Supplementary material

Supplementary information

$$\text{Pseudo-first order model: } \ln(q_e - q_t) = \ln q_e - \frac{k_f}{2.303}t \quad \text{(S1)}$$

$$\text{Pseudo-second order model: } \frac{t}{q_t} = \frac{1}{k_s q_e^2} + \frac{t}{q_e} \quad \text{(S2)}$$

$$\text{Intra-particle diffusion model: } q_t = k_{ip} t^{\frac{1}{2}} + C \quad \text{(S3)}$$

where t is the adsorption time; q_t the amount of daptomycin adsorbed on the adsorbent at time t; k_f and k_s are the rate constants of pseudo-second-order and pseudo-second-order models, respectively; k_{ip} is liquid film diffusion constants; C the constant describing the thickness of the bounder layer.

$$\text{Langmuir isotherm: } \frac{C_e}{q_e} = \frac{1}{q_m k_L} + \frac{C_e}{q_m} \quad \text{(S4)}$$

$$\text{Freundlich isotherm: } \ln q_e = \ln k_f + \frac{1}{n} \ln C_e \quad \text{(S5)}$$

$$\text{Temkin isotherm: } q_e = k_T \ln(C_e) + k_T f \quad \text{(S6)}$$

$$\text{D–R isotherm: } \ln q_e = \ln q_D - \left(\frac{RT}{\sqrt{2}E}\right)^2 \left(\ln\left(1 + \frac{1}{C_e}\right)\right)^2 \quad \text{(S7)}$$

where (mg g^{-1}) is the equilibrium adsorption capacity; C_e (mg L^{-1}) the concentration of equilibrium; q_m the monolayer saturation adsorption capacity; k_L the Langmuir adsorption equilibrium constant; k_f and n are the Freundlich constants, related to the adsorbent, adsorbate

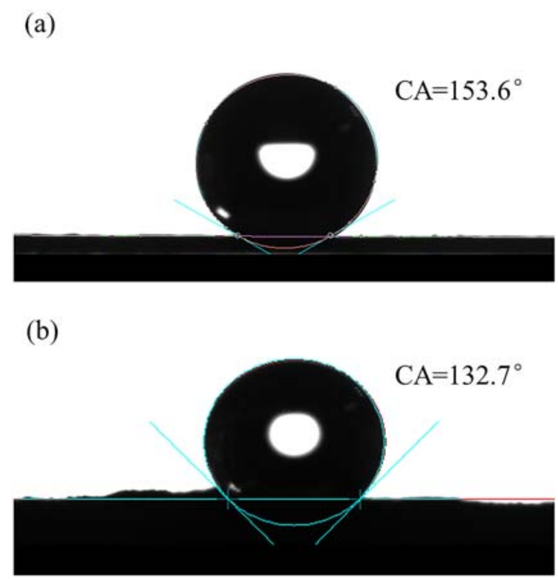


Figure S1: Contact angle measurement of water droplet on the surface of (a) Biochar and (b) AF-biochar.

