Supporting Information

Nano-fused Multidirectional Rotatable Floating Biocarrier: an Innovative Approach for the Removal of Petroleum Oil Spills

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SI-1. GC-MS chromatogram of the aqueous leaf extract of *R. apiculata* mangrove.

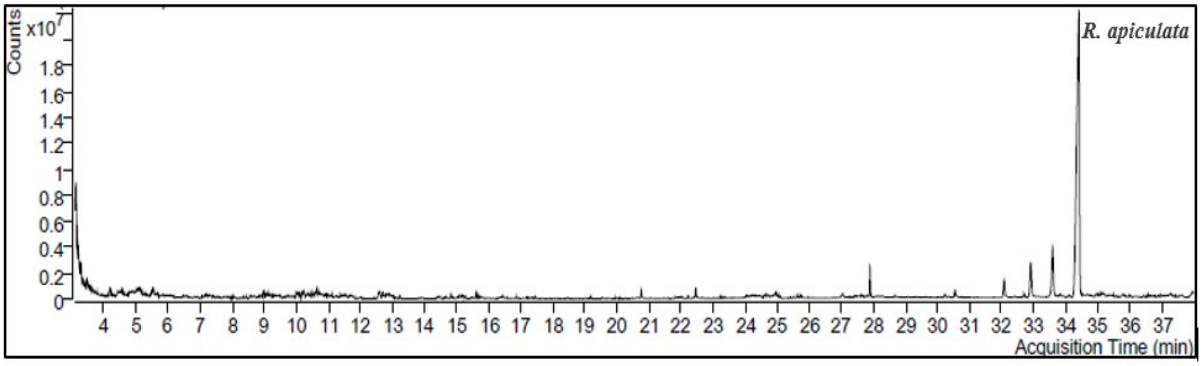

Table *S-1* List of phytochemicals present in aqueous leaf extract of *R. apiculata* as predicted by GC-MS analysis.

S. No.	Name of the Phytochemicals	RT	Peak Area%	Molecular Formula
1	1-Bromo-5-methoxypentane	9.625	0.63	$C_6H_{13}BrO$
2	Silane, butoxytrimethyl-	10.226	0.04	$C_7H_{18}OSi$
3	1-Hexanol	10.467	0.06	$C_6H_{14}O$
4	1,3-Cyclohexadiene	10.603	1.18	$C_{10}H_{16}$
5	1,3-Diisopropoxy-1,3-dimethyl-1,3-disiletane	11.320	1.82	$C_{10}H_{26}O_2Si_2$
6	Silane, (1,1-dimethyl-2-propene)	13.617	1.29	$C_5H_{12}Si$
7	Megastigmatrienone	15.827	1.14	$C_{13}H_{18}O$
9	2-Cyclohexen-1-one	16.599	1.79	C_6H_8O
10	6,7-Dehydro-7,8-dihydro-3-oxo-.alpha.-ionol	17.344	1.08	$C_{13}H_{20}O_2$
11	2(4H)-Benzofuranone	18.026	1.39	$C_8H_6O_2$
12	Pluchidiol	18.220	6.44	$C_{15}H_{22}O_2$
13	3,4,5-Trimethoxybenzyl alcohol	18.608	8.00	$C_{10}H_{14}O_4$
14	Pyridine, 2,2′-(1,2-phenylene)	18.550	11.71	$C_{16}H_{12}N_2$
15	Silane, dimethyl(2-pentyloxy)	18.885	5.66	$C_7H_{18}OSi$
16	2,4-dichloro-6-pip-s-Triazine	18.951	8.91	$C_8H_{10}Cl_2N_4$
17	10-Undecenyl Hexofuranoside	19.018	7.08	$C_{17}H_{32}O_6$
18	Bis(2,3,4,5,6-Pentamethyl-4-piperidyl)	19.043	10.44	$C_{18}H_{36}N_2$
19	2-O-tert-Butyl-dimethyl-silyl-4,6-O-ethyl-idene-myo-insitol	19.255	6.28	$C_{16}H_{34}O_6Si$
20	Hexadecanoic acid	19.463	9.01	$C_{16}H_{32}O_2$
21	9,12-Octadecadienoic acid/linoleic acid	21.128	2.17	$C_{18}H_{32}O_2$
22	9,12,15-Octadecatrienoic acid/linolenic acid	21.190	5.06	$C_{18}H_{30}O_2$
23	Phytol	21.301	2.07	$C_{20}H_{40}O$
24	Octadecanoic acid/stearic acid	21.394	1.63	$C_{18}H_{36}O_2$

SI-2. Drop-collapse assay demonstrating biosurfactant activity by *A. baumannii*.

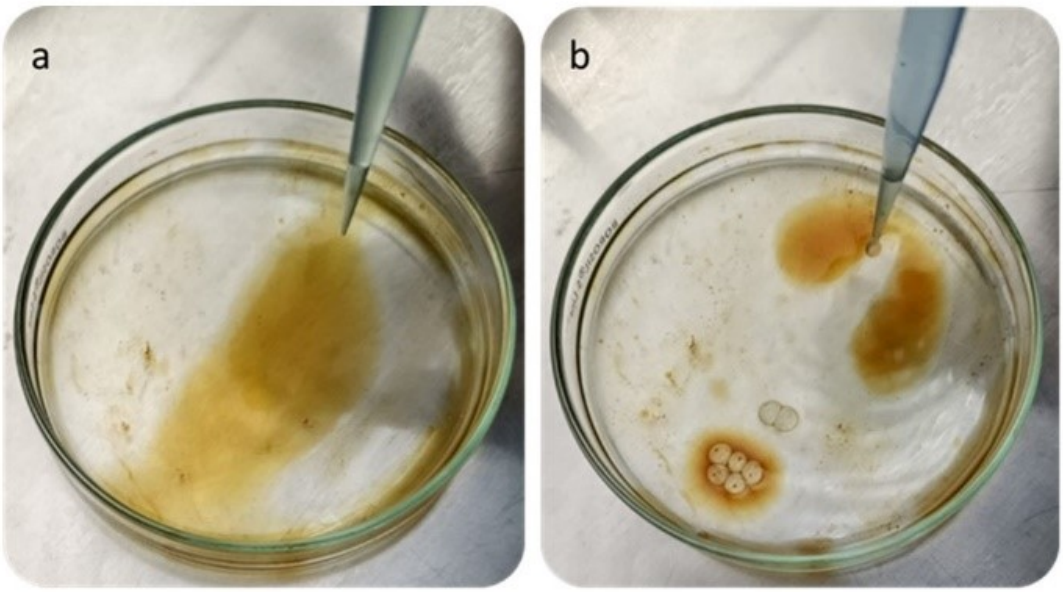

Fig. *SI-1* Images of the drop collapse assay (a) control and (b) drop collapse test.

SI-3. FT-IR spectrum of Ag_2O nanoparticles green-synthesized using *R. apiculata* mangrove leaf extract.

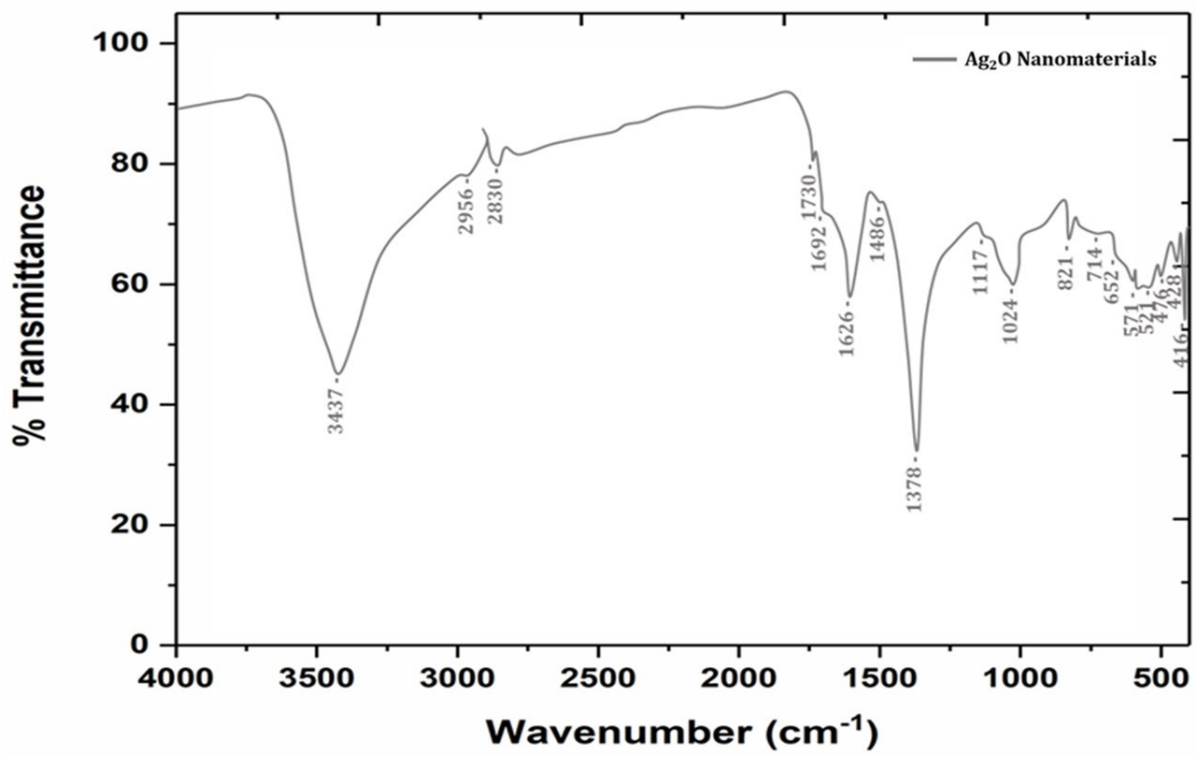

Fig. *SI-2* FT-IR spectrum of the green synthesized Ag_2O nanomaterials using *R. apiculate* mangrove leaf extract.

SI-4. Energy-dispersive X-ray spectrum of Ag_2O nanocubes.

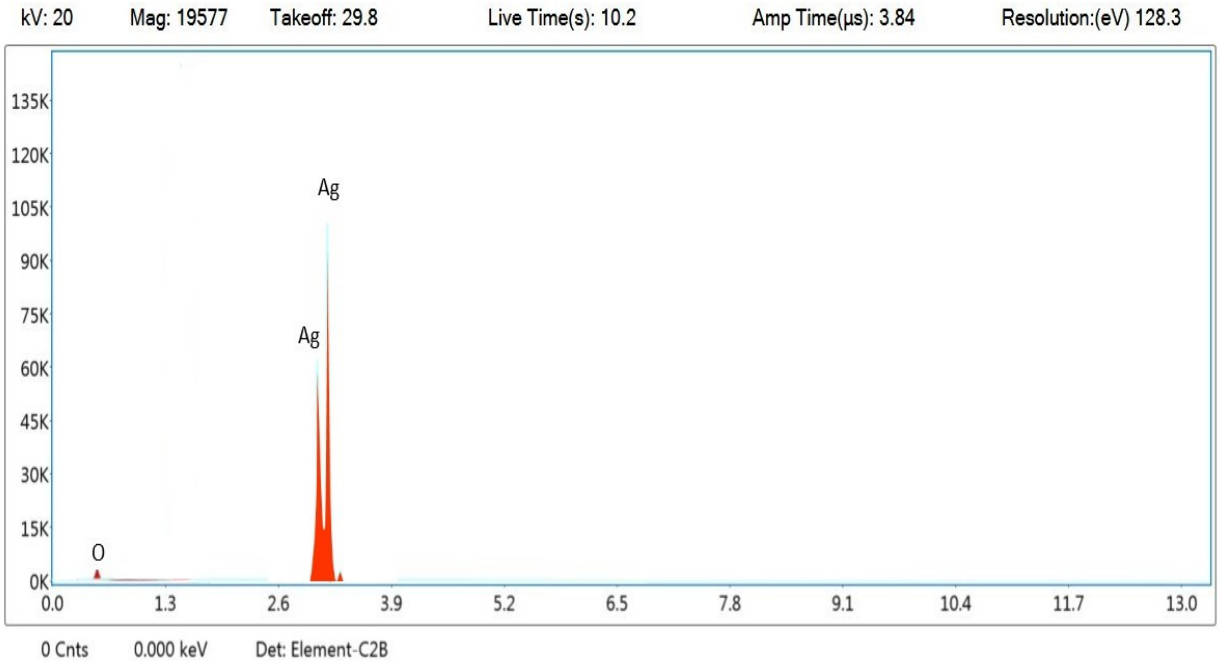

Fig. *SI-3* EDX spectrum of green synthesized Ag_2O nanocubes.

