Supplementary Information (SI) for Environmental Science: Water Research & Technology.

Supplementary Information

Improved microbial water quality and ozone performance following coagulation: Implications for carbon based advanced treatment for potable reuse.

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Table S1. Water quality after enhanced coagulation with ferric chloride (Test 1).

Wastewater	Ferric Dose (mg-Fe/L)	DOC (mg/L)	UVA_{254} (cm^{-1})	SUVA (L/mg.m)	Turbidity (NTU)	Alkalinity (mg/L as $CaCO_3$)	pH	ATP (pg/mL)	ICC (events/µL)
Nevada (WW_{NV})	0	6.8	0.116	1.7	3.8	123	7.3	719	NA
	0	6.8	0.116	1.7	4.2	122	7.6	500	NA
	10	5.2	0.092	1.8	2.4	99	7.6	18	NA
	20	4.8	0.080	1.7	2.2	76	7.4	3.0	NA
	30	4.5	0.073	1.6	2.6	54	7.2	4.0	NA
	30	4.4	0.073	1.7	2.1	53	6.9	1.5	NA
	40	4.0	0.065	1.6	1.8	29	6.9	3.0	NA
	50	3.7	0.060	1.6	3.0	10	6.9	0.5	NA
Virginia (WW_{VA})	0	6.7	0.148	2.2	2.7	127	6.7	1933	NA
	0	6.6	ND	ND	2.1	127	7.1	1805	1.2×10^4
	10	5.2	0.107	2.1	2.2	104	6.9	500	6.5×10^3
	20	4.7	0.088	1.9	0.8	80	6.6	88	1.3×10^3
	30	4.0	0.074	1.9	0.4	53	6.4	3.7	2.7×10^2
	30	3.9	0.077	2.0	0.4	50	6.5	4.0	2.6×10^2
	40	3.6	0.063	1.8	0.4	29	6.5	0.7	1.6×10^2
	50	3.1	0.052	1.7	0.5	11	6.3	0.2	1.1×10^2
California (WW_{CA})	0	9.1	0.173	1.9	4.3	124	7.7	-	NA
	0	9.1	0.173	1.9	3.8	128	7.8	377	1.3×10^4
	10	7.0	0.132	1.9	3.8	100	6.9	50	1.0×10^4
	20	6.6	0.117	1.8	1.5	77	7.1	3.9	4.0×10^3
	30	5.4	0.096	1.8	1.0	52	7.0	1.0	7.9×10^2
	30	5.8	0.101	1.7	1.8	53	6.8	5.7	1.0×10^3
	40	4.9	0.086	1.8	1.0	27	6.7	0.5	3.7×10^2
	50	4.3	0.080	1.9	0.9	5.9	6.1	0.4	2.4×10^2

Table S2. Water quality after enhanced coagulation with ferric chloride (Test 2).

Wastewater	Ferric Dose (mg-Fe/L)	DOC (mg/L)	UVA_{254} (cm^{-1})	SUVA (L/mg.m)	Turbidity (NTU)	Alkalinity (mg/L as $CaCO_3$)	pH
Virginia (WW_{VA-2})	0	7.0	0.143	2.04	1.5	107	7.0
	0	7.0	0.145	2.07	1.5	106	-
	0	6.9	0.144	2.09	1.4	-	-
	10	5.8	0.107	1.84	0.8	79	6.4
	10	5.9	0.109	1.85	0.6	-	-
	10	5.9	0.110	1.86	0.6	-	-
	30	4.6	0.073	1.59	0.5	26	5.8
	30	4.4	0.076	1.73	0.5	-	-
	30	4.3	0.072	1.67	0.6	-	-
	50	4.1	0.112	2.73	5.3	<2.0	3.4
	50	4.2	0.111	2.64	5.5	-	-
	50	4.2	0.118	2.81	7.2	-	-

Table S3. Microbial water quality after coagulation/flocculation with ferric chloride. TCC = total cell count via flow cytometry; ICC = intact cell count via flow cytometry with live/dead staining.

