Supporting Information

Rapid Defluorination of 22 Per - and Polyfluoroalkyl Substances in Water Using Sulfite Irradiated by Medium-Pressure UV

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Table S1. Details on PFAS analytes

PFAS	Acronym	CAS #	Assay (%)	Supplier
Perfluorocarboxylic Acids (PFCAs)				
Pentafluoropropionic acid	PFPrA	422-64-0	97	Sigma Aldrich
Perfluorobutyric acid	PFBA	375-22-4	98	Sigma Aldrich
Perfluoropentanoic acid	PFPeA	2706-90-3	97	Sigma Aldrich
Perfluoroheptanoic acid	PFHpA	375-85-9	99	Sigma Aldrich
Perfluorooctanoic acid	PFOA	335-67-1	95	Sigma Aldrich
Perfluorononanoic acid	PFNA	375-95-1	97	Sigma Aldrich
Perfluorodecanoic acid	PFDA	335-76-2	98	Sigma Aldrich
Perfluoroundecanoic acid	PFUdA	2058-94-8	95	Sigma Aldrich
Perfluorododecanoic acid	PFDoA	307-55-1	95	Sigma Aldrich
Perfluorotridecanoic acid	PFTrDA	72629-94-8	97	Sigma Aldrich
Perfluorotetradecanoic acid	PFTeDA	376-06-7	96	Sigma Aldrich
Fluorotelomer Alcohols (FTOHs)				
H,1H,2H,2H-Perfluoro-1-hexanol	4:2 FTOH	2043-47-2	97	Sigma Aldrich
1H,1H,2H,2H-Perfluoro-1-octanol	6:2 FTOH	647-42-7	97	Sigma Aldrich
1H,1H,2H,2H-Perfluoro-1-decanol	8:2 FTOH	678-39-7	97	Sigma Aldrich
Perfluorosulfonic Acids (PFSAs)				
Perfluorooctanesulfonic acid	PFOS	2795-39-3	98	Alfa-Aesar
Perfluorohexanesulfonic acid	PFHxS	355-46-4	97	Sigma Aldrich
Iodinated PFASs				
Perfluorohexyl iodide	PFHxI	355-43-1	99	Sigma Aldrich
Tridecafluoro-1-iodooct-1-ene	TFIE	150223-14-6	100	SynQuest Laboratories
1H,1H,2H,2H-Perfluorooctyl iodide	6:2 FTI	2043-57-4	96	SynQuest Laboratories
Other PFASs				
1H,1H,2H,2H-Perfluorodecyle acrylate	8:2 FTAC	27905-45-9	97	SynQuest Laboratories
(Perfluorohexyl)ethylene	6:2 FTO	25291-17-2	99	Alfa-Aesar
Ammonium perfluoro(2-methyl-3-oxahexanoate)	GenX	62037-80-3	99	SynQuest Laboratories