SI-5. Dynamic light scattering analysis for particle size distribution of Ag_2O nanocubes.

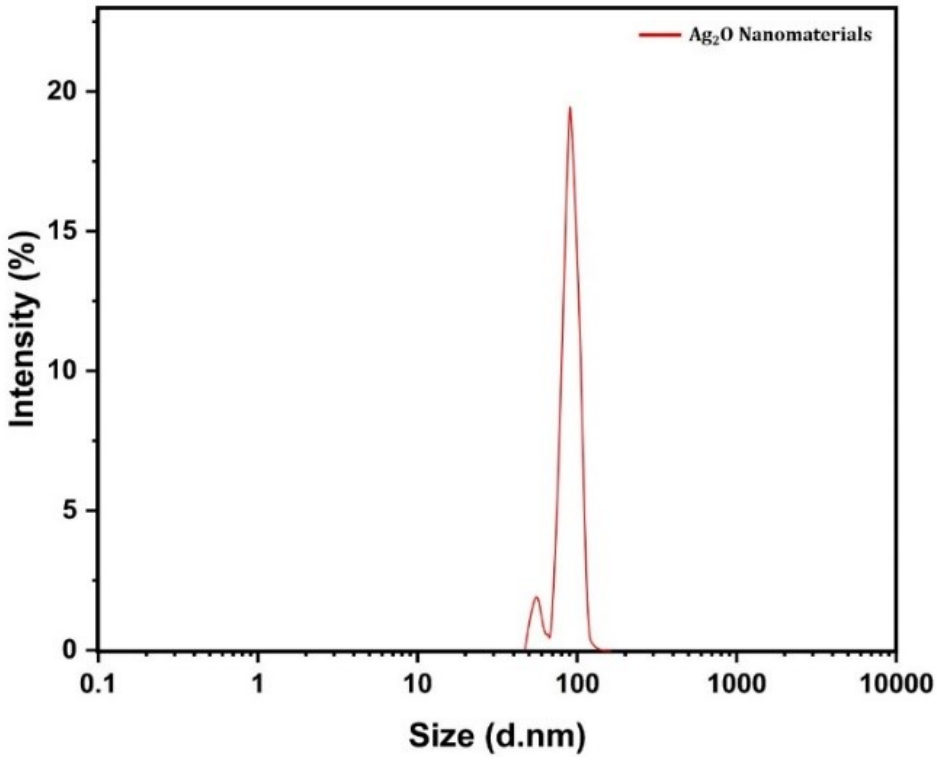

Fig. *SI-4* Surface size distribution analysis Ag_2O nanocubes using *R. apiculate* mangrove leaf extract.

SI-6. Surface charge distribution analysis of silver oxide nanocubes synthesized by dynamic light scattering.

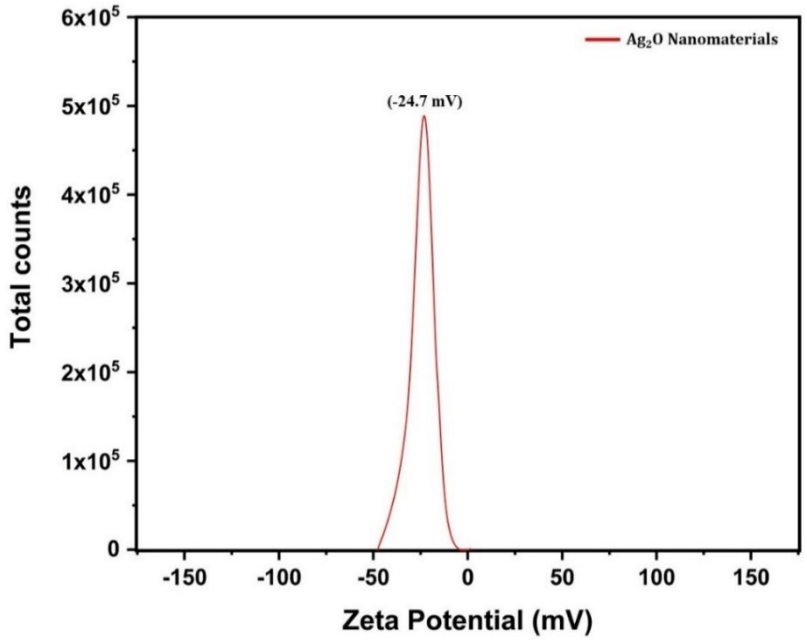

Fig. *SI-5* Surface charge distribution analysis silver oxide nanocubes using *R. apiculate* mangrove leaf extract.

SI-7. Photo-stability of m-NBR platform of Ag_2O nanocubes under prolonged daylight illumination and suppression of photo-corrosion.

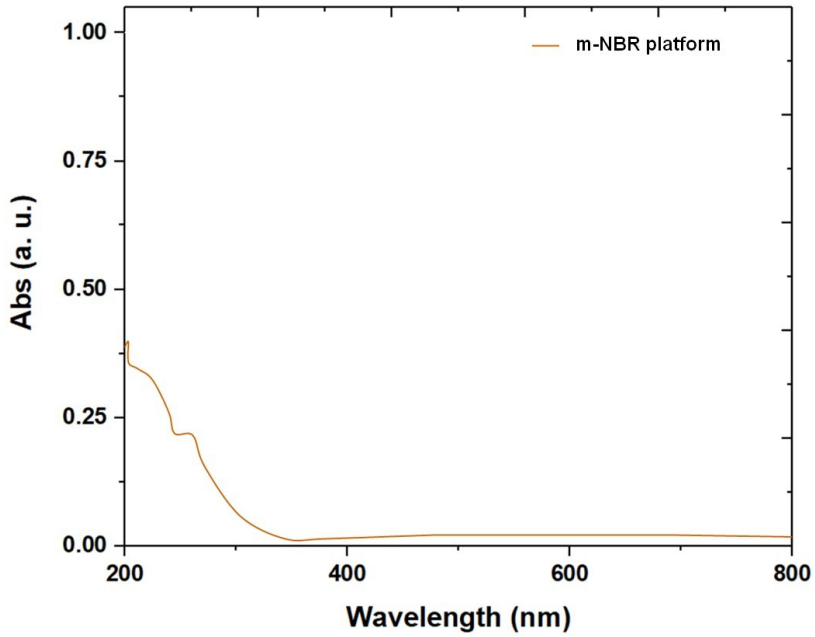

Fig. *SI-6* Photo-stability of m-NBR platform of Ag_2O under prolonged day light illumination, demonstrating the no suppression of photo-corrosion in the m-NBR platform on fifth catalytic degradation cycle as evidenced by UV-Vis absorption spectrum.

SI-8. Re-usability and catalytic performance of the m-NBR platform for HCs degradation.

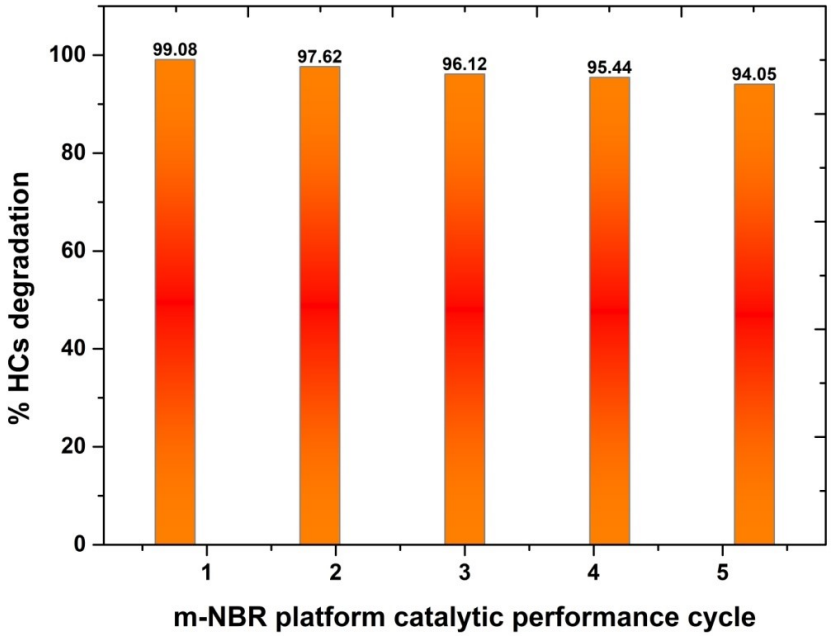

Fig. *SI-7* Reusability of the m-NBR platform for catalytic degradation of HCs, displays sustained degradation efficiency (> 94%) over five successive cycles.

SI-9. Time-dependent silver ion leaching from the m-NBR platform.

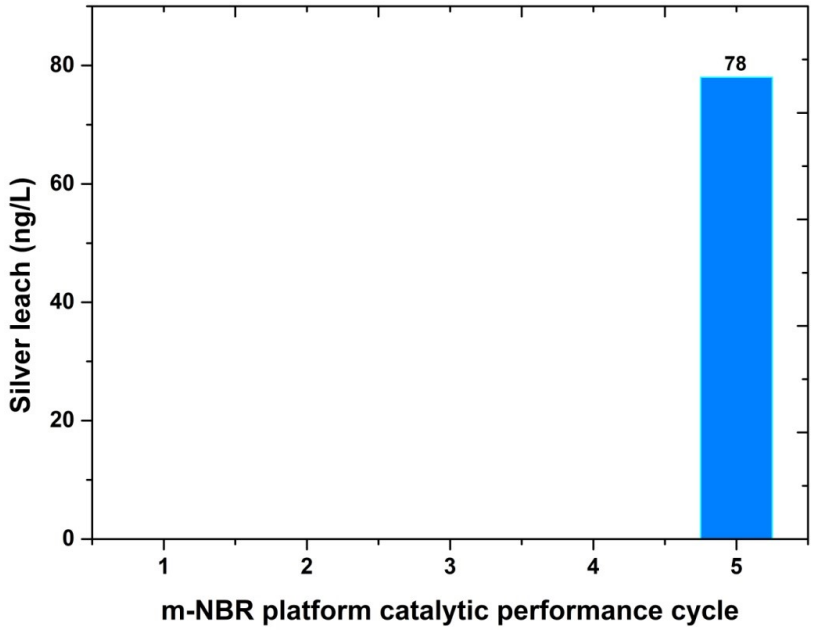

Fig. *SI-8* Time-dependent silver ion leaching from the m-NBR platform, demonstrating for catalytic degradation of HCs, displays sustained degradation efficiency (> 94%) over five successive cycles. Low metal release (ng/L) and good stability at fifth cycle.

SI-10. GC-MS quantification of HCs degradation from petroleum oil by *A. baumannii* from second day to tenth day.

Day 2

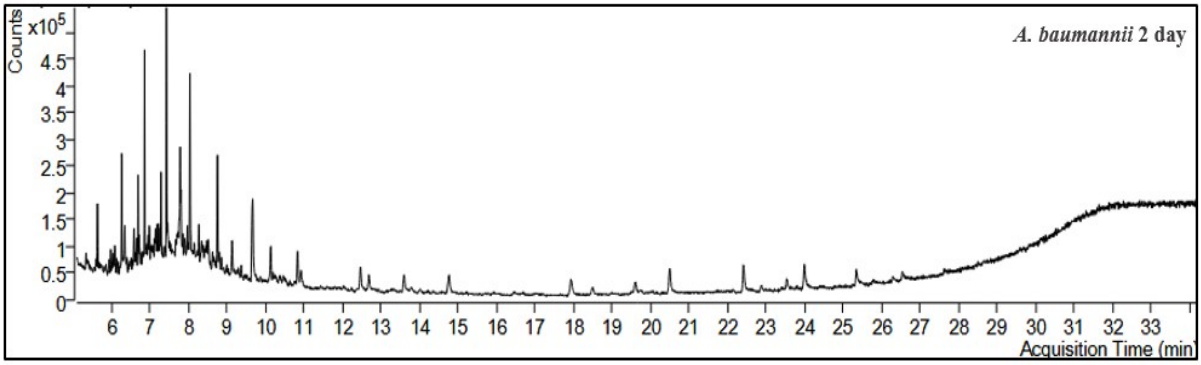

Table *S-2*. GC-MS chromatogram peak list of HCs Compounds detected on second day biodegradation by *A. baumannii*.

