SUPPORTING INFORMATION

UV/Chlorine *vs.* UV/H_2O_2 for water reuse at Orange County Water District, CA: A pilot study

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Table S1. Selected elementary reactions considered in the kinetic model

No.	**Reaction**	**Rate constant**
1	$NH_2Cl + hv \rightarrow NH_2\bullet + Cl\bullet$	$\varepsilon = 371\ M^{-1}\ cm^{-1}$ [1] $\Phi = 0.294$ [2]
2	$NHCl_2 + hv \rightarrow NHCl\bullet + Cl\bullet$	$\varepsilon = 126\ M^{-1}\ cm^{-1}$ [1] $\Phi = 0.82$ [1]
3	$HOCl + hv \rightarrow \bullet OH + Cl\bullet$	$\varepsilon = 58\ M^{-1}\ cm^{-1}$ [2] $\Phi = 0.55$ [3]
4	$H_2O_2 + hv \rightarrow 2\bullet OH$	$\varepsilon = 19.6\ M^{-1}\ cm^{-1}$ [4] $\Phi = 0.5$ [4]
5	$\bullet OH + NH_2Cl \rightarrow NHCl\bullet + H_2O$	$5.2 \times 10^{8}\ M^{-1}\ s^{-1}$ [5] $6.1 \times 10^{8}\ M^{-1}\ s^{-1}$ [6] $8.64 \times 10^{8}\ M^{-1}\ s^{-1}$ [2] $1.02 \times 10^{9}\ M^{-1}\ s^{-1}$ [7] $2.8 \times 10^{9}\ M^{-1}\ s^{-1}$ [8]
6	$\bullet OH + NHCl_2 \rightarrow NCl_2\bullet + H_2O$	$2.57 \times 10^{8}\ M^{-1}\ s^{-1}$ [6] $6.21 \times 10^{8}\ M^{-1}\ s^{-1}$ [9]
7	$\bullet OH + NCl_3 \rightarrow NCl_2\bullet + HOCl$	$1.67 \times 10^{8}\ M^{-1}\ s^{-1}$ [6]
8	$\bullet OH + HOCl \rightarrow ClO\bullet + H_2O$	$8.5 \times 10^{4}\ M^{-1}\ s^{-1}$ [10] $1.4 \times 10^{8}\ M^{-1}\ s^{-1}$ [11] $5.0 \times 10^{8}\ M^{-1}\ s^{-1}$ [7] $2.0 \times 10^{9}\ M^{-1}\ s^{-1}$ [12]
9	$\bullet OH + OCl^{-} \rightarrow ClO\bullet + OH^{-}$	$1.8 \times 10^{9}\ M^{-1}\ s^{-1}$ [7] $8.8 \times 10^{9}\ M^{-1}\ s^{-1}$ [13]
10	$\bullet OH + NO_2^{-} \rightarrow OH^{-} + NO_2\bullet$	$5.3 \times 10^{9}\ M^{-1}\ s^{-1}$ [14] $1.0 \times 10^{10}\ M^{-1}\ s^{-1}$ [15]
11	$\bullet OH + H_2O_2 \rightarrow HO_2\bullet + H_2O$	$2.7 \times 10^{7}\ M^{-1}\ s^{-1}$ [15]
12	$\bullet OH + Cl^{-} \rightarrow ClOH\bullet^{-}$	$4.3 \times 10^{9}\ M^{-1}\ s^{-1}$ [16]
13	$\bullet OH + ONOO^{-} \rightarrow ONOO\bullet + OH^{-}$	$4.8 \times 10^{9}\ M^{-1}\ s^{-1}$ [17]
14	$\bullet OH + HCO_3^{-} \rightarrow CO_3\bullet^{-} + H_2O$	$8.5 \times 10^{6}\ M^{-1}\ s^{-1}$ [15]
15	$\bullet OH + CO_3^{2-} \rightarrow CO_3\bullet^{-} + OH^{-}$	$3.9 \times 10^{8}\ M^{-1}\ s^{-1}$ [15]
16	$Cl\bullet + NH_2Cl \rightarrow NHCl\bullet + HCl$	$1.0 \times 10^{9}\ M^{-1}\ s^{-1}$ [7] $2.4 \times 10^{7}\ M^{-1}\ s^{-1}$ [18]
17	$Cl\bullet + HOCl \rightarrow ClO\bullet + H^{+} + Cl^{-}$	$3.0 \times 10^{9}\ M^{-1}\ s^{-1}$ [19]
18	$Cl\bullet + OCl^{-} \rightarrow ClO\bullet + Cl^{-}$	$8.2 \times 10^{9}\ M^{-1}\ s^{-1}$ [19]
19	$Cl\bullet + Cl^{-} \rightarrow Cl_2\bullet^{-}$	$6.5 \times 10^{9}\ M^{-1}\ s^{-1}$ [19] $7.8 \times 10^{9}\ M^{-1}\ s^{-1}$ [20] $8.0 \times 10^{9}\ M^{-1}\ s^{-1}$ [21] $8.5 \times 10^{9}\ M^{-1}\ s^{-1}$ [22]
20	$Cl\bullet + NO_2^{-} \rightarrow Cl^{-} + NO_2\bullet$	$5.0 \times 10^{9}\ M^{-1}\ s^{-1}$ [23]
21	$Cl\bullet + H_2O_2 \rightarrow H^{+} + Cl^{-} + HO_2\bullet$	$1.0 \times 10^{9}\ M^{-1}\ s^{-1}$ [24]