Wastewater	Ferric Dose (mg-Fe/L)	MS2 (pfu/mL)	*B. subtilis* spores (cfu/mL)	Total Coliforms (MPN/100 mL)	*E. coli* (MPN/100 mL)	Total ATP (pg/mL)	Intracellular ATP (pg/mL)	TCC (events/µL)	ICC (events/µL)
Virginia	0	2.1×10^{6}	1.5×10^{5}	1.7×10^{4}	1.5×10^{3}	4.5×10^{2}	3.5×10^{2}	7.4×10^{3}	7.9×10^{3}
	0	2.2×10^{6}	1.5×10^{5}	1.7×10^{4}	1.7×10^{3}	3.9×10^{2}	3.4×10^{2}	8.5×10^{3}	7.9×10^{3}
	0	1.1×10^{6}	1.4×10^{5}	-	-	4.5×10^{2}	4.2×10^{2}	8.5×10^{3}	7.9×10^{3}
	10	2.1×10^{5}	5.4×10^{3}	1.0×10^{3}	1.9×10^{2}	1.2×10^{1}	9.0×10^{0}	4.6×10^{3}	2.8×10^{3}
	10	1.8×10^{5}	3.0×10^{3}	1.2×10^{3}	1.7×10^{2}	1.4×10^{1}	1.2×10^{1}	4.8×10^{3}	2.8×10^{3}
	10	4.0×10^{5}	3.7×10^{3}	-	-	1.1×10^{1}	6.3×10^{0}	4.8×10^{3}	2.8×10^{3}
	30	7.4×10^{3}	9.6×10^{2}	7.3×10^{1}	4.0×10^{0}	7.5×10^{-1}	$< 3.5 \times 10^{-1}$	5.9×10^{2}	1.9×10^{2}
	30	1.4×10^{4}	9.2×10^{1}	4.0×10^{1}	1.0×10^{0}	5.0×10^{-1}	$< 3.5 \times 10^{-1}$	6.0×10^{2}	1.9×10^{2}
	30	1.2×10^{4}	1.4×10^{3}	-	-	5.0×10^{-1}	5.0×10^{-1}	5.3×10^{2}	1.8×10^{2}
	50	1.4×10^{3}	4.9×10^{1}	9.1×10^{1}	1.7×10^{1}	$< 3.5 \times 10^{-1}$	$< 3.5 \times 10^{-1}$	1.7×10^{2}	1.0×10^{1}
	50	5.0×10^{3}	2.3×10^{1}	6.5×10^{1}	9.0×10^{0}	$< 3.5 \times 10^{-1}$	$< 3.5 \times 10^{-1}$	7.8×10^{1}	7.0×10^{0}
	50	1.0×10^{3}	8.3×10^{1}	-	-	$< 3.5 \times 10^{-1}$	$< 3.5 \times 10^{-1}$	6.4×10^{1}	8.0×10^{0}