S. No.	Name of the Compound	Type of Hydrocarbon	RT	Peak Area	Area Percentage	Molecular Formula	Match Score
1	Undecane	n-Alkane	5.629	65388	1.22	$C_{11}H_{24}$	95.7
2	Dodecane		6.261	153493	2.86	$C_{12}H_{26}$	95.2
3	Tridecane		6.853	231792	4.33	$C_{13}H_{28}$	97.1
4	Tetradecane		7.420	193947	3.62	$C_{14}H_{30}$	98.3
5	Pentadecane		8.032	179448	3.35	$C_{15}H_{32}$	93.3
6	Hexadecane		8.747	170031	3.17	$C_{16}H_{34}$	94.7
7	Heptadecane		9.659	109676	2.04	$C_{17}H_{36}$	91.3
8	Octadecane		10.830	97085	1.81	$C_{18}H_{38}$	89.7
			n-Alkane percentage			**22.44**	
9	Hexane, 3,3-dimethyl-	iso-Alkane	5.334	48710	0.91	C_8H_{18}	91.8
10	Nonane, 5-(2-methylpropyl)-		6.038	19734	0.36	$C_{13}H_{28}$	88.4
11	4,4-Dipropylheptane		6.023	13450	0.25	$C_{13}H_{28}$	80.9
12	Octane, 4-ethyl-		6.338	20140	0.37	$C_{10}H_{22}$	86.3
13	Undecane, 3-methyl-		6.644	10868	0.20	$C_{12}H_{26}$	90.5
14	Undecane, 6-ethyl-		6.687	75412	1.40	$C_{13}H_{28}$	86.0
15	Undecane, 4,7-dimethyl-		6.976	37886	0.70	$C_{13}H_{28}$	86.2
16	Dodecane, 3-methyl-		7.212	32334	0.60	$C_{13}H_{28}$	88.4
17	Dodecane, 2,6,10-trimethyl-		7.777	32060	0.59	$C_{15}H_{32}$	90.0
18	Tetradecane, 3-methyl-		7.847	23327	0.43	$C_{15}H_{32}$	83.0
19	Heptadecane, 7-methyl-		9.127	62568	1.16	$C_{18}H_{38}$	88.7
20	Hexadecane, 2,6,10-trimethyl-		9.663	75792	1.41	$C_{19}H_{40}$	63.1
21	Undecane, 2-methyl-		10.131	64558	1.20	$C_{12}H_{26}$	90.8
22	Nonane, 3,7-dimethyl-		10.919	40215	0.75	$C_{11}H_{24}$	89.2
23	Undecane, 3,7-dimethyl-		12.461	69029	1.28	$C_{13}H_{28}$	91.3
24	Octane, 3,4,5,6-tetramethyl-		27.628	17040	0.31	$C_{12}H_{26}$	85.1
25	Butane, 2,2-dimethyl-		28.123	944	0.01	C_6H_{14}	58.6
			iso-Alkane percentage			**12.03**	

26	Cyclohexane		5.259	3160	0.06	C_6H_{12}	61.8
27	Cyclooctane	**Cycloalkanes**	6.578	31842	0.59	C_8H_{16}	82.2
		Cycloalkane percentage				**0.65**	
28	Benzene, tert-butyl-		5.186	8182	0.15	$C_{10}H_{14}$	86.2
29	Benzene, 1,2,3-trimethyl-		5.555	10203	0.19	C_9H_{12}	76.1
30	Benzene, 1,2,3,5-tetramethyl-		6.070	26009	0.49	$C_{10}H_{14}$	82.7
31	Benzene, pentamethyl-		6.299	21580	0.40	$C_{11}H_{16}$	86.2
32	p-Cymene		7.116	30848	0.58	$C_{10}H_{14}$	87.0
33	Naphthalene, 1-methyl-		7.751	49690	0.93	$C_{12}H_{10}$	88.5
34	Naphthalene, 2-methyl-		7.782	80856	1.51	$C_{12}H_{10}$	89.9
35	Naphthalene, 1,2-dimethyl-		7.892	28170	0.53	$C_{12}H_{12}$	78.4
36	Naphthalene, 1,5-dimethyl-		7.898	26596	0.50	$C_{12}H_{12}$	88.4
37	Naphthalene, 2,6-dimethyl-	**PAHs**	8.319	28949	0.54	$C_{12}H_{12}$	84.6
38	Naphthalene, 2,3-dimethyl-		8.436	10186	0.19	$C_{12}H_{12}$	82.9
39	Naphthalene, 1,6,7-trimethyl-		8.446	63413	1.18	$C_{13}H_{14}$	83.3
40	Naphthalene, 2,3,6-trimethyl-		8.506	28485	0.53	$C_{13}H_{14}$	88.6
41	Naphthalene, 2-ethyl-		8.668	10420	0.19	$C_{12}H_{12}$	85.3
42	1,4,5,8-Tetramethylnaphthalene		8.752	57238	1.07	$C_{14}H_{16}$	81.0
43	Anthracene, 2-methyl-		19.900	7938	0.15	$C_{15}H_{12}$	84.3
	Phenanthrene, 2-methyl-		20.033	6510	0.12	$C_{15}H_{12}$	80.5
44	Dibenzo[fg,ij]pentaphene		32.015	875	0.02	$C_{28}H_{16}$	86.8
PAHs percentage						**9.27**	
Aliphatic Hydrocarbons percentage						**35.13**	
HCs percentage						**44.40**	

Day 4

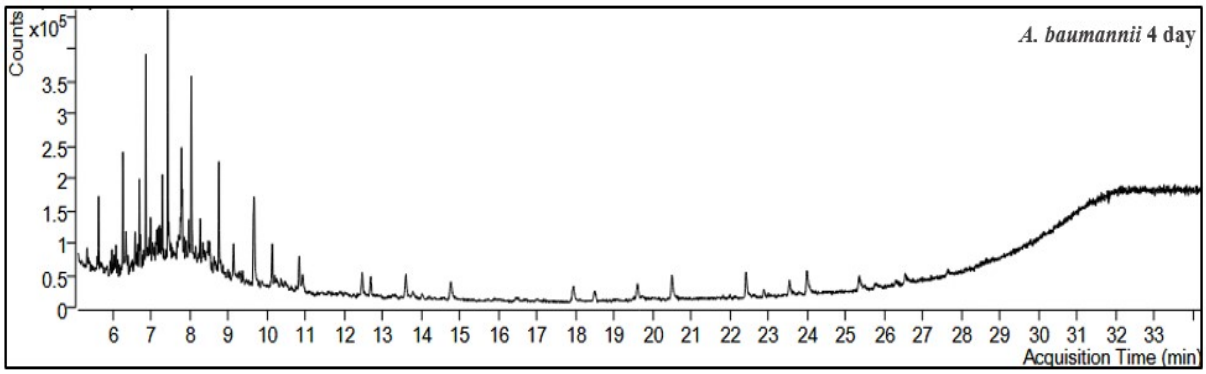

Table *S-3.* GC-MS chromatogram peak list of HCs Compounds detected on fourth day biodegradation by *A. baumannii*.

S.	Name of the Compound	Type of	RT	Peak	Area	Molecular	Match

No.		Hydrocarbon		Area	Percentage	Formula	Score
1	Undecane	n-Alkane	5.619	55234	1.53	$C_{11}H_{24}$	95.4
2	Dodecane		6.261	110274	3.06	$C_{12}H_{26}$	97.2
3	Tridecane		6.853	183213	5.09	$C_{13}H_{28}$	97.1
4	Tetradecane		7.424	152088	4.22	$C_{14}H_{30}$	98.4
5	Pentadecane		8.032	135824	3.77	$C_{15}H_{32}$	95.3
6	Hexadecane		8.546	186077	5.17	$C_{16}H_{34}$	94.7
7	Heptadecane		9.600	80948	2.25	$C_{17}H_{36}$	94.3
8	Octadecane		10.629	8085	0.22	$C_{18}H_{38}$	89.2
		n-Alkane percentage				**25.33**	
9	Hexane, 3,3-dimethyl-	iso-Alkane	5.331	31363	0.87	C_8H_{18}	93.8
10	Nonane, 5-(2-methylpropyl)-		6.069	12734	0.35	$C_{13}H_{28}$	88.4
11	4,4-Dipropylheptane		6.086	10032	0.28	$C_{13}H_{28}$	80.9
12	Octane, 4-ethyl-		6.306	15487	0.43	$C_{10}H_{22}$	88.3
13	Undecane, 3-methyl-		6.642	9978	0.28	$C_{12}H_{26}$	90.5
14	Undecane, 6-ethyl-		6.686	68062	1.89	$C_{13}H_{28}$	86.0
15	Undecane, 4,7-dimethyl-		6.816	33733	0.94	$C_{13}H_{28}$	86.2
16	Dodecane, 3-methyl-		7.174	27550	0.76	$C_{13}H_{28}$	88.9
17	Dodecane, 2,6,10-trimethyl-		7.789	21323	0.59	$C_{15}H_{32}$	90.0
18	Tetradecane, 3-methyl-		7.793	204274	5.67	$C_{15}H_{32}$	83.0
19	Heptadecane, 7-methyl-		9.147	12693	0.35	$C_{18}H_{38}$	88.7
20	Hexadecane, 2,6,10-trimethyl-		9.628	70625	1.96	$C_{19}H_{40}$	83.1
21	Undecane, 2-methyl-		10.158	43096	1.20	$C_{12}H_{26}$	90.8
22	Nonane, 3,7-dimethyl-		10.830	36350	1.01	$C_{11}H_{24}$	90.2
23	Undecane, 3,7-dimethyl-		12.584	58836	1.63	$C_{13}H_{28}$	91.3
24	Octane, 3,4,5,6-tetramethyl-		27.518	5657	0.16	$C_{12}H_{26}$	85.1
25	Butane, 2,2-dimethyl-		28.296	634	0.02	C_6H_{14}	88.6
		iso-Alkane percentage				**18.40**	
26	Cyclohexane	cycloalkanes	6.549	2328	0.06	C_6H_{12}	81.8
27	Cyclooctane		6.534	23769	0.66	C_8H_{16}	82.2
		Cycloalkane percentage				**0.72**	
28	Benzene, tert-butyl-	PAHs	5.185	6910	0.19	$C_{10}H_{14}$	84.2
29	Benzene, 1,2,3-trimethyl-		6.045	9585	0.27	C_9H_{12}	76.1
30	Benzene, 1,2,3,5-tetramethyl-		6.370	10956	0.30	$C_{10}H_{14}$	82.7
31	Benzene, pentamethyl-		6.489	12649	0.35	$C_{11}H_{16}$	89.2
32	p-Cymene		6.516	23824	0.66	$C_{10}H_{14}$	87.0
33	Naphthalene, 1-methyl-		7.454	30277	0.84	$C_{12}H_{10}$	86.5
34	Naphthalene, 2-methyl-		7.182	66361	1.84	$C_{12}H_{10}$	89.9
35	Naphthalene, 1,2-dimethyl-		7.692	15473	0.43	$C_{12}H_{12}$	74.4
36	Naphthalene, 1,5-dimethyl-		7.798	20250	0.56	$C_{12}H_{12}$	80.4
37	Naphthalene, 2,6-dimethyl-		7.789	23485	0.65	$C_{12}H_{12}$	81.6
38	Naphthalene, 2,3-dimethyl-		7.481	8055	0.22	$C_{12}H_{12}$	82.9
39	Naphthalene, 1,6,7-trimethyl-		8.444	48860	1.36	$C_{13}H_{14}$	83.3
40	Naphthalene, 2,3,6-		8.505	20560	0.57	$C_{13}H_{14}$	85.6

	trimethyl-						
41	Naphthalene, 2-ethyl-		8.222	8781	0.24	$C_{12}H_{12}$	85.1
42	1,4,5,8-Tetramethylnaphthalene		10.142	41808	1.16	$C_{14}H_{16}$	80.0
43	Anthracene, 2-methyl-		28.500	6571	0.18	$C_{15}H_{12}$	84.3
	Phenanthrene, 2-methyl-		30.013	4893	0.13	$C_{15}H_{12}$	81.5
44	Dibenzo[fg,ij]pentaphene		32.033	572	0.01	$C_{28}H_{16}$	86.8
PAHs percentage						**10.00**	
Aliphatic Hydrocarbons percentage						**44.64**	
HCs percentage						**54.64**	

Day 6

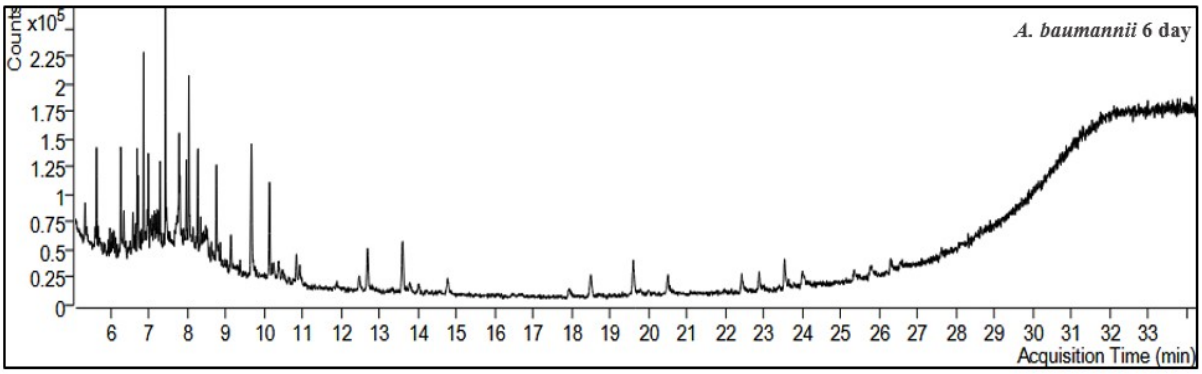

Table *S-4.* GC-MS chromatogram peak list of HCs Compounds detected on sixth day biodegradation by *A. baumannii*.

