Supplementary Information

Ash pretreatment of pine and biosolids produces biochars with enhanced capacity for organic micropollutant removal from surface water, wastewater, and stormwater

Matthew J Bentley*, R Scott Summers

University of Colorado Boulder, Environmental Engineering, 4001 Discovery Drive – 607 UCB, Boulder, CO 80309, USA

* Corresponding Author. Email: matthew.bentley@colorado.edu

Contents:

Table S1 Dissolved ash solution characterization. Only metals exceeding 100 ppb are listed, and all metals are listed in ppb.

Ash Leachate	pH	Ba	Ca	K	Mg	Na	P	Si
Pine Ash Solution	11	140	7850	>50,000	43,700	1740	2200	4120
Biosolids Ash Solution	9	233	10,100	5330	8960	1190	3460	2600

Table S2 Dose to achieve 25% and 75% removal of 2,4-D and SMX for all adsorbents in DI, BEM, WW, and SW after a 7-day contact time.

Compound	Sorbent	DI		BEM		WW		SW	
		25%	75%	25%	75%	25%	75%	25%	75%
2,4-D	PAC	0.3	1.8	1.0	5.8	3	9	6	21
	PAB	5.3	14	4.9	20	13	56	32	121
	PAMB	4.0	23	7.5	28	27	81	66	196
	PUB	64	115	51	177	158	468	368	1404
	BAB-C	45	183	88	296	-	-	636	1713
	BUB	63	246	73	366	204	680	1757	>2000
	BAB	84	312	87	417	266	1189	729	>2000
SMX	PAC	0.4	2.2	1.8	8.5	4	19	6	21
	PAB	6.4	17	7.4	42	27	88	44	202
	PAMB	5.5	39	17.4	51	37	>100	88	232
	PUB	75	225	141	223	393	1040	584	>2000
	BAB-C	74	223	137	609	-	-	686	1786
	BUB	76	329	144	674	435	1413	1648	>2000
	BAB	116	475	255	853	594	2079	760	>2000

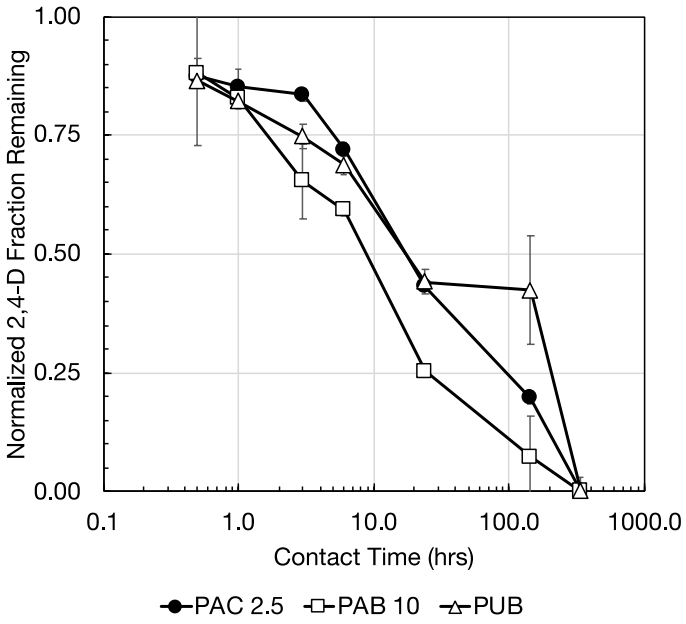

Figure S1 Kinetic performance, normalized to removal at 14-days, of PUB, PAB, and PAC in DI water. Error bars denote range of two standard deviations.

