

*Supporting Information for*

**Fate of Per- and Polyfluoroalkyl Substances (PFAS) during Hydrothermal  
Liquefaction of Municipal Wastewater Treatment Sludge**

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**Table s1** Apparent recoveries of isotope-labeled PFAS standards in different matrices, linearity range and determination coefficients ( $R^2$ ) of calibration curves for the target PFAS measurement during the HTL reactions of sludge.

PFAS	HTL conditions		Recovery (%)			Linearity range (ng/mL)	$R^2$
	Temperature (°C)	Time (min)	Aqueous	Biocrude oil	Solid		
PFOA	control		105 ± 59		96 ± 53	0.015-77	0.992
	260	60	110 ± 7	88 ± 6	89 ± 1		
	300	60	134 ± 12	55 ± 3	103 ± 1		
	350	60	84 ± 5	57 ± 19	103 ± 20		
	350	30	73 ± 1	137 ± 25	88 ± 5		
	350	90	88 ± 5	34 ± 2	85 ± 2		
PFOS	control		114 ± 65		80 ± 44	0.008-77	0.999
	260	60	93 ± 3	56 ± 4	60 ± 1		
	300	60	111 ± 15	16 ± 2	77 ± 6		
	350	60	82 ± 12	20 ± 4	82 ± 21		
	350	30	81 ± 1	51 ± 10	88 ± 6		
	350	90	84 ± 4	15 ± 1	77 ± 2		
8:2 FTUCA	control		134 ± 44		77 ± 39	0.015-77	0.999
	260	60	268 ± 12	147 ± 17	69 ± 3		
	300	60	380 ± 40	98 ± 1	90 ± 9		
	350	60	115 ± 1	93 ± 49	73 ± 12		
	350	30	106 ± 1	131 ± 32	77 ± 4		
	350	90	122 ± 6	43 ± 1	70 ± 1		
7:3 FTCA	control		41 ± 1		45 ± 6	0.077-77	0.996
	260	60	96 ± 3	23 ± 2	13 ± 1		
	300	60	127 ± 18	11 ± 1	19 ± 1		
	350	60	87 ± 19	12 ± 1	26 ± 7		
	350	30	42 ± 1	29 ± 2	40 ± 5		
	350	90	71 ± 1	10 ± 1	32 ± 1		
8:2 FTS	control		138 ± 46		138 ± 43	0.015-15	0.993
	260	60	92 ± 5	89 ± 12	111 ± 6		
	300	60	98 ± 13	46 ± 7	91 ± 5		
	350	60	102 ± 1	54 ± 15	93 ± 30		
	350	30	75 ± 1	195 ± 1	93 ± 12		
	350	90	109 ± 2	34 ± 1	75 ± 5		

Control refers to the re-hydrated sludge maintained at ambient temperature during the reaction period.

**Table s2** Apparent recoveries of isotope-labeled PFAS standards for the target PFAS measurement during the 60-min aqueous-only reactions.

HTL temperatures (°C)	Recovery (%)				
	PFOA	PFOS	8:2 FTUCA	7:3 FTCA	8:2 FTS
260	64 ± 2	35 ± 1	79 ± 3	83 ± 3	127 ± 1
300	51 ± 2	29 ± 1	89 ± 2	93 ± 4	116 ± 2
350	73 ± 1	39 ± 1	104 ± 1	108 ± 1	59 ± 1

**Table s3** F and p values from one-way analysis of variance (ANOVA) and multiple comparisons of product yields with HTL temperature as a variable (data from Fig. 1a).

Yield	One-way ANOVA		p <sup>b</sup> (multiple comparisons)		
	F <sup>a</sup>	p <sup>b</sup>	260°C	300°C	350°C
solid	148	0.000*	260°C	-	-
			300°C	0.000*	-
			350°C	0.000*	0.850
biocrude oil	58	0.000*	260°C	-	-
			300°C	0.000*	-
			350°C	0.000*	0.509
gas	12	0.004*	260°C	-	-
			300°C	0.058	-
			350°C	0.001*	0.056

<sup>a</sup> F value refers to ratio of mean square between groups to within groups.

<sup>b</sup> p value refers to the significance of difference. \* indicates statistical difference (p<0.05).

**Table s4** F and p values from one-way ANOVA and multiple comparisons of carbon mass distribution in products with HTL temperature as a variable (data from Fig. 1b).

