

Supplementary Material

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Figure S1. On-site pictures in Tahe Oilfield, Xinjiang (in order are oil-contaminated soil, soil thermal desorption device and condensed wastewater)

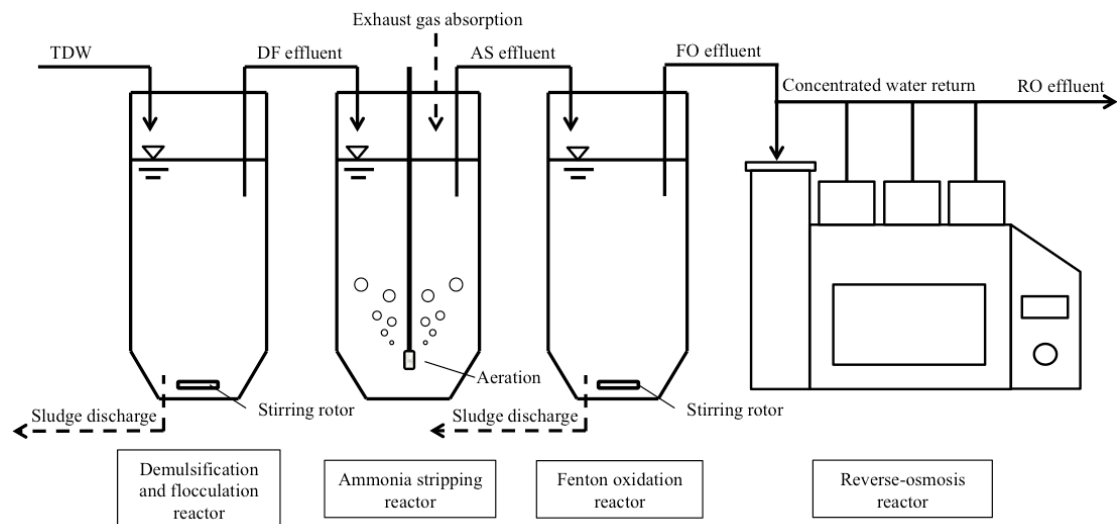


Figure S2. Experimental setup and working schematic diagram for treating TDW

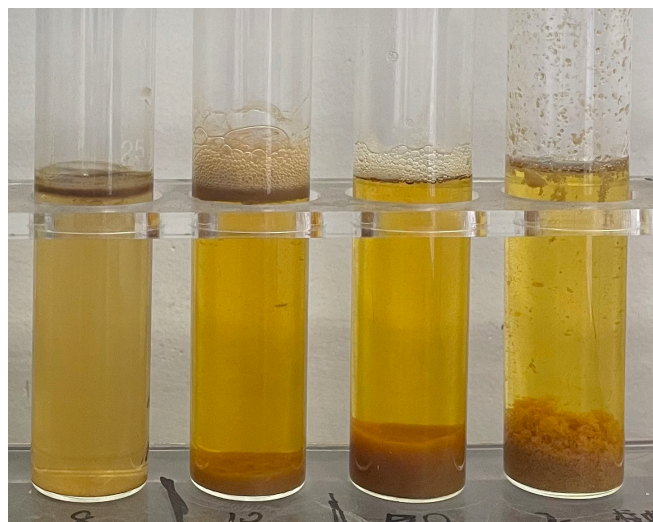


Figure S3. Effect drawing of wastewater treatment in DF process (from left to right, NaClO, CaCl₂, PAC and PAM are added in order)

Table.S1. Orthogonal experimental design table for the treatment effect of DF on COD, turbidity and oil content

Factors	NaClO (ml/L)	CaCl ₂ (g/L)	PAC (g/L)	PAM (g/L)
A	20	2	2	1
B	30	4	4	2
C	40	6	6	3