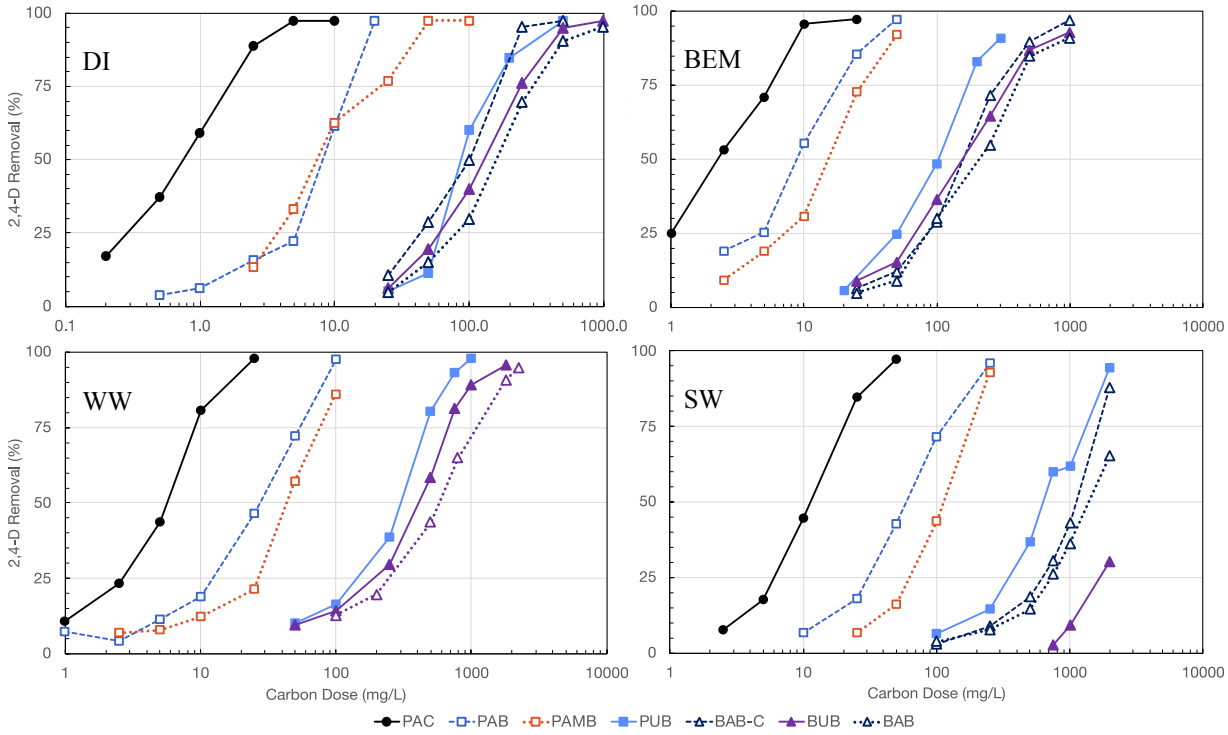

Figure S2 Dose response curves in DI, BEM, WW, and SW for removal of 2,4-D with all sorbents after a 7-day contact time.

.

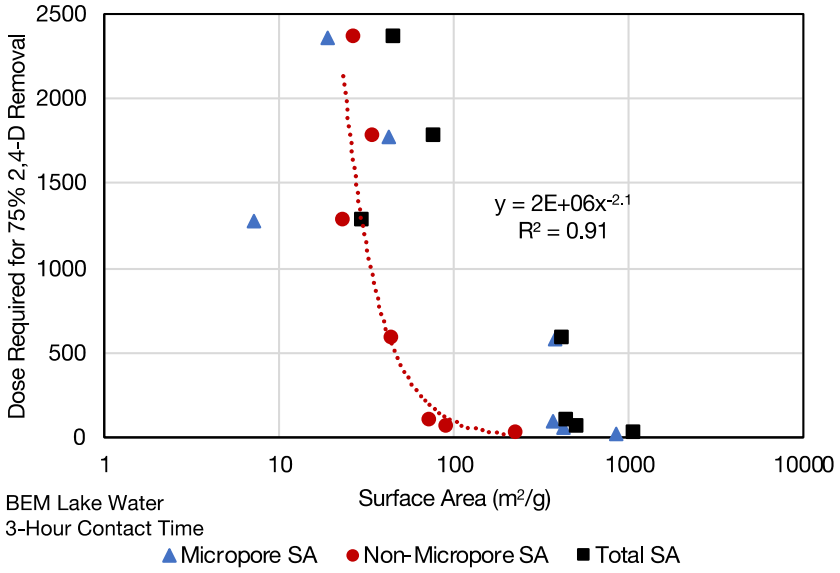

Figure S3 Micropore, non-micropore, and total surface area vs. dose required for 75% 2,4-D removal in 3-hour BEM. Correlation shown is for non-micropore surface area calculated by the T-Plot method.