		2.0×10^{9} M^{-1} s^{-1} [20]
22	$Cl\bullet + OH^- \rightarrow ClOH\bullet^-$	1.8×10^{10} M^{-1} s^{-1} [19]
23	$Cl\bullet + H_2O \rightarrow ClOH\bullet^- + H^+$	7.2×10^{4} s^{-1} [16] 1.6×10^{5} s^{-1} [19,25] 1.8×10^{5} s^{-1} [20] 2.5×10^{5} s^{-1} [23,26]
24	$Cl\bullet + HCO_3^- \rightarrow CO_3\bullet^- + H^+ + Cl^-$	2.2×10^{8} M^{-1} s^{-1} [27] 2.4×10^{9} M^{-1} s^{-1} [23]
25	$Cl\bullet + CO_3^{2-} \rightarrow CO_3\bullet^- + Cl^-$	5.0×10^{8} M^{-1} s^{-1} [27]
26	$Cl_2\bullet^- + NH_2Cl \rightarrow NHCl\bullet + H^+ + 2Cl^-$	6.5×10^{6} M^{-1} s^{-1} [18]
27	$Cl_2\bullet^- + H_2O \rightarrow Cl^- + ClOH\bullet^- + H^+$	≤ 100 s^{-1} [20] ≤ 1300 s^{-1} [26]
28	$Cl_2\bullet^- \rightarrow Cl\bullet + Cl^-$	5.7×10^{4} s^{-1} [20] 6.0×10^{4} s^{-1} [28] 1.1×10^{5} s^{-1} [16]
29	$Cl_2\bullet^- + Cl\bullet \rightarrow Cl_2 + Cl^-$	2.1×10^{9} M^{-1} s^{-1} [29]
30	$Cl_2\bullet^- + Cl_2\bullet^- \rightarrow 2Cl^- + Cl_2$	9.0×10^{8} M^{-1} s^{-1} [28] 3.5×10^{9} M^{-1} s^{-1} [20]
31	$CO_3\bullet^- + H_2O_2 \rightarrow HO_2\bullet + HCO_3^-$	4.3×10^{5} M^{-1} s^{-1} [30]
32	$ClOH\bullet^- \rightarrow Cl^- + \bullet OH$	6.0×10^{9} s^{-1} [20]
33	$ClOH\bullet^- \rightarrow Cl\bullet + OH^-$	23 s^{-1} [16]
34	$ClOH\bullet^- + Cl^- \rightarrow OH^- + Cl_2\bullet^-$	1.0×10^{4} M^{-1} s^{-1} [31]
35	$ClOH\bullet^- + H^+ \rightarrow Cl\bullet + H_2O$	2.1×10^{10} M^{-1} s^{-1} [16] 2.4×10^{10} M^{-1} s^{-1} [20] 2.6×10^{10} M^{-1} s^{-1} [25] 5.0×10^{10} M^{-1} s^{-1} [23]
36	$ClO\bullet + ClO\bullet \rightarrow Cl_2O_2$	2.5×10^{9} M^{-1} s^{-1} [19] 7.5×10^{9} M^{-1} s^{-1} [32]
37	$\bullet OH + ClO_2^- \rightarrow ClO_2\bullet + OH^-$	6.3×10^{9} $M^{-1}s^{-1}$ [32] 7.0×10^{9} $M^{-1}s^{-1}$ [33]
38	$\bullet OH + ClO_2\bullet \rightarrow ClO_3^- + H^+$	4.0×10^{9} $M^{-1}s^{-1}$ [19]
39	$\bullet Cl + ClO_2\bullet \rightarrow Cl_2O_2$	1.0×10^{9} $M^{-1}s^{-1}$ [34] 4.0×10^{9} $M^{-1}s^{-1}$ [7]
40	$Cl_2\bullet^- + ClO_2\bullet \rightarrow Cl_2O_2 + Cl^-$	1.0×10^{9} $M^{-1}s^{-1}$ [34]
41	$ClO\bullet + ClO_2\bullet \rightarrow Cl_2O_3$	1.4×10^{9} $M^{-1}s^{-1}$ [35]
42	$Cl_2\bullet^- + ClO_2^- \rightarrow ClO_2\bullet + 2Cl^-$	1.3×10^{9} M^{-1} s^{-1} [11]
43	$ClO\bullet + ClO_2^- \rightarrow OCl^- + ClO_2\bullet$	9.4×10^{8} M^{-1} s^{-1} [36]
44	$Cl_2O_2 + ClO_2^- + Cl^- \rightarrow 2ClO_2\bullet + 2Cl^-$	8.4×10^{9} M^{-2} s^{-1} [37]
45	$Cl_2O_2 + ClO_2^- + H_2O \rightarrow ClO_3^- + 2HOCl$	1.2×10^{4} M^{-1} s^{-1} [38] 5.3×10^{5} M^{-1} s^{-1} [37]
46	$ClO_2^- + HOCl + H^+ \rightarrow Cl_2O_2 + H_2O$	1.12×10^{6} M^{-2} s^{-1} [39]