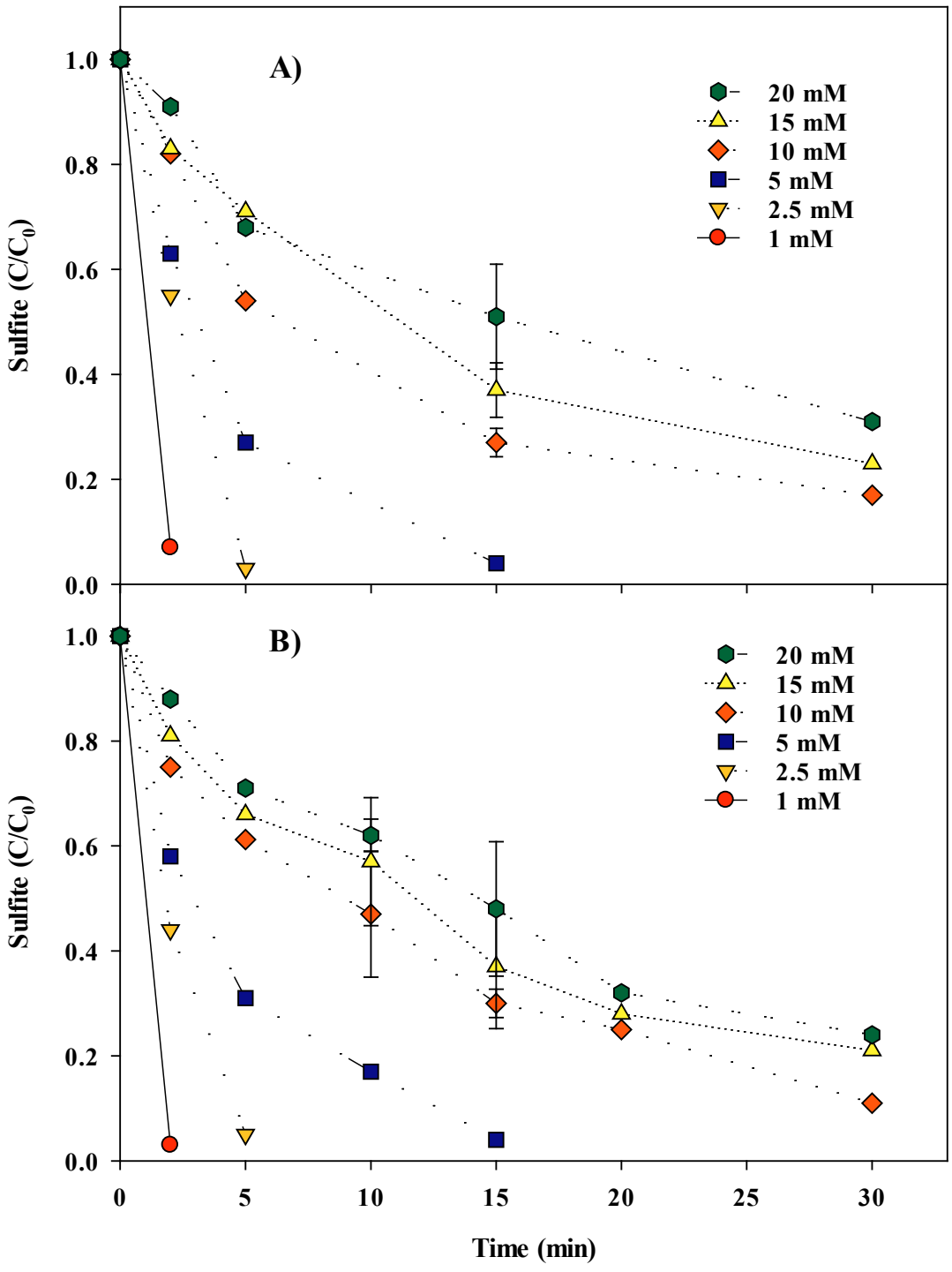

Figure S1. A) Sulfite consumption during PFOS defluorination. **B)** Sulfite consumption during PFOA defluorination. Conditions: Sulfite 1-20 mM, pH 12 ± 0.2, O_2 = ~0.8 mg/L, PFAS = 2 mg/L. Error bars represent the standard deviation of triplicate samples.

Table S2. PFOA and PFOS defluorination under control conditions

PFAS	UV alone pH 2	UV alone pH 7	UV alone pH 9	UV alone pH 12
PFOA	1.3	0.8	3.4± 0.4	2.4
PFOS	3.8 ± 0.1	2 ± 0.2	3.1	1.7
	Sulfite alone pH 2	**Sulfite alone pH 7**	**Sulfite alone pH 9**	**Sulfite alone pH 12**
PFOA	4.4 ± 0.6	1.6 ± 0.6	4.6 ± 0.1	1.8 ± 2.0
PFOS	1.1	1 ± 1	3.9	1.5 ± 0.4

Exposure time = 30 min, PFAS = 2 mg/L, Sulfite concentration = 10 mM, O_2 = 0.4 mg/L

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Table S3. PFAS defluorination under control conditions

