

Fig. S1. Elemental analysis of (a) QB and (b) KQB

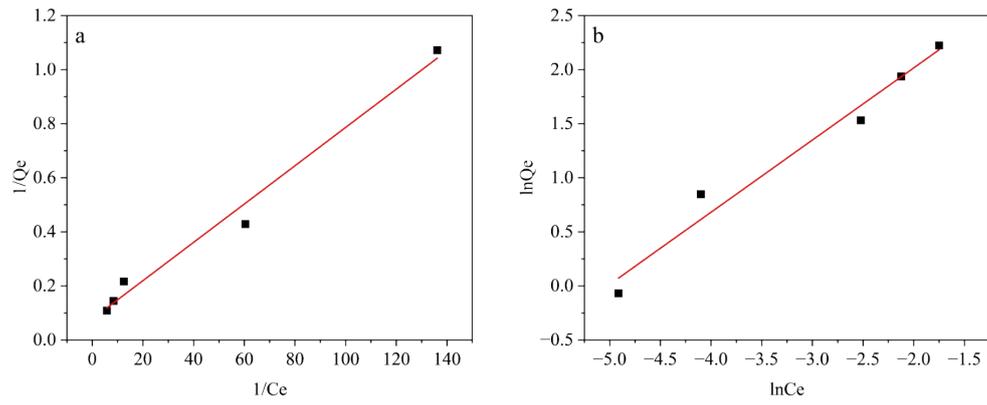


Fig.S2. Langmuir(a) and Freundlich(b) adsorption isotherm model curve

Table. S1 Kinetic parameters of Pb<sup>2+</sup> adsorption by chitosan /biochar composites

Kinetic model	Parameter	KQB
	Q <sub>e</sub> (mg/g)	4.49
	Q <sub>cal</sub> (mg/g)	4.41
Pseudo-first-order kinetic model	K <sub>1</sub> (1/h)	0.87
	R <sup>2</sup>	0.9382
	F value	1194.62
	Prob>F	1.35×10 <sup>-9</sup>
	Q <sub>cal</sub> (mg/g)	4.77
Pseudo-second-order kinetic model	K <sub>2</sub> (g/(mg·h))	0.27
	R <sup>2</sup>	0.9757
	F value	3045.28
	Prob>F	5.13×10 <sup>-11</sup>

Table.S2 Isotherm parameters of Pb<sup>2+</sup> adsorption by chitosan /biochar composites

Isotherm Model	Parameter	KQB
Langmuir Model	Q <sub>max</sub> (mg/g)	12.87
	K <sub>L</sub> (L/mg)	10.97
	R <sup>2</sup>	0.98
	F Value	198.41
	Prob>F	7.75×10 <sup>-5</sup>
	K <sub>F</sub> ((mg/g)/(mg/L) <sup>n</sup> )	1.21
	n	1.50
Freundlich Model	R <sup>2</sup>	0.96
	F Value	104.53
	Prob>F	1.99×10 <sup>-3</sup>

Table.S3 Dynamic adsorption parameters of Pb<sup>2+</sup> on chitosan/biochar composites

Initial concentration	Influent flow rate	Adsorption Parameters				
		t <sub>b</sub>	t <sub>e</sub>	q <sub>t</sub>	q <sub>0</sub>	R
C <sub>0</sub> (mg/L)	Q (ml/min)	(min)	(min)	(mg)	(mg/g)	(%)
	0.999	720	6120	22.48	11.24	92.01
3.996	1.512	240	2520	13.86	6.93	91.03
	3.024	30	1260	13.69	6.85	89.91

Table.S4 Models fitting parameters

Influent flow rate (ml/min)	Thomas				Yoon-Nelson			
	$K_T$ (ml/(min·mg))	$q_{0,cal}$ (mg/g)	$q_{0,exp}$ (mg/g)	$R^2$	$K_Y$	$\tau_{cal}$ (min)	$\tau_{exp}$ (min)	$R^2$
0.999	$2.22 \times 10^{-4}$	9.84	11.24	0.9728	$8.89 \times 10^{-4}$	4380	4320	0.9728
1.512	$3.9 \times 10^{-4}$	6.06	6.93	0.9785	$1.58 \times 10^{-3}$	1685	1627	0.9785
3.024	$8.2 \times 10^{-4}$	5.93	6.85	0.9817	$3.29 \times 10^{-3}$	647	598	0.9817

Table.S5 Results of coagulation and precipitation test

PAC dosage (mg/L)	Secondary Regulation pH	Removal Rate Pb <sup>2+</sup> (%)	pH of Treated Wastewater
80	9.5	76.77	6.68
90		78.14	6.77
80	10	82.21	8.40
90		82.56	8.59
80	10.5	85.92	9.25
90		85.53	9.45

Table. S6 Design and results of Box-Behnken experiment

Experiment Number	Variable			Adsorption Rate R (%)	
	pH	Adsorbent dosage (g/L)	Adsorption time (h)	Measured Value	Predicted Value
1	4	1	2	47.52	48.14
2	6	1	2	70.63	68.59
3	4	1	10	43.97	46.01
4	6	1	10	69.79	69.17
5	4	0.5	6	53.29	50.83
6	6	0.5	6	74.23	74.43
7	4	1.5	6	60.29	60.09
8	6	1.5	6	77.62	80.09
9	5	0.5	2	55.98	57.82
10	5	0.5	10	51.95	52.37
11	5	1.5	2	61.03	60.61
12	5	1.5	10	66.35	64.51
13	5	1	6	92.02	93.78
14	5	1	6	96.01	93.78
15	5	1	6	91.93	93.78
16	5	1	6	92.09	93.78
17	5	1	6	96.86	93.78

Table. S7 Regression model variance analysis based on Pb<sup>2+</sup> adsorption rate of  
composite materials

Source of variance	Sum of squares	Degrees of freedom	Mean square	F value	P value	Significance
Model	5040.52	9	560.06	74.91	< 0.0001	**
A-pH	950.48	1	950.48	127.13	< 0.0001	**
B-adsorption Time	1.2	1	1.2	0.1607	0.7005	Not significant
C-adsorbent dosage	111.3	1	111.3	14.89	0.0062	**
AB	1.84	1	1.84	0.2456	0.6354	Not significant
AC	3.26	1	3.26	0.4358	0.5303	Not significant
BC	21.86	1	21.86	2.92	0.1311	Not significant
A <sup>2</sup>	841.52	1	841.52	112.56	< 0.0001	**
B <sup>2</sup>	1976.71	1	1976.71	264.4	< 0.0001	**
C <sup>2</sup>	743.37	1	743.37	99.43	< 0.0001	**
Residual	52.33	7	7.48			

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Lack of fit	28.5	3	9.5	1.59	0.3236	Not significant
Pure error	23.84	4	5.96			
Total variation	5092.86	16				

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Note:  $P < 0.05$  , \*, significant difference;  $P < 0.01$  \*\*, highly significant difference;  $P > 0.05$ , nonsignificant difference.