

SUPPLEMENTARY MATERIAL

**Easily pyrolyzable biomass components significantly affect physicochemical properties and water holding capacity of the pyrolyzed biochar**

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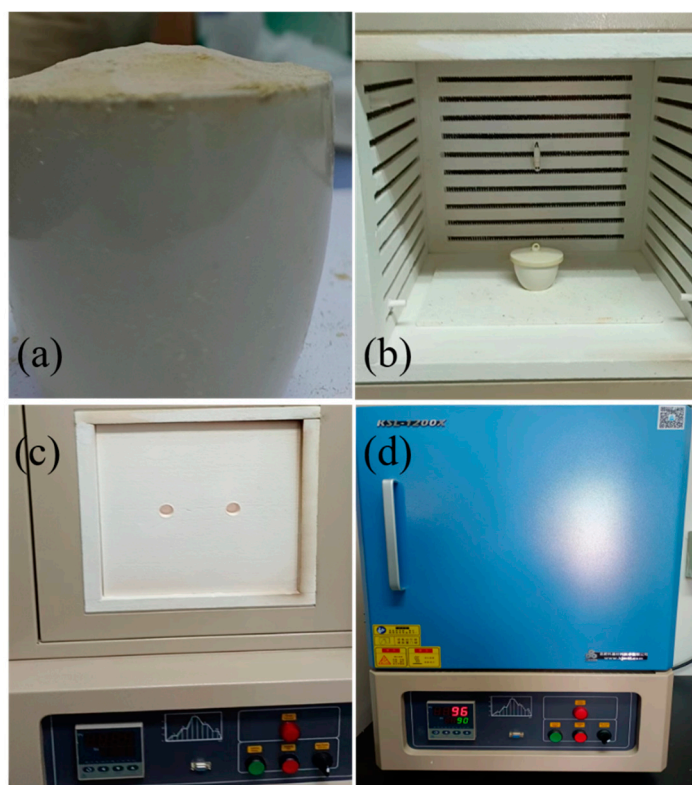


Fig. S1 Biochar preparation process, (a) the compression of the biomass into the crucible, (b) the crucible after compaction of the lid placed inside the muffle furnace, (c) the muffle furnace after placing the heat shield, (d) the muffle furnace in working condition.

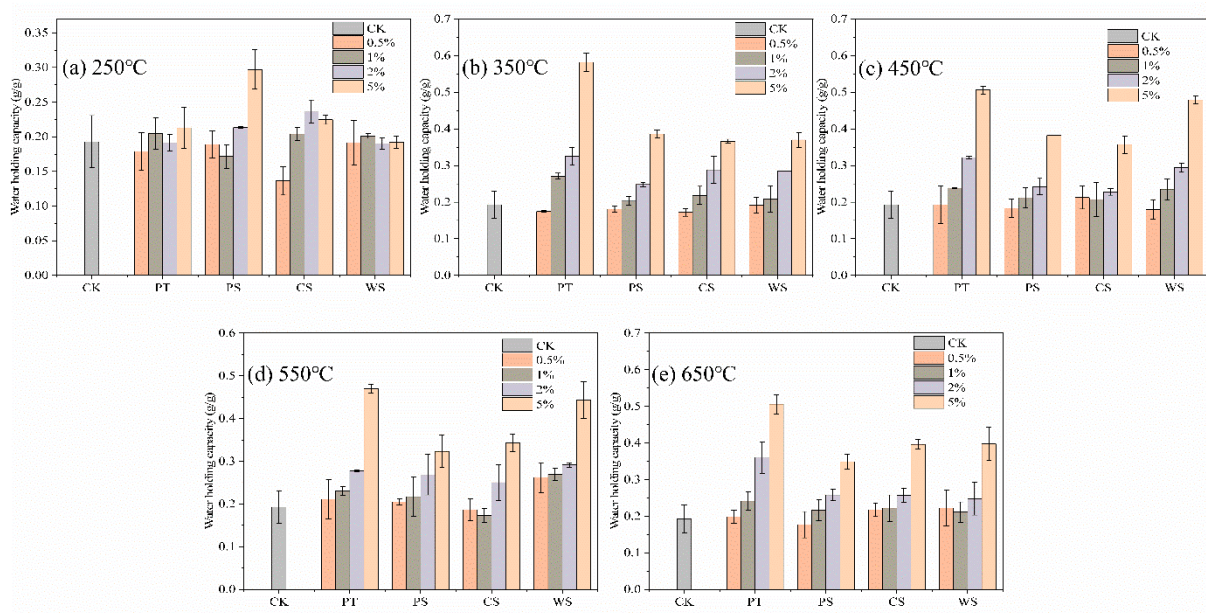


Fig. S2 Difference in water-holding capacity (WHC) of biochar-SS mixtures with different types and additions of biochar pyrolyzed at 250°C (a), 350°C (b), 450°C (c), 550°C (d), 650°C (e).

Table S1 Ratio of peak area of C=O (1700 cm<sup>-1</sup>) to C-H (1456 cm<sup>-1</sup>) of biochar pyrolyzed at different temperatures

Feedstock	Pyrolysis temperature (°C)				
	250°C	350°C	450°C	550°C	650°C
PT	2.54	0.85	0.42	A	0.17
PS	1.84	0.35	A	A	A
CS	1.93	B	B	AB	AB
WS	3.86	1.24	0.85	0.36	1.36

A and B denote the peak of C=O and C-H are not observed in the FTIR spectra, respectively.

