

Performance evaluation of small sized powdered ferric hydroxide as arsenic adsorbent

Muhammad Usman, Ioannis Katsoyiannis, Manassis Mitrakas, Anastasios Zouboulis and Mathias Ernst

Small sized powdered ferric hydroxide pore water content= 51.5%

Granular ferric hydroxide pore water content= 43.0%

Table 7: Used adsorbents dosages of small sized powdered ferric hydroxide (DFH) for adsorption isotherm experiments of As(V) in deionized ultrapure water.

Flask Nr.	Adsorbent dosages, mg/500 mL		Equilibrium pH	Equilibrium concentration (µg/L)	As(V) loading (µg/mg)
	Moist	dry			
1	0	0	7.8	185.0	-
2	5	2.43	7.8	117.0	15.05
3	10	4.85	7.9	67.4	12.64
4	15	7.28	7.9	40.6	10.27
5	20	9.70	7.9	20.8	8.72
6	25	12.13	7.9	11.8	7.36
7	30	14.55	7.9	6.58	6.30
8	40	19.40	8.0	4.4	4.78
9	50	24.50	8.0	1.3	3.89
10	60	29.10	8.0	1.2	3.24

Table 8: Used adsorbents dosages of conventional granular GFH for adsorption isotherm experiments of As(V) in deionized ultrapure water.

Flask Nr.	Adsorbent dosages, mg/500 mL		Equilibrium pH	Equilibrium concentration (µg/L)	As(V) loading (µg/mg)
	Moist	dry			
1	0	0	7.9	187.0	-
2	5	2.85	7.8	146.0	8.00
3	10	5.70	7.8	106.9	7.42
4	15	8.55	8.0	85.9	6.20
5	20	11.40	7.9	75.3	5.13
6	30	17.10	7.9	43.6	4.35
7	40	22.80	8.0	30.2	3.56
8	50	28.50	7.8	4.44	3.06
9	60	34.20	8.0	13.6	2.63
10	80	45.60	7.9	7.40	2.00

Table 9: Used adsorbents dosages of DFH for adsorption isotherm experiments of As(V) in Hamburg tap water.

Flask Nr.	Adsorbent dosages, mg/500 mL		Equilibrium pH	Equilibrium concentration (µg/L)	As(V) loading (µg/mg)
	Moist	dry			
1	0	0	7.9	184	-
2	5	2.43	7.9	122.1	14.02
3	6	2.91	8.0	106.8	13.23
4	10	4.85	7.9	74.8	10.49
5	15	7.27	7.8	43.1	9.25
6	20	9.70	7.8	17.8	8.21
7	25	12.12	8.0	12.7	7.22
8	30	14.55	7.9	8.3	6.16
9	40	19.40	8.0	4.1	4.79
10	50	24.50	7.8	3.5	3.82

Table 10: Used adsorbents dosages of DFH for adsorption isotherm experiments of As(V) in NSF challenge water.

Flask Nr.	Adsorbent dosages, mg/500 mL		Equilibrium pH	Equilibrium concentration (µg/L)	As(V) loading (µg/mg)
	Moist	dry			
1	0	0	7.9	182	-
2	5	2.43	8.1	142	9.90
3	10	4.85	8.0	106.5	8.61
4	15	7.27	7.9	76.8	7.78
5	20	9.70	7.8	54.6	6.98
6	25	12.12	7.8	50.1	5.77
7	30	14.55	8.0	38.1	5.22
8	40	19.40	7.9	13.5	4.55
9	50	24.50	8.0	12.5	3.66
10	60	29.10	7.8	11.4	3.07
11	70	33.95	8.0	10.3	2.65
12	80	38.80	8.0	7.9	2.35

Table 11: Used adsorbents dosages of DFH for adsorption isotherm experiments of As(III) in deionized ultrapure water.

