Supplementary Information (SI)

Text S1. VOCs analysis method

The C_2-C_5 hydrocarbons were trapped by HP-PLOT/Q (30 m × 0.32 mm ID × 20 um Agilent, USA) column with an FID channel, while a DB-1 (30 m × 0.32 mm ID × 1.0 um, Agilent, USA) with an MS detector was used to detect other compounds. The initial temperature of the column was 5 °C for 6 min, then increased to 170 °C at 6 °C/min for 5 min, and finally to 220 °C at 15 °C/min for 6 min. Temperatures of the mass detector, ion source, and transfer line were maintained at 220 °C, 230 °C, and 280 °C, respectively. Helium was applied as the carrier gas for GC at a flow rate of 1 L min^{-1}. As for quality assurance and quality control, the Summa containers were pre-cleaned with high-purity nitrogen (≥99.999%) at least 5 times, and one-fifth of the containers were randomly selected for the blank experiment. Blank tests and standard samples with known concentrations were conducted every 24 h during the analysis. Each sampling location received approximately three samples, including the parallel ones. More information on analysis has been previously reported (Zhong et al., 2017).

Text S2. Water samples analysis

For water samples, chemical oxygen demand (COD) was determined using a DR900 portable water quality multiparameter analyzer (HACH, USA) after digestion with a DRB200 (HACH, USA) thermostat. Total organic carbon (TOC) in the liquid phase was measured by a TOC analyzer (TOC-V CSH, Shimadzu, Japan). Three-dimensional excitation-emission matrix (3D-EEM) fluorescence spectroscopy (FLS1000/FS5, Edinburgh, UK) was conducted to investigate the dissolved organic matter (DOM) in liquid phase.

Text S3. Health risk assessment calculation methods

The values of LCR_i and HR_i are calculated using Eqs. (S1) and (S2) (Wang et al., 2023), respectively.

$$HR_i = \frac{C_i}{RfC_i} \quad , \quad \text{(S1)}$$

where HR_i is the unit risk of the ith VOC, Ci is the daily concentration of the ith VOC (μg/m^3), and RfC_i is reference concentration (μg/m^3) of the ith VOC. Compounds with hazard ratios more than 1, between 0.1 and 1, and less than 0.1 were labeled as definite, probable or possible and negligible health risks, respectively.

$$LCR_i = C_i \times UR_i \quad , \quad \text{(S2)}$$

where LCR_i is the unit risk of the ith VOC, C_i is the daily concentration of the ith VOC (μg/m^3), and UR_i is reference concentration (μg/m^3) of the ith VOC. Compounds with LCR more than 10^{-4}, between 10^{-4} and 10^{-5}, between 10^{-5} and 10^{-6}, and less than 10^{-6} were labeled as "definite, probable, possible and negligible risk", respectively. Compounds with hazard ratios more than 1, between 0.1 and 1, and less than 0.1 were labeled as definite, probable or possible and negligible health risks, respectively (US EPA, 2014).

Table S1 Detection of VOCs in Electrophoresis exhaust gas.