Carbon mass distribution	One-way ANOVA		p (multiple comparisons)		
	F	p	260°C	300°C	350°C
aqueous	218	0.001*	260°C	-	-
			300°C	0.001*	-
			350°C	0.000*	0.004*
solid	47	0.005*	260°C	-	-
			300°C	0.004*	-
			350°C	0.004*	0.957
biocrude oil	142	0.001*	260°C	-	-
			300°C	0.001*	-
			350°C	0.001*	0.314
gas	2	0.265	260°C	-	-
			300°C	0.212	-
			350°C	0.147	0.739

\* indicates statistical difference (p<0.05).

**Table s5** F and p values from one-way ANOVA and multiple comparisons of extent of PFAS degradation during aqueous-only HTL reactions with temperature as a variable (data from Fig. 2a).

Extent of degradation	One-way ANOVA		p (multiple comparisons)		
	F	p	260°C	300°C	350°C
PFOA	0.8	0.535	260°C	-	
			300°C	0.324	-
			350°C	0.828	0.416
8:2 FTUCA	1	0.315	260°C	-	
			300°C	0.186	-
			350°C	0.229	1.000
7:3 FTCA	54	0.004*	260°C	-	
			300°C	0.003*	-
			350°C	0.003*	0.652
8:2 FTS	0.2	0.839	260°C	-	
			300°C	0.832	-
			350°C	0.705	0.574

Data for PFOS not shown because no degradation of PFOS was observed in the aqueous-only reactions.

\* indicates statistical difference ( $p < 0.05$ ).

**Table s6** F and p values from one-way ANOVA and multiple comparisons of extent of PFAS degradation during wet sludge HTL reactions with temperature as a variable (data from Fig. 2b).

Extent of degradation	One-way ANOVA		p (multiple comparisons)		
	F	p	260°C	300°C	350°C
PFOA	1	0.379	260°C	-	
			300°C	0.213	-
			350°C	0.312	0.741
PFOS	0.2	0.854	260°C		
			300°C	0.884	
			350°C	0.715	0.615
7:3 FTCA	581	0.000*	260°C	-	
			300°C	-	-
			350°C	0.000*	0.000*
8:2 FTS	71	0.003*	260°C	-	
			300°C	0.005*	-
			350°C	0.001*	0.025*

Data for 8:2 FTUCA not shown because it is fully degraded following wet sludge HTL reactions.

\* indicates statistical difference ( $p < 0.05$ ).

**Table s7** F and p values from one-way ANOVA and multiple comparisons of extent of defluorination during aqueous-only HTL reactions with temperature as a variable (data from Fig. 2c).

Extent of defluorination	One-way ANOVA		p (multiple comparisons)		
	F	p	260°C	300°C	350°C
PFOA	7	0.029*	260°C	-	
			300°C	0.089	-
			350°C	0.254	0.010*
8:2 FTUCA	23	0.015*	260°C	-	
			300°C	0.017*	-
			350°C	0.007*	0.176
7:3 FTCA	25	0.014*	260°C	-	
			300°C	0.038*	-
			350°C	0.006*	0.039*
8:2 FTS	9	0.054	260°C	-	
			300°C	0.462	-
			350°C	0.028*	0.050*

Data for PFOS not shown because no defluorination of PFOS was observed in the aqueous-only reactions.

\* indicates statistical difference ( $p < 0.05$ ).

**Table s8** F and p values from one-way ANOVA and multiple comparisons of extent of PFAS degradation during wet sludge HTL reactions with reaction time as a variable (data from Fig. 3).

Extent of degradation	One-way ANOVA		p (multiple comparisons)		
	F	p	30 min	60 min	90 min
PFOA	9	0.055	30 min	-	
			60 min	0.033*	-
			90 min	0.038*	0.862
PFOS	2	0.319	30 min	-	
			60 min	0.171	-
			90 min	0.286	0.653
7:3 FTCA	8	0.066	30 min	-	
			60 min	0.048*	-
			90 min	0.038*	0.766
8:2 FTS	6	0.091	30 min	-	
			60 min	0.285	-
			90 min	0.042*	0.126

Data for 8:2 FTUCA not shown because it is fully degraded following wet sludge HTL reactions.

\* indicates statistical difference ( $p < 0.05$ ).

**Table s9** P values from one-way ANOVA of extent of PFAS degradation between the aqueous-only and wet sludge HTL reactions (data from Fig. 2a and 2b).

Extent of degradation	p (one-way ANOVA)		
	260°C	300°C	350°C
PFOA	0.054	0.385	0.291
PFOS	0.038*	0.060	0.119
8:2 FTUCA	0.366	-	0.423
7:3 FTCA	0.134	0.000*	0.256
8:2 FTS	0.636	0.037*	0.017*

\* indicates statistical difference ( $p < 0.05$ ).