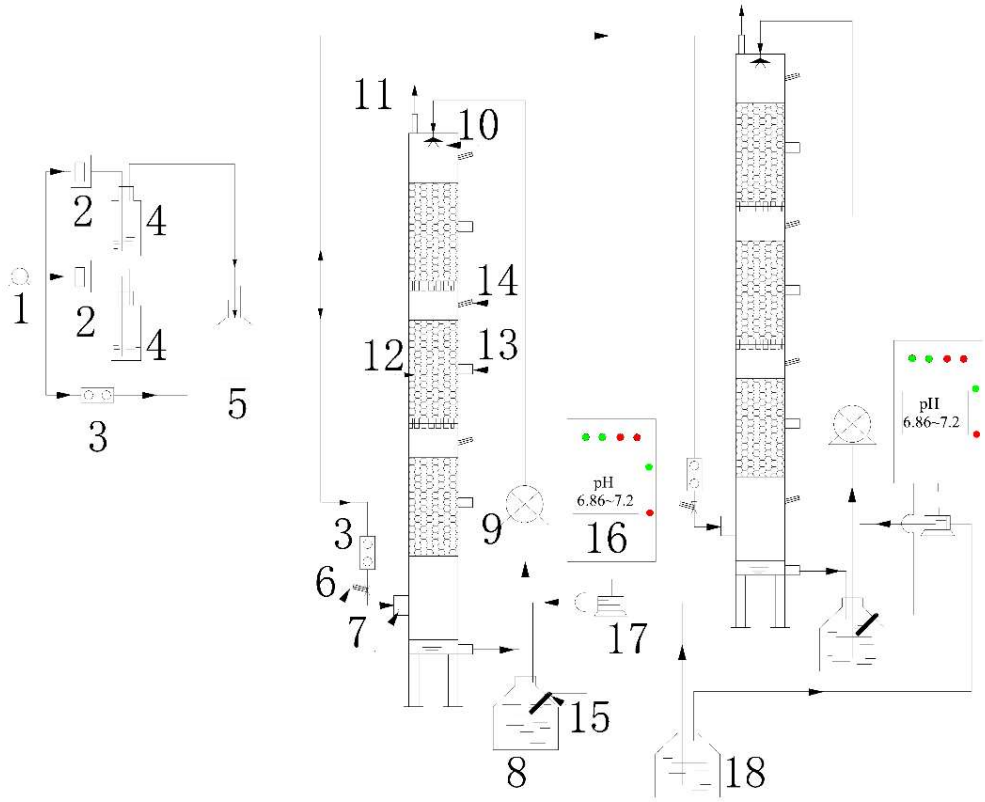
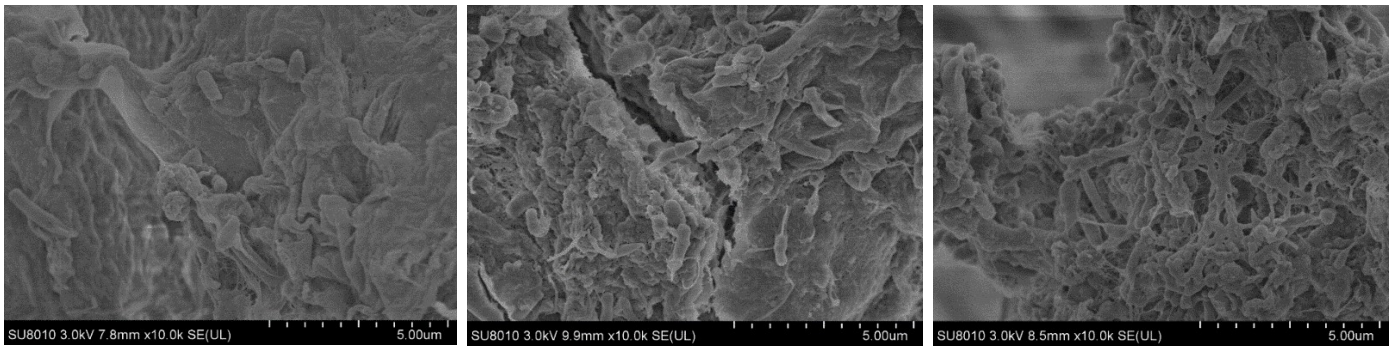


