Electronic Supplemental Information

Triclosan adsorption using wastewater biosolids-derived biochar

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S1. Triclosan structure and physical-chemical properties

The triclosan molecule, shown in Figure S1, is a trichlorinated binuclear aromatic that is classified as a pesticide and antimicrobial drug[1]. Triclosan has a pKa value of 7.9. The log K_{ow} value of 4.76 suggests that the compound is hydrophobic. The vapor pressure of 4.65E-06 mm Hg indicates it is characterized by low volatility.

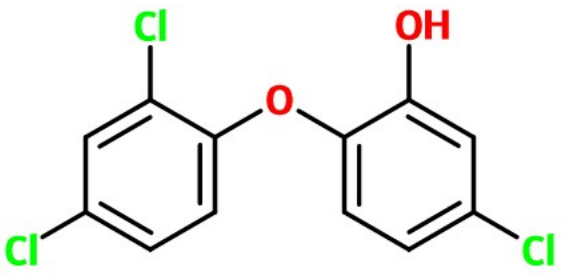


Figure S1- Triclosan chemical structure

S2. Kinetics studies

To determine the adsorption equilibrium, 600°C HCl-biochar was added at a concentration of 0.4 g/L to deionized water spiked with triclosan at an initial concentration of approximately 130 µg/L. Samples were taken over time and were quantified using the LC-MS. The results are shown in Figure S2. The equilibrium time was determined as 24 hours.

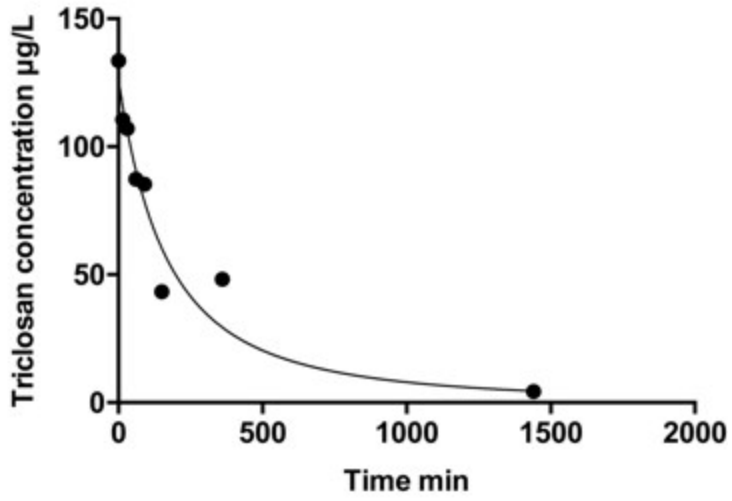


Figure S2- Triclosan adsorption kinetics curve

S3. LC-MS operation

Filtered water samples were mixed with methanol (50/50) in 2 mL amber vials. A binary gradient of Milli-Q water and 100% HPLC-grade methanol was used as the eluent. The method described by Ross et al. (2016) was modified and applied. The gradient began at 80% methanol, raised to 100% methanol at 8 minutes, ramped down to 80% methanol from 8 to 9 minutes and remained at 80% methanol to 13 minutes to allow column re-equilibration. The eluent flow rate was 0.4 mL/min. Sample injections of 20 µL were passed through a Phenomenex® (Torrance, CA, USA) Luna 3u C18 reverse-phase column (150×3 mm, 100Å pore size). Triclosan was detected in mass-spectrometry with negative electrospray ionization (ESI^-), at a mass-to-charge (*m/z*) ratio of 287.

S4. FT-IR spectra of HCl, NaOH, and Milli-Q water treated biochar

Biochar, pyrolyzed at 600°C and pretreated with HCl, NaOH or Milli-Q water, was ground to fine powder (<10 μm). The scanning of each sample was 32. Variability observed in the spectra may be due to the amorphous nature of biosolids-derived biochar.