NO.	NaClO (ml/L)	CaCl ₂ (g/L)	PAC (g/L)	PAM (g/L)	COD (%)	Turbidity (%)	Oil content (%)
1	20	2	2	1	9.5	96.8	59.3
2	20	4	4	2	15.3	97.6	64.3
3	20	6	6	3	12.7	97.1	65.3
4	30	2	4	3	10.8	94.5	63.9
5	30	4	6	1	11.5	97.4	57.7
6	30	6	2	2	7.6	97.3	63.3
7	40	2	6	2	10.8	91.2	59.9
8	40	4	2	3	10.2	95.6	56.8
9	40	6	4	1	14.0	97.0	61.4
K1	37.5	31.2	27.4	35.0			
	291.6	282.6	289.7	291.3			
	188.8	183.1	179.4	178.4			
K2	29.9	36.9	40.1	33.7			
	289.3	290.6	289.1	286.1			
	184.9	178.8	189.6	187.5			
K3	35.0	34.4	35.0	33.7			
	283.8	291.4	285.8	287.3			
	178.1	189.9	182.9	186.0			
k1	12.5	10.4	9.1	11.7			
	97.2	94.2	96.6	97.1			
	62.9	61.0	59.8	59.5			
k2	10.0	12.3	13.4	11.2			
	96.4	96.9	96.4	95.4			
	61.6	59.6	63.2	62.5			
k3	11.7	11.5	11.7	11.2			
	94.6	97.1	95.6	95.8			
	59.4	63.3	61.0	62.0			
R	2.5	1.9	4.2	0.4			
	2.6	3.0	1.3	1.7			
	3.6	3.7	3.4	3.0			
Signific	2	3	1	4			

ance	2	1	3	4
order	2	1	3	4

Table.S2. Orthogonal experimental design table for the treatment effect of ammonia nitrogen in the AS process

Factors		pH	Time (min)	Temperature (°C)	
A		9	30	30	
B		10	60	50	
C		11	90	70	
NO.	pH	Time (min)	Temperature (°C)	NH ⁴⁺ -N (mg/L)	Removal (%)
1	9	30	30	197.2	3.4
2	9	60	50	179.6	12.0
3	9	90	70	122.1	40.2
4	10	30	50	139.6	31.6
5	10	60	70	41.1	79.9
6	10	90	30	136.7	33.0
7	11	30	70	62.5	69.3
8	11	60	30	119.1	41.6
9	11	90	50	49.9	75.6
K1	105.8	113.4	76.5		
K2	163.0	165.1	151.4		
K3	183.9	173.9	224.8		
k1	35.3	37.8	25.5		
k2	54.4	55.2	50.5		
k3	61.3	58.0	74.9		
R	26.1	20.2	49.4		
Significance order	2	3	1		

Table.S3. Orthogonal experimental design table for the treatment effect of FO

process on COD

Factors		pH	Time (h)	Fe ²⁺ (mmol/L)	H ₂ O ₂ (mol/L)	
A		3	1	10.8	0.3	
B		5	3	21.6	0.6	
C		7	5	32.4	0.9	
NO.	pH	Time (h)	Fe ²⁺ (mmol/L)	H ₂ O ₂ (mol/L)	COD (mg/L)	Removal (%)
1	3	1	10.8	0.3	4240	31.2
2	3	3	21.6	0.6	2680	56.5
3	3	5	32.4	0.9	2250	63.5
4	5	1	21.6	0.9	3420	44.5
5	5	3	32.4	0.3	3340	45.8
6	5	5	10.8	0.6	3780	38.6
7	7	1	32.4	0.6	2830	54.1
8	7	3	10.8	0.9	5800	5.8
9	7	5	21.6	0.3	3380	45.1
K1	151.1	129.7	75.7	122.1		
K2	128.9	108.1	146.1	149.2		
K3	105.0	147.2	163.3	113.8		
k1	50.4	43.2	25.2	40.7		
k2	43.0	36.0	48.7	49.7		
k3	35.0	49.1	54.4	37.9		
R	15.4	5.8	29.2	9.0		
Significance order	2	4	1	3		