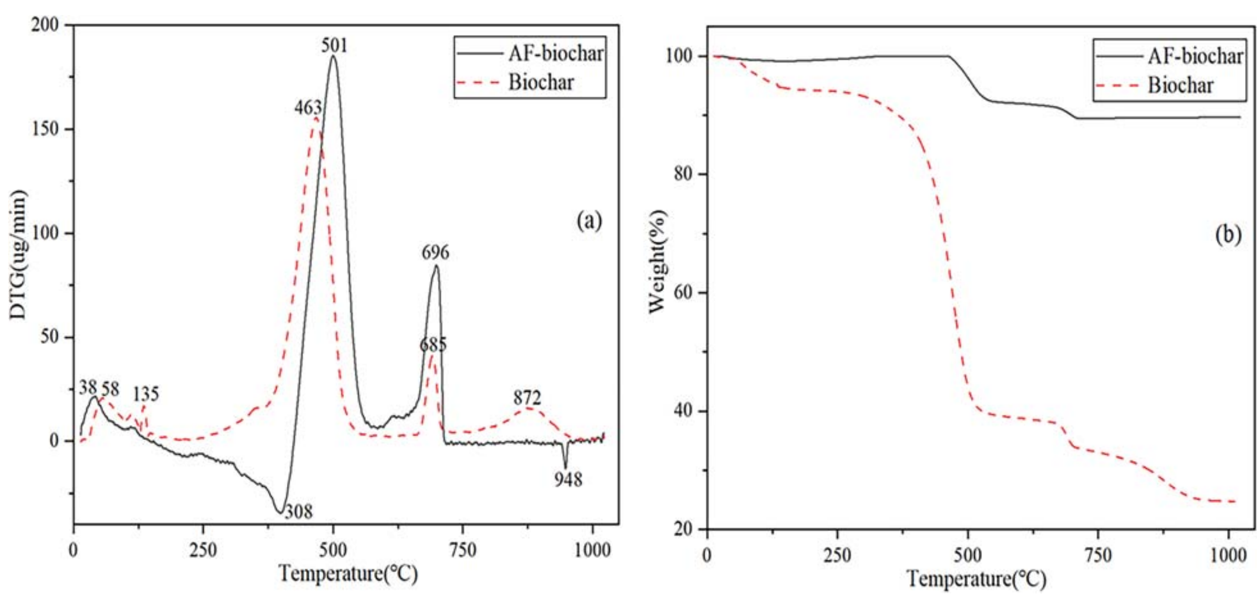


Figure S2: (a) DTG and (b) TG profiles of AF-biochar and Biochar.

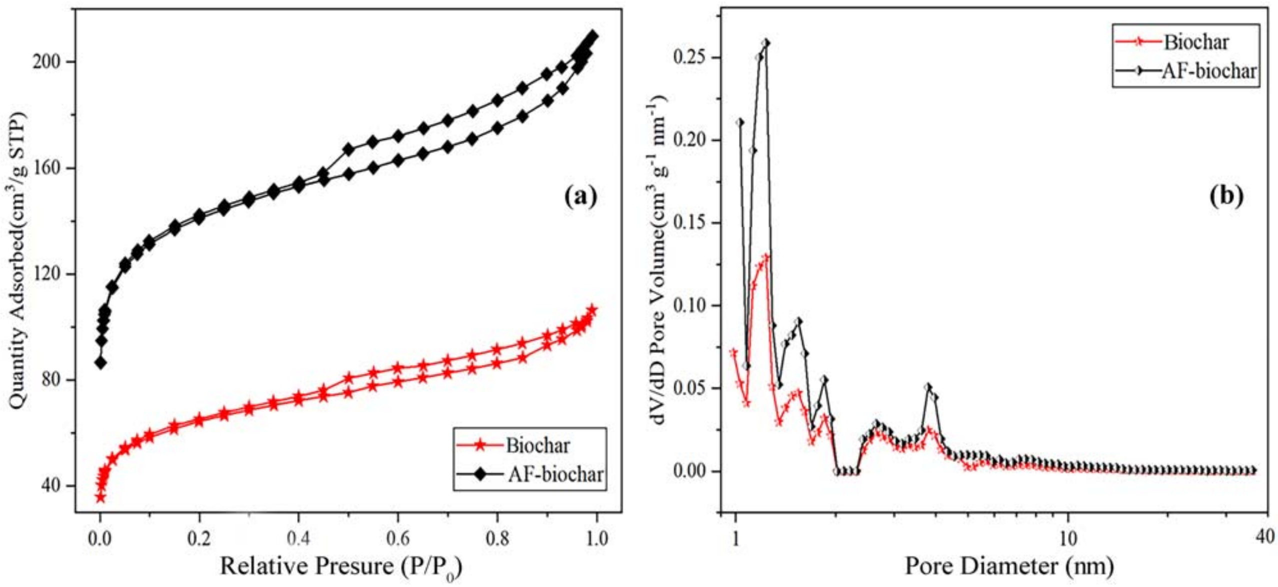


Figure S3: (a) N_2 adsorption and desorption isotherms at 77 K and (b) pore size distribution of AF-biochar and Biochar.

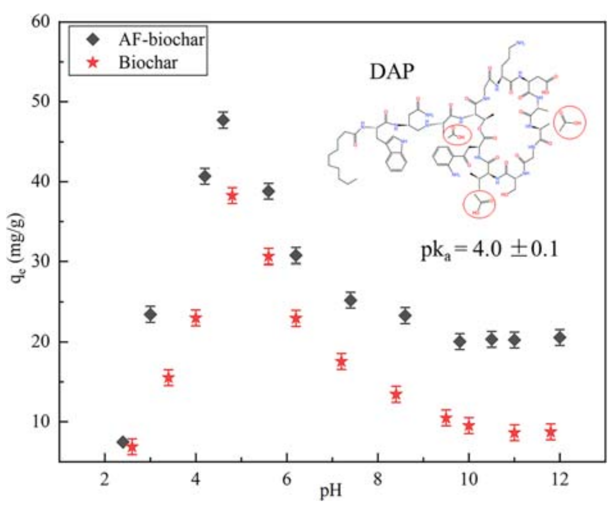


Figure S4: Relation of adsorbed capacities of AF-biochar and Biochar to the pH values of DAP. (conditions: the temperature of 298 K, the initial concentration of 25 mg L^{-1}, and the duration of 85 min).

