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UV. Conditions: $[NaClO]_0$ = $[PDS]_0$ = $[PAA]_0$ = 40 μM, UV fluence rate = 0.145 mW/cm^2, [NB] = 0.5 μM； pH = 7.0 ± 0.2； T = 25 ± 2°C.

Table S1. Primers for the amplification of the *opr* gene.

Target Gene	Sequence	Amplicon length
opr-LF	ATGGAAATGCTGAAATTCGGC	504 bp
opr-LR	CTTCTTCAGCTCGACGCGACG	

Note: "*opr*-LF" and "*opr*-LR" stand for *opr* Long Forward and *opr* Long Reverse primer.

Table S2. Second-order rate constants k (M^{-1} s^{-1}) for probe compounds and free radical species.

	HO•	SO_4•$^-$	Cl•	Cl_2•$^-$
NB[1]	3.9×10^9	$<10^6$	$<10^5$	2.0×10^5
MET[2]	$3.8 (\pm 0.1) \times 10^9$	$8.4 (\pm 0.3) \times 10^9$	-	-

Table S3. UPLC operation conditions for NB.

Parameter name	Parameter condition
mobile phase	methanol /water（65% / 35%）
UV detector set	270 nm
flow rate	1 mL/min
analysis time	10 min
injection volume	100 μL
column temperature	40°C

Table S4. UPLC operation conditions for MET.

Parameter name	Parameter condition
mobile phase	methanol /water（20% / 80%）
UV detector set	320 nm
flow rate	0.8 mL/min
analysis time	15 min
injection volume	100 μL
column temperature	40°C

Table S5. The disinfection effect of different disinfection methods on different pathogenic bacteria.

Process	Pathogenic Bacteria	Oxidant Concentration	Inactivation rate constant	Reactivation	Ref.
Chlorination	tetracycline-resistant bacteria	[NaClO] =7 μM [NaClO] =14 μM [NaClO] =28 μM	1.53 1.69 1.73	not mentioned	[3]
UV_{254}	tetracycline-resistant bacteria	UV fluence rate = 3.59 mW/cm^2 UV fluence rate = 6.22 mW/cm^2 UV fluence rate = 9.03 mW /cm^2	0.42 0.6 1.01	not mentioned	[3]
UV/ NaClO	tetracycline-resistant bacteria	UV fluence rate = 9.03 mW/cm^2 [NaClO] =28 μM	2.10	not mentioned	[3]
Chlorination	amoxicillin-resistant bacteria	[NaClO] =7 μM [NaClO] =14 μM [NaClO] = 28 μM	1.36 1.97 2.03	not mentioned	[3]
UV_{254}	amoxicillin-resistant bacteria	UV fluence rate = 3.59 mW/cm^2 UV fluence rate = 6.22 mW/cm^2 UV fluence rate = 9.03 mW/cm^2	0.62 0.85 0.89	not mentioned	[3]
UV/ NaClO	amoxicillin-resistant bacteria	UV fluence rate = 9.03 mW/cm^2 [NaClO] =28 μM	1.91	not mentioned	[3]
UV_{254}	*Pseudomonas aeruginosa*	UV fluence rate = 0.2 mW/cm^2	not mentioned	24 h	[4]
NaClO	*Pseudomonas aeruginosa*	[NaClO] =14 μM	not mentioned	24 h	[4]
UV/ NaClO	*Pseudomonas aeruginosa*	UV fluence rate = 0.2 mW/cm^2 [NaClO] =14 μM	not mentioned	216 h	[4]
UV_{254}	*Escherichia coli*	UV fluence rate = 0.99 mW/cm^2	0.811	not mentioned	[5]