Components of VOCs		Detection limit(ug/m^3)	MIR	Electrophoresis exhaust gas (μg/m^3)	
				VOCs emission profile	After AC
Alkanes	Isobutane	0.6	1.23	50.4	44.4
	N-butane	0.4	1.15	10.8	9.4
	Isopentane	0.6	1.45	34.4	29.9
	Pentane	0.6	1.31	3.4	2.8
	2-Methylpentane	0.3	1.5	1.7	1.5
	3-Methylpentane	0.3	1.8	1.3	1.1
	Hexane	0.6	1.24	11.9	4.6
	Cyclopentane	0.6	2.39	2.3	1.9
	Cyclohexane	0.6	1.25	3.0	2.7
	Heptane	0.4	1.07	6.5	8.5
	N-octane	1.0	0.9	2.4	2.5
	Nonane	1.0	0.78	18.7	0.0
	Undecane	1.0	0.61	5.4	5.2
	Dodecane	1.0	0.55	4.5	2.3
	Ethane	0.3	0.28	29.0	23.1
	Propane	0.4	0.49	13.1	12.6
Total				**198.7**	**152.6**
Olefins	N-Butene	0.5	9.73	7.9	3.4
	Ethylene	0.3	9	35.1	21.3
	Propylene	0.2	11.66	13.5	12.1
	Styrene	0.6	1.73	2.1	1.2
Total				**58.5**	**38**
Aromatics	Benzene	0.2	0.78	41.8	50.7
	Toluene	0.5	4	36.3	44.3
	Ethylbenzene	0.6	3.04	6.3	7.5
	M, p-xylene	0.6	7.8	18.8	19.7
	O-xylene	0.6	7.64	6.4	6.0
	n-propylbenzene	0.3	2.15	3.8	4.0
	M-ethyl toluene	1.0	7.39	12.8	13.3
	P-ethyl toluene	0.9	4.44	6.3	6.8
	1,3,5-Trimethylbenzene	1.0	9.35	6.9	6.9
	o-ethyl toluene	1.0	5.33	7.5	8.1
	1,2,4-Trimethylbenzene	1.0	7.88	34.8	36.1
	1,2,3-trimethyl benzene	0.9	9.86	8.8	9.7
	p-diethyl benzene	0.4	4.18	2.5	2.7
Total				**192.9**	**215.8**
Halocarbons	Monochloromethane	0.3	0.04	2.3	1.9
	Vinyl Chloride	0.1	2.83	0.4	0.3
	Dichloromethane	0.1	0.04	846.6	589.8
	Trichloromethane	0.5	0.74	2.1	1.6
	1,2-Dichloroethane	0.7	0.21	5.7	6.6

	Chlorobenzene	2.0	0.52	1.6	1.7
Total				**858.7**	**602.1**
	Acetone	1.3	0.36	172.3	154.7
	Isopropanol	0.1	0.61	14.1	11.3
	2-Butanone	0.6	1.48	13.4	11.6
	4-Methyl-2-Pentanone	0.7	3.88	5565.0	5267.1
	acetaldehyde	0.7	6.07	192.0	158.6
	Propionaldehyde	0.7	7.08	141.9	122.9
OVOCs	Methacrolein	0.7	6.01	54.5	54.1
	Vinyl Acetate	0.6	3.2	2.5	2.9
	Butyraldehyde	0.5	5.97	170.6	153.2
	Ethyl Acetate	0.7	0.63	20.5	20.5
	benzaldehyde	0.8	-0.328	3.3	2.7
	Tetrahydrofuran	0.9	4.31	10.6	10.8
	Methyl tert butyl ether	0.6	0.705	1.8	1.7
Total				**6362.7**	**5972.2**
ρ（VOCs）mg/m^3				**7.67**	**6.98**

Table S2 The non-cancer risk of detected VOCs

VOCs	*RfC*$_i$, ug/m^3
Hexane	700
Heptane	400
Nonane	20
Dichloromethane	600
1,2-Dichloroethane	7
Vinyl chloride	100
Acetaldehyde	9
Propionaldehyde	8
4-Methyl-2-Pentanone	3000
Benzene	30
Toluene	5000
Ethylbenzene	1000
M,p-xylene	100
O-xylene	100
Chlorobenzene	50
1,3,5-Trimethylbenzene	60
1,2,4-Trimethylbenzene	80
1,2,3-Trimethylbenzene	60

Table S3 The cancer risks of detected VOCs

VOCs	UR_i, ug/m^3
Acetaldehyde	2.2×10^{-6}
Cyclohexane	3.0×10^{-5}
Benzene	7.8×10^{-6}
Ethylbenzene	2.6×10^{-6}
Vinyl Chloride	8.8×10^{-6}
Dichloromethane	8.0×10^{-8}
1,2-Dichloroethane	2.6×10^{-5}