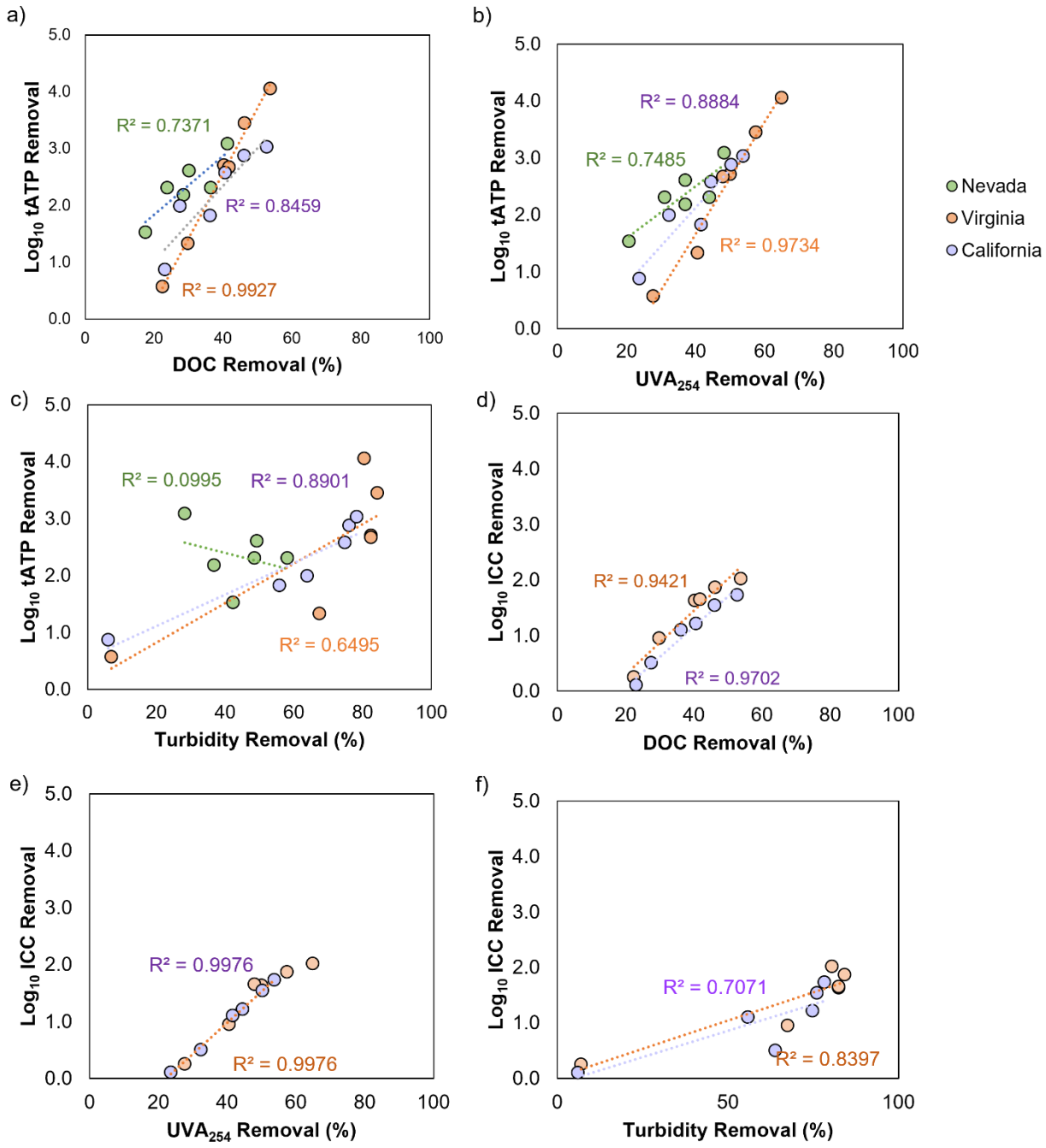

Figure S1. Pearson's correlations between removals of a) tATP and DOC, b) tATP and UVA_{254}, c) tATP and turbidity, d) ICC and DOC, e) ICC and UVA_{254}, and f) ICC and turbidity after coagulation with ferric chloride during Test 1.

