

Supporting information

Table S1. Comparison of adsorption capacity between batch and column studies

Sample	Batch Experiment			Column Experiment		
	pH 9 q_e (mg/g)	pH 7 q_e (mg/g)	pH 6 q_e (mg/g)	pH 9 q_e (mg/g)	pH 7 q_e (mg/g)	pH 6 q_e (mg/g)
E33	14.9	15.7	17.1	19.4	33.9	31.5
E33/Mn	7.2	13.2	14.8	15.4	21.6	28.5
E33/AgI	12.4	14.6	15.9	18.6	24.3	29.9
E33/AgII	14.9	15.7	17.0	23.5	33.8	40.1

Table S2. Calculation of cumulative adsorption capacity for column test for E33 at pH 6.

Elapsed Time (min)	Influent Concentration (mg/L)	Effluent Concentration (mg/L)	Flow Rate (ml/min)	Cross Flow (m/hr)	Cumulative ml Fed Column	Bed Volumes Fed	Delta Capacity of Media (mg/g)	Cumulative capacity of Media (mg/g)
0	80	1.61	2.0	0.423	0	0	0.0	0.0
5	80	3.18	2.0	0.423	10	3	0.8	0.8
15	80	2.94	2.0	0.423	30	8	1.5	2.3
30	80	1.63	2.0	0.423	60	17	2.3	4.6
45	80	5.05	2.0	0.423	90	25	2.3	6.9
60	80	11.06	2.0	0.423	120	34	2.2	9.1
90	80	31.57	2.0	0.423	180	51	3.5	12.6
120	80	41.8	2.0	0.423	240	68	2.6	15.2
180	80	53.81	2.0	0.423	360	102	3.9	19.1
240	80	61.63	2.0	0.423	480	135	2.7	21.8
300	80	63.82	2.0	0.423	600	169	2.1	23.8
360	80	70.55	2.0	0.423	720	203	1.5	25.4
480	80	75.28	2.0	0.423	960	271	1.7	27.1
600	80	75.96	2.0	0.423	1200	339	1.1	28.1
1440	80	80	2.0	0.423	2880	813	3.4	31.5

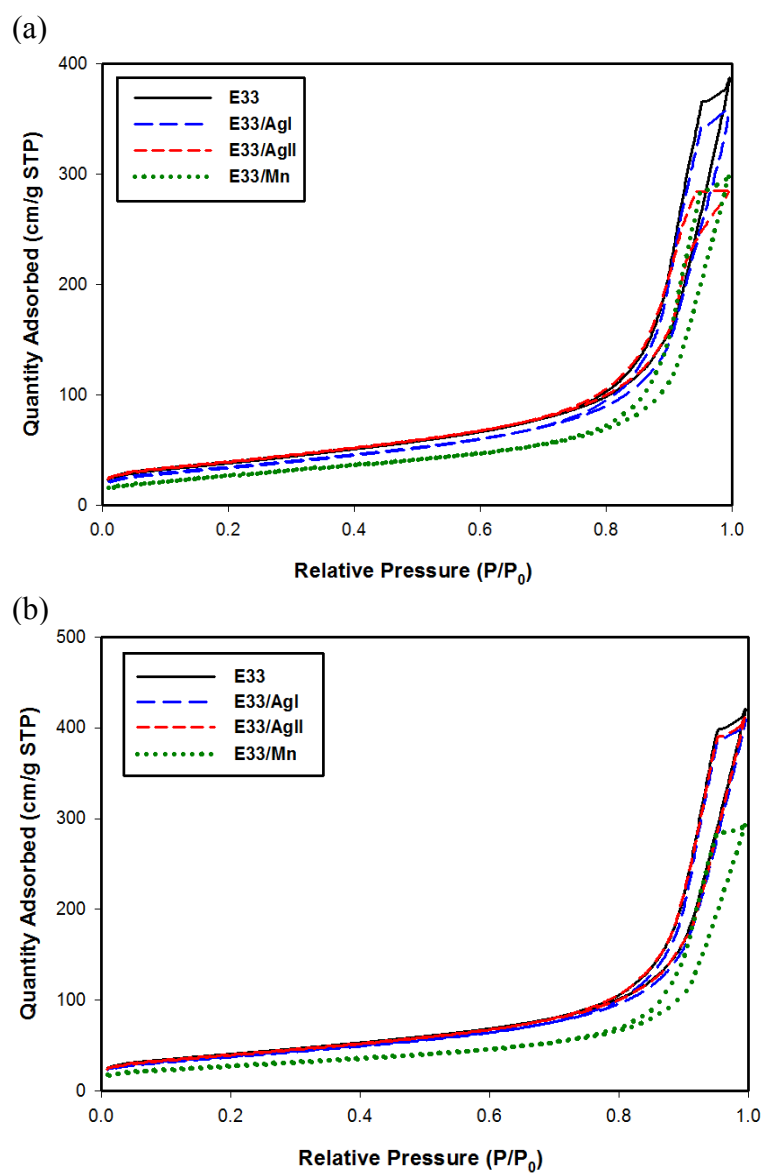


Figure S1. N₂ adsorption-desorption isotherms of E33 and surface-modified E33: (a) before and (b) after using for phosphate removal.