47	$ClO_2^- + HOCl + Cl^- \rightarrow ClO_3^- + 2Cl^- + H^+$	180 M^{-2} s^{-1} [38]
48	$Cl_2O_2 \rightarrow 2ClO\bullet$	$k_{45}/(1.3\times10^5)/1.93/0.034$ s^{-1} [32]
49	$NH_2\bullet + O_2 \rightarrow NH_2O_2\bullet$	1.0×10^7 M^{-1} s^{-1} [40] 1.2×10^8 M^{-1} s^{-1} [41] 3.0×10^8 M^{-1} s^{-1} [42] 1.1×10^9 M^{-1} s^{-1} [43] 1.2×10^9 M^{-1} s^{-1} [44]
50	$NH_2O_2\bullet \rightarrow NO\bullet + H_2O$	1.0×10^8 s^{-1} [9]
51	$NH_2O_2\bullet \rightarrow$ transient species $\rightarrow N_2O$	5.98×10^8 s^{-1} [9]
52	$NO\bullet + O_2 \rightarrow ONOO\bullet$	50–3000 M^{-1} s^{-1} [45] 1×10^6 M^{-1} s^{-1} [46]
53	$ONOO\bullet + NO\bullet \rightarrow 2NO_2\bullet$	5.8×10^5 M^{-1} s^{-1} [46] 1.0×10^9 M^{-1} s^{-1} [45]
54	$ONOO\bullet \rightarrow NO\bullet + O_2$	6500 s^{-1} [45] 2.0×10^5 s^{-1} [46]
55	$NO\bullet + \bullet OH \rightarrow HNO_2$	1.0×10^{10} M^{-1} s^{-1} [47] 2.0×10^{10} M^{-1} s^{-1} [48]
56	$NO\bullet + NO_2\bullet \rightarrow N_2O_3$	1.1×10^9 M^{-1} s^{-1} [49]
57	$NO_2\bullet + NO_2\bullet \rightarrow N_2O_4$	4.5×10^8 M^{-1} s^{-1} [50]
58	$N_2O_3 \rightarrow NO\bullet + NO_2\bullet$	2.2×10^4 s^{-1} [51] 8.0×10^4 s^{-1} [49] 4.3×10^6 s^{-1} [52]
59	$N_2O_3 + H_2O \rightarrow 2NO_2^- + 2H^+$	530 s^{-1} [49] 1600 s^{-1} [53] 2000 s^{-1} [51]
60	$N_2O_4 \rightarrow 2NO_2\bullet$	6900 s^{-1} [50]
61	$N_2O_4 + H_2O \rightarrow NO_2^- + NO_3^- + 2H^+$	300 s^{-1} [51] 1000 s^{-1} [50]
62	$2HNO \rightarrow [HONNOH] \rightarrow N_2O + H_2O$	8.0×10^6 M^{-1} s^{-1} [54]
63	$HNO + O_2 \rightarrow ONOOH$	3.8×10^2 M^{-1} s^{-1} [55] 3.0×10^3 M^{-1} s^{-1} [56] 1.8×10^4 M^{-1} s^{-1} [57]
64	$H^+ + NH_2Cl + NO_2^- \rightarrow NH_3 + NO_2Cl$	7.6×10^6 M^{-2} s^{-1} [58] 1.2×10^7 M^{-2} s^{-1} [59]
65	$NO_2Cl + NO_2^- \rightarrow N_2O_4 + Cl^-$	8000 M^{-1} s^{-1} [60]
66	$NO_2Cl + H_2O \rightarrow NO_3^- + Cl^- + 2H^+$	4.8 s^{-1} [60]
67	$ONOOH \rightarrow NO_2\bullet + \bullet OH$	0.232 s^{-1} [61] 0.35 s^{-1} [62]
68	$ONOOH \rightarrow NO_3^- + H^+$	0.568 s^{-1} [61] 0.90 s^{-1} [62] 1.15 s^{-1} [63]
69	$ONOO^- \rightarrow O_2\bullet^- + NO\bullet$	0.02 s^{-1} [64]
70	$ONOO^- \rightarrow NO_3^-$	8.0×10^{-6} s^{-1} [62]

71	$O_2\bullet^- + HO_2\bullet \rightarrow HO_2^- + O_2$	$9.7 \times 10^7\ M^{-1}\ s^{-1}$ [65]
72	$HO_2\bullet + H_2O_2 \rightarrow \bullet OH + H_2O + O_2$	$3.0\ M^{-1}\ s^{-1}$ [15]
73	$O_2\bullet^- + H_2O_2 \rightarrow \bullet OH + OH^- + O_2$	$0.13\ M^{-1}\ s^{-1}$ [15]
74	$HOCl + NH_3 \rightarrow NH_2Cl + H_2O$	$4.2 \times 10^6\ M^{-1}\ s^{-1}$ [66]
75	$HOCl + NH_2Cl \rightarrow NHCl_2 + H_2O$	$280\ M^{-1}\ s^{-1}$ [66]
76	$HOCl + NHCl_2 + OH^- \rightarrow NCl_3 + OH^- + H_2O$	$3.3 \times 10^9\ M^{-2}\ s^{-1}$ [67]
77	$HOCl + NHCl_2 + OCl^- \rightarrow NCl_3 + OH^- + HOCl$	$1.0 \times 10^5\ M^{-2}\ s^{-1}$ [67]
78	$NH_2Cl + H_2O \rightarrow HOCl + NH_3$	$2.1 \times 10^{-5}\ s^{-1}$ [66]
79	$NHCl_2 + H_2O \rightarrow HOCl + NH_2Cl$	$6.5 \times 10^{-7}\ s^{-1}$ [68]
80	$NCl_3 + H_2O \rightarrow HOCl + NHCl_2$	$3.2 \times 10^{-5}\ s^{-1}$ [68]
81	$NH_2Cl + NH_2Cl + H^+ \rightarrow NHCl_2 + NH_4^+$	$6944\ M^{-2}\ s^{-1}$ [69]
82	$NH_2Cl + NH_2Cl + H_2CO_3 \rightarrow NHCl_2 + NH_4^+ + HCO_3^-$	$11\ M^{-2}\ s^{-1}$ [69]
83	$NH_2Cl + NH_2Cl + HCO_3^- \rightarrow NHCl_2 + NH_3 + HCO_3^-$	$0.22\ M^{-2}\ s^{-1}$ [69]
84	$NH_2Cl + NHCl_2 \rightarrow N_2 + 3H^+ + 3Cl^-$ (assumed products)	$0.015\ M^{-1}\ s^{-1}$ [70]
85	$NHCl_2 + NH_3 + H^+ \rightarrow NH_2Cl + NH_2Cl + H^+$	$6.0 \times 10^4\ M^{-2}\ s^{-1}$ [67]
86	$NHCl_2 + OH^- \rightarrow$ I + products	$110\ M^{-1}\ s^{-1}$ [71]
87	I + $NHCl_2 \rightarrow HOCl$ + products	$2.8 \times 10^4\ M^{-1}\ s^{-1}$ [72]
88	I + $NH_2Cl \rightarrow$ products	$8.3 \times 10^3\ M^{-1}\ s^{-1}$ [72]
89	$NH_2Cl + NCl_3 + OH^- \rightarrow HOCl$ + products	$1.4 \times 10^9\ M^{-2}\ s^{-1}$ [70]
90	$NHCl_2 + NCl_3 + OH^- \rightarrow 2HOCl$ + products	$5.6 \times 10^{10}\ M^{-2}\ s^{-1}$ [70]
91	$H_2O_2 + NH_2Cl \rightarrow$ products	$0.0276\ M^{-1}\ s^{-1}$ (24.6 °C) [73]
92	$HOCl + NO_2^- \rightarrow NO_2Cl + OH^-$	$7.4 \times 10^3\ M^{-1}\ s^{-1}$ [74] $4.4 \times 10^4\ M^{-1}\ s^{-1}$ [58]
93	$H_2O_2 + HOCl \rightarrow Cl^- + H_2O + O_2 + H^+$	$1.1 \times 10^4\ M^{-1}\ s^{-1}$ [13]
94	$H_2O_2 + OCl^- \rightarrow Cl^- + H_2O + O_2$	$1.7 \times 10^5\ M^{-1}\ s^{-1}$ [13]
95	$\bullet OH$ + 1,4−dioxane →	$2.8 \times 10^9\ M^{-1}\ s^{-1}$ [15] $3.1 \times 10^9\ M^{-1}\ s^{-1}$ [75]
96	$Cl\bullet$ + 1,4−dioxane →	$4.4 \times 10^6\ M^{-1}\ s^{-1}$ [76] $2.8–3.4 \times 10^9\ M^{-1}\ s^{-1}$ [77]
97	$Cl_2\bullet^-$ + 1,4−dioxane →	$3.3 \times 10^6\ M^{-1}\ s^{-1}$ [76]
98	$HOCl \leftrightarrow OCl^-$ $OCl^- + H^+ \rightarrow HOCl$ $HOCl \rightarrow OCl^- + H^+$	pKa=7.5 [78] $5.0 \times 10^{10}\ M^{-1}\ s^{-1}$ $1.58 \times 10^3\ s^{-1}$
99	$H_2CO_3 \leftrightarrow HCO_3^- \leftrightarrow CO_3^{2-}$ $HCO_3^- + H^+ \rightarrow H_2CO_3$ $H_2CO_3 \rightarrow H^+ + HCO_3^-$ $CO_3^{2-} + H^+ \rightarrow HCO_3^-$	pKa_1=6.3 & pKa_2=10.3 [79] $1.0 \times 10^{10}\ M^{-1}\ s^{-1}$ $5.0 \times 10^3\ s^{-1}$ $5.0 \times 10^{10}\ M^{-1}\ s^{-1}$