Table S4 One-time investment budget

Device name	**Structures**	**Quantity**	**Amount (USD)**
AC adsorption device (available)	Adsorption device (5400 mm×1600 mm×2050 mm)	1 set	47,959.27
	AC	1.081 t	839.3
	Water eliminator	2 sets	4,094.18
	Controlling system	1 set	699.42
	Others (pipeline, installation…)	-	4,994.18
Total			**58,586.35**
PAC+WCO device (budget)	Absorption oxidation tower (Φ2500×5500)	2 sets	41,965.09
	Diaphragm pump	1 set	1,328.89
	Controlling system	1 set	769.36
	Ozone generator device	1 set	6994.18
	Ozone destructor	1 set	4,196.51
	Others (pipeline, installation…)	-	6294.76
Total			**61,548.79**

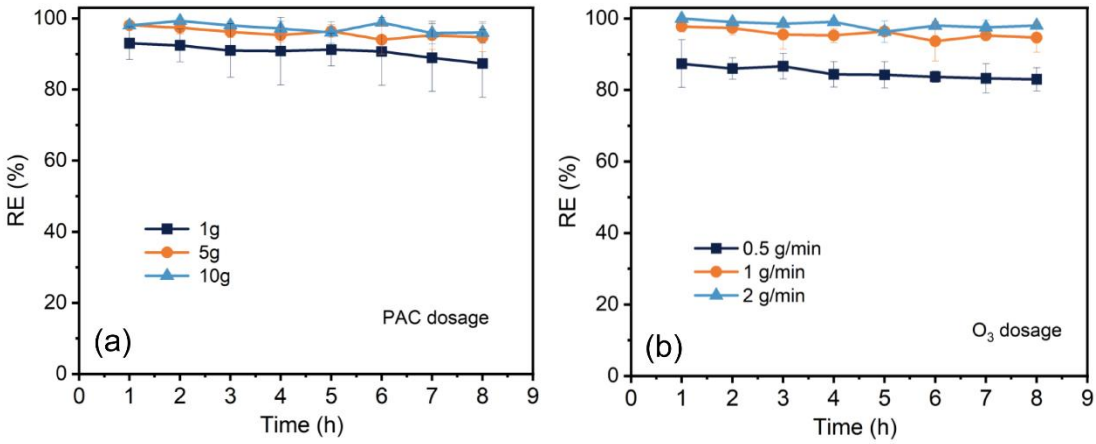

Fig. S1 Impact of (a) PAC dosage and (b) ozonation dosage on the VOCs removal in PAC+WCO system

Fig. S2 Measurement equipment

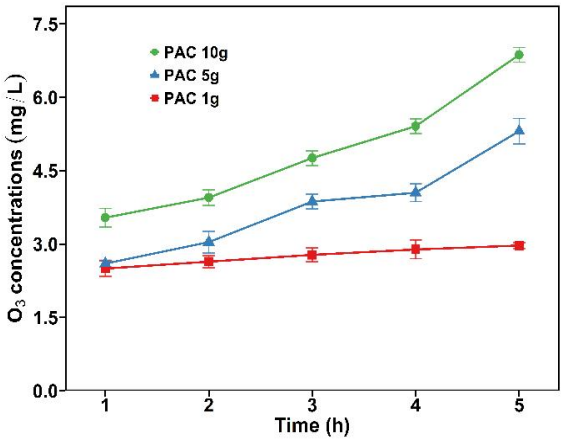

Fig. S3 The O_3 concentration in the liquid phase with the increase of PAC dosage in the H_2O+ O_3+PAC system

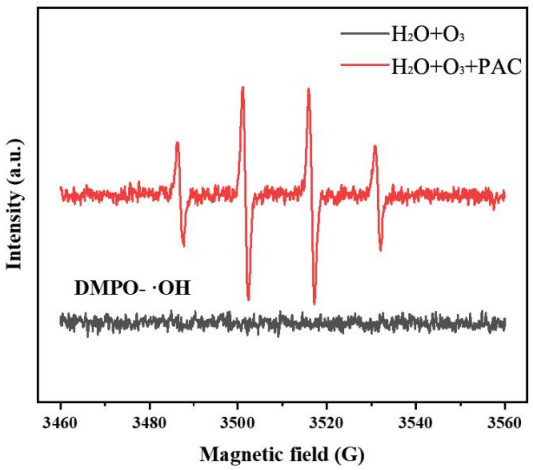

Fig. S4 The EPR of the system

References

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