UV_{254}	*Pseudomonas aeruginosa*	UV fluence rate = 0.99 mW/cm^2	0.448	not mentioned	[5]
UV_{254}	*L.pneumophila*	UV fluence rate = 0.99 mW/cm^2	0.662	not mentioned	[5]
UV_{254}	*Bacteriophage*	UV fluence rate = 0.99 mW/cm^2	0.085	not mentioned	[5]
UV_{254}	*B. subtilis spores*	UV fluence rate = 0.99 mW/cm^2	0.099	not mentioned	[5]
UV_{254}	*Pseudomonas aeruginosa*	UV fluence rate = 0.145 mW/cm^2	0.0599	10 h	[6]
NaClO	*Pseudomonas aeruginosa*	[NaClO] = 40 μM	0.0478	16 h	[6]
PAA	*Pseudomonas aeruginosa*	[PAA] = 40 μM	0.017	not mentioned	[6]

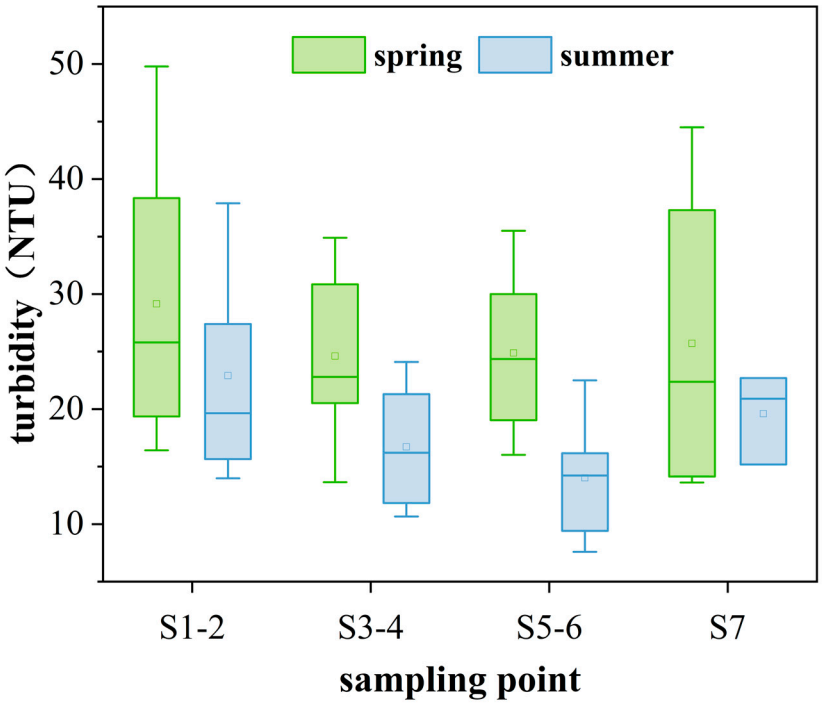

Figure S1. Water turbidity in spring and summer at each sampling point in Shanghai, China.

This study takes reservoir A as the starting point, and the pipe network passes from three pumping stations to the end of the pipe network, with a total length of 44.8 km. Seven sampling points are selected, including S1-2 points in the reservoir of reservoir A, S3-4 points in the inlet and outlet of pumping station B along the water transmission pipeline, and S5-6 points in the inlet and outlet of pumping station C along the pipeline. The last point is S7, the intake of pumping station D.