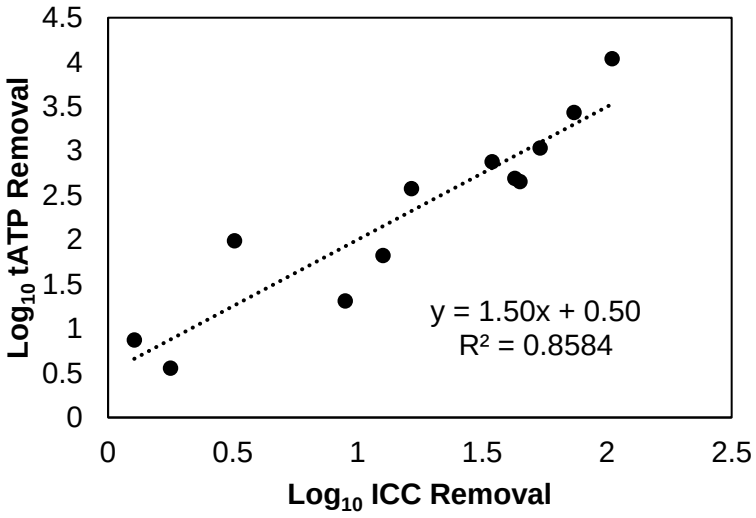

Figure S2. Relationship between tATP and ICC removal after coagulation with ferric chloride across three secondary effluents during Test 1.

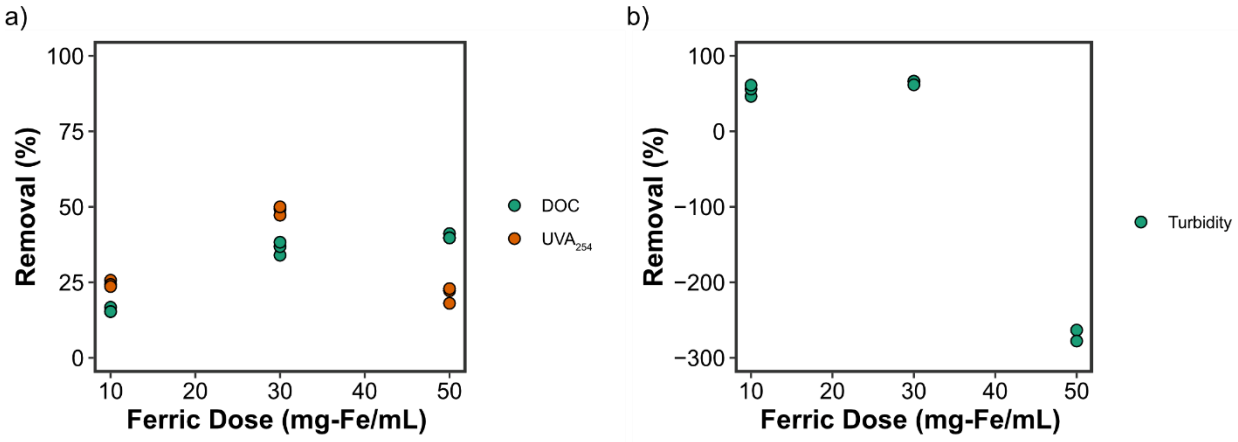

Figure S3. Percent removal of (a) DOC, UVA_{254} and (b) turbidity after coagulation with ferric chloride during Test 2.

