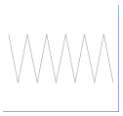
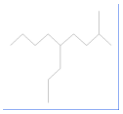
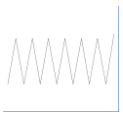
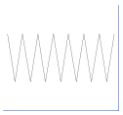
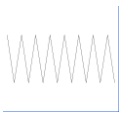
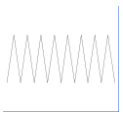
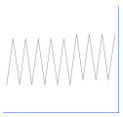
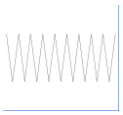
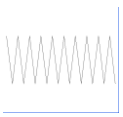
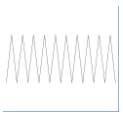
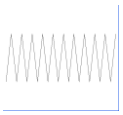
Supplementary Materials

Table S1. Petroleum Hydrocarbon Components in Contaminated Soil

Peak number	Retention time/min	Peak area	Peak area %	Substance name	Molecular formula	Structure
1	13.696	3,347,868	0.28	2,3,7-Trimethyloctane	C11H24	
2	14.493	5,942,928	0.5	Dodecane	C12H26	
3	16.767	7,574,512	0.64	2-Methyl-5-propylnonane	C13H28	
4	17.608	15,781,615	1.33	Tetradecane	C14H30	
5	19.137	9,787,869	0.82	Pentadecane	C15H32	
6	19.963	29,858,998	2.52	Hexadecane	C16H34	
7	21.658	36,518,045	3.08	Heptadecane	C17H36	
8	23.501	26,618,532	2.24	Octadecane	C18H38	
9	25.373	46,324,585	3.9	onadecane	C19H40	
10	25.498	1.07E+08	9.06	Eicosane	C20H42	
11	27.108	49,873,889	4.2	Heneicosane	C21H44	
12	28.726	60,119,123	5.07	Docosane	C22H46	

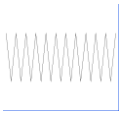
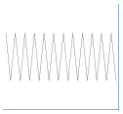
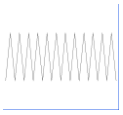
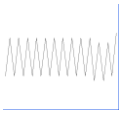
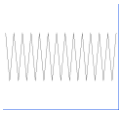
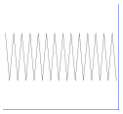
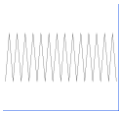
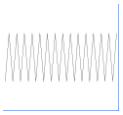
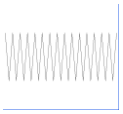
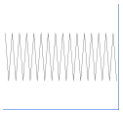
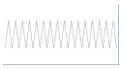
13	30.242	65,878,996	5.55	Tricosane	C23H48	
14	31.67	7,5049,919	6.32	Tetracosane	C24H50	
15	33.019	85,842,780	7.23	Pentacosane	C25H52	
16	34.302	87,994,700	7.42	Hexacosane	C26H54	
17	35.525	85,088,524	7.17	Heptacosane	C27H56	
18	36.695	82,989,682	6.99	Octacosane	C28H58	
19	37.829	81,323,369	6.85	Nonacosane	C29H60	
20	39.078	73,230,360	6.17	Triacontane	C30H62	
21	40.529	62,361,689	5.26	Hentriacontane	C31H64	
22	42.258	49,261,758	4.15	Dotriacontane	C32H66	
23	44.366	38,,556,569	3.25	Tritriacontane	C33H68	

Table S2. Orthogonal Experiment Results

Serial number	Factors				Petroleum hydrocarbon removal rate/%
	Surfactant type	Oscillation time/min	Temperature /℃	Surfactant concentration/mg/L	
1	Tween-80	15	25	500	45.10
2	Tween-60	75	25	1,000	46.56
3	Rhamnolipid	60	25	1,500	52.63
4	SDBS	45	25	2,000	61.86
5	TRS-1	30	25	2,500	57.59
6	Tween-80	30	35	1,000	57.08
7	Tween-60	15	35	1,500	53.87
8	Rhamnolipid	75	35	2,000	64.59
9	SDBS	60	35	2,500	68.10
10	TRS-1	45	35	500	48.55
11	Tween-80	45	45	1,500	60.99
12	Tween-60	30	45	2,000	56.07
13	Rhamnolipid	15	45	2,500	60.62
14	SDBS	75	45	500	50.74
15	TRS-1	60	45	1,000	55.81
16	Tween-80	60	55	2,000	64.34
17	Tween-60	45	55	2,500	58.34
18	Rhamnolipid	30	55	500	49.35
19	SDBS	15	55	1,000	58.35
20	TRS-1	75	55	1,500	63.83
21	Tween-80	75	65	2,500	67.86
22	Tween-60	60	65	500	46.37
23	Rhamnolipid	45	65	1,000	60.32
24	SDBS	30	65	1,500	63.58
25	TRS-1	15	65	2,000	62.02
T1	295.37	280	263.7	240.11	—
T2	261.21	283.7	292.2	278.12	—

Serial number	Factors				Petroleum hydrocarbon removal rate/%
	Surfactant type	Oscillation time/min	Temperature /℃	Surfactant concentration/mg/L	
T3	287.51	290.1	284.2	294.9	—
T4	302.63	287.3	294.2	308.88	—
T5	287.8	293.6	300.2	312.51	—
A1	59.074	55.99	52.75	48.022	—
A2	52.242	56.73	58.44	55.624	—
A3	57.502	58.01	56.85	58.98	—
A4	60.526	57.45	58.84	61.776	—
A5	57.56	58.72	60.03	62.502	—
R	8.284	2.724	7.282	14.48	—