S. No.	Name of the Compound	Type of Hydrocarbon	RT	Peak Area	Area Percentage	Molecular Formula	Match Score
1	Undecane		5.421	32721	1.89	$C_{11}H_{24}$	94.4
2	Dodecane		6.653	81827	4.72	$C_{12}H_{26}$	84.1
3	Tridecane		6.810	107409	6.19	$C_{13}H_{28}$	89.5
4	Tetradecane	**n-Alkane**	7.432	68089	3.93	$C_{14}H_{30}$	86.4
5	Pentadecane		8.063	95801	5.52	$C_{15}H_{32}$	92.1
6	Hexadecane		8.352	85061	4.90	$C_{16}H_{34}$	83.6
7	Heptadecane		9.669	71948	4.15	$C_{17}H_{36}$	88.1
8	Octadecane		10.463	6047	0.35	$C_{18}H_{38}$	82.2
		n-Alkane percentage				**31.65**	
9	Hexane, 3,3-dimethyl-		5.329	21001	1.21	C_8H_{18}	94.4
10	Nonane, 5-(2-methylpropyl)-		6.331	8523	0.49	$C_{13}H_{28}$	86.1
11	4,4-Dipropylheptane		6.686	7689	0.44	$C_{13}H_{28}$	88.5
12	Octane, 4-ethyl-		6.734	10178	0.59	$C_{10}H_{22}$	86.0
13	Undecane, 3-methyl-		6.671	8205	0.47	$C_{12}H_{26}$	92.1
14	Undecane, 6-ethyl-		6.680	46741	2.69	$C_{13}H_{28}$	83.6
15	Undecane, 4,7-dimethyl-		6.866	20037	1.15	$C_{13}H_{28}$	88.2
16	Dodecane, 3-methyl-		7.850	7278	0.42	$C_{13}H_{28}$	65.2
17	Dodecane, 2,6,10-trimethyl-	**iso-Alkane**	7.969	8459	0.49	$C_{15}H_{32}$	89.8
18	Tetradecane, 3-methyl-		7.766	92347	5.32	$C_{15}H_{32}$	89.6

19	Heptadecane, 7-methyl-		9.128	10144	0.58	$C_{18}H_{38}$	86.2
20	Hexadecane, 2,6,10-trimethyl-		9.660	52136	3.01	$C_{19}H_{40}$	93.5
21	Undecane, 2-methyl-		10.130	23523	1.36	$C_{12}H_{26}$	90.2
22	Nonane, 3,7-dimethyl-		10.832	27981	1.61	$C_{11}H_{24}$	85.3
23	Undecane, 3,7-dimethyl-		12.591	42457	2.45	$C_{13}H_{28}$	83.4
24	Octane, 3,4,5,6-tetramethyl-		27.629	30781	1.77	$C_{12}H_{26}$	91.4
25	Butane, 2,2-dimethyl-		28.331	230	0.01	C_6H_{14}	86.1
			iso-Alkane percentage			**24.09**	
26	Cyclohexane	**Cycloalkanes**	6.551	1431	0.08	C_6H_{12}	81.0
27	Cyclooctane		6.564	10681	0.62	C_8H_{16}	81.3
			Cycloalkane percentage			**0.70**	
28	Benzene, tert-butyl-		5.181	6139	0.35	$C_{10}H_{14}$	84.9
29	Benzene, 1,2,3-trimethyl-		6.048	5284	0.30	C_9H_{12}	94.4
30	Benzene, 1,2,3,5-tetramethyl-		6.372	7329	0.42	$C_{10}H_{14}$	86.9
31	Benzene, pentamethyl-		6.490	8104	0.47	$C_{11}H_{16}$	89.6
32	p-Cymene		6.516	18567	1.07	$C_{10}H_{14}$	93.5
33	Naphthalene, 1-methyl-		7.051	17784	1.02	$C_{12}H_{10}$	91.9
34	Naphthalene, 2-methyl-		7.181	27237	1.57	$C_{12}H_{10}$	84.3
35	Naphthalene, 1,2-dimethyl-		7.692	10097	0.58	$C_{12}H_{12}$	85.3
36	Naphthalene, 1,5-dimethyl-		7.798	12170	0.70	$C_{12}H_{12}$	90.1
37	Naphthalene, 2,6-dimethyl-		7.785	18281	1.05	$C_{12}H_{12}$	94.9
38	Naphthalene, 2,3-dimethyl-	**PAHs**	7.481	6013	0.35	$C_{12}H_{12}$	94.6
39	Naphthalene, 1,6,7-trimethyl-		8.440	29840	1.72	$C_{13}H_{14}$	86.9
40	Naphthalene, 2,3,6-trimethyl-		8.505	15570	0.90	$C_{13}H_{14}$	94.6
41	Naphthalene, 2-ethyl-		8.622	6741	0.39	$C_{12}H_{12}$	93.5
42	1,4,5,8-Tetramethylnaphthalene		10.154	31708	1.83	$C_{14}H_{16}$	81.9
43	Anthracene, 2-methyl-		28.503	4541	0.26	C7H7N	94.3
	Phenanthrene, 2-methyl-		30.013	2993	0.17	$C_{15}H_{12}$	85.7
44	Dibenzo[fg,ij]pentaphene		32.031	130	0.0	$C_{28}H_{16}$	90.1
PAHs percentage						**13.18**	
Aliphatic Hydrocarbons percentage						**56.44**	
HCs percentage						**69.62**	

Day 8

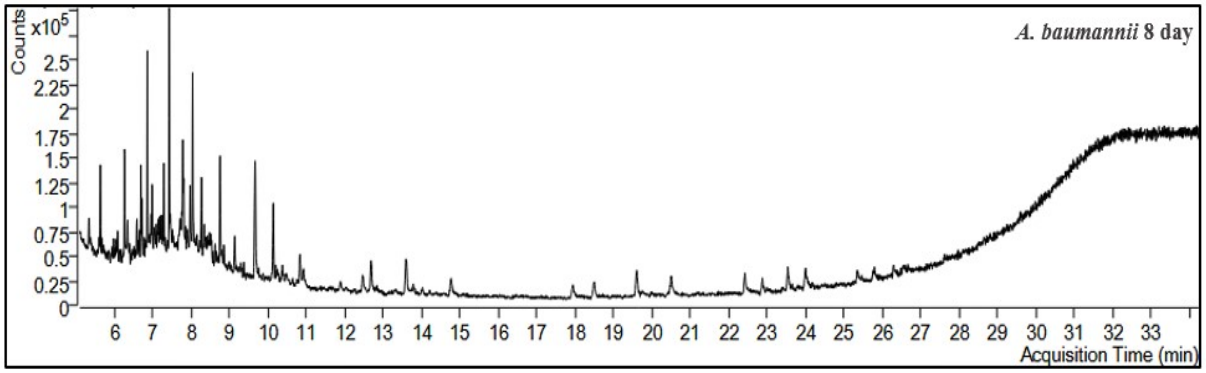

Table *S-5.* GC-MS chromatogram peak list of HCs Compounds detected on eighth day biodegradation by *A. baumannii*.

S. No.	Name of the Compound	Type of Hydrocarbon	RT	Peak Area	Area Percentage	Molecular Formula	Match Score
1	Undecane	n-Alkane	5.641	14761	1.48	$C_{11}H_{24}$	86.6
2	Dodecane		6.852	54787	5.51	$C_{12}H_{26}$	90.2
3	Tridecane		6.480	84472	8.50	$C_{13}H_{28}$	86.0
4	Tetradecane		7.467	37526	3.77	$C_{14}H_{30}$	84.0
5	Pentadecane		8.047	78519	7.90	$C_{15}H_{32}$	92.7
6	Hexadecane		8.766	62011	6.24	$C_{16}H_{34}$	86.4
7	Heptadecane		9.632	58347	5.87	$C_{17}H_{36}$	86.2
8	Octadecane		10.794	4135	0.42	$C_{18}H_{38}$	94.3
			n-Alkane percentage			**39.69**	
9	Hexane, 3,3-dimethyl-	iso-Alkane	5.322	10027	1.01	C_8H_{18}	90.1
10	Nonane, 5-(2-methylpropyl)-		6.397	5696	0.57	$C_{13}H_{28}$	93.4
11	4,4-Dipropylheptane		6.677	6817	0.68	$C_{13}H_{28}$	97.1
12	Octane, 4-ethyl-		6.788	9274	0.93	$C_{10}H_{22}$	86.0
13	Undecane, 3-methyl-		6.676	6583	0.66	$C_{12}H_{26}$	90.6
14	Undecane, 6-ethyl-		6.612	32272	3.25	$C_{13}H_{28}$	83.1
15	Undecane, 4,7-dimethyl-		6.855	10078	1.01	$C_{13}H_{28}$	83.6
16	Dodecane, 3-methyl-		7.804	5884	0.59	$C_{13}H_{28}$	87.2
17	Dodecane, 2,6,10-trimethyl-		7.966	5339	0.54	$C_{15}H_{32}$	84.1
18	Tetradecane, 3-methyl-		7.767	41196	4.14	$C_{15}H_{32}$	90.8
19	Heptadecane, 7-methyl-		9.100	8363	0.84	$C_{18}H_{38}$	89.0
20	Hexadecane, 2,6,10-trimethyl-		9.650	42845	4.31	$C_{19}H_{40}$	92.4
21	Undecane, 2-methyl-		10.131	10117	1.02	$C_{12}H_{26}$	91.2
22	Nonane, 3,7-dimethyl-		10.885	11461	1.15	$C_{11}H_{24}$	89.3
23	Undecane, 3,7-dimethyl-		12.433	18457	1.86	$C_{13}H_{28}$	90.1
24	Octane, 3,4,5,6-tetramethyl-		27.605	15784	1.59	$C_{12}H_{26}$	93.4
			iso-Alkane percentage			**24.16**	
25	Cyclohexane	Cycloalkanes	6.809	945	0.09	C_6H_{12}	92.9
26	Cyclooctane		6.505	7961	0.80	C_8H_{16}	91.2
			Cycloalkane percentage			**0.89**	
28	Benzene, tert-butyl-	PAHs	5.063	40418	4.07	$C_{10}H_{14}$	93.6
29	Benzene, 1,2,3-trimethyl-		6.021	3457	0.35	C_9H_{12}	89.0
30	Benzene, 1,2,3,5-tetramethyl-		6.132	6521	0.66	$C_{10}H_{14}$	84.9
31	Benzene, pentamethyl-		6.458	5490	0.55	$C_{11}H_{16}$	86.4
32	p-Cymene		6.514	10319	1.04	$C_{10}H_{14}$	81.9
33	Naphthalene, 1-methyl-		7.006	13496	1.36	$C_{12}H_{10}$	80.4
34	Naphthalene, 2-methyl-		7.157	15844	1.59	$C_{12}H_{10}$	91.3
35	Naphthalene, 1,2-dimethyl-		7.621	9105	0.92	$C_{12}H_{12}$	87.3
36	Naphthalene, 1,5-dimethyl-		7.711	7703	0.77	$C_{12}H_{12}$	83.4
37	Naphthalene, 2,6-dimethyl-		7.700	3916	0.39	$C_{12}H_{12}$	89.0
38	Naphthalene, 2,3-		7.409	4852	0.49	$C_{12}H_{12}$	84.9

	dimethyl-						
39	Naphthalene, 1,6,7-trimethyl-		8.427	17078	1.72	$C_{13}H_{14}$	86.7
40	Naphthalene, 2,3,6-trimethyl-		8.518	10258	1.03	$C_{13}H_{14}$	84.9
41	Naphthalene, 2-ethyl-		8.618	5417	0.54	$C_{12}H_{12}$	96.4
42	1,4,5,8-Tetramethylnaphthalene		10.109	20781	2.09	$C_{14}H_{16}$	80.3
43	Anthracene, 2-methyl-		28.501	2487	0.25	$C_{15}H_{12}$	87.4
44	Phenanthrene, 2-methyl-		30.018	1438	0.14	$C_{15}H_{12}$	81.8
PAHs percentage						**17.97**	
Aliphatic Hydrocarbons percentage						**64.75**	
HCs percentage						**82.72**	