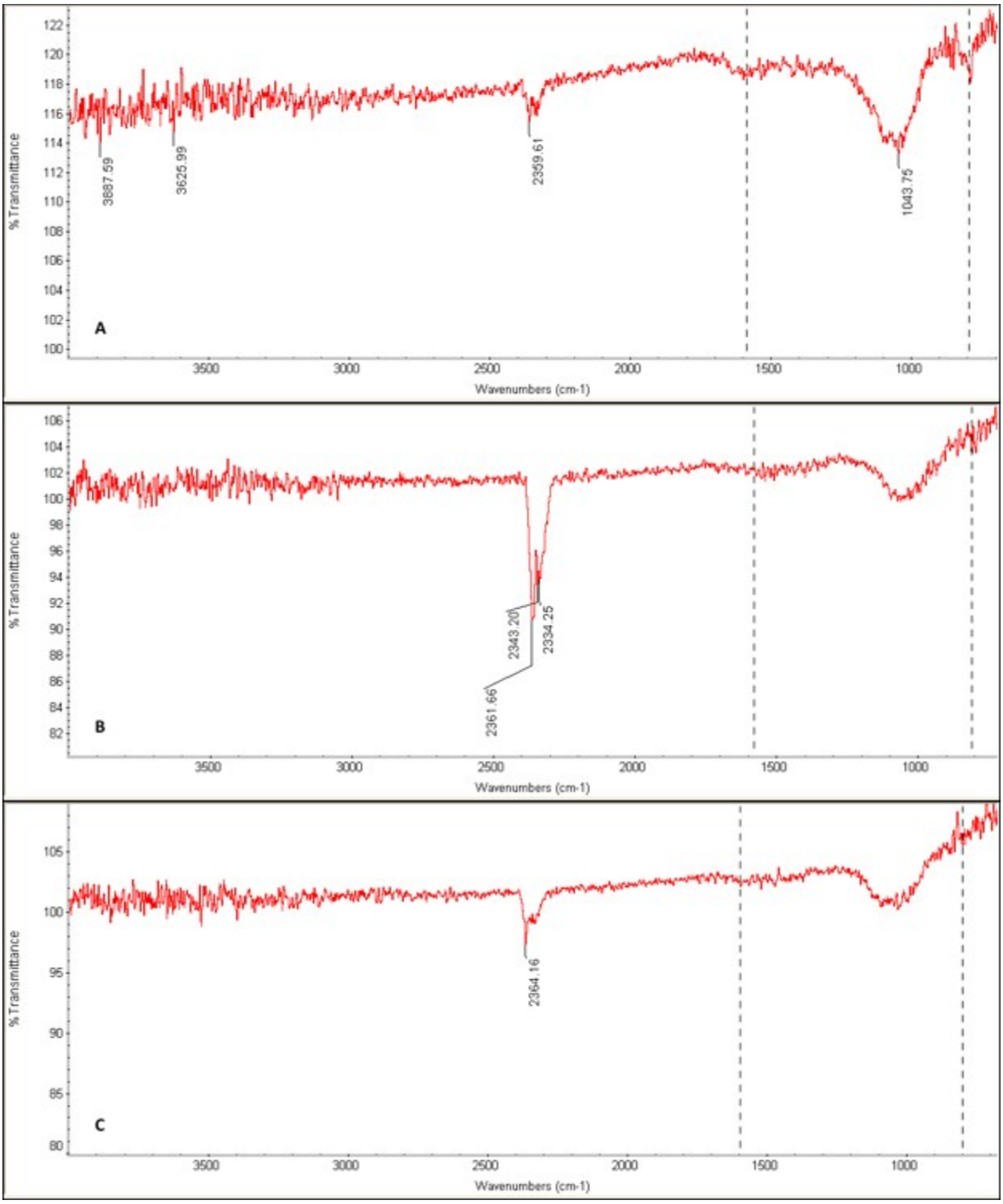
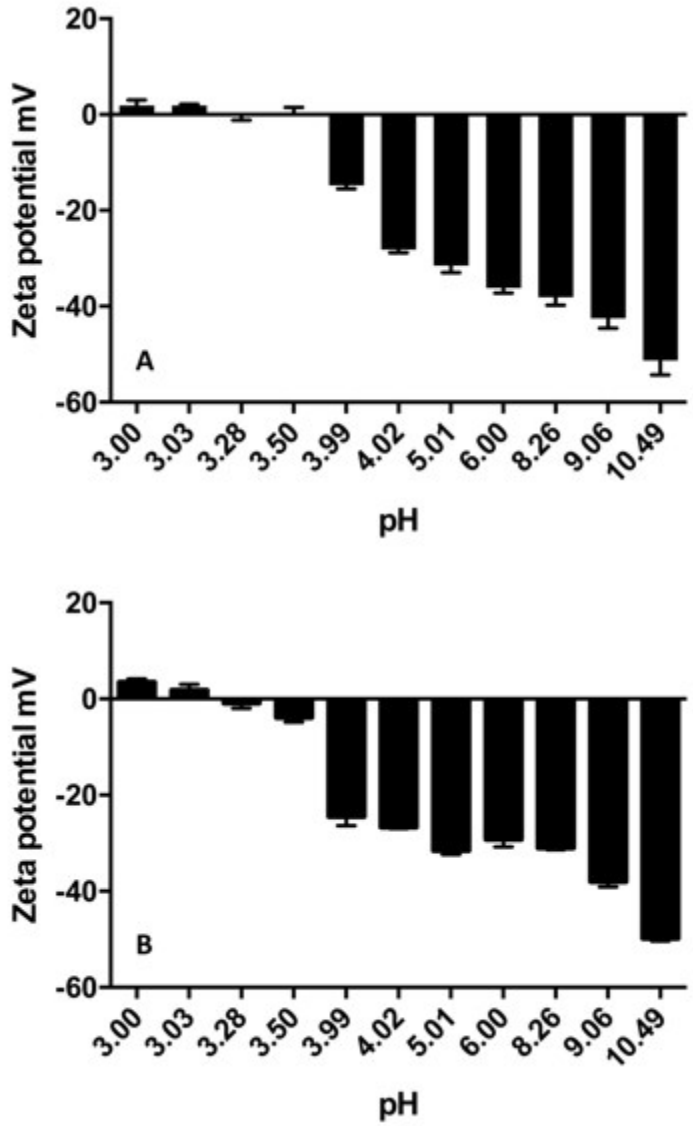