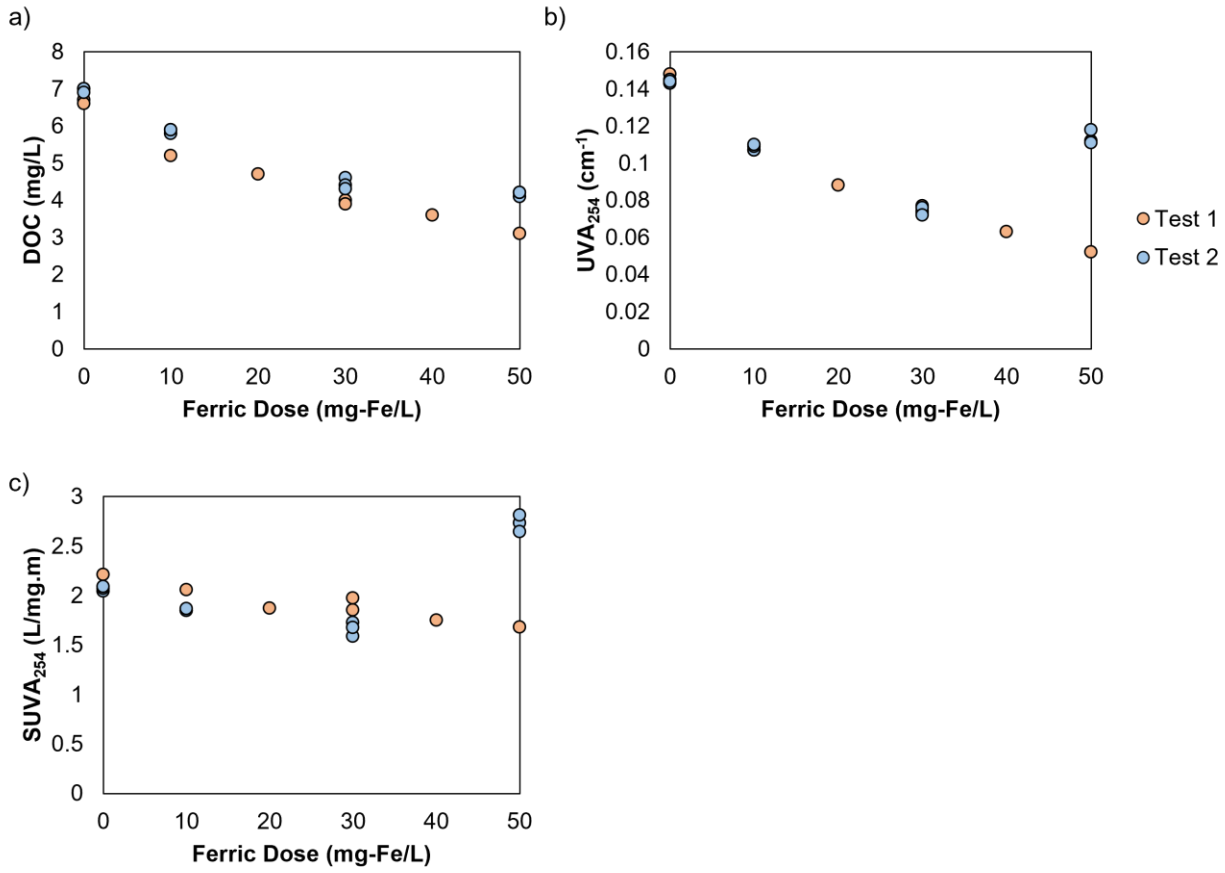

Figure S4. Comparison of raw data for secondary effluent from Virginia after coagulation with ferric chloride between Tests 1 and 2 for (a) DOC, (b) UVA_{254}, and (c) $SUVA_{254}$.

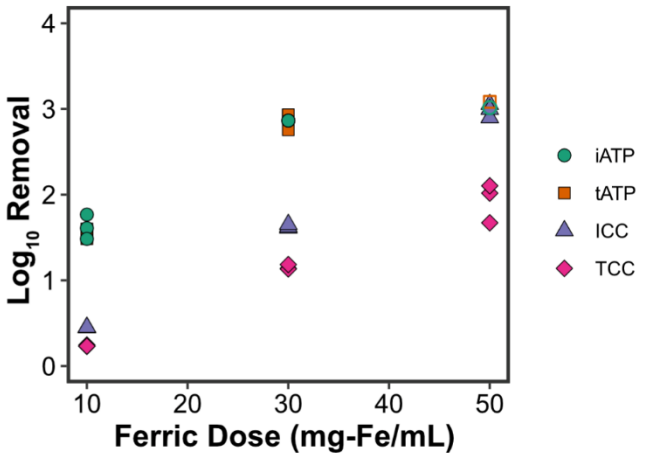

Figure S5. Log_{10} removals of total and intracellular ATP (tATP, iATP) and intact and total cell counts (ICC, TCC) during enhanced coagulation of secondary effluent.

