

Supplementary data

Pyrolysis and volatile evolution behaviors of cold-rolling oily sludge

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Table S1 Compents of the volatile products from cold-rolling oil sludge pyrolysis by GC/MS at 393–844 K and 844–1173 K.

Name of compounds	RT /min	Area /%	
		339–	844–
		844 K	1173 K
Aliphatic hydrocarbons			
Propene	1.773	---	0.148
Propene	2.064	---	26.206
Propene	2.108	1.132	---
Butane	2.173	---	6.659
Cyclobutene	2.180	---	5.385
2-Butene, (E)-	2.209	1.778	---
2-Butyne	2.217	0.586	---
2-Pentene, (E)-	2.410	1.977	---
Pentane	2.415	---	2.351
Cyclopropane, 1,1'-methylenebis-	2.473	0.218	---
1,4-Pentadiene	2.523	---	1.085
1,3-Pentadiene	2.549	0.246	---
Cyclopentene	2.575	---	0.760
1,3-Cyclopentadiene	2.603	0.484	---
Cyclopentene	2.660	---	0.163
Cyclopentene	2.686	0.437	---
1-Hexene	2.737	0.124	---
1,5-Hexadiene	2.816	0.163	---
Cyclopropane, propyl-	2.856	---	0.315
1-Hexene	2.884	2.031	---
n-Hexane	2.912	---	0.966
n-Hexane	2.940	0.608	---
1-Pentene, 3-methyl-	2.993	0.118	---
Cyclobutene, 3,3-dimethyl-	3.062	0.139	---
1,3-Cyclopentadiene, 1-methyl-	3.352	0.115	---
Cyclopentene, 3-methyl-	3.394	---	0.140
Cyclopentene, 3-methyl-	3.428	0.164	---
1,4-Cyclohexadiene	3.615	---	0.254
Cyclobutane, 1,2-bis(methylene)-	3.639	0.773	---
Cyclohexene	3.784	0.249	---
Butane, 2-cyclopropyl-	3.851	---	0.229
1-Heptene	3.892	1.630	---
Heptane	3.970	---	0.628
Heptane	4.010	0.681	---
2-Heptene, (E)-	4.116	0.109	---
1-Pentene, 2,4,4-trimethyl-	4.222	0.217	---
1,4-Heptadiene	4.399	0.105	---
Cyclohexene, 1-methyl-	5.327	0.119	---

Isopropylcyclobutane	5.723	---	0.105
1-Octene	5.770	1.655	---
Octane	5.933	---	0.433
Octane	5.980	0.848	---
1,3-Octadiene	6.662	0.142	---
1-Nonene	8.668	1.182	---
Nonane	8.950	0.503	---
Bicyclo[2.2.2]octane	9.050	0.131	---
1-Decene	12.257	1.385	---
Decane	12.579	0.392	---
Cyclopropane, octyl-	16.116	1.545	---
Undecane	16.446	0.538	---
2-Undecene, (E)-	16.628	0.277	---
1,4-Undecadiene, (E)-	17.429	0.233	---
Azulene	19.784	---	3.953
1-Dodecene	19.972	1.642	---
Dodecane	20.296	0.480	---
Cyclododecene	21.252	0.228	---
Tricyclo[3.2.1.0(2,4)]octane, 3-methylene-	22.550	0.165	---
1-Tridecene	23.716	1.352	---
Tridecane	24.006	0.671	---
1-Tetradecene	27.252	1.901	---
Tetradecane	27.514	0.618	---
Cyclopropane, 1-(1-methylethyl)-2-nonyl-	30.379	0.151	---
1-Pentadecene	30.592	1.739	---
Pentadecane	30.842	1.378	---
1-Pentadecene	30.962	0.111	---
Cyclohexene, 1-nonyl-	31.687	0.165	---
cis,cis-5,9-Tetradecadiene	33.262	0.118	---
7-Hexadecene, (Z)-	33.495	0.147	---
Cetene	33.737	0.504	---
Hexadecane	33.961	0.222	---
Cyclododecene, (Z)-	36.067	0.189	---
Bicyclo[3.2.1]octane	36.250	0.117	---
Cyclopentane, (2-methylbutyl)-	36.443	0.169	---
1-Heptadecene	36.735	0.367	---
Undecane, 4,7-dimethyl-	36.935	0.269	---
Heptadecane	36.941	0.260	---
Cetene	39.571	0.143	---
1,6-Octadiene, 5,7-dimethyl-, (R)-	49.762	0.396	---
Heptadecane, 4-propyl-	55.524	0.599	---
Sub Total		37.133	49.780
Aliphatic hydrocarbons			
Benzene	3.550	0.766	---

Toluene	5.262	0.589	---
Ethylbenzene	7.718	0.143	---
Styrene	8.707	0.198	---
Benzene, propyl-	10.855	0.100	---
Indene	14.307	0.131	---
Benzene, pentyl-	18.655	0.101	---
Indene	19.813	0.128	---
Benzene, heptyl-	26.274	0.143	---
Benzene, octyl-	29.784	0.138	---
Benzene, decyl-	36.273	0.475	---
Benzene	3.515	---	15.965
Toluene	5.214	---	13.365
Ethylbenzene	7.680	---	0.455
Ethylbenzene	7.956	---	2.279
Styrene	8.660	---	1.698
Benzene, 1,2,3-trimethyl-	12.332	---	0.298
Indane	12.373	---	0.566
Indane	23.928	---	0.771
Benzene, 1,2,3-trimethyl-	24.481	---	0.632
Ethylbenzene	26.870	---	0.564
Sub Total		2.912	36.594
Fatty acids			
Propanoic acid, anhydride	2.704	0.390	---
3,4,5,6-Tetrahydrophthalic anhydride	15.476	0.262	---
Nonanoic acid	23.043	0.106	---
Dodecanoic acid	33.137	2.122	---
Tetradecanoic acid	38.788	0.714	---
n-Hexadecanoic acid	45.603	8.091	---
Sub Total		11.684	0
Esters			
Butyric acid, neopentyl ester	5.922	0.122	---
Dodecanoic acid, ethenyl ester	41.305	0.213	---
Carbonic acid, prop-1-en-2-yl tetradecyl ester	41.659	0.117	---
1-Naphthoic acid, 2-dimethylaminoethyl ester	41.894	0.128	---
Allyl heptanoate	41.952	0.222	---
Octadecanoic acid, 2-propenyl ester	49.497	4.474	---
Acetic acid, (dodecahydro-7-hydroxy-1,4b,8,8-tetramethyl-10-oxo-2(1H)- phenanthrenylidene)-,2-(dimethylamino)ethyl ester	49.742	0.104	---
Pivalic acid vinyl ester	49.754	0.136	---
Dodecanoic acid, ethenyl ester	51.946	0.294	---
i-Propyl 9-octadecenoate	55.537	0.636	---
Palmitic acid vinyl ester	55.758	0.522	---
Octadecanoic acid, 2-propenyl ester	56.442	0.274	---

Phosphonic acid, ethyl hexyl ester	59.504	0.104	---
Sub Total		7.346	0
Ketones			
2-Butanone	2.435	0.634	---
2(5H)-Furanone	5.802	0.368	---
2-Cyclopenten-1-one	6.885	0.123	---
4,6-Octadiyn-3-one, 2-methyl-	8.686	---	1.114