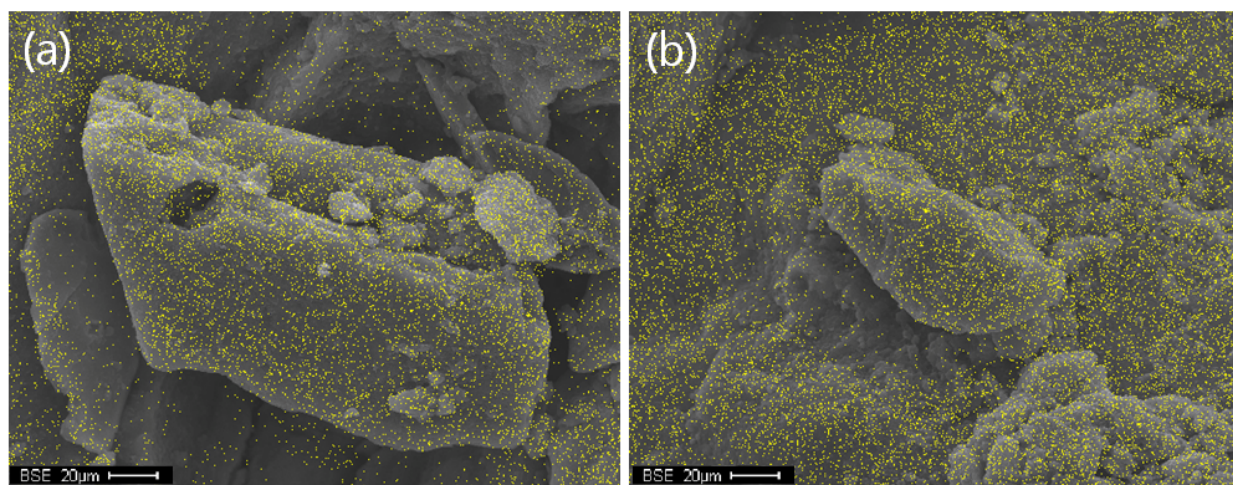


Figure S2. EDX mapping for adsorbed phosphate (yellow color) on E33 (a) and E33/AgII (b).

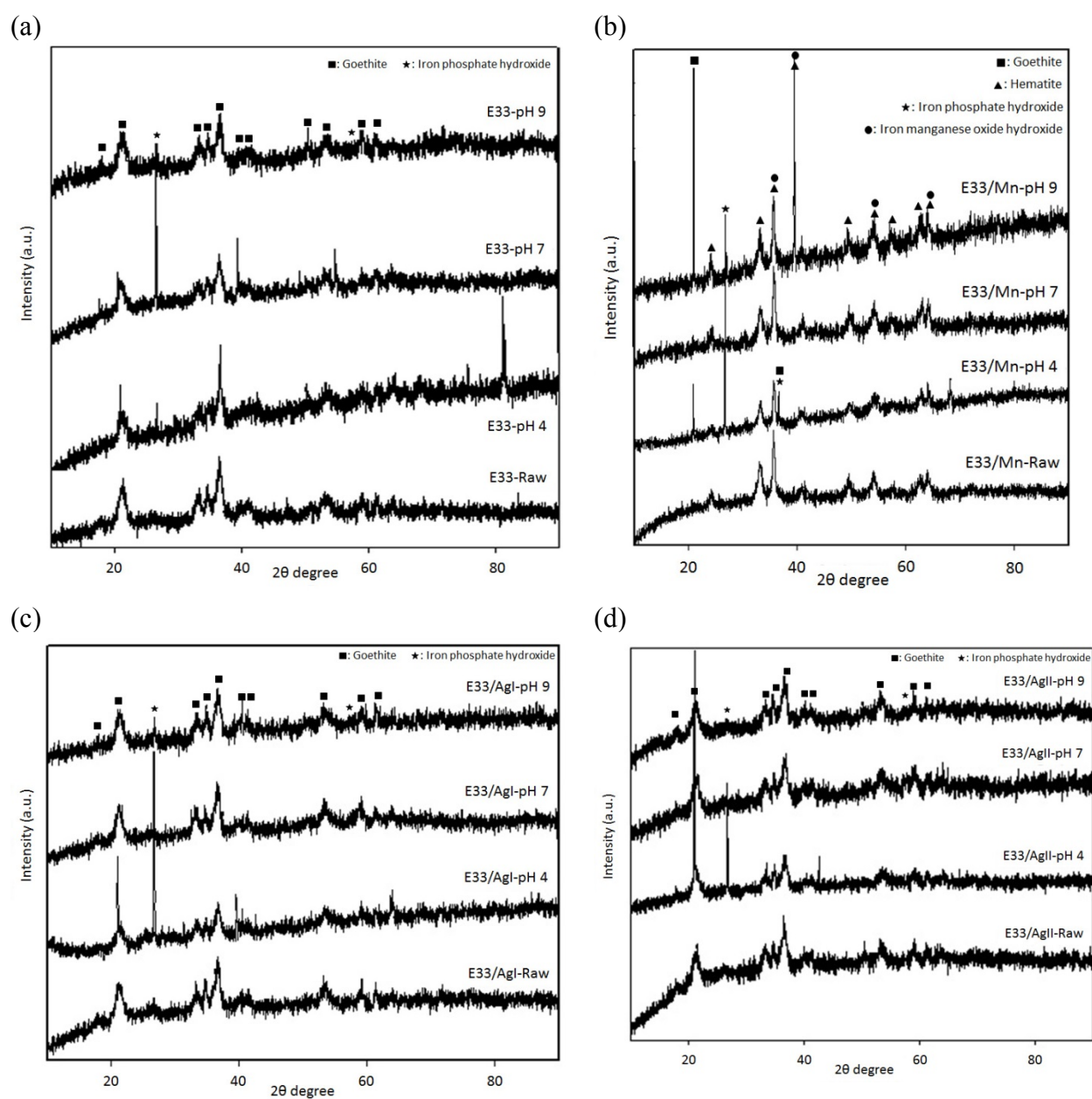


Figure S3. XRD patterns of E33 and surface-modified E33: (a) E33, (b) E33/Mn, (c) E33/AgI, and (d) E33/AgII.