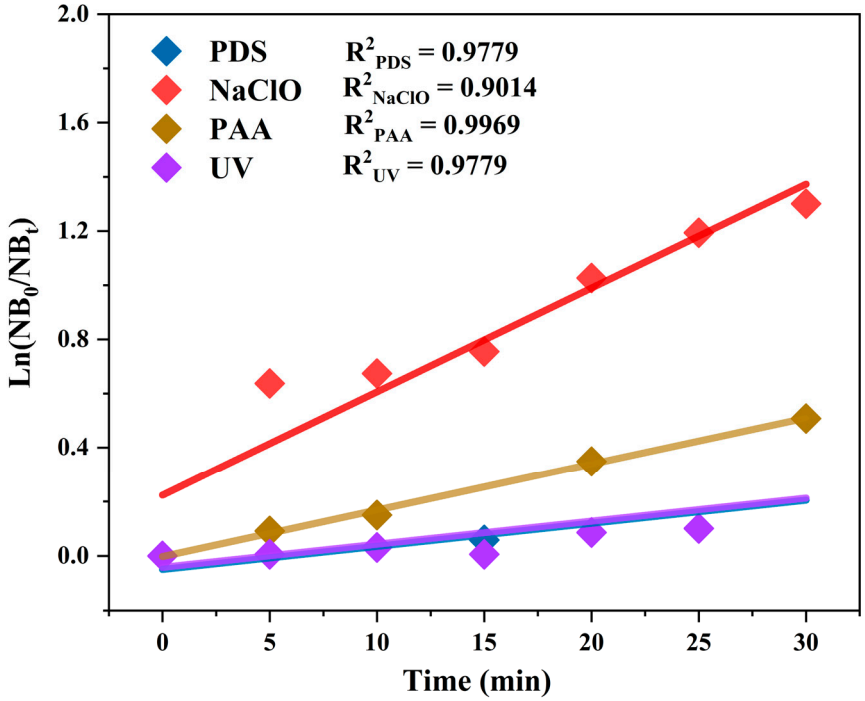

Figure S2. Inactivation rate constants of *P. aeruginosa* under single disinfection method. Conditions: $[NaClO]_0 = [PDS]_0 = [PAA]_0 = 40$ μM, $[TBA]_0 = 50$ mM, UV fluence rate = 0.145 mW/cm^2, initial concentration of *P. aeruginosa* = 3.32×10^7 CFU/mL, pH = 7.0 ± 0.2, and T = 25 ± 2°C.

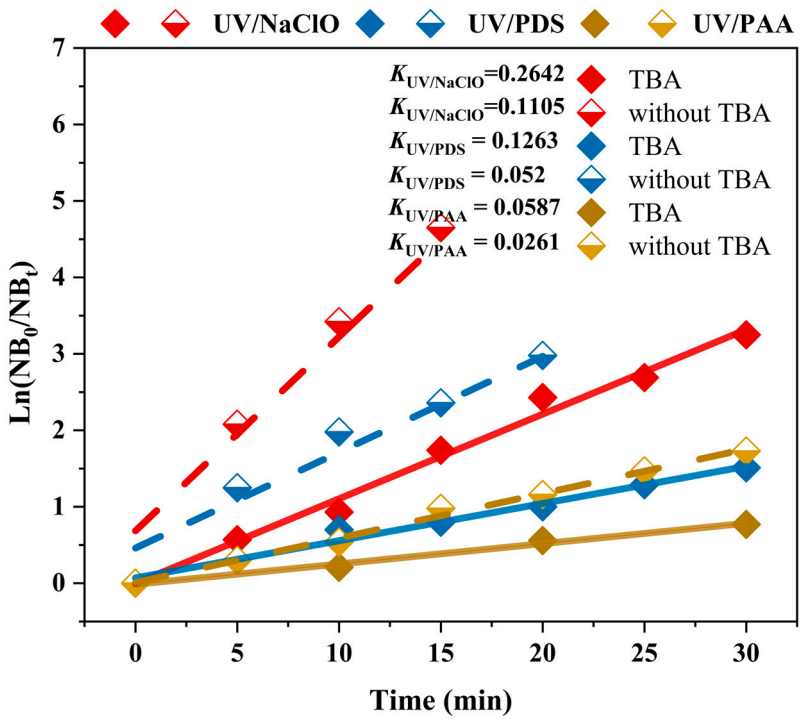

Figure S3. Inactivation rate constants of *P. aeruginosa* under combined disinfection. Conditions: $[NaClO]_0 = [PDS]_0 = [PAA]_0 = 40$ μM, $[TBA]_0 = 50$ mM, UV fluence rate = 0.145 mW/cm^2, initial concentration of *P. aeruginosa* = 3.32×10^7 CFU/mL, pH = 7.0 ± 0.2, and T = 25 ± 2°C.