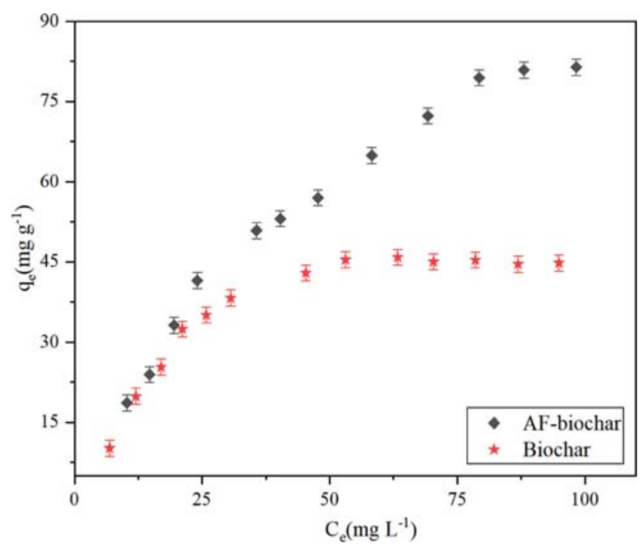


Figure S5: Influence of DAP ionic concentration on adsorbed capacities (conditions: temperature 298 K, pH 4.8, and duration of 85 min).