Figure S1. The schematic of the multi-layer BTF. (1) Air pump, (2,3) Rotor meter, (4) Sample flask, (5) Mixture flask, (6) air inlet, (7) sampling port, (8) Nutrition flask, (9) packing port, (10) spray header, (11) air outlet, (12) packing material, (13) packing material sampling port, (14) air sampling port, (15) pH detector, (16) Auto-pH adjustor, (17) control panel, (18) NaOH solution flask.



(a) (b) (c)

Figure S2. FESEM microphotographs of the packing material (a); sample of the biofilter on day 20 during startup period (b) sample on day 77 during operational period (c) sample on day 240 during end period.

Table S1. Operation condition of BTF treatment.

Phase	Time, days	EBRT, s	Inlet conc. mg·m-3	Flow rate, m3·h-1	Inlet loading rate, g·m-3·h-1
0	0-22	56	196-287	0.2	11-16
Ⅰ	23-39	56	198-1161	0.2	11-66
Ⅱ	40-56	28	262-1032	0.4	30-118
Ⅲ	57-77	20	260-1529	0.6	45-262

Text 1 Strain isolation of *Pseudomonas putida* S-1

The activated sludge used as microbial source was obtained from a pharmaceutical factory in Zhejiang, China. The sample was incubated in MMP to enrich potential PT-degrading bacteria. After the microbes were acclimatized with 10–50 mg/L liquid-phase PT for approximately 2 months, 1 mL of sludge samples was introduced to 50 mL of MMP containing 28 mg/L of liquid-phase PT as a sole carbon and energy source; the resulting mixture was incubated at 30 ℃ and 160 rpm for 3 days. Afterward, 1.0 mL of the culture was transferred to the same fresh medium and incubated under the same conditions. The same procedure was repeated five times, and the microbial suspensions were purified on R2A solid medium by applying conventional spread plate techniques. The obtained pure bacterial strains were kept at 4 ℃ for further use.

Table S2. Comparison CO_2 production of recent results of removal single or mixed pollutants with present study.

Pollutant	Bioprocess	Maximum EC (g·m-3·h-1)	P CO2 Coefficient	Ref.
Single				
DMS	Biofilter	/	0.22	[27]
Propanethiol	Biofilm	/	1.23	[2]
Toluene	Biofilter	40.3	2.41	[40]
Toluene	Biofilter	1280	1.77	[29]
Toluene	Biofiltration	140	2.59	[26]
Toluene	Biofiltration	80	2.5	[28]
Mixture				
DMS+CS2+H2S+COS	Biofilters	/	0.344	[55]
Toluene +Ethyl Acetate	Biofilter	150	3.06	[56]
Toluene + methanol	BTF	55	1.60	[57]
Toluene +p-xylene	Biofilters	32.4	2.60	[40]
DMS 56 s	BTF	45.90	2.26	In this study
Propanethiol 56 s	BTF	36.52		In this study
Toluene 56 s	BTF	21.27		In this study
DMS 28 s	BTF	50.60	1.88	In this study
Propanethiol 28	BTF	39.02		In this study
Toluene 28 s	BTF	51.28		In this study
DMS 20 s	BTF	71.71	1.72	In this study
Propanethiol 20 s	BTF	70.03		In this study
Toluene 20 s	BTF	43.58		In this study

Table S3. α-Diversity of each sample.

Index	Startup period	Operational period	End period
Shannon index	5.03	4.58	4.076
Simpson index	0.027	0.067	0.11
Chao 1	5044.37	4541.82	5905.2
OTU	2599	2511	3070