Supporting Information For

Phosphate removal by one-step hydrothermal prepared Ca-modified magnetic sludge biochar

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Supplementary Table S1-S4

Supplementary Figure S1

Supplementary Information Table

Table S1 ICP-MS and elemental quantitative analysis results

No.	Elements	Content	
		SS	Ca-MSBC
1	C	56.93%	49.76%
2	O	37.24%	37.24%
3	Fe	50.98 mg g^{-1}	225.15 mg g^{-1}
4	Ca	13.35 mg g^{-1}	17.29 mg g^{-1}
5	P	30.73 mg g^{-1}	38.08 mg g^{-1}

Table S2 Specific surface area and pore volume pore size table

Sample Name	Total specific surface area ($m^2 g^{-1}$)	Total accumulated pore volume for desorption ($cm^3 g^{-1}$)	Desorption average pore size (nm)
Ca-MSBC （Before adsorption）	349.73	0.12	36.73
Ca-MSBC （After adsorption）	224.62	0.10	21.79

Table S3 Comparison of similar feedstock adsorption capacities

No.	Treatment method	Target sorbate	Adsorption capacity	References
1	Biochar activated using MgO	phosphate	8.42 mg P g^{-1} pH=10.0	[1]
2	Feedstock impregnated with $MgCl_2$		8.1 mg P g^{-1} pH=9.0	[2]
3	Hydrothermal carbonization in $MgCl_2$-$AlCl_3$ solution		51 mg P g^{-1} pH=10.0	[3]
4	Sludge iron based adsorbent		15 mg P g^{-1} pH=10.0	[4]
5	Ca-MSBC		89.25 P g^{-1} pH=10.0	Present study

Table S4 Thermodynamic parameters of phosphate adsorption on Ca-MSBC

T（K）	ΔG^{θ} (kJ mol^{-1})	ΔS^{θ} (J $mol^{-1}\cdot K^{-1}$)	ΔH^{θ} (J mol^{-1})
303	-16.11	166.5	48.5
313	-17.68		
323	-23.42		
333	-39.80		
343	-43.46		
353	-23.84		

Supplementary Information Figure

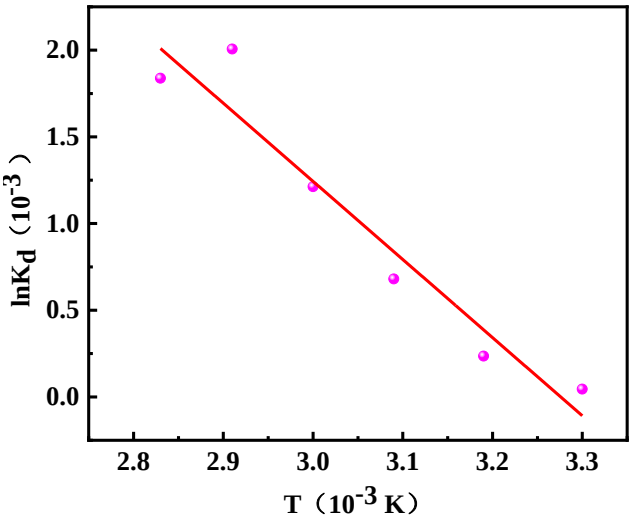

Figure S1. Linear plot of $\ln K_d$ vs 1/T

References

[1] Park JH, Ok YS, Kim SH, Cho JS, Heo JS, Delaune RD, Seo DC (2015) Evaluation of phosphorus adsorption capacity of sesame straw biochar on aqueous solution: influence of activation methods and pyrolysis temperatures. Environ Geochem Health 37:969–983.

[2] Fang C, Zhang T, Li P, Jiang RF, Wang YC (2014) Application of magnesium modified corn biochar for phosphorus removal and recovery from swine wastewater. Int J Environ Res Public Health 11:9217–9237.

[3] Zhang M, Gao B, Fang J, Creamer AE, Ullman JL (2014) Self-assembly of needle-like layered double hydroxide (LDH) nanocrystals on hydrochar: characterization and phosphate removal ability. RSC Adv 4:28171–28175.

[4] Musfique Ahmed, Mina Aziziha, Rifat Anwar, Matthew B. Johnson, Lian-Shin Lin (2021) Magnetic sludge byproducts for adsorptive phosphorus removal: Resource recovery from iron-based anaerobic sewage sludge. Waste Management 120 :269–276.