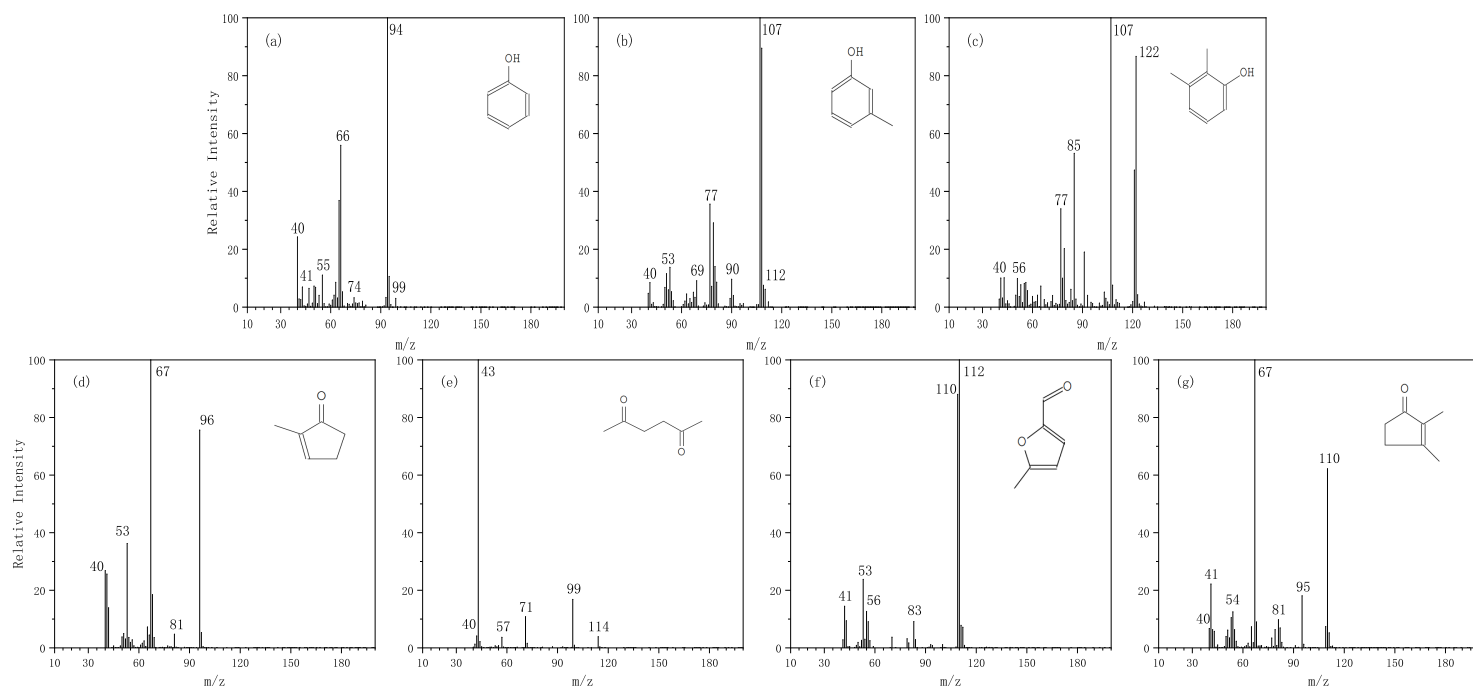
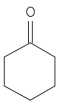
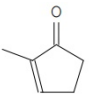
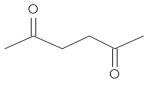



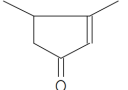


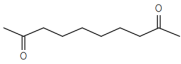


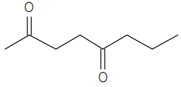
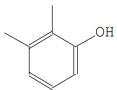