	$HCO_3^- \rightarrow CO_3^{2-} + H^+$	$2.5\ s^{-1}$
100	$HO_2\bullet \leftrightarrow O_2\bullet^-$ $O_2\bullet^- + H^+ \rightarrow HO_2\bullet$ $HO_2\bullet \rightarrow O_2\bullet^- + H^+$	pKa= 4.8 [65] $5.0 \times 10^{10}\ M^{-1}\ s^{-1}$ $7.9 \times 10^{5}\ s^{-1}$
101	$ONOOH \leftrightarrow ONOO^-$ $ONOO^- + H^+ \rightarrow ONOOH$ $ONOOH \rightarrow ONOO^- + H^+$	pKa= 6.6 [62] $5.0 \times 10^{10}\ M^{-1}\ s^{-1}$ $1.26 \times 10^{4}\ s^{-1}$
102	NDMA+ *hv* →	$\varepsilon = 1650\ M^{-1}\ cm^{-1}$ [80] $\Phi = 0.28$ [80]

Section S1. 1,4-Dioxane analysis

A Gas Chromatograph (7890A, Agilent Technologies) equipped with triple-axis detector (5975C, VL MSD, Agilent Technologies) and autosampler (GC sampler 80, Agilent Technologies) was used to analyze 1,4-dioxane. An automated solid-phase microextraction (SPME) unit is connected to the GC-MS autosampler for 1,4-dioxane extraction from the sample using a method developed in-house. A ZB-WAXPlus (30 m×0.25 mm×0.5 μm) GC column was used with a temperature program (37 °C for 5 min → 85 °C at 10 °C min^{-1} → 200 °C for 1.6 min) and helium as a carrier gas (1 mL min^{-1}). The MS source, MS Quad, and transfer line temperatures were maintained at 230, 150, and 280 °C, respectively. The instrument was used in the electron impact ionization mode (electron energy of 70 eV at 230 °C).

Section S2. The photolysis rate and reactive radical formation rate from oxidants.

The direct photolysis rate of a specific compound M can be calculated using the fundamental expression of photolysis rate constant shown in equation S1[81]:

$$k_{d,M}^{'} = \frac{\varepsilon_M \times \Phi_M \times \ln(10)}{U_{254}} \qquad \text{(S1)}$$

where ε_M is the molar absorption coefficient at 254 nm (M^{-1} cm^{-1}), Φ_M is the quantum yield (mol einstein^{-1}; dimensionless parameter), and $U_{253.7}$ is the molar photon energy (J einstein^{-1}) at 253.7 nm. The •OH and Cl• radicals are the primary radical species responsible for 1,4-dioxane treatment in the UV/HOCl and UV/H_2O_2 AOPs in the presence of chloramines. In this study, NH_2• and NHCl• are not considered as reactive radical species toward 1,4-dioxane. The radical generation rates were calculated according to the reactive radical formation yield from each oxidant. Table S2 lists the photochemical properties of oxidants.

Table S2. Photochemical properties of oxidants

	Molar absorption coefficient, ε M^{-1} cm^{-1}	Quantum yield, Φ	Direct photolysis rate constant, k_d' (cm^2 mJ^{-1})	Reactive radical generation rate, constant $k_{radical}'$ (cm^2 mJ^{-1})
NH_2Cl	371 [1]	0.296 [2]	5.33×10^{-4}	5.33×10^{-4}
$NHCl_2$	126 [1]	0.82 [1]	5.05×10^{-4}	5.05×10^{-4}
HOCl	58 [2]	0.55 [3]	1.56×10^{-4}	3.12×10^{-4}
H_2O_2	19.6 [4]	0.5 [4]	0.48×10^{-4}	0.96×10^{-4}

Section S3. Bench-scale tests using a closed-loop recirculation UV reactor

A bench-scale UV system (UVMax™ D4 reactor, Viqua, Canada) equipped with one 43W-low-pressure Hg-vapor arc lamp was used to treat water sample volumes up to 8L in a recirculation mode. The lamp emits primarily the 253.7 nm wavelength and the average UV fluence rate in milliQ water was determined as 5.5±0.1 mW cm^{-2} using very low concentrations (μM) of either sulfamethoxazole or H_2O_2 as chemical probes.