Day 10

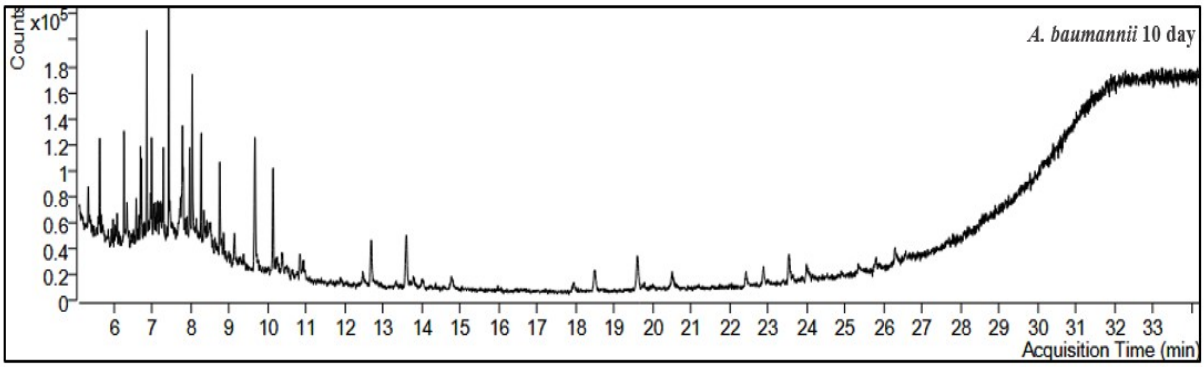

Table *S-6.* GC-MS chromatogram peak list of HCs Compounds detected on tenth day biodegradation by *A. baumannii*.

S. No.	Name of the Compound	Type of Hydrocarbon	RT	Peak Area	Area Percentage	Molecular Formula	Match Score
1	Undecane		5.642	12834	1.64	$C_{11}H_{24}$	80.8
2	Dodecane		6.705	46821	5.97	$C_{12}H_{26}$	83.3
3	Tridecane		6.420	75514	9.63	$C_{13}H_{28}$	87.6
4	Tetradecane	**n-Alkane**	7.432	35929	4.58	$C_{14}H_{30}$	92.7
5	Pentadecane		8.146	63281	8.07	$C_{15}H_{32}$	90.8
6	Hexadecane		8.465	56217	7.17	$C_{16}H_{34}$	95.3
7	Heptadecane		9.531	44751	5.71	$C_{17}H_{36}$	83.6
8	Octadecane		10.614	3301	0.42	$C_{18}H_{38}$	84.5
		n-Alkane percentage				**43.19**	
9	Hexane, 3,3-dimethyl-		5.216	9332	1.19	C_8H_{18}	81.1
10	Nonane, 5-(2-methylpropyl)-		6.391	4414	0.56	$C_{13}H_{28}$	94.4
11	4,4-Dipropylheptane	**iso-Alkane**	6.646	5992	0.76	$C_{13}H_{28}$	85.2
12	Octane, 4-ethyl-		6.781	7817	1.00	$C_{10}H_{22}$	80.1
13	Undecane, 3-methyl-		6.534	5364	0.68	$C_{12}H_{26}$	86.8
14	Undecane, 6-ethyl-		6.642	23407	2.98	$C_{13}H_{28}$	81.9
15	Undecane, 4,7-dimethyl-		6.830	4887	0.62	$C_{13}H_{28}$	87.3

16	Dodecane, 3-methyl-		7.815	22115	2.82	$C_{13}H_{28}$	91.9
17	Dodecane, 2,6,10-trimethyl-		7.921	4936	0.63	$C_{15}H_{32}$	92.0
18	Tetradecane, 3-methyl-		7.722	31124	3.97	$C_{15}H_{32}$	95.1
19	Heptadecane, 7-methyl-		9.125	7760	0.99	$C_{18}H_{38}$	85.3
20	Hexadecane, 2,6,10-trimethyl-		9.619	34786	4.444	$C_{19}H_{40}$	84.5
21	Undecane, 2-methyl-		10.132	8500	1.08	$C_{12}H_{26}$	86.4
22	Nonane, 3,7-dimethyl-		10.803	9984	1.27	$C_{11}H_{24}$	95.4
23	Undecane, 3,7-dimethyl-		12.436	14181	1.81	$C_{13}H_{28}$	81.4
24	Octane, 3,4,5,6-tetramethyl-		27.667	10361	1.32	$C_{12}H_{26}$	80.7
			iso-Alkane percentage			**26.14**	
25	Cyclooctane	**Cycloalkanes**	6.318	2473	0.31	C_8H_{16}	98.1
			Cycloalkane percentage			**0.31**	
26	Benzene, tert-butyl-		5.041	31497	4.02	$C_{10}H_{14}$	90.1
27	Benzene, 1,2,3-trimethyl-		6.014	2738	0.35	C_9H_{12}	96.4
28	Benzene, 1,2,3,5-tetramethyl-		6.150	5455	0.69	$C_{10}H_{14}$	92.3
29	p-Cymene		6.187	9327	1.19	$C_{10}H_{14}$	82.1
30	Naphthalene, 1-methyl-		7.605	12434	1.58	$C_{12}H_{10}$	83.7
31	Naphthalene, 2-methyl-		7.171	12734	1.62	$C_{12}H_{10}$	80.4
32	Naphthalene, 1,2-dimethyl-		7.646	8134	1.04	$C_{12}H_{12}$	95.3
33	Naphthalene, 1,5-dimethyl-		7.714	6904	0.88	$C_{12}H_{12}$	90.7
34	Naphthalene, 2,6-dimethyl-		7.751	3715	0.47	$C_{12}H_{12}$	95.6
35	Naphthalene, 2,3-dimethyl-		7.474	4027	0.51	$C_{12}H_{12}$	88.9
36	Naphthalene, 1,6,7-trimethyl-		8.424	15062	1.92	$C_{13}H_{14}$	85.1
37	Naphthalene, 2,3,6-trimethyl-	**PAHs**	8.516	9837	1.25	$C_{13}H_{14}$	89.4
38	Naphthalene, 2-ethyl-		8.643	4834	0.62	$C_{12}H_{12}$	80.4
39	1,4,5,8-Tetramethylnaphthalene		10.179	15379	1.96	$C_{14}H_{16}$	91.8
40	Anthracene, 2-methyl-		28.571	1867	0.24	$C_{15}H_{12}$	92.1
41	Phenanthrene, 2-methyl-		30.740	1069	0.14	$C_{15}H_{12}$	86.4
PAHs percentage						**18.49**	
Aliphatic Hydrocarbons percentage						**69.65**	
HCs percentage						**88.14**	

SI-11. GC-MS quantification of HCs degradation from petroleum oil by m-NBR platform from second day to sixth day.

Day2

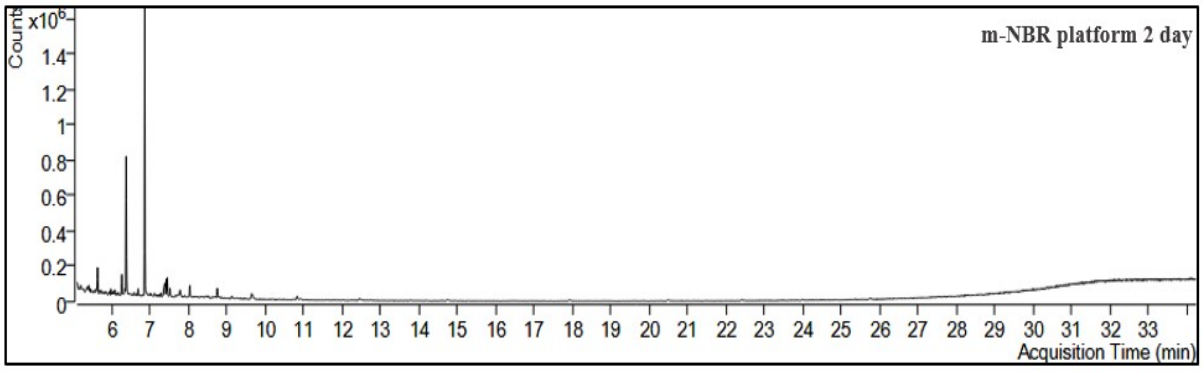

Table *S-7.* GC-MS chromatogram peak list of HCs Compounds detected on second day degradation by m-NBR platform.

S. No.	Name of the Compound	Type of Hydrocarbon	RT	Peak Area	Area Percentage	Molecular Formula	Match Score
1	Undecane	n-Alkane	5.538	35341	1.34	$C_{11}H_{24}$	80.4
2	Dodecane		6.346	103474	3.93	$C_{12}H_{26}$	88.1
3	Tridecane		6.847	141192	5.37	$C_{13}H_{28}$	90.5
4	Tetradecane		7.391	123437	4.69	$C_{14}H_{30}$	90.0
5	Pentadecane		8.081	109738	4.17	$C_{15}H_{32}$	91.7
6	Hexadecane		8.640	110551	4.20	$C_{16}H_{34}$	85.4
7	Heptadecane		9.586	89316	3.39	$C_{17}H_{36}$	87.8
8	Octadecane		10.801	87615	3.33	$C_{18}H_{38}$	84.5
		n-Alkane percentage				**30.44**	
9	Hexane, 3,3-dimethyl-	iso-Alkane	5.261	35110	1.33	C_8H_{18}	82.1
10	Nonane, 5-(2-methylpropyl)-		6.037	14734	0.56	$C_{13}H_{28}$	84.1
11	4,4-Dipropylheptane		6.090	10410	0.39	$C_{13}H_{28}$	84.6
12	Octane, 4-ethyl-		6.321	18140	0.69	$C_{10}H_{22}$	81.0
13	Undecane, 3-methyl-		6.623	9748	0.37	$C_{12}H_{26}$	96.4
14	Undecane, 6-ethyl-		6.670	63414	2.41	$C_{13}H_{28}$	94.8
15	Undecane, 4,7-dimethyl-		6.994	35801	1.36	$C_{13}H_{28}$	91.1
16	Dodecane, 3-methyl-		7.314	28304	1.08	$C_{13}H_{28}$	83.7
17	Dodecane, 2,6,10-trimethyl-		7.821	27010	1.03	$C_{15}H_{32}$	86.3
18	Tetradecane, 3-methyl-		7.744	19314	0.73	$C_{15}H_{32}$	84.4
19	Heptadecane, 7-methyl-		9.174	52564	2.00	$C_{18}H_{38}$	80.6
20	Hexadecane, 2,6,10-trimethyl-		9.439	65442	2.49	$C_{19}H_{40}$	85.0
21	Undecane, 2-methyl-		10.316	34058	1.29	$C_{12}H_{26}$	94.8
22	Nonane, 3,7-dimethyl-		10.9394	31214	1.19	$C_{11}H_{24}$	97.1
23	Undecane, 3,7-dimethyl-		12.411	61007	2.32	$C_{13}H_{28}$	96.4
24	Octane, 3,4,5,6-tetramethyl-		27.865	10010	0.38	$C_{12}H_{26}$	85.6
25	Butane, 2,2-dimethyl-		28.168	640	0.02	C_6H_{14}	80.4
		iso-Alkane percentage				**19.65**	
26	Cyclohexane	Cycloalkanes	5.204	2060	0.08	C_6H_{12}	82.1
27	Cyclooctane		6.431	24842	0.94	C_8H_{16}	83.5
		Cycloalkane percentage				**1.02**	
28	Benzene, tert-butyl-		5.139	6571	0.25	$C_{10}H_{14}$	85.9
29	Benzene, 1,2,3-trimethyl-		5.542	9405	0.36	C_9H_{12}	80.1