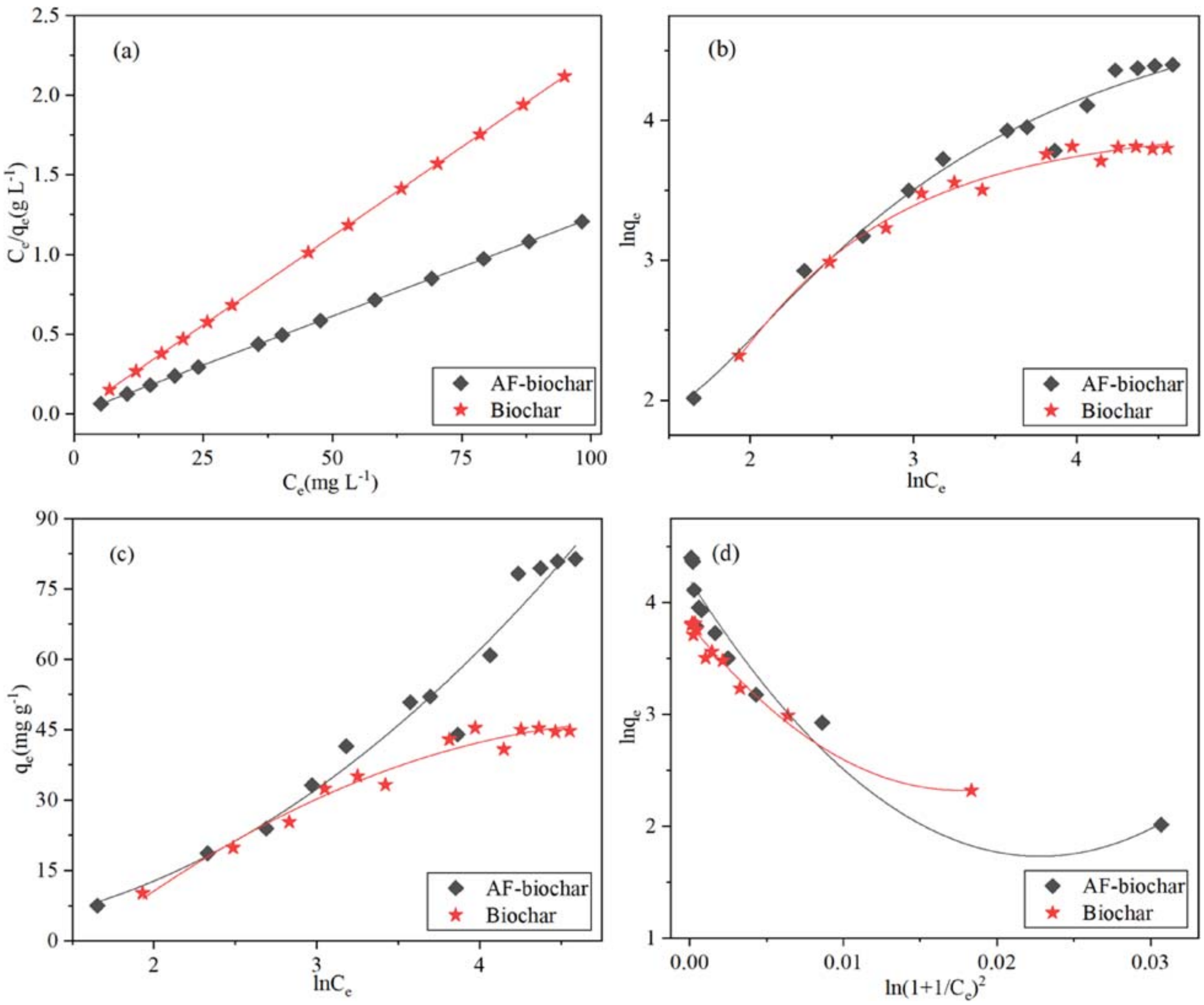


Figure S6: DAP adsorption isotherms in the aqueous solution at pH 4.8, temperature 298 K, and the duration of 85 min fitted in isotherm models: (a) Langmuir; (b) Freundlich; (c) Temkin; (d) Dubinin–Radushkevich (D–R).

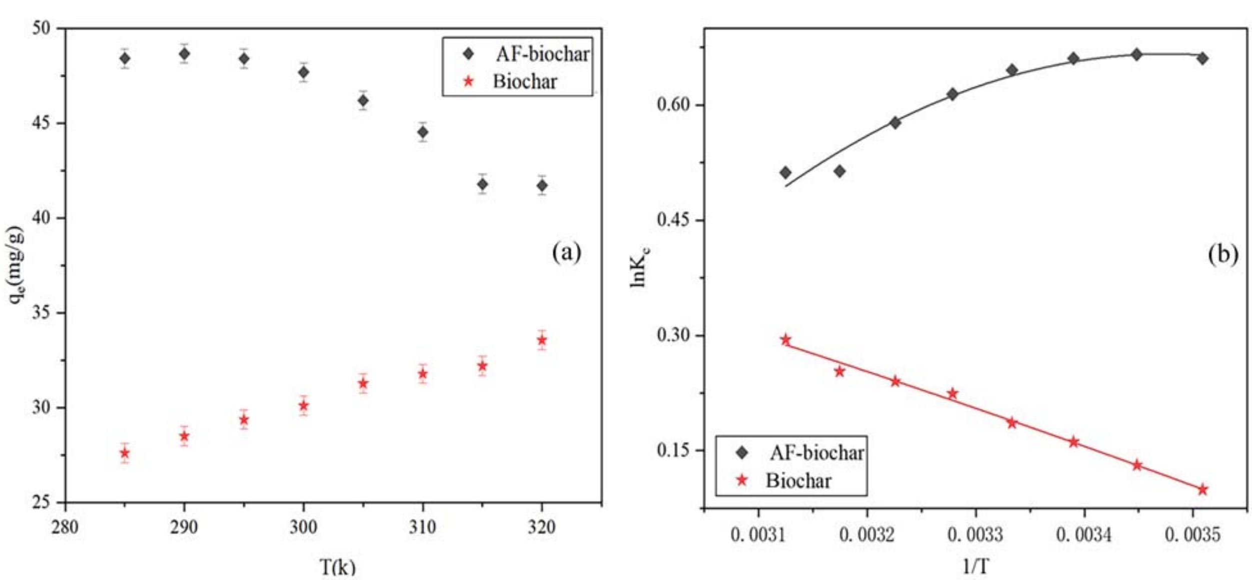


Figure S7: (a) Variation curve of the adsorption capacity of DAP by AF-biochar and Biochar with the temperature; (b) Plot for the thermodynamic analysis.

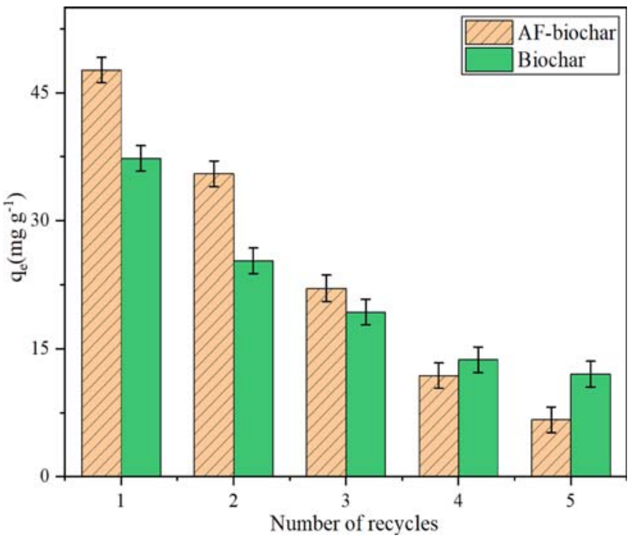
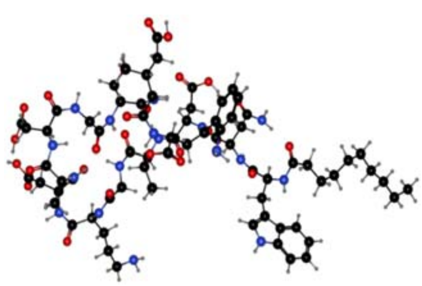