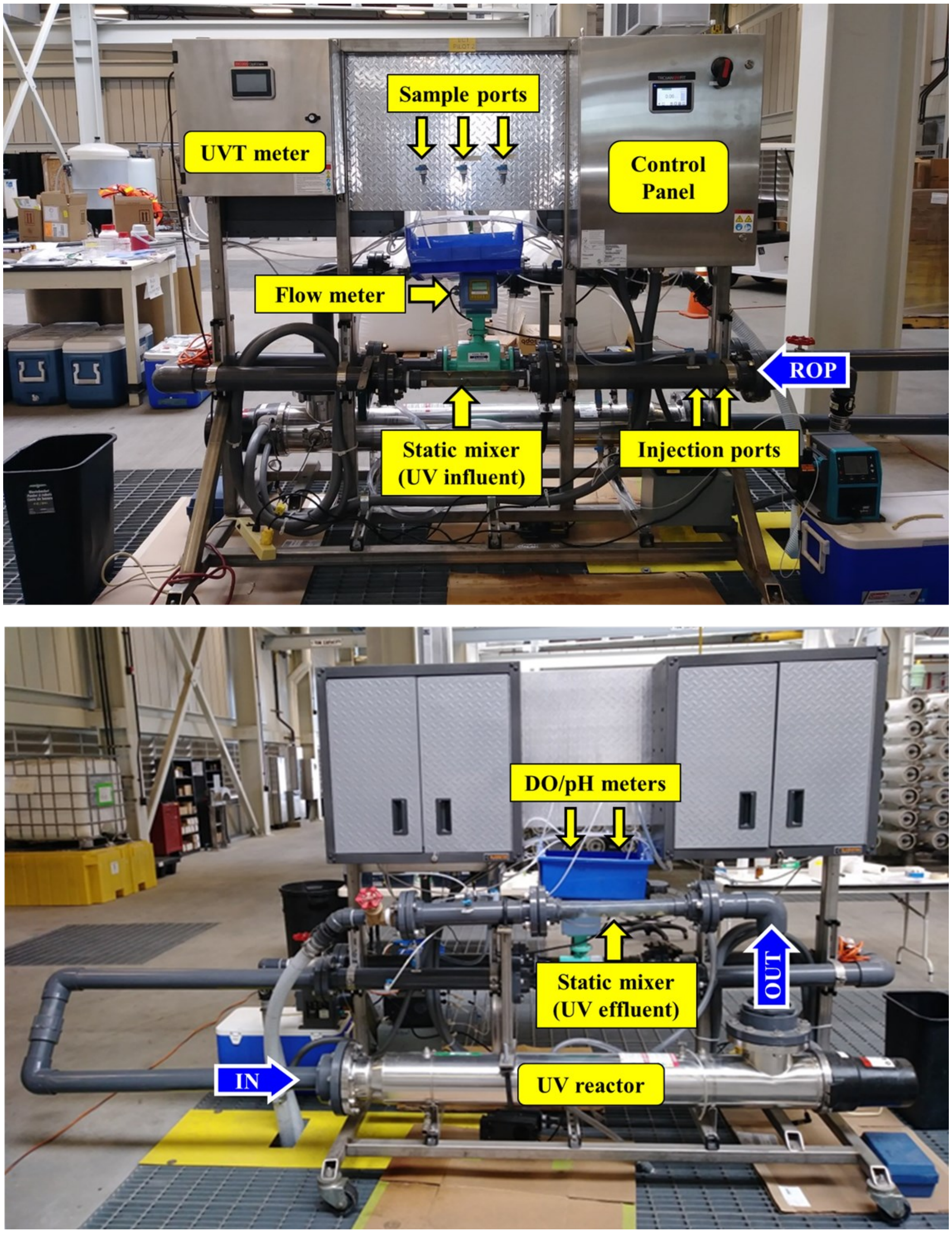

Figure S1. The pilot system comprising a TrojanUVPhox™08AL20 reactor, a flow meter, injection ports, static mixers, sample ports, online UV effluent transmittance instrument, and real-time pH and DO meters.