30	Benzene, 1,2,3,5-tetramethyl-		6.072	18034	0.68	$C_{10}H_{14}$	93.0
31	Benzene, pentamethyl-		6.218	16570	0.63	$C_{11}H_{16}$	85.0
32	p-Cymene		7.104	19835	0.75	$C_{10}H_{14}$	90.1
33	Naphthalene, 1-methyl-		7.740	32640	1.24	$C_{12}H_{10}$	92.7
34	Naphthalene, 2-methyl-		7.828	50253	1.91	$C_{12}H_{10}$	92.8
35	Naphthalene, 1,2-dimethyl-		7.894	24150	0.92	$C_{12}H_{12}$	95.3
36	Naphthalene, 1,5-dimethyl-	**PAHs**	7.899	21536	0.82	$C_{12}H_{12}$	90.3
37	Naphthalene, 2,6-dimethyl-		8.161	22432	0.85	$C_{12}H_{12}$	93.4
38	Naphthalene, 2,3-dimethyl-		8.336	10186	0.39	$C_{12}H_{12}$	90.8
39	Naphthalene, 1,6,7-trimethyl-		8.410	51420	1.95	$C_{13}H_{14}$	89.9
40	Naphthalene, 2,3,6-trimethyl-		8.500	16413	0.62	$C_{13}H_{14}$	86.1
41	Naphthalene, 2-ethyl-		8.656	7320	0.28	$C_{12}H_{12}$	98.5
42	1,4,5,8-Tetramethylnaphthalene		8.536	44238	1.68	$C_{14}H_{16}$	82.1
43	Anthracene, 2-methyl-		19.014	5936	0.22	$C_{15}H_{12}$	84.4
	Phenanthrene, 2-methyl-		20.314	4215	0.16	$C_{15}H_{12}$	90.6
44	Dibenzo[fg,ij]pentaphene		32.017	530	0.02	$C_{28}H_{16}$	85.0
PAHs percentage						**13.75**	
Aliphatic Hydrocarbons percentage						**51.12**	
HCs percentage						**64.87**	

Day 4

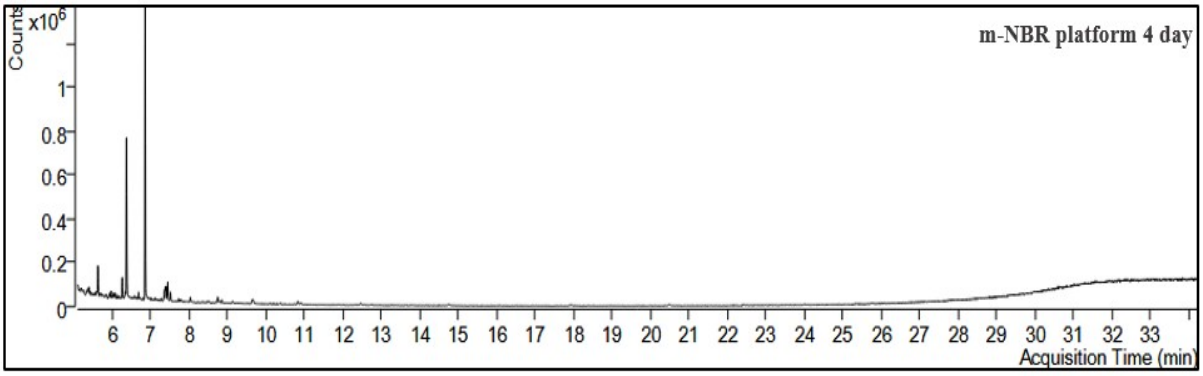

Table *S-8.* GC-MS chromatogram peak list of HCs Compounds detected on fourth day degradation by m-NBR platform.

S. No.	Name of the Compound	Type of Hydrocarbon	RT	Peak Area	Area Percentage	Molecular Formula	Match Score
1	Dodecane		6.337	70173	4.81	$C_{12}H_{26}$	80.0
2	Tridecane		6.834	81490	5.58	$C_{13}H_{28}$	95.3
3	Tetradecane		7.394	63445	4.35	$C_{14}H_{30}$	83.1
4	Pentadecane	**n-Alkane**	8.015	89740	6.15	$C_{15}H_{32}$	95.7
5	Hexadecane		8.634	80550	5.52	$C_{16}H_{34}$	94.1
6	Heptadecane		9.527	89316	6.12	$C_{17}H_{36}$	84.6

7	Octadecane		10.810	66814	4.58	$C_{18}H_{38}$	80.4
			n-Alkane percentage		**37.10**		
8	Nonane, 5-(2-methylpropyl)-		6.140	10621	0.73	$C_{13}H_{28}$	84.0
9	4,4-Dipropylheptane		6.024	9102	0.62	$C_{13}H_{28}$	93.3
10	Octane, 4-ethyl-		6.301	16120	1.10	$C_{10}H_{22}$	81.0
11	Undecane, 3-methyl-		6.633		3.66	$C_{12}H_{26}$	93.4
12	Undecane, 6-ethyl-	**iso-Alkane**	6.690	53400	2.98	$C_{13}H_{28}$	81.2
13	Heptadecane, 7-methyl-		9.135	43565	3.66	$C_{18}H_{38}$	82.3
14	Hexadecane, 2,6,10-trimethyl-		9.614	53440	2.19	$C_{19}H_{40}$	94.0
15	Undecane, 2-methyl-		10.345	32008	2.00	$C_{12}H_{26}$	94.5
16	Nonane, 3,7-dimethyl-		10.930	29215	4.05	$C_{11}H_{24}$	87.5
17	Undecane, 3,7-dimethyl-		12.476	59055	0.73	$C_{13}H_{28}$	96.1
			iso-Alkane percentage			**21.00**	
18	Cyclooctane	**Cycloalkanes**	6.540	18805	1.29	C_8H_{16}	80.5
			Cycloalkane percentage			**1.29**	
19	Benzene, 1,2,3,5-tetramethyl-		6.035	12085	0.83	$C_{10}H_{14}$	90.1
20	Benzene, pentamethyl-		6.229	12430	0.85	$C_{11}H_{16}$	92.3
21	p-Cymene		7.115	14635	1.00	$C_{10}H_{14}$	91.1
22	Naphthalene, 1-methyl-		7.765	24860	1.70	$C_{12}H_{10}$	90.4
23	Naphthalene, 2-methyl-		7.764	36254	2.48	$C_{12}H_{10}$	89.8
24	Naphthalene, 1,2-dimethyl-		7.863	14100	0.97	$C_{12}H_{12}$	80.6
25	Naphthalene, 1,5-dimethyl-		7.892	17545	1.20	$C_{12}H_{12}$	82.3
26	Naphthalene, 2,6-dimethyl-	**PAHs**	8.336	19431	1.33	$C_{12}H_{12}$	83.4
27	Naphthalene, 2,3-dimethyl-		8.469	8100	0.55	$C_{12}H_{12}$	85.7
28	Naphthalene, 1,6,7-trimethyl-		8.415	15478	1.06	$C_{13}H_{14}$	90.5
29	Naphthalene, 2,3,6-trimethyl-		8.507	8010	0.55	$C_{13}H_{14}$	87.1
30	Naphthalene, 2-ethyl-		8.635	4050	0.28	$C_{12}H_{12}$	84.0
31	1,4,5,8-Tetramethylnaphthalene		8.741	30079	2.06	$C_{14}H_{16}$	82.6
32	Anthracene, 2-methyl-		19.904	3940	0.27	$C_{15}H_{12}$	80.7
33	Phenanthrene, 2-methyl-		20.017	2250	0.15	$C_{15}H_{12}$	90.5
PAHs percentage						**15.29**	
Aliphatic Hydrocarbons percentage						**59.39**	
HCs percentage						**74.69**	

Day 6 or 1-Cycle

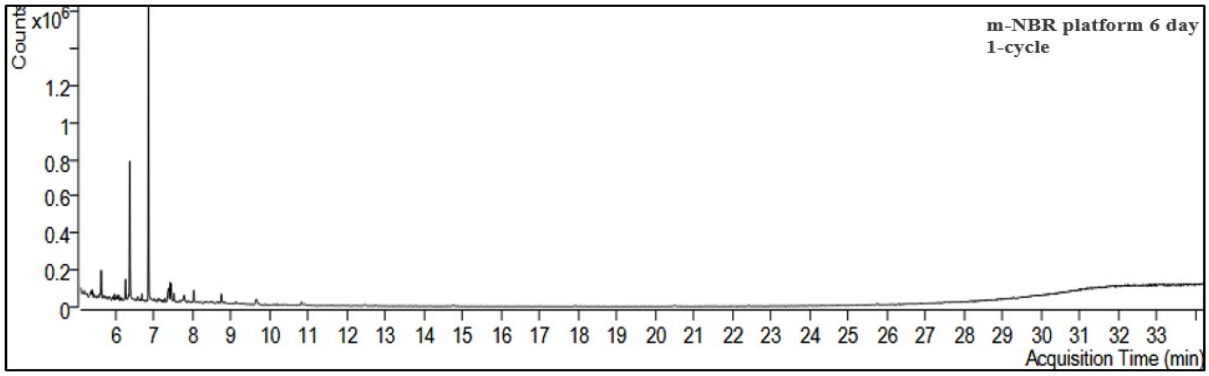

Table *S-9.* GC-MS chromatogram peak list of HCs Compounds detected on sixth day degradation or first catalytic degradation cycle by m-NBR platform.

S. No.	Name of the Compound	Type of Hydrocarbon	RT	Peak Area	Area Percentage	Molecular Formula	Match Score
1	Tridecane	n-Alkane	6.721	50490	12.27	$C_{13}H_{28}$	80.1
2	Pentadecane		8.037	48740	11.84	$C_{15}H_{32}$	81.5
3	Hexadecane		8.856	36550	8.88	$C_{16}H_{34}$	85.4
4	Heptadecane		9.518	65316	15.87	$C_{17}H_{36}$	87.1
		n-Alkane percentage				**48.86**	
5	Undecane, 6-ethyl-	iso-Alkane	6.474	21400	5.20	$C_{13}H_{28}$	94.5
6	Heptadecane, 7-methyl-		9.976	18565	4.51	$C_{18}H_{38}$	84.2
7	Hexadecane, 2,6,10-trimethyl-		9.6134	33140	8.05	$C_{19}H_{40}$	82.0
8	Undecane, 3,7-dimethyl-		12.437	41055	9.97	$C_{13}H_{28}$	98.4
		iso-Alkane percentage				**27.74**	
9	Cyclooctane	Cycloalkanes	6.543	7805	1.90	C_8H_{16}	81.5
		Cycloalkane percentage				**1.90**	
10	p-Cymene	PAHs	7.139	8610	2.09	$C_{10}H_{14}$	80.3
11	Naphthalene, 1-methyl-		7.794	16860	4.10	$C_{12}H_{10}$	92.4
12	Naphthalene, 2-methyl-		7.747	21250	5.16	$C_{12}H_{10}$	94.8
13	Naphthalene, 1,2-dimethyl-		7.847	14531	3.53	$C_{12}H_{12}$	95.7
14	Naphthalene, 1,5-dimethyl-		7.856	8434	2.05	$C_{12}H_{12}$	92.3
15	Naphthalene, 2,6-dimethyl-		8.365	15079	3.66	$C_{12}H_{12}$	90.2
16	1,4,5,8-Tetramethylnaphthalene		8.797	8610	2.09	$C_{14}H_{16}$	86.4
PAHs percentage						**20.59**	
Aliphatic Hydrocarbons percentage						**78.49**	
HCs percentage						**99.08**	

SI-12. GC-MS quantification of HCs degradation catalytic performance cycles by m-NBR platform.

2-Cycle

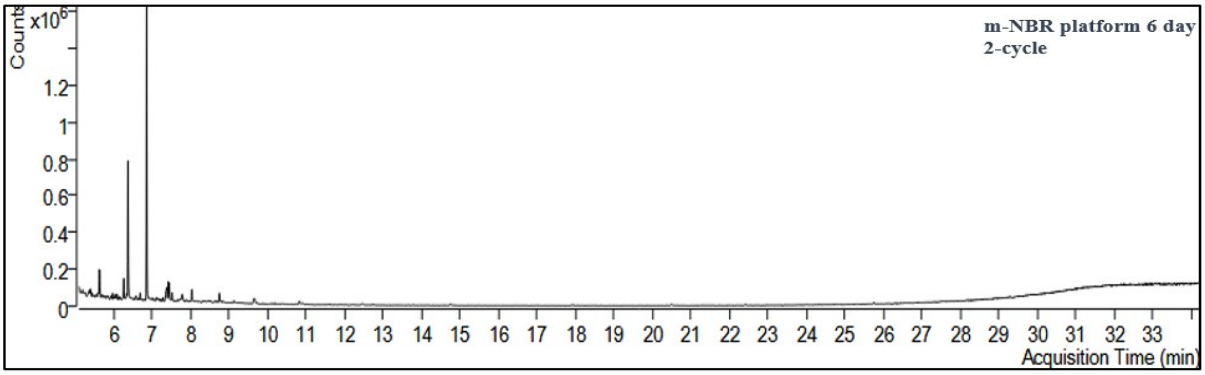

Table *S-10.* GC-MS chromatogram peak list of HCs Compounds detected on second day catalytic degradation cycle by m-NBR platform.