Figure S4. Mass spectra of characteristic pollutants of TDW

Table.S4. Analysis of Main Organic Compounds in TDW

NO.	Retention time (min)	Organic compounds	Proposed structures	Peak area (%)	Probability
1	3.893	Cyclohexanone		2.87	94
2	4.027	2-Cyclopenten-1-one		6.94	96
3	4.342	Acetonyl acetone		3.82	97
4	4.921	5-Methyl furfural		2.70	85
5	4.986	3-Methyl-2-cyclopenten-1-one		11.34	89
6	5.267	Phenol		20.53	92
7	5.493	3,4-Dimethyl-2-cyclopenten-1-one		1.71	88

8	5.900	2,5-Heptanedione		4.30	87
9	6.138	2,3-Dimethyl-2-cyclopentene-1-one		4.06	95
10	6.281	2,9-Decanedione		1.27	88
11	6.460	m-Cresol		16.67	87
12	6.783	m-Cresol		15.87	94
13	7.255	2,5-Octanedione		2.15	92
14	7.913	2,3-Dimethylphenol		2.89	84

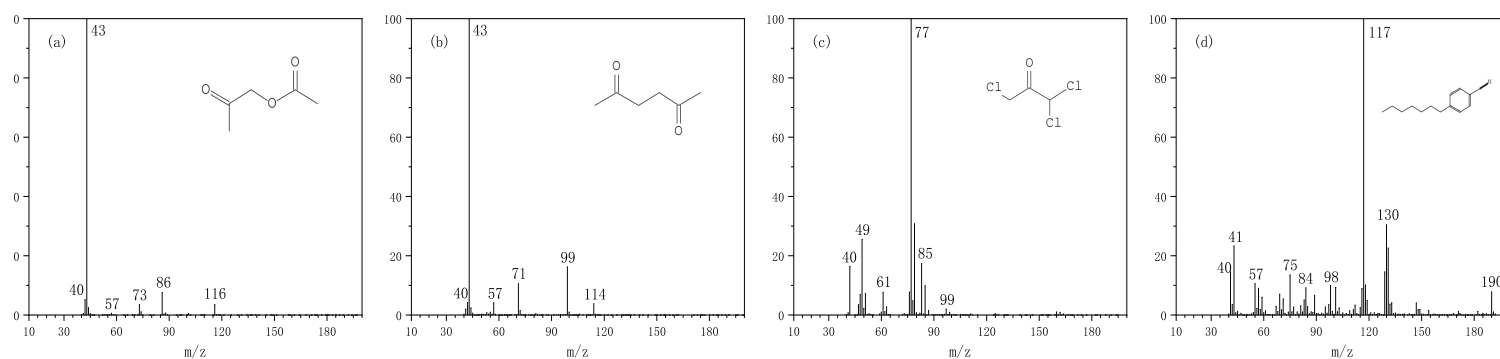
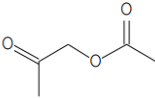
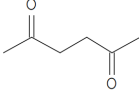
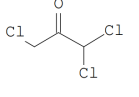
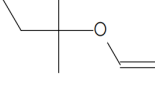
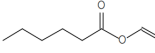
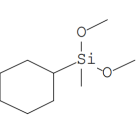
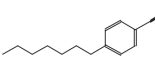
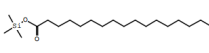


Figure S5. Mass spectra of characteristic pollutants of FO effluent

Table.S5. Analysis of Main Organic Compounds in FO effluent

NO.	Retention time (min)	Organic compounds	Proposed structures	Peak area (%)	Probability
1	3.346	1-(Acetyloxy)propan-2-one		13.99	98
2	4.322	Acetonyl acetone		12.59	97
3	4.939	1,1,3-Trichloroacetone		5.98	97
4	5.248	Butane,2-(ethenyloxy)-2-methyl-		3.78	83
5	7.240	Hexanoic acid, ethenylester		2.38	89
6	7.960	Cyclohexyldimethoxymethylsilane		1.18	88
7	22.395	4-N-HEPTYLBENZONITRILE		23.55	66
8	24.136	Octadecanoic acid,trimethylsilyl ester		10.41	68