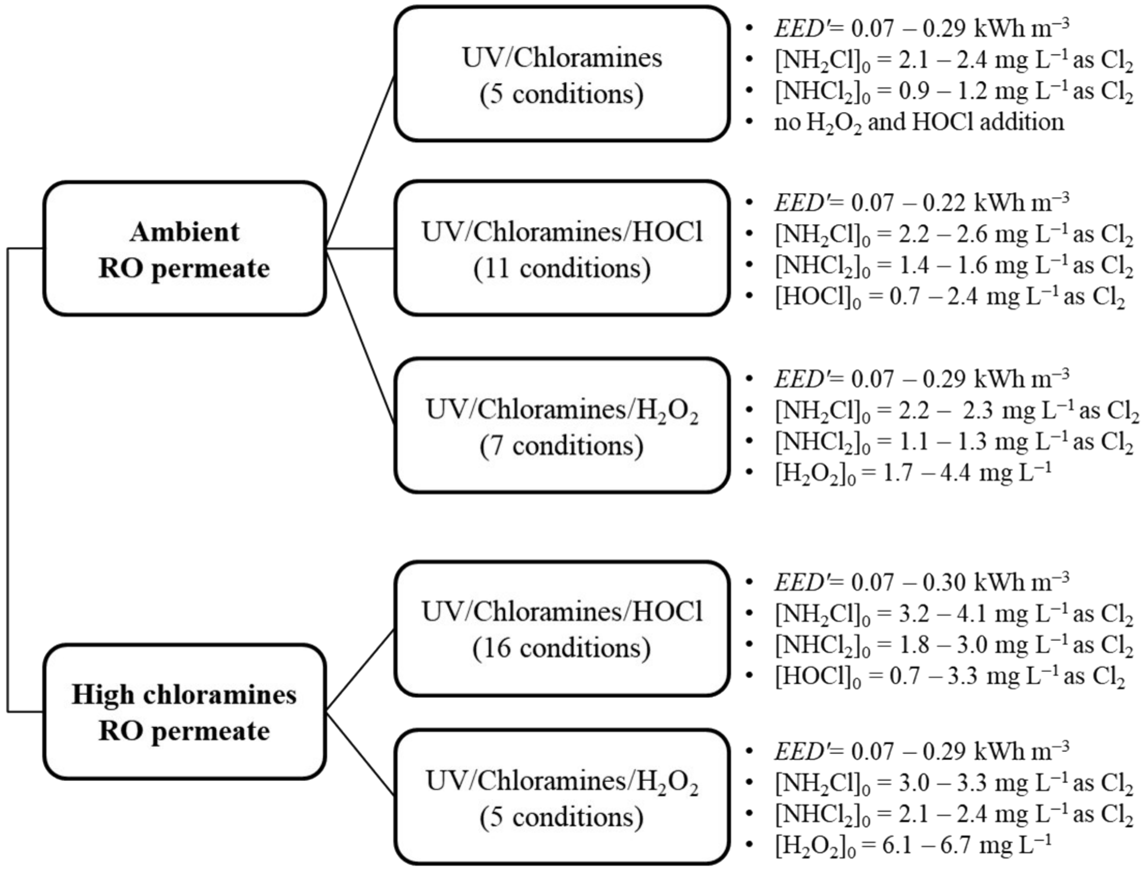

Figure S2. Pilot test description including the electrical energy dose (*EED′*) corrected for the lamp efficiency at the operating %BPL, RO permeate quality, and oxidant concentrations.

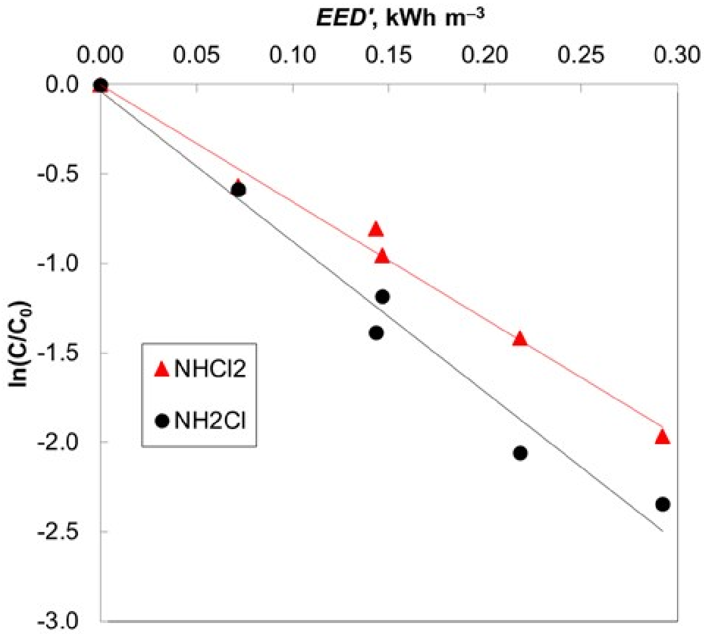

Figure S3. Photodegradation of chloramines in RO permeate at ambient quality conditions. $[NH_2Cl]_0$= 2.1–2.4 mg L^{-1} as Cl_2; $[NHCl_2]_0$= 0.9–1.2 mg L^{-1} as Cl_2; pH 5.1–5.3; 97.1−97.5% *T*.

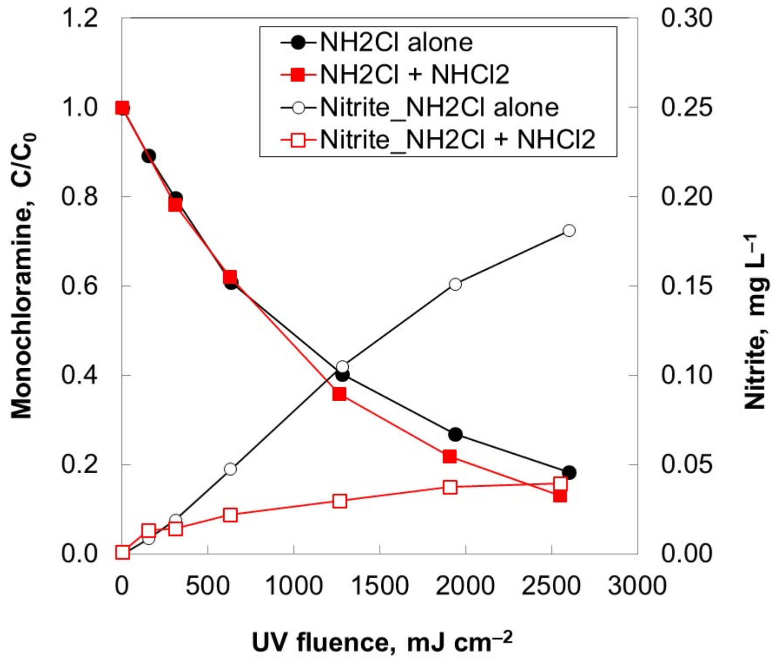

Figure S4. Formation of NO_2^- from photodegradation of NH_2Cl in the presence and the absence of $NHCl_2$ in the bench-scale tests: $[NH_2Cl]_0$ =0.9−1.1 mg L^{-1} as Cl_2; $[NHCl_2]_0$= 2.2 mg L^{-1} as Cl_2; E_0= 5.5±0.1 mW cm^{-2}; pH 5.5 (phosphate buffer).