S. No.	Name of the Compound	Type of Hydrocarbon	RT	Peak Area	Area Percentage	Molecular Formula	Match Score
1	Tridecane	n-Alkane	6.347	49011	11.91	$C_{13}H_{28}$	90.1
2	Pentadecane		8.674	48018	11.49	$C_{15}H_{32}$	81.5
3	Hexadecane		8.198	36012	8.62	$C_{16}H_{34}$	94.0
4	Heptadecane		9.538	64012	15.40	$C_{17}H_{36}$	97.1
			n-Alkane percentage			**48.22**	
5	Undecane, 6-ethyl-	iso-Alkane	6.367	21085	5.12	$C_{13}H_{28}$	84.5
6	Heptadecane, 7-methyl-		9.196	18294	4.44	$C_{18}H_{38}$	80.2
7	Hexadecane, 2,6,10-trimethyl-		9.462	32652	7.93	$C_{19}H_{40}$	91.0
8	Undecane, 3,7-dimethyl-		12.357	40453	9.82	$C_{13}H_{28}$	98.4
			iso-Alkane percentage			**27.32**	
9	Cyclooctane	Cycloalkanes	6.851	7689	1.87	C_8H_{16}	81.5
			Cycloalkane percentage			**1.87**	
10	p-Cymene	PAHs	7.317	8484	2.06	$C_{10}H_{14}$	90.3
11	Naphthalene, 1-methyl-		7.146	16615	4.04	$C_{12}H_{10}$	92.5
12	Naphthalene, 2-methyl-		7.394	20938	5.09	$C_{12}H_{10}$	90.8
13	Naphthalene, 1,2-dimethyl-		7.267	14315	3.48	$C_{12}H_{12}$	95.3
14	Naphthalene, 1,5-dimethyl-		7.168	8309	2.02	$C_{12}H_{12}$	82.1
15	Naphthalene, 2,6-dimethyl-		8.943	14859	3.61	$C_{12}H_{12}$	90.7
16	1,4,5,8-Tetramethylnaphthalene		8.135	8484	2.06	$C_{14}H_{16}$	96.5
PAHs percentage						**20.21**	
Aliphatic Hydrocarbons percentage						**77.41**	
HCs percentage						**97.62**	

3-Cycle

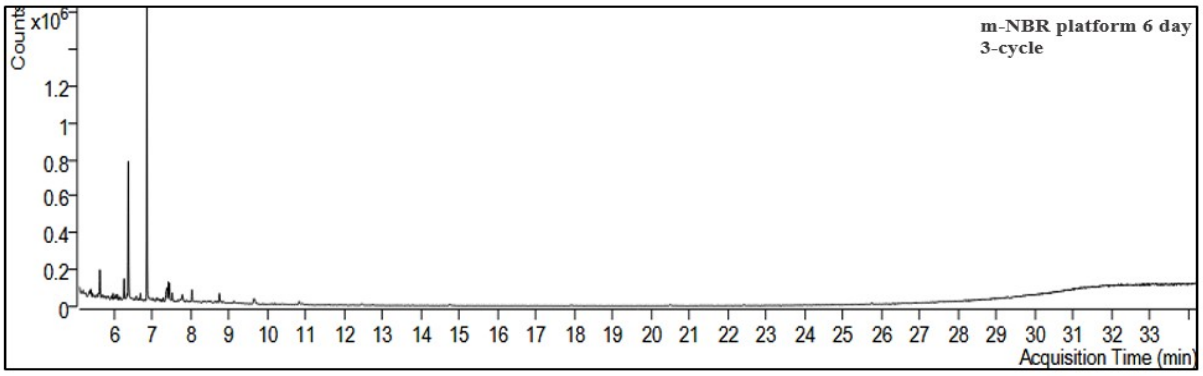

Table *S-11.* GC-MS chromatogram peak list of HCs Compounds detected on third day catalytic degradation cycle by m-NBR platform.

S. No.	Name of the Compound	Type of Hydrocarbon	RT	Peak Area	Area Percentage	Molecular Formula	Match Score
1	Tridecane	n-Alkane	6.815	48249	11.72	$C_{13}H_{28}$	90.0
2	Pentadecane		8.041	47278	11.32	$C_{15}H_{32}$	91.6
3	Hexadecane		8.073	35455	8.48	$C_{16}H_{34}$	89.4
4	Heptadecane		9.537	63356	15.17	$C_{17}H_{36}$	87.1
n-Alkane percentage						**47.39**	
5	Undecane, 6-ethyl-	iso-Alkane	6.613	20757	5.04	$C_{13}H_{28}$	91.3
6	Heptadecane, 7-methyl-		9.134	18009	4.37	$C_{18}H_{38}$	80.1
7	Hexadecane, 2,6,10-trimethyl-		9.614	32146	7.81	$C_{19}H_{40}$	81.8
8	Undecane, 3,7-dimethyl-		12.436	39823	9.67	$C_{13}H_{28}$	96.1
iso-Alkane percentage						**26.90**	
9	Cyclooctane	Cycloalkanes	6.543	7569	1.84	C_8H_{16}	94.4
Cycloalkane percentage						**1.84**	
10	p-Cymene	PAHs	7.107	8351	2.03	$C_{10}H_{14}$	80.4
11	Naphthalene, 1-methyl-		7.164	16353	3.97	$C_{12}H_{10}$	96.1
12	Naphthalene, 2-methyl-		7.3467	20612	5.01	$C_{12}H_{10}$	90.9
13	Naphthalene, 1,2-dimethyl-		7.471	14095	3.42	$C_{12}H_{12}$	85.0
14	Naphthalene, 1,5-dimethyl-		7.876	8181	1.99	$C_{12}H_{12}$	82.3
15	Naphthalene, 2,6-dimethyl-		8.334	14627	3.55	$C_{12}H_{12}$	91.6
16	1,4,5,8-Tetramethylnaphthalene		8.794	8351	2.03	$C_{14}H_{16}$	96.1
PAHs percentage						**19.98**	
Aliphatic Hydrocarbons percentage						**76.14**	
HCs percentage						**96.12**	

4-Cycle

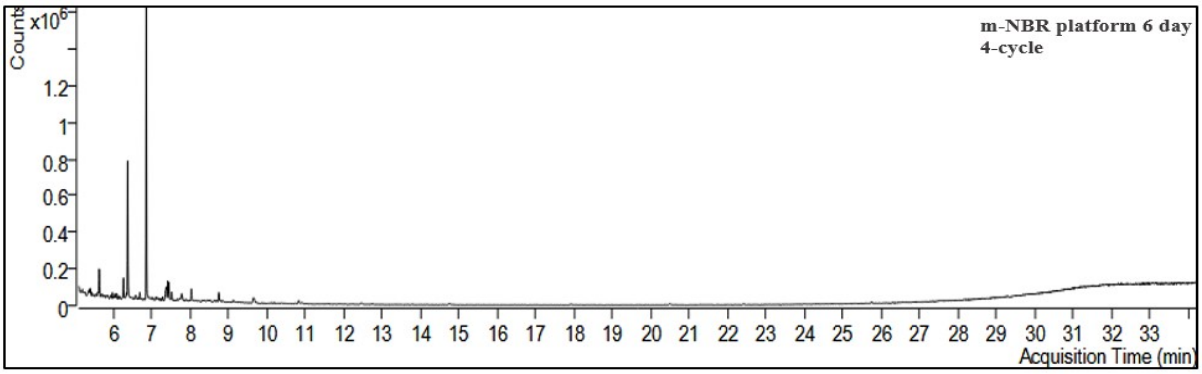

Table *S-12.* GC-MS chromatogram peak list of HCs Compounds detected on fourth day catalytic degradation cycle by m-NBR platform.

S. No.	Name of the Compound	Type of Hydrocarbon	RT	Peak Area	Area Percentage	Molecular Formula	Match Score
1	Tridecane	n-Alkane	6.964	47905	11.64	$C_{13}H_{28}$	80.6
2	Pentadecane		8.016	46937	11.23	$C_{15}H_{32}$	91.5
3	Hexadecane		8.248	35198	8.43	$C_{16}H_{34}$	85.1
4	Heptadecane		9.671	62900	15.05	$C_{17}H_{36}$	97.3
		n-Alkane percentage				**47.05**	
5	Undecane, 6-ethyl-	iso-Alkane	6.034	20605	5.01	$C_{13}H_{28}$	84.5
6	Heptadecane, 7-methyl-		9.147	17879	4.34	$C_{18}H_{38}$	90.2
7	Hexadecane, 2,6,10-trimethyl-		9.946	31912	7.75	$C_{19}H_{40}$	41.8
8	Undecane, 3,7-dimethyl-		12.367	39534	9.60	$C_{13}H_{28}$	88.4
		iso-Alkane percentage				**26.70**	
9	Cyclooctane	Cycloalkanes	6.143	7518	1.83	C_8H_{16}	91.1
		Cycloalkane percentage				**1.83**	
10	p-Cymene	PAHs	7.012	8288	2.01	$C_{10}H_{14}$	80.3
11	Naphthalene, 1-methyl-		7.136	16222	3.95	$C_{12}H_{10}$	82.4
12	Naphthalene, 2-methyl-		7.476	20464	4.97	$C_{12}H_{10}$	90.7
13	Naphthalene, 1,2-dimethyl-		7.671	14005	3.40	$C_{12}H_{12}$	85.3
14	Naphthalene, 1,5-dimethyl-		7.710	8121	1.97	$C_{12}H_{12}$	92.3
15	Naphthalene, 2,6-dimethyl-		8.231	14510	3.53	$C_{12}H_{12}$	81.7
16	1,4,5,8-Tetramethylnaphthalene		8.972	8288	2.01	$C_{14}H_{16}$	96.2
PAHs percentage						**19.86**	
Aliphatic Hydrocarbons percentage						**75.58**	
HCs percentage						**95.44**	

5-Cycle

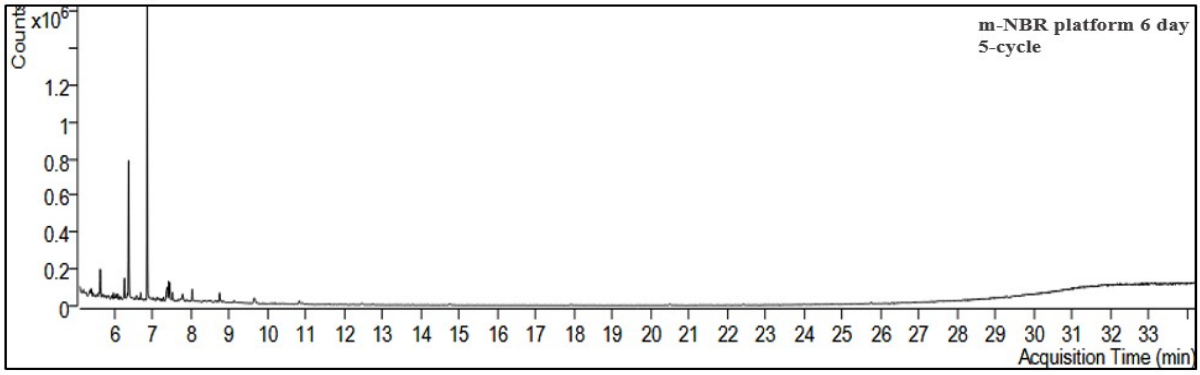

Table *S-13.* GC-MS chromatogram peak list of HCs Compounds detected on fifth day catalytic degradation cycle by m-NBR platform.