PFAS	Solvent	UV alone (%)	Sulfite alone (%)
PFPrA	H_2O	3.8 ± 0.4	1.2 ± 0.4
PFBA	H_2O	4.0 ± 0.1	0.1 ± 0.05
PFPeA	H_2O	3.1 ± 0.3	2.0 ± 0.2
PFHpA	H_2O	2.4 ± 0.1	1.8 ± 0.1
PFOA	H_2O	1.6 ± 0.2	0.9 ± 0.1
PFNA	H_2O	0.3 ± 0.06	1.1 ± 0.7
PFDA	H_2O	2.1 ± 0.4	2.6 ± 0.4
PFUdA	0.2% MeOH	1.2 ± 0.06	1.4 ± 0.6
PFDoA	0.2% MeOH	0.5 ± 0.08	1.0 ± 0.1
PFTrDA	0.2% MeOH	2.2 ± 0.1	0.8 ± 0.6
PFTeDA	0.2% MeOH	3.4 ± 0.4	1.1 ± 0.2
4:2 FTOH	0.2% MeOH	1.4 ± 0.4	0.2 ± 0.07
6:2 FTOH	0.2% MeOH	0.8 ± 0.03	0.4 ± 0.1
8:2 FTOH	0.2% MeOH	0.9 ± 0.08	0.6 ± 0.06
PFOS	H_2O	1.5 ± 0.01	1.0 ± 0.2
PFHxS	H_2O	2.3 ± 0.3	1.0 ± 0.2
PFHxI	0.2% MeOH	4.3 ± 0.1	0.6 ± 0.1
TFIE	0.2% MeOH	1.2 ± 0.5	0.8 ± 0.4
6:2 FTI	0.2% MeOH	1.1 ± 0.1	0.9 ± 0.3
8:2 FTAC	0.2% MeOH	0.8 ± 0.1	0.8 ± 0.2
6:2 FTO	0.2% MeOH	1.2 ± 0.5	0.4 ± 0.1
GenX	H_2O	3.2 ± 0.1	1.0 ± 0.1

Exposure time = 30 min, PFAS = 2 mg/L , Sulfite concentration = 10 mM, O_2 = 6.4 mg/L, pH 12 ± 0.2

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Table S4. Energy distribution of medium pressure UV vapor arc lamps
(Provided by manufacturer: Ace Glass Incorporated)

Wavelength (nm)	Radiated Energy (W)
222.4	3.7
232	1.5
236	2.3
238	2.3
240	1.9
248.2	2.3
253.7	5.8
257.1	1.5
265.2	4
270	1
275.3	0.7
280.4	2.4
289.4	1.6
296.7	4.3
302.5	7.2
313	13.2
334.1	2.4
366	25.6
404.5	11
435.8	20.2
546.1	24.5
578	20
1014	10.5
1128.7	3.3
1367.3	2.6