Figure S3- FT-IR spectra of biochar produced at 600˚C, treated with A) HCl, B) NaOH, and C) Milli-Q water.

S5. Biochar zeta potential

Biochar, pyrolyzed at 600°C and pretreated with HCl, NaOH or Milli-Q water, was ground to fine powder (<10 μm). Approximately 0.01 g of biochar powder was suspended in 40 mL of Milli-Q water. The solution pH was then adjusted with HCl or NaOH. The zeta potential was immediately measured using a Malvern Zetasizer Nano ZS (Malvern Instruments Ltd, MA, USA). Results are shown in Figure S4.



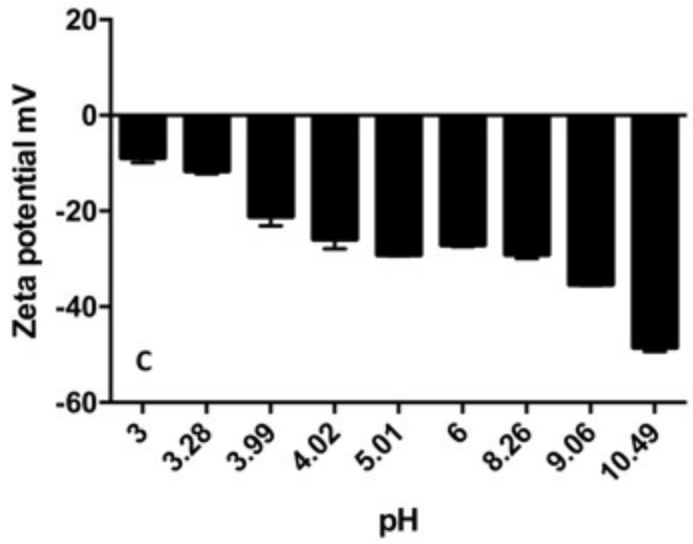


Figure S4- Zeta potentials of biochar produced at 600˚C, pretreated with A) HCl, B) NaOH, and C) Milli-Q water.

S6. Isotherm model fitting

Table S1-Isotherms of HCl-biochar produced at multiple temperatures and activated carbon fitted with Linear, Langmuir and Freundlich models.

Isotherm model	**Equation**	**Parameter**	**Sorbent**					
			300˚C	500˚C	600˚C	700˚C	800˚C	Activated carbon
Linear	$Q_e = AC_e + B$	A	0.345	3.09	2.40	4.82	8.29	30.0
		B	120	190	237	153	332	1440
		R^2	0.049	0.936	0.757	0.917	0.859	0.877
Langmuir	$Q_e = \frac{Q_{max}K_aC_e}{1 + K_aC_e}$	Q_{max}	5.07×10^3	9.02×10^4	5.70×10^4	1.44×10^4	4.42×10^3	1.50×10^5
		K_a	0.0389	0.0113	0.0151	0.0405	0.204	0.0345
		R^2	0.070	0.867	0.896	0.76	0.977	0.967
Freundlich	$Q_e = K_F C_e^{1/n}$	K_F	56.5	43.2	62.0	62.9	254	554
		1/n	0.22	0.54	0.45	0.46	0.30	0.44
		R^2	0.0593	0.912	0.835	0.85	0.977	0.928

S7. Treated wastewater effluent qualities

Table S2-Treated municipal wastewater effluent qualities

pH	**COD (mg/L)**	**TOC (mg/L)**	**Turbidity (NTU)**	**TSS (mg/L)**
7.2	BD*	70.0	2.1	4.6

*: BD: below detection. Detection limit: 125 mg/L

S8. References

1 R. U. Halden and D. H. Paull, *Environ. Sci. Technol.*, 2005, **39**, 1420–1426.

2 J. J. Ross, D. H. Zitomer, T. R. Miller, C. A. Weirich and P. J. McNamara, *Environ. Sci. Water Res. Technol.*, 2016.