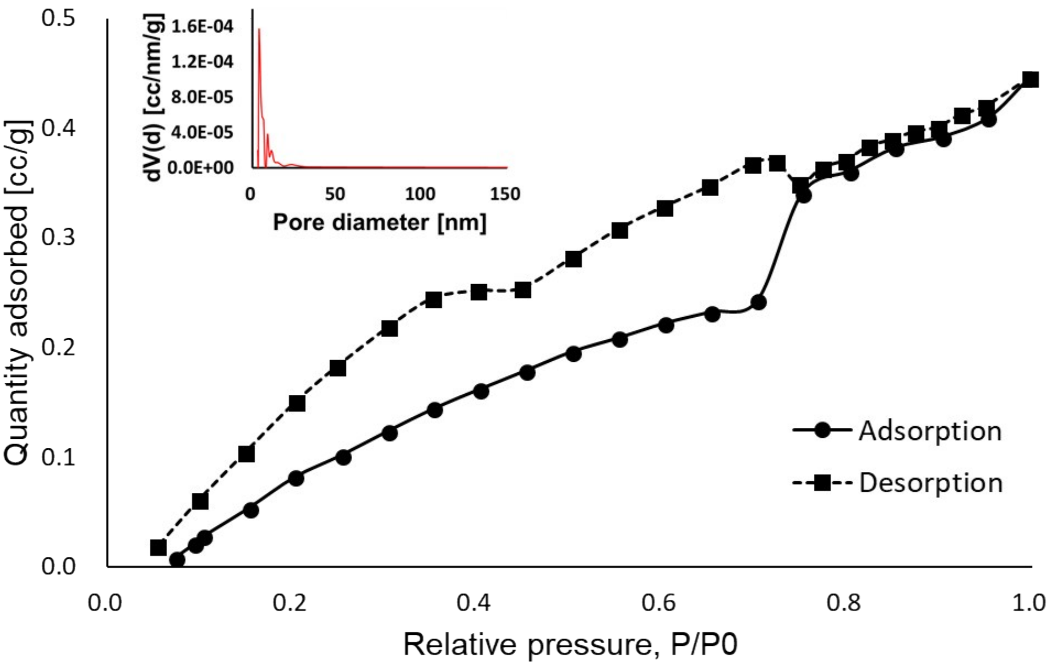
(b)

Fig. S1. FTIR spectra of (a) HIO-P- and (b) HIO-alginate beads.

FTIR (Fourier transform infrared) analysis for HIO-P- and HIO-alginate beads was conducted to investigate whether unreacted carbonate and bicarbonate ions existed in the beads using a FTIR spectrometer (Spectrum One™, Perkin Elmer, USA). Samples for the analysis were prepared using KBr pellet method. As shown in Fig. S1, the peaks at 1650-1780 cm^{-1} (small shoulder in the blue circles) and 1000-1300 cm^{-1} (red circles) correspond to C=O and C-O bonds, respectively. In these regions, the peaks of HIO-P- and HIO-alginate beads were similar, proposing that unreacted carbonate and bicarbonate ions hardly remained in HIO-P-alginate beads and thus did not exert any significantly negative effect on arsenic adsorption by the HIO-P-alginate beads in this study.



(a)



(b)

Fig. S2. N_2 adsorption-desorption isotherms and pore size distributions of (a) HIO-P- and (b) HIO-alginate beads.

Fig. S2 shows that the N_2 adsorption-desorption isotherms of HIO-P- and HIO-alginate beads are similar to type IV, according to IUPAC classification, which means they were mesoporous adsorbents.[S4] Also, HIO-P- and HIO-alginate beads had broad H2 hysteresis loops, which is the characteristics of mesoporous materials with complex pore structure.[S4, S5] In the pore size distribution results of Fig. S2, the average pore size of HIO-P- and HIO-alginate beads were 4.5 and 4.2 nm, respectively. These results also indicate that both of the HIO-P- and HIO-alginate beads had mesoporous structures.

References

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