S. No.	Name of the Compound	Type of Hydrocarbon	RT	Peak Area	Area Percentage	Molecular Formula	Match Score
1	Tridecane	n-Alkane	6.017	47200	11.46	$C_{13}H_{28}$	90.7
2	Pentadecane		8.317	46240	11.07	$C_{15}H_{32}$	92.1
3	Hexadecane		8.396	34680	8.30	$C_{16}H_{34}$	88.3
4	Heptadecane		9.873	61980	14.84	$C_{17}H_{36}$	83.8
			n-Alkane percentage			**45.68**	
5	Undecane, 6-ethyl-	iso-Alkane	6.767	20309	4.93	$C_{13}H_{28}$	94.5
6	Heptadecane, 7-methyl-		9.697	17619	4.28	$C_{18}H_{38}$	80.1
7	Hexadecane, 2,6,10-trimethyl-		9.776	31440	7.64	$C_{19}H_{40}$	93.0
8	Undecane, 3,7-dimethyl-		12.143	38960	9.47	$C_{13}H_{28}$	98.4
			iso-Alkane percentage			**26.33**	
9	Cyclooctane	Cycloalkanes	6.517	7400	1.80	C_8H_{16}	81.5
			Cycloalkane percentage			**1.80**	
10	p-Cymene	PAHs	7.113	8170	1.98	$C_{10}H_{14}$	80.1
11	Naphthalene, 1-methyl-		7.716	15990	3.89	$C_{12}H_{10}$	92.4
12	Naphthalene, 2-methyl-		7.177	20150	4.90	$C_{12}H_{10}$	90.6
13	Naphthalene, 1,2-dimethyl-		7.964	13790	3.34	$C_{12}H_{12}$	85.3
14	Naphthalene, 1,5-dimethyl-		7.183	7990	1.93	$C_{12}H_{12}$	92.3
15	Naphthalene, 2,6-dimethyl-		8.173	14290	3.46	$C_{12}H_{12}$	83.7
16	1,4,5,8-Tetramethylnaphthalene		8.169	8170	1.98	$C_{14}H_{16}$	86.4
PAHs percentage						**20.24**	
Aliphatic Hydrocarbons percentage						**73.81**	
HCs percentage						**94.05**	

SI-13. Density functional theory quantum chemical calculations for oxides of silver species (AgO^-, Ag_2O and Ag_4O^{2+}).

a. The Cartesian coordinates of optimized geometries of the designed dyes AgO^- Symbolic Z-matrix:

---
opt b3pw91/lanl2dz geom = connectivity

AgO^-

Symbolic Z-matrix:
Charge = 1 Multiplicity = 1

Ag	-3.58761	1.30471	-1.79217
O	-2.52278	1.18497	-0.39596

b. The Cartesian coordinates of optimized geometries of the designed dyes Ag_2O, Symbolic Z-matrix:

---
opt b3pw91/lanl2dz geom = connectivity

Ag_2O

Charge = 0 Multiplicity = 1
Cartesian coordinates:

Ag	-0.76751	-0.01347	-0.22536
Ag	-1.37564	2.93799	-0.38199
O	-2.35915	1.19566	-0.30096

c. The Cartesian coordinates of optimized geometries of the designed dyes Ag_4O^{2+} Symbolic Z-matrix:

---
opt b3pw91/lanl2dz geom = connectivity

Ag_4O^{2+}

Symbolic Z-matrix:
Charge = 2 Multiplicity = 1

Ag	-0.99619	-0.14238	-0.68243
Ag	-1.64336	2.96726	0.07783
Ag	-3.66022	1.31287	-1.88737

Ag	-3.50095	0.56948	1.2889
O	-2.45018	1.17681	-0.30077

d. The Cartesian coordinates of optimized geometries of the designed dyes H_2OSymbolic Z-matrix:

---
opt b3pw91/lanl2dz geom = connectivity

H_2O

Symbolic Z-matrix:
Charge = 0 Multiplicity = 1

O	-2.11572	-0.42636	-2.53263
H	-1.15572	-0.42636	-2.53263
H	-2.43618	0.47857	-2.53263

e. The Cartesian coordinates of optimized geometries of the designed dyes HO• Symbolic Z-matrix:

---
opt b3pw91/lanl2dz geom = connectivity

HO•

Symbolic Z-matrix:
Charge = 0 Multiplicity = 2

O	-2.11572	-0.42636	-2.53263
H	-1.79527	-0.39478	-1.62824

f. The Cartesian coordinates of optimized geometries of the designed dyes O_2Symbolic Z-matrix:

---
opt b3pw91/lanl2dz geom = connectivity

O_2

Symbolic Z-matrix:
Charge = 0 Multiplicity = 1

O	-2.11572	-0.42636	-2.53263
O	-3.27732	-0.42636	-2.53263

g. The Cartesian coordinates of optimized geometries of the designed dyes $O_2^{\bullet-}$ Symbolic Z-matrix:

$O_2^{\bullet-}$

Symbolic Z-matrix:

Charge = -1 Multiplicity = 2

O -2.11572 -0.42636 -2.53263

O -3.27732 -0.42636 -2.53263

SI-14. List of Electronic Energies of HCs including n-alkanes, iso-alkanes, cycloalkanes, poly aromatic hydrocarbons and secondary metabolites from GC-MS studies

Table *S-14* List of electronic energies of HCs from petroleum oil pollutants of all n-alkanes, iso-alkanes, cycloalkanes and PAHs are calculated at the B3PW91/LANL2DZ level of theory and basis sets.

Hydrocarbon classifications	Name of the compound	Multiplicity	E (Hartree)	ZPE (Hartree)	Thermal correction to energy (Hartree)	Thermal correction to Gibbs free energy (Hartree)	Solvation (Water) kcal/mol	Total energy including solvent, ZPE and thermal corrections (Hartree)
n-Alkanes	undecane	singlet	-433.439317053	0.334619	0.349816	0.290951	-0.10	-432.4639311
	dodecane	singlet	-472.733373916	0.363332	0.379894	0.317476	-0.11	-471.6726719
	tridecane	singlet	-512.027433178	0.392086	0.409998	0.344134	-0.12	-510.8812152
	tetradecane	singlet	-551.321489126	0.420799	0.440078	0.370682	-0.13	-550.0899301
	pentadecane	singlet	-590.615547418	0.449546	0.470178	0.397348	-0.14	-589.2984754
	hexadecane	singlet	-629.909603125	0.478261	0.500260	0.423911	-0.15	-628.5071711
	heptadecane	singlet	-669.203660951	0.507004	0.530357	0.450581	-0.15	-667.715719
	octadecane	singlet	-708.497716649	0.535720	0.560441	0.477156	-0.16	-706.9243996
Iso-Alkanes	butane, 2,2-dimethyl-	singlet	-236.967870777	0.189924	0.198156	0.158643	-0.06	-236.4211478
	hexane, 3,3-dimethyl-	singlet	-315.552649751	0.247170	0.258274	0.211035	-0.07	-314.8361708
	octane, 4-ethyl-	singlet	-394.138955287	0.305564	0.319318	0.264526	-0.09	-393.2495473
	octane, 3,4,5,6-tetramethyl-	singlet	-472.714969834	0.362883	0.378803	0.320972	-0.10	-471.6523118
	heptane, 4,4-dipropyl-	singlet	-512.012759444	0.391948	0.409493	0.347230	-0.11	-510.8640884
	nonane, 3,7-dimethyl-	singlet	-433.435331518	0.333833	0.349013	0.290692	-0.09	-432.4617935
	nonane, 5-(2-methylpropyl)-	singlet	-512.020881393	0.391594	0.409227	0.345527	-0.11	-510.8745334
	undecane, 2-methyl-	singlet	-472.732844854	0.362786	0.379338	0.316865	-0.10	-471.6738559
	undecane, 3-methyl-	singlet	-472.731368865	0.362802	0.379405	0.316815	-0.10	-471.6723469
	undecane, 6-ethyl-	singlet	-512.021043646	0.391857	0.409712	0.343587	-0.11	-510.8758876
	undecane, 3,7-dimethyl-	singlet	-512.023308558	0.390842	0.408938	0.342270	-0.11	-510.8812586
	undecane, 4,7-dimethyl-	singlet	-512.023074336	0.390994	0.409020	0.343310	-0.11	-510.8797503
	dodecane, 3-methyl-	singlet	-511.248269533	0.383678	0.402683	0.335724	-0.11	-510.1261845
	dodecane, 2,6,10-trimethyl-	singlet	-590.610841306	0.447782	0.468599	0.395287	-0.12	-589.2991733
	tetradecane, 3-	singlet	-589.854305027	0.440838	0.462507	0.388706	-0.13	-588.562254

	methyl-hexadecane, 2,6,10-trimethyl-	singlet	-747.785533658	0.562676	0.588996	0.501444	-0.15	-746.1324177
	heptadecane, 7-methyl-	singlet	-708.495592106	0.534959	0.559826	0.475938	-0.15	-706.9248691
Cycloalkanes	cyclohexane	singlet	-235.764915140	0.171949	0.177688	0.143096	-0.05	-235.2721821
	cyclooctane	singlet	-314.321273328	0.229869	0.237633	0.197492	-0.06	-313.6562793
Poly Aromatic Hydrocarbons	benzene, tert-butyl-	singlet	-389.305229744	0.215123	0.224936	0.180495	-0.14	-388.6846757
	p-cymene	singlet	-389.312427097	0.214574	0.225114	0.177267	-0.11	-388.6954721
	benzene, 1,2,3-trimethyl-	singlet	-350.020274289	0.185710	0.194890	0.151747	-0.14	-349.4879273
	Benzene, 1,2,3,5-tetramethyl-	singlet	-389.318899917	0.213278	0.223498	0.177995	-0.15	-388.7041289
	Benzene, pentamethyl-	singlet	-420.601642679	0.116289	0.123365	0.084307	-0.17	-420.2776817
	naphthalene, 1-methyl-	singlet	-424.988295507	0.177736	0.186007	0.144794	-0.17	-424.4797585
	naphthalene, 2-methyl-	singlet	-424.988741552	0.177117	0.184842	0.144593	-0.17	-424.4821896
	naphthalene, 2-ethyl-	singlet	-464.281134570	0.206400	0.215199	0.172604	-0.17	-463.6869316
	naphthalene, 1,2-dimethyl-	singlet	-464.284064506	0.205851	0.215750	0.170999	-0.18	-463.6914645
	naphthalene, 2,3-dimethyl-	singlet	-464.287657439	0.205480	0.215445	0.170495	-0.18	-463.6962374
	naphthalene, 1,5-dimethyl-	singlet	-464.285937276	0.205821	0.215690	0.171090	-0.17	-463.6933363
	naphthalene, 2,6-dimethyl-	singlet	-464.288741834	0.205051	0.215335	0.169166	-0.18	-463.6991898
	naphthalene, 1,6,7-trimethyl-	singlet	-503.585561560	0.233549	0.245122	0.196782	-0.19	-502.9101086
	naphthalene, 2,3,6-trimethyl-	singlet	-503.586712444	0.233151	0.244928	0.195828	-0.18	-502.9128054
	naphthalene, 1,4,5,8-tetramethyl-	singlet	-542.855025338	0.262533	0.273813	0.226144	-0.20	-542.0925353
	anthracene, 2-methyl-	singlet	-578.546370098	0.224704	0.235748	0.187839	-0.21	-577.8980791
	phenanthrene, 2-methyl-	singlet	-578.554725533	0.225039	0.236137	0.187891	-0.22	-577.9056585
	dibenzo[fg,ij]pentaphene	singlet	-1076.12960032	0.354280	0.372224	0.307770	-0.31	-1075.095326
Poly Aromatic Hydrocarbon biodegraded secondary metabolites	benzoic acid	singlet	-420.601642679	0.116289	0.123365	0.084307	-0.30	-420.2776817
	2,5-dihydroxy benzoic acid	singlet	-570.943259054	0.122988	0.131611	0.089454	-0.69	-570.5992061
	1,3-benzene diol	singlet	-382.493441237	0.109075	0.115788	0.078540	-0.38	-382.1900382
	m-toluic acid	singlet	-459.900927098	0.143897	0.151981	0.110528	-0.30	-459.4945211
Aliphatic hydrocarbon biodegraded secondary metabolites	malonic acid	singlet	-417.423438815	0.076605	0.083620	0.044035	-0.49	-417.2191788
	oxalic acid	singlet	-378.107271164	0.047489	0.052253	0.019153	-0.52	-377.9883762
	adipic acid	singlet	-535.314425103	0.162997	0.174098	0.122672	-0.51	-534.8546581
	acetic acid	singlet	-228.965175235	0.061663	0.066297	0.034161	-0.28	-228.8030542
	acetaldehyde	singlet	-153.748810415	0.056020	0.059907	0.031043	-0.21	-153.6018404
	but-2-enoic acid	singlet	-306.323683904	0.095683	0.102232	0.065405	-0.30	-306.0603639
	2,3-butenediol	singlet	-308.738822641	0.141352	0.149293	0.110078	-0.31	-308.3380996
Complete mineralization	Carbon dioxide	singlet	-188.464111154	0.011024	0.013694	-0.009738	-0.11	-188.4491312

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