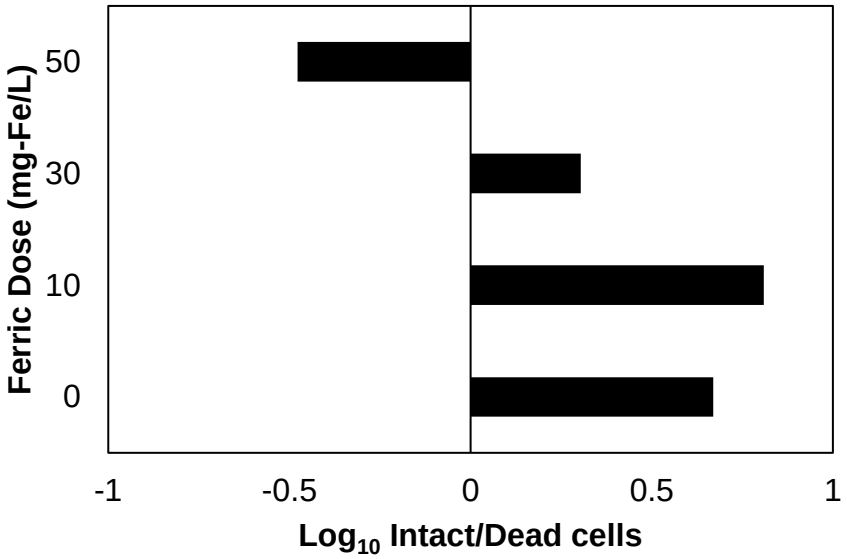

Figure S6. Ratio of intact vs. dead cells as determined via FCM with increasing ferric doses. X-axis: $log_{10}(\frac{N_{Intact\ Cells}}{N_{Dead\ Cells}})$ where N = number of cells. Negative values indicate a greater abundance of dead cells for a given coagulant dosing condition (50 mg-Fe/L), and positive values indicate a greater abundance of intact cells (0-30 mg-Fe/L).