Figure S8: Adsorption-capacity variation with recycles for regenerating AF-biochar and Biochar.

Table S2: Parameters of thermodynamic adsorbing DAP on AF-biochar and biochar (conditions: pH 4.6; duration = 85 min; C_0 = 25 mg L^{-1})

Parameter	Temperature (K)	AF-biochar	Biochar
ΔG^o (kJ mol^{-1})	285	−1.565	−0.235
	290	−1.605	−0.316
	295	−1.621	−0.395
	300	−1.610	−0.463
	305	−1.557	−0.568
	310	−1.487	−0.618
	315	−1.345	−0.662
	320	−1.362	−0.783
ΔH^o (kJ mol^{-1})		−24.833	3.837
ΔS^o (kJ mol^{-1})		−74.799	1.485
R^2		0.9631	0.9912

Table S1: Physico-chemical properties of daptomycin

Parameter	Character
Compound	Daptomycin
Molecular formula	$C_{72}H_{101}N_{17}O_{26}$
CAS number[a]	103060-53-3
Molecular structure	
Molar mass[a]	1620.67 g mol^{-1}
pK_a[a]	4.00 ± 0.10
Density[a]	1.45 ± 0.1 g cm^{-3}
Solubility in water[a]	5 mg mL^{-1}
Storage condition[a]	−20°C

[a] Data from the website: https://www.chemicalbook.com/ProductChemicalPropertiesCB8855073.htm.

type, and temperature; k_T is the Tempkin constant reflecting the adsorption heat; f (L mg^{-1}) is the Tempkin binding constant reflecting the maximum combine energy.

$$K_C = q_e/C_e \tag{S8}$$

$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ \tag{S9}$$

$$\Delta G^\circ = -RT \ln K_C \tag{S10}$$

$$\ln K_C = \frac{\Delta S^\circ}{R} - \frac{\Delta H^\circ}{RT} \tag{S11}$$

where K_C (mL g^{-1}) is the thermodynamic-equilibrium constant.

Table S3: Comparison of maximum adsorption capacity/removal efficiency and adsorption equilibrium time of removing macrolide antibiotics from wastewater with other adsorbents

Adsorbent	Abbreviation	Macrolide antibiotic	q_m (mg g^{-1})/ removal efficiency (%)	Equilibration time (min)	References
Clivia biochar	Biochar	Daptomycin	81.53	85	This study
Ag/Fe clivia biochar	AF-biochar		44.81		
Willow sawdust biochar	WSBC	Daptomycin	57.47	240	[1]
	WSBC/Fe_3O_4		217.39	120	
Pine sawdust biochar	PSBC		55.56	240	
	PSBC/Fe_3O_4		212.77	120	
Boron nitride–carbon nanosheets	BCNs	Roxithromycin	460.09	60	[2]
Mesoporous boron nitride–carbon nanosheets	MBCNs		575.68		
Activated carbon impregnated magnetite composite	PAC/Fe/Ag/Zn	Azithromycin	14.18	120	[3]
L-Methionine modified montmorillonite K10	LMP clay	Azithromycin	298.78	90	[4]
3-Aminopropyltriethoxysilane functionalized magnesium phyllosilicat	AMP clay		286.10		
Magnetic nanocrystalline cellulose	NC·Fe_3O_4	Azithromycin	86.61	180	[5]
$MnFe_2O_4$	N/A	Azithromycin	55.5%	240	[6]
Amino $MnFe_2O_4$ magnetic nanomaterials	$MnFe_2O_4$-N_2		82.3%		
Thiol-functionalized $MnFe_2O_4$ magnetic nanomaterials	$MnFe_2O_4$-HS		92.6%		
Nanoemulsions	CNF 1	Clarithromycin	92.9%	30	[7]
	CNF 2		89.8%		
	CNF 3		82.8%		
	CNF 4		74.9%		
	CNF 5		70.7%		

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