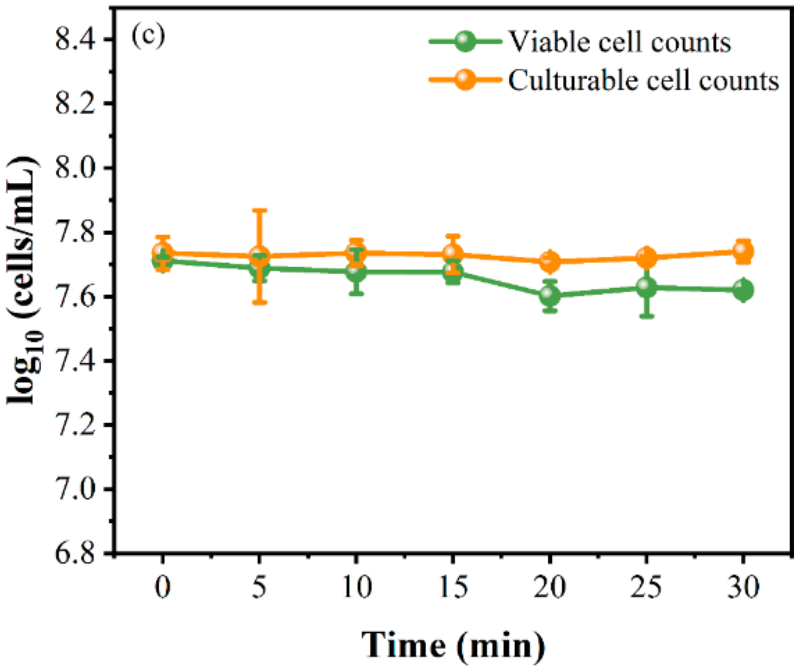

Figure S4. Inactivation curves after the addition of excess TBA. Conditions: $[NaClO]_0$ = =$[PDS]_0$ = $[PAA]_0$ = 40 μM, $[TBA]_0$ = 50 mM, UV fluence rate = 0.145 mW/cm^2, initial concentration of *P. aeruginosa* = 3.32 × 10^7 CFU/mL, pH = 7.0 ± 0.2, and T = 25 ± 2°C.

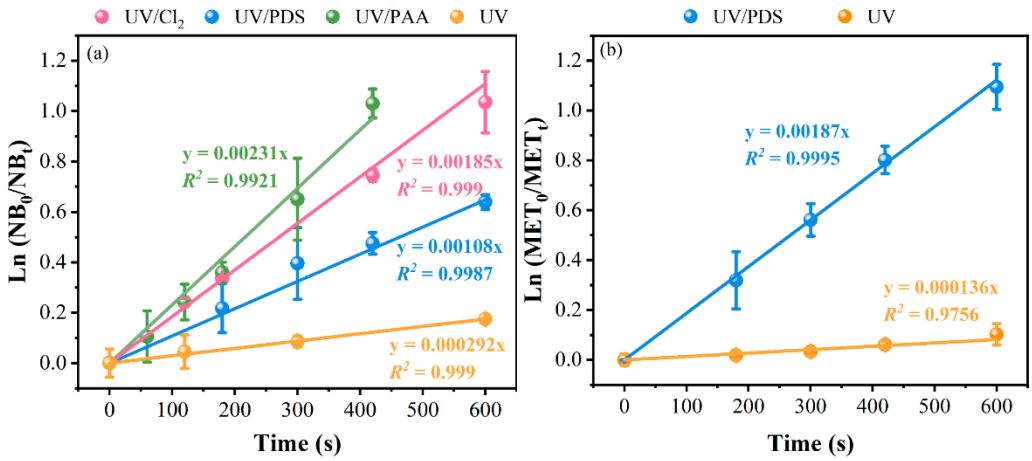

Figure S5. Degradation of NB and MET by UV/NaClO, UV/PDS, UV/PAA, and UV (a), (b). Conditions: $[NaClO]_0$ = =$[PDS]_0$ = $[PAA]_0$ = 40 μM, UV fluence rate = 0.145 mW/cm^2, [NB] = 0.5 μM； pH = 7.0 ± 0.2； T = 25 ± 2°C.

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