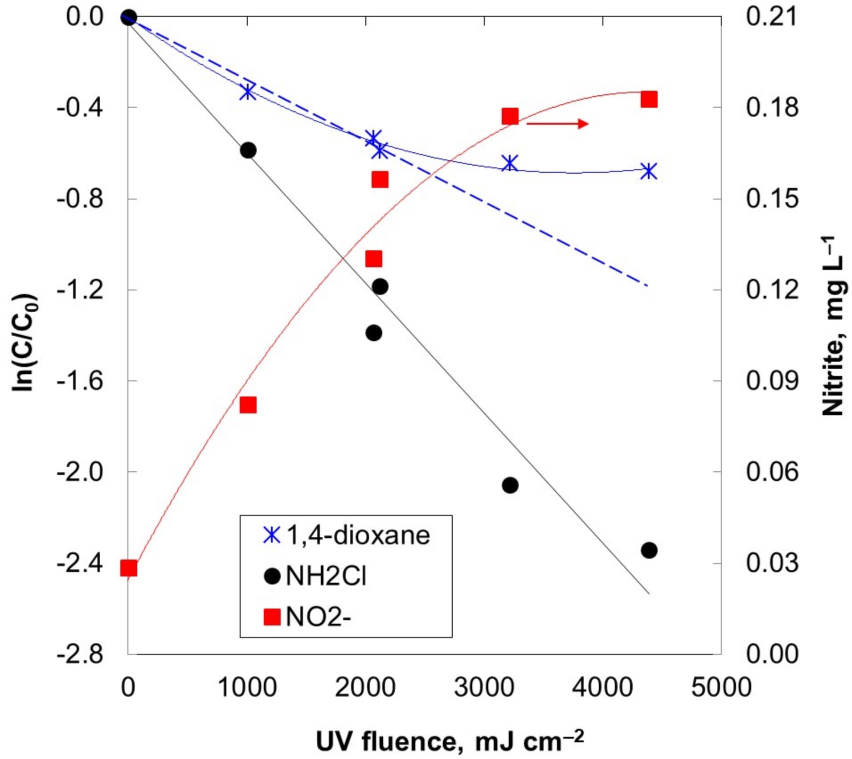

Figure S5. The degradation of NH_2Cl and 1,4-dioxane and NO_2^- formation in the UV/chloramine process at OCWD with RO permeate at ambient chloramine concentrations. $[NH_2Cl]_0$= 2.1–2.4 mg L^{-1} as Cl_2, $[NHCl_2]_0$= 0.9–1.2 mg L^{-1} as Cl_2, $[1,4\text{-dioxane}]_0$= 0.19 mg L^{-1}, pH 5.1–5.3, and 97.1−97.5% *T*. The symbols represent the experimental data; the black line is the regression line for the *pseudo*-first-order kinetics of NH_2Cl decay; the solid blue and red lines represent best fits for 1,4-dioxane and NO_2^- experimental data, respectively; the blue dashed line indicates the trend for a *pseudo*-first order kinetics of 1,4-dioxane decay.

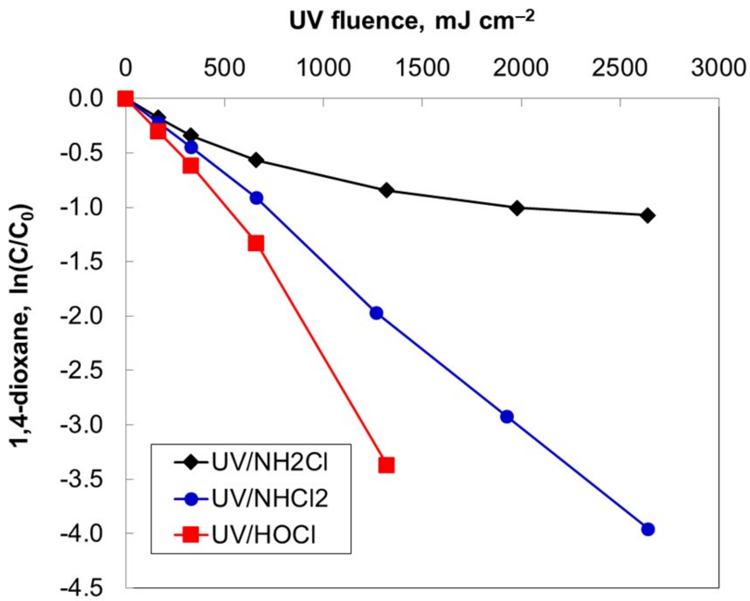

Figure S6. Degradation of 1,4-dioxane with the UV/NH_2Cl, UV/$NHCl_2$, and UV/HOCl processes in milliQ water using the bench-scale UV reactor. Test conditions: $[\text{oxidant}]_0$= 0.05 mmol L^{-1}; $[\text{1,4-dioxane}]_0$ = 0.048±0.005 mg L^{-1}; E_0= 5.5±0.1 mW cm^{-2}; pH 5.5.

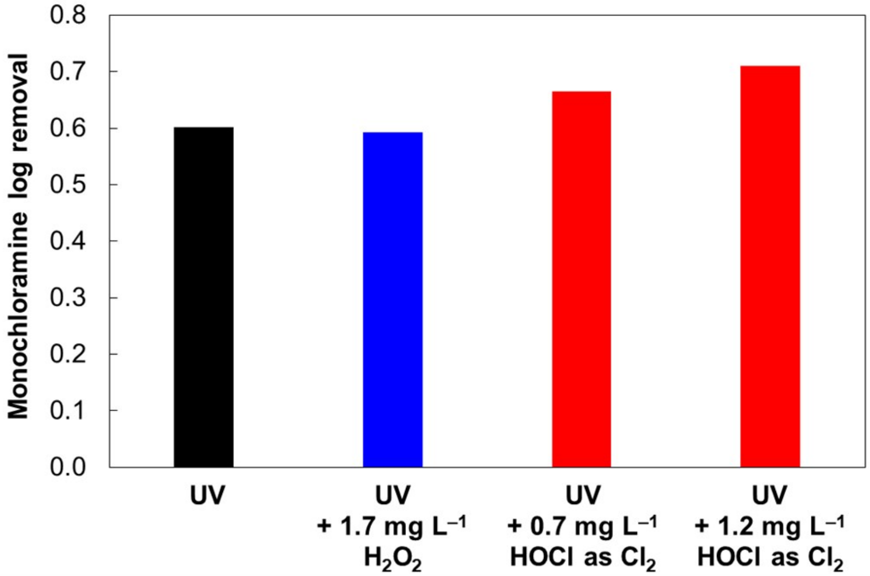

Figure S7. The log-removal of NH_2Cl in UV/chloramine, UV/chloramine/H_2O_2, and UV/chloramine/HOCl processes at *EED′*= 0.145 kWh m^{-3} RO permeate at ambient chloramine concentrations: $[NH_2Cl]_0$= 2.2 mg L^{-1} as Cl_2 (UV/chloramine and UV/chloramine/H_2O_2); $[NH_2Cl]_0$=2.5 mg L^{-1} as Cl_2 (UV/chloramine/HOCl).