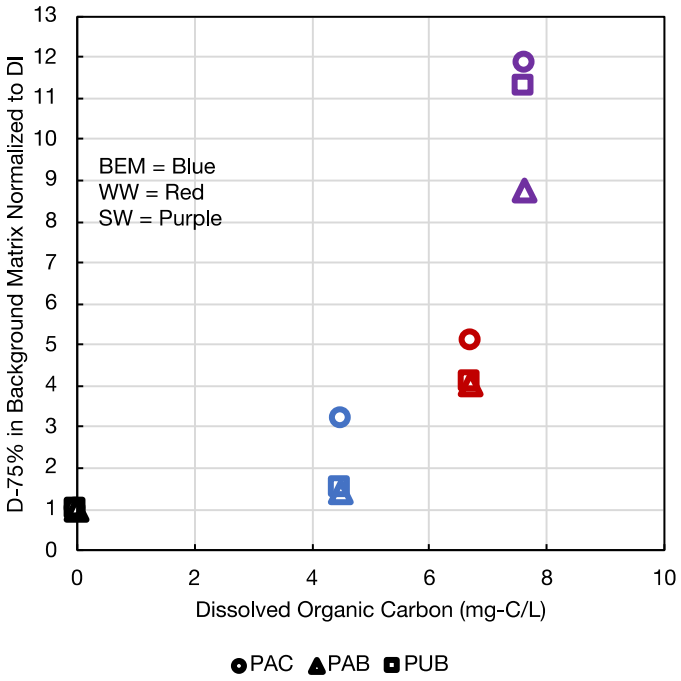

Figure S4 Normalized dose required to achieve 75% removal (D-75%) of 2,4-D in BEM (DOC = 4.5 mg/L), WW (DOC = 6.7 mg/L, and SW (DOC = 7.6 mg/l) normalized to that in DI for PAC, PAB, and UPB at 7-day contact time.

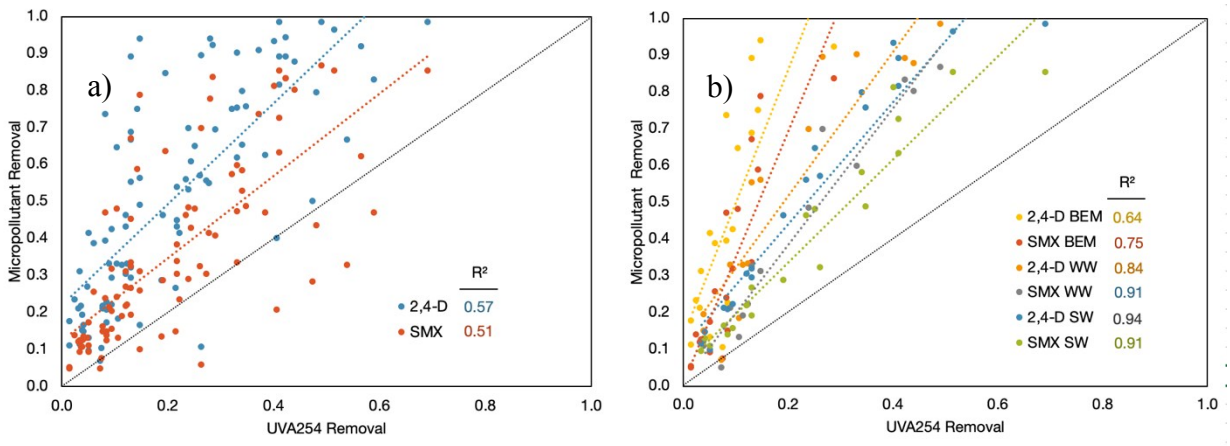

Figure S5 UVA_{254} removal vs. micropollutant removal in a) all background matrices for all biochars, grouped by target compound, and b) PAC and pine biochars (no biosolids biochars) grouped by compound and background matrix. The black dotted line depicts a 1:1 correlation.

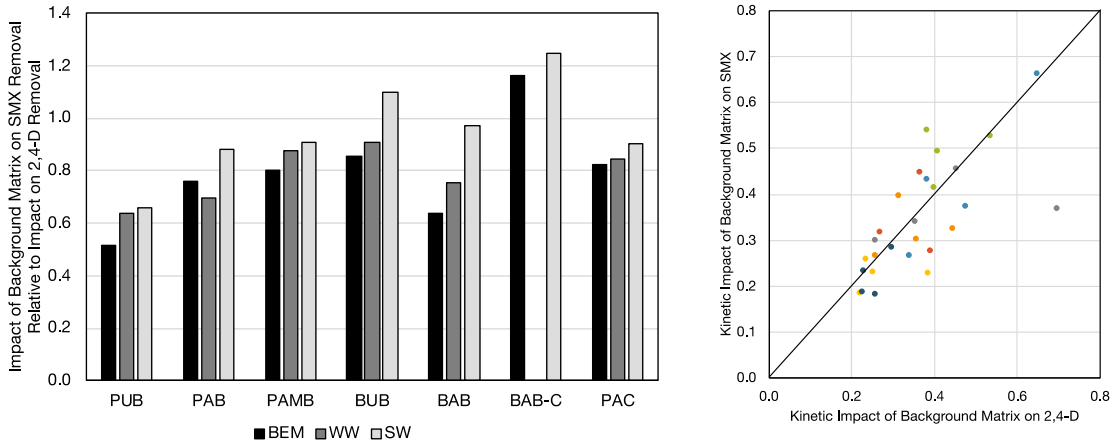

Figure S6 a) Impact of the background matrix on SMX removal relative to 2,4-D removal. Values below 1.0 indicate that background matrix affected SMX more than 2,4-D. b) Kinetic impacts of 2,4-D and SMX in the presence of background organic matter, and a 1:1 line corresponding to no compound-specific impact from the background matrix on sorption kinetics.