Flask Nr.	Adsorbent dosages, mg/500 mL		Equilibrium pH	Equilibrium concentration (µg/L)	As(III) loading (µg/mg)
	Moist	dry			
1	0	0	7.8	186.0	-
2	5	2.43	7.8	150.8	8.09
3	10	4.85	7.9	122.5	6.96
4	12.5	6.06	7.9	110.3	6.57
5	15	7.28	7.8	97.3	6.37
6	20	9.70	7.8	78.8	5.73
7	25	12.13	7.8	59.8	5.37
8	35	14.55	7.9	33.1	4.62
9	40	19.40	7.8	30.8	4.10
10	50	24.50	7.8	10.8	3.70
11	60	29.10	7.8	7.81	3.13

Table 12: Used adsorbents dosages of conventional granular GFH for adsorption isotherm experiments of As(III) in deionized ultrapure water.

Flask Nr.	Adsorbent dosages, mg/500 mL		Equilibrium pH	Equilibrium concentration (µg/L)	As(III) loading (µg/mg)
	Moist	dry			
1	0	0	7.9	187.0	-
2	5	2.85	7.9	167.2	4.04
3	10	5.70	7.9	146.4	3.86
4	15	8.55	7.9	127.4	3.68
5	20	7.28	7.9	109.6	3.53
6	30	17.10	7.8	87.1	3.01
7	40	22.80	7.8	64.9	2.74
8	60	34.20	7.9	39.0	2.21
9	80	45.60	7.8	19.6	1.87
10	100	57.00	7.8	14.1	1.54
11	120	68.40	7.8	8.6	1.33

Table 13: Used adsorbents dosages of DFH for adsorption isotherm experiments of As(III) in Hamburg tap water.

Flask Nr.	Adsorbent dosages, mg/500 mL		Equilibrium pH	Equilibrium concentration (µg/L)	As(III) loading (µg/mg)
	Moist	dry			
1	0	0	7.9	189.0	-
2	5	2.43	7.9	160.8	6.03
3	10	4.85	7.9	135.0	5.67
4	15	7.27	7.9	117.0	5.01
5	20	9.70	7.8	97.5	4.76
6	25	12.12	7.8	77.5	4.65
7	30	14.55	7.9	64.8	4.30
8	40	19.40	7.9	44.5	3.75
9	50	24.50	7.8	24.6	3.41
10	60	29.10	7.8	15.2	3.00
11	75	36.37	7.9	8.93	2.49
12	100	48.50	7.9	1.06	1.95

Table 14: Used adsorbents dosages of DFH for adsorption isotherm experiments of As(III) in NSF challenge water.

Flask Nr.	Adsorbent dosages, mg/500 mL		Equilibrium pH	Equilibrium concentration ($\mu\text{g/L}$)	As(III) loading ($\mu\text{g/mg}$)
	Moist	dry			
1	0	0	7.8	189.0	-
2	5	2.43	7.8	177.5	2.58
3	10	4.85	7.8	167.0	2.37
4	15	7.27	7.8	155.0	2.40
5	30	14.55	7.8	127.3	2.16
6	40	19.40	7.8	82.5	1.88
7	60	29.10	7.9	57.5	1.85
8	80	38.80	7.8	35.6	1.71
9	100	48.50	7.8	35.6	1.59
10	125	24.50	7.8	22.4	1.38
11	150	72.75	7.8	14.1	1.21
12	200	97.0	7.9	4.72	0.96

Table 15: Langmuir isotherm constants for adsorption of As(V) along with the correlation coefficients and the respective chi-squared values.

Water matrix	Adsorbent	K_L (L/mg)	Q_m ($\mu\text{g/mg}$)	Q_{10} ($\mu\text{g/mg}$)	R^2	χ^2
DI water	GFH	0.021	9.5	1.7	0.963	0.033
DI water	DFH	0.047	18.9	6.0	0.948	0.847
HH tap water	DFH	0.105	12.7	6.5	0.900	0.930
NSF water	DFH	0.040	9.9	2.8	0.872	0.578

Table 16: Langmuir isotherm constants for adsorption of As(III) along with the correlation coefficients and the respective chi-squared values.

Water matrix	Adsorbent	K_L (L/mg)	Q_m ($\mu\text{g/mg}$)	Q_{10} ($\mu\text{g/mg}$)	R^2	χ^2
DI water	GFH	0.048	3.8	1.2	0.921	0.051
DI water	DFH	0.102	6.7	3.4	0.905	0.164
HH tap water	DFH	0.115	4.9	2.6	0.887	0.059
NSF water	DFH	0.153	1.9	1.1	0.910	0.011