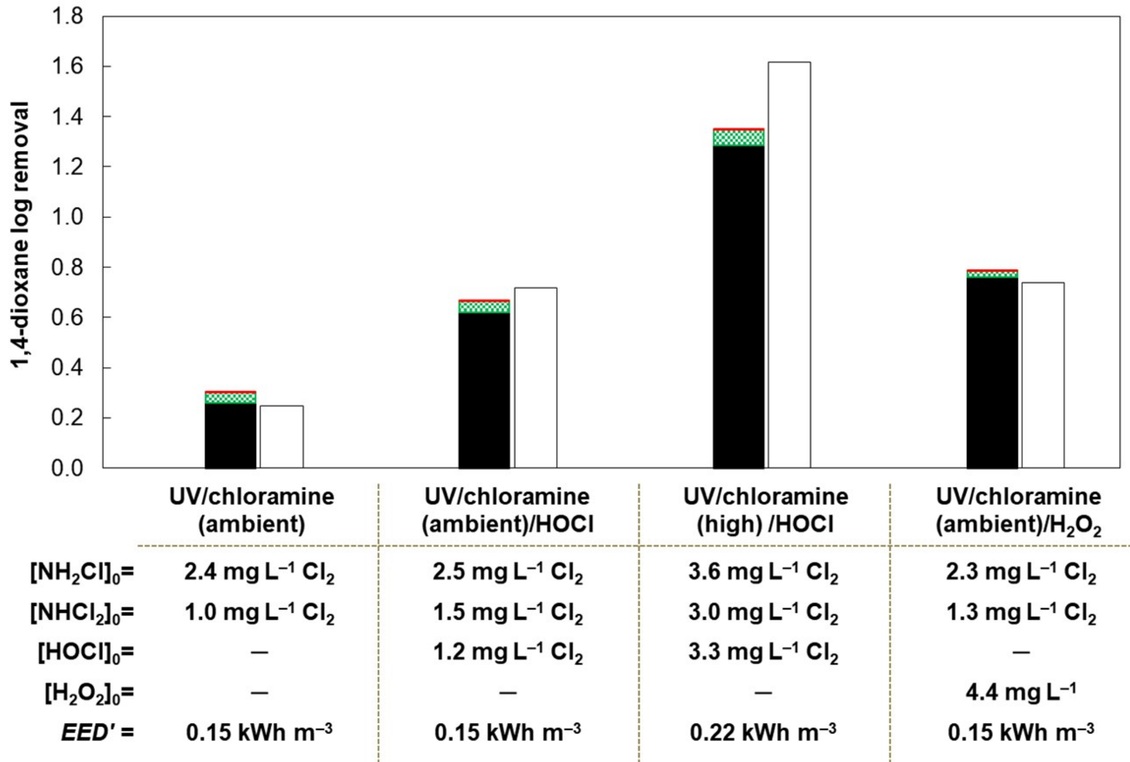

Figure S8. Contribution of radical species to 1,4-dioxane log-removal in the UV/chloramine and UV/chloramine/H_2O_2 processes at ambient chloramine condition, and in the UV/chloramine/HOCl process at both ambient and high chloramine conditions. Experimental data (empty bars) *vs*. model-predicted data (solid bars); radical contributions: •OH (black); Cl• (green); Cl_2•$^-$ (red).

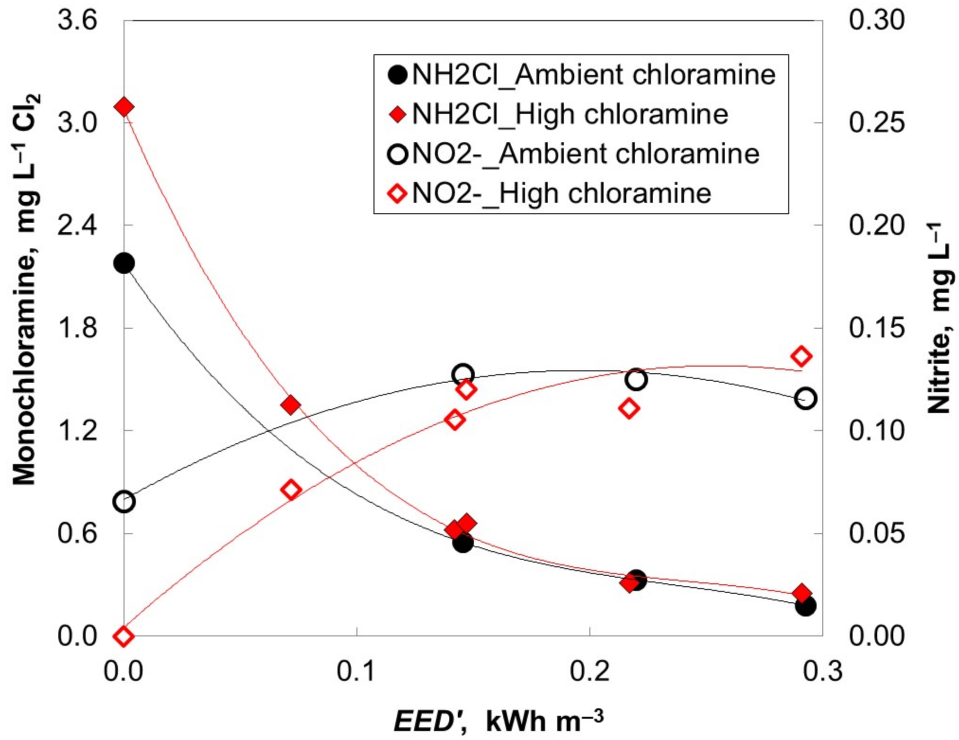

Figure S9. Chloramine decay and nitrite formation in the UV/chloramine/H_2O_2 process during the pilot tests with the RO permeate at ambient and high chloramine concentrations. Conditions: $[H_2O_2]_0$= 1.7 mg L^{-1} and 97.1% *T* (ambient chloramine levels); $[H_2O_2]_0$=6.1−6.7 mg L^{-1} and 95.7% *T* (high chloramine levels); pH 5.0–5.3.

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