Table S2 Spearman's correlation between the PT biochar properties and the WHC of the biochar-silica sand mixture (5% biochar addition, n=5)

Biochar properties	Correlation coefficient	<i>P</i> value
Surface area (BET-N <sub>2</sub> )	0.000	1.000
Mesopore volume	0.100	0.873
Surface area (BET-CO <sub>2</sub> )	0.300	0.624
Micropore volume	0.300	0.624
Aromaticity (H/C)	-0.100	0.873
Polarity (O/C)	-0.100	0.873
Thermal residual mass of biomass	-0.100	0.873

Table S3 Pearson's correlation (Thermal residual mass of biomass is spearman's correlation) between the PS biochar properties and the WHC of the biochar-silica sand mixture (5% biochar addition, n=5)

Biochar properties	Correlation coefficient	<i>P</i> value
Surface area (BET-N <sub>2</sub> )	-0.183	0.768
Mesopore volume	-0.103	0.869
Surface area (BET-CO <sub>2</sub> )	0.247	0.689
Micropore volume	0.247	0.689
Aromaticity (H/C)	-0.355	0.558
Polarity (O/C)	-0.448	0.450
Thermal residual mass of biomass	-0.100	0.873

Table S4 Spearman's correlation between the CS biochar properties and the WHC of the biochar-silica sand mixture (5% biochar addition, n=5)

Biochar properties	Correlation coefficient	<i>P</i> value
Surface area (BET-N <sub>2</sub> )	0.700	0.188
Mesopore volume	0.154	0.805
Surface area (BET-CO <sub>2</sub> )	0.600	0.285
Micropore volume	0.600	0.285
Aromaticity (H/C)	0.600	0.285
Polarity (O/C)	0.600	0.285
Thermal residual mass of biomass	0.600	0.285

Table S5 Pearson's correlation (Surface area (BET-CO<sub>2</sub>), Micropore volume, Aromaticity (H/C), Polarity(O/C)) and spearman's correlation (Surface area (BET-N<sub>2</sub>, Mesopore volume, Thermal residual mass of biomass) between the WS biochar properties and the WHC of the biochar-silica sand mixture (5% biochar addition, n=5)

Biochar properties	Correlation coefficient	<i>P</i> value
Surface area (BET-N <sub>2</sub> )	0.600	0.285
Mesopore volume	0.462	0.434
Surface area (BET-CO <sub>2</sub> )	0.554	0.332
Micropore volume	0.570	0.315
Aromaticity (H/C)	-0.795	0.108
Polarity (O/C)	-0.867	0.057
Thermal residual mass of biomass	0.600	0.285



Table S6 Pearson's correlation between the 250°C-pyrolyzed biochar properties and the WHC of the biochar-silica sand mixture (5% biochar addition, n=4)

Biochar properties	Correlation coefficient	<i>P</i> value
Surface area (BET-N <sub>2</sub> )	0.011	0.989
Mesopore volume	0.924	0.076
Surface area (BET-CO <sub>2</sub> )	-0.603	0.397
Micropore volume	-0.445	0.555
Aromaticity (H/C)	0.454	0.546
Polarity (O/C)	0.186	0.814
Thermal residual mass of biomass	0.387	0.613

Table S7 Spearman's correlation between the 350°C-pyrolyzed biochar properties and the WHC of the biochar-silica sand mixture (5% biochar addition, n=4)

Biochar properties	Correlation coefficient	<i>P</i> value
Surface area (BET-N <sub>2</sub> )	0.800	0.200
Mesopore volume	1.000	0
Surface area (BET-CO <sub>2</sub> )	0.800	0.200
Micropore volume	0.800	0.200
Aromaticity (H/C)	0.800	0.200
Polarity (O/C)	0.400	0.600
Thermal residual mass of biomass	0.400	0.600

Table S8 Pearson's correlation between the 450°C-pyrolyzed biochar properties and the WHC of the biochar-silica sand mixture (5% biochar addition, n=4)

Biochar properties	Correlation coefficient	<i>P</i> value
Surface area (BET-N <sub>2</sub> )	0.551	0.449
Mesopore volume	0.507	0.493
Surface area (BET-CO <sub>2</sub> )	0.353	0.647
Micropore volume	0.318	0.682
Aromaticity (H/C)	-0.784	0.216
Polarity (O/C)	0.610	0.390
Thermal residual mass of biomass	-0.572	0.428

Table S9 Pearson's correlation between the 550°C-pyrolyzed biochar properties and the WHC of the biochar-silica sand mixture (5% biochar addition, n=4)

Biochar properties	Correlation coefficient	<i>P</i> value
Surface area (BET-N <sub>2</sub> )	.303	.697
Mesopore volume	.296	.704
Surface area (BET-CO <sub>2</sub> )	-.045	.955
Micropore volume	.004	.996
Aromaticity (H/C)	.190	.810
Polarity (O/C)	-.076	.924
Thermal residual mass of biomass	-.414	.586

Table S10 Pearson's correlation (Surface area (BET-N<sub>2</sub>), Mesopore volume, Surface area (BET-CO<sub>2</sub>), Micropore volume, Polarity (O/C), Thermal residual mass of biomass) and spearman's correlation (Aromaticity(H/C)) between the 650°C-pyrolyzed biochar properties and the WHC of the biochar-silica sand mixture (5% biochar addition, n=4)

Biochar properties	Correlation coefficient	<i>P</i> value
Surface area (BET-N <sub>2</sub> )	0.401	0.599
Mesopore volume	0.476	0.524
Surface area (BET-CO <sub>2</sub> )	0.911	0.089
Micropore volume	0.733	0.267
Aromaticity (H/C)	-0.258	0.742
Polarity (O/C)	-0.010	0.990
Thermal residual mass of biomass	-0.628	0.372