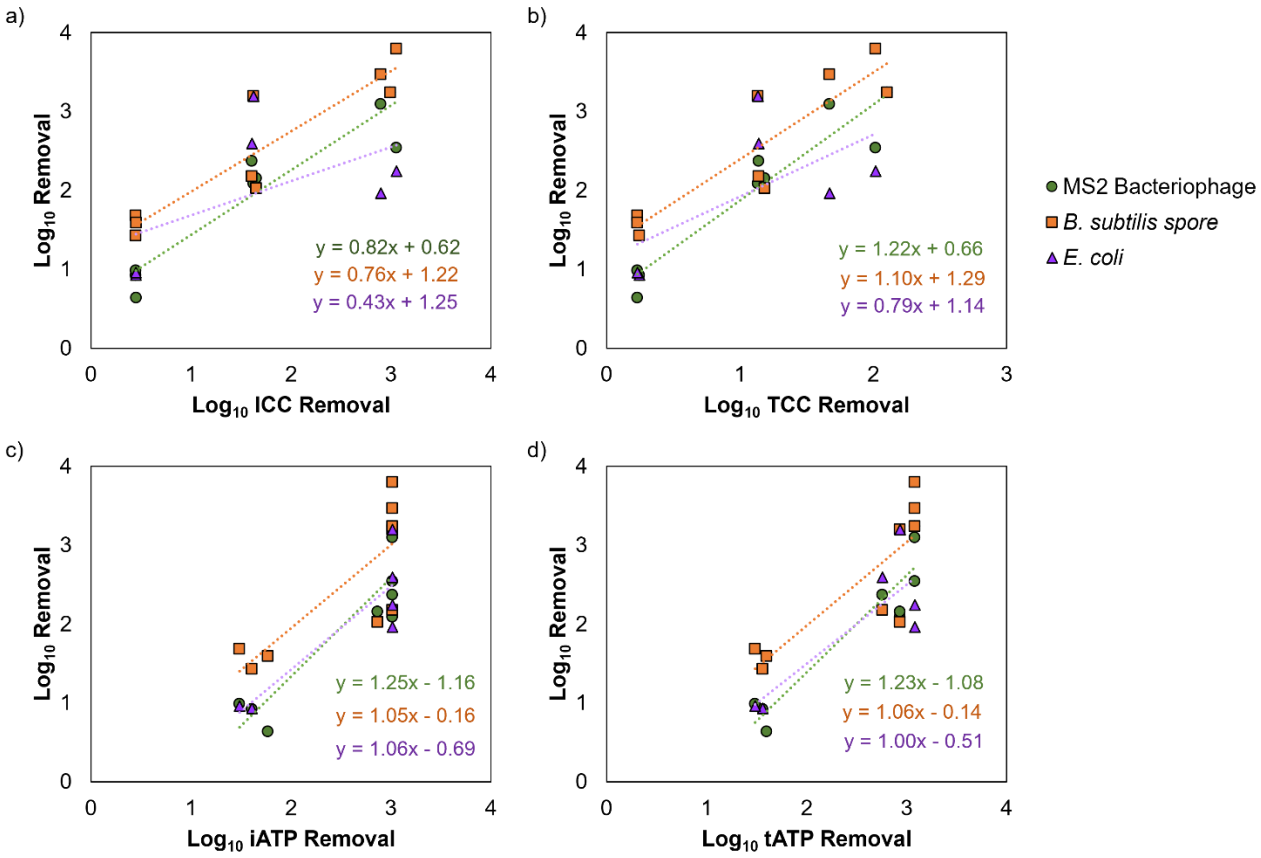

Figure S7. Log_{10} removals of (a) intact cell count (ICC) via flow cytometry, (b) total cell count (TCC) via flow cytometry, (c) intracellular ATP (iATP) and (d) total ATP (tATP) compared directly against removal of MS2 bacteriophage, *Bacillus subtilis* spores, and *E. coli* after coagulation with ferric chloride during Test 2.

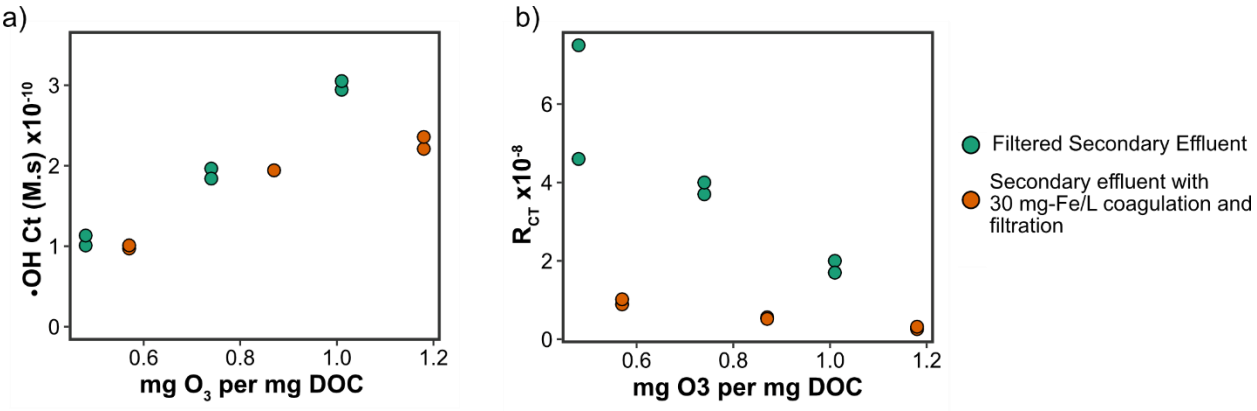

Figure S8. (a) Hydroxyl radical (·OH) exposure as estimated from the removal of probe compound para-chlorobenzoic acid (pCBA) and (b) the ratio of ozone/·OH exposure (R_{CT}) as a function of specific ozone dose for secondary effluent with and without upstream coagulation with 30 mg-Fe/L.