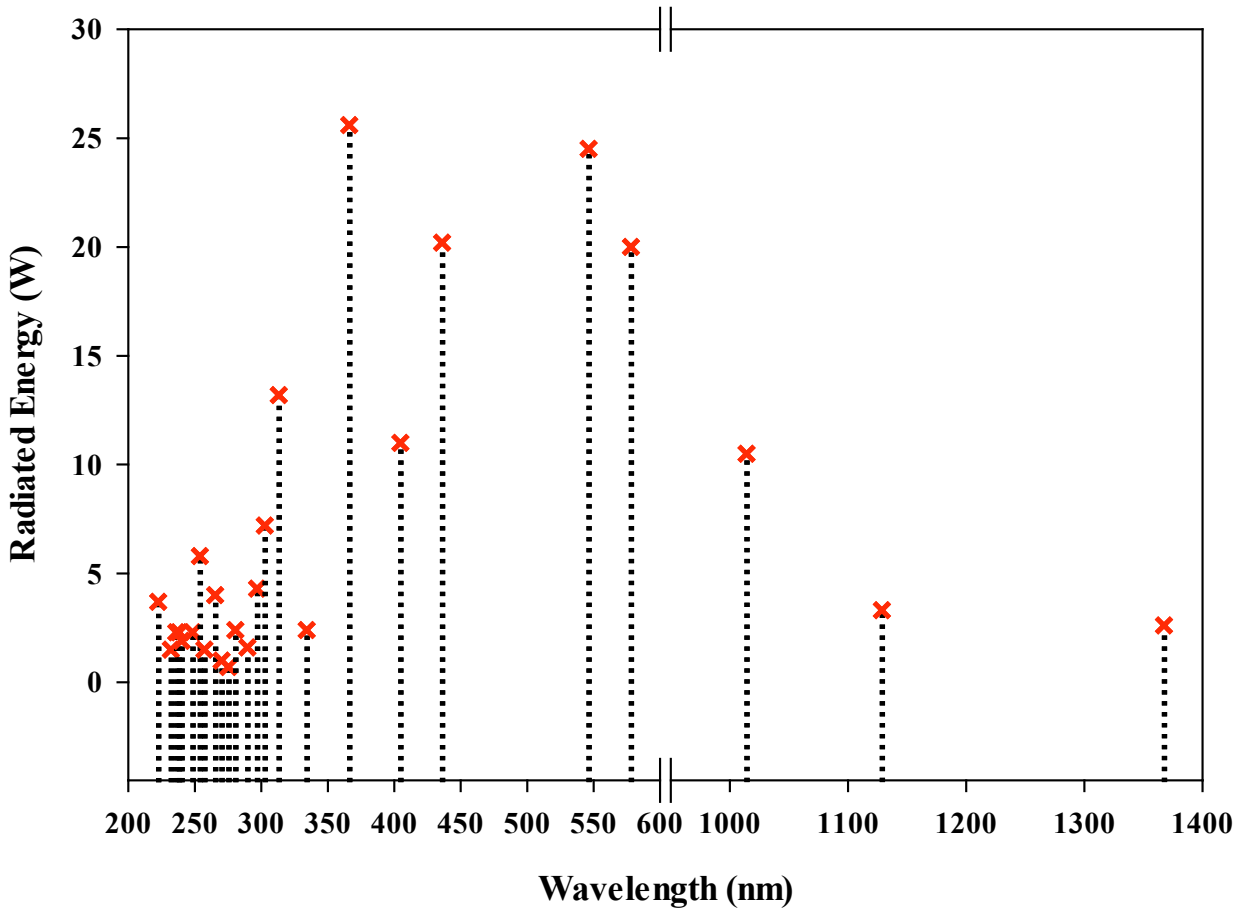

Figure S2. Emission spectrum of 450W medium pressure mercury lamp (manufacturer provided)

Table S5. Uncorrected Total EE/O for PFASs under medium pressure UV/sulfite

PFAS	k_p ($min^{-1} \times 10^{-2}$)	EE/O considering only 254 nm light (kWh m^{-3})	EE/O considering all wavelengths (kWh m^{-3})
PFPrA	8.84 ± 2	168	5094
PFBA	8.85 ± 3	168	5088
PFPeA	7.17 ± 0.6	207	6280
PFHpA	6.23 ± 2	238	7228
PFOA	6.16 ± 0.8	241	7310
PFNA	5.37 ± 0.7	276	8386
PFDA	4.03 ± 2	368	11174
PFUdA	2.33 ± 1	637	19326
PFDoA	0.71 ± 0.05	2091	63423
PFTrDA	0.34 ± 0.05	4367	132442
PFTeDA	0.12 ± 0.01	12373	375253
PFHxS	1.57 ± 0.5	946	28682
PFOS	3.14 ± 1	473	14341
4:2 FTOH	0.57 ± 0.08	2605	79001
6:2 FTOH	0.52 ± 0.04	2855	86597
8:2 FTOH	0.46 ± 0.06	3228	97892
PFHxI	0.45 ± 0.08	3300	100068
TIFE	0.37 ± 0.02	4013	121704
6:2 FTI	0.28 ± 0.04	5303	160823
GenX	16.04 ± 7	93	2807
6:2 FTO	0.25 ± 0.04	5939	180122
8:2 FTAC	0.03 ± 0.007	49493	1501013

In Table S4, we report total energy consumed to achieve the observed PFASs defluorination rates. EE/O was calculated from the center of the MP lamp using Eq. 2 in the main text. Total power of the lamp was the sum of MP radiated energy in Table S3. About 93% of total power of the lamp is not incident to the vial reactor used in this study but is included in the values provided in this table. This was estimated based on the irradiated surface area of the vial (40 cm^2) to the total surface area of ideal cylindrical batch reactor surrounding MP lamp with radius of 3 cm (591 cm^2).

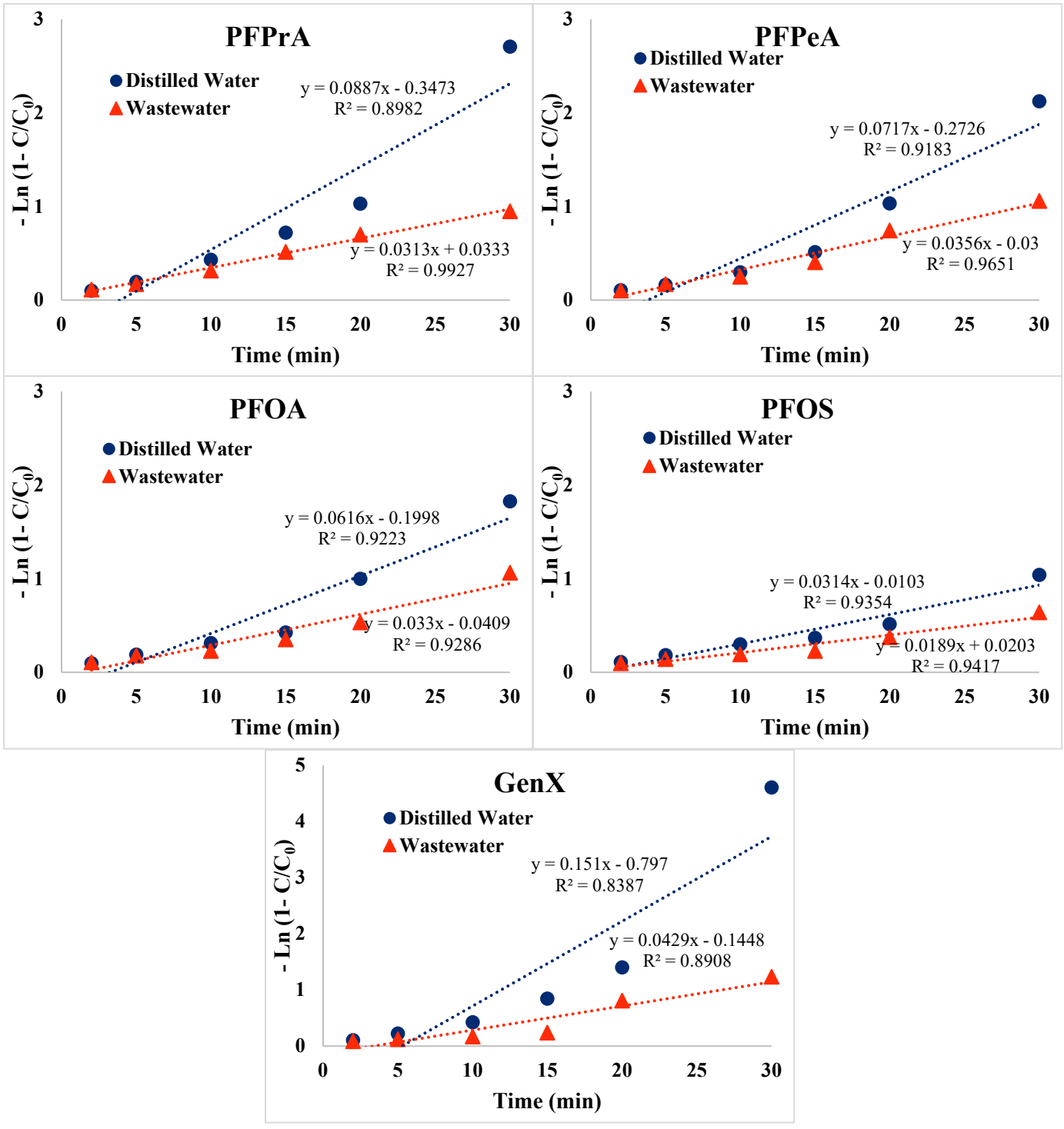

Figure S3. Impact of wastewater matrix on MP UV/sulfite reductive defluorination kinetics of PFPrA, PFPeA, PFOA, PFOS and GenX. Experimental conditions: sulfite 20 mM, pH 12 ± 0.2, O_2 in wastewater = 7.2 mg/L, O_2 in distilled water = 6.1 mg/L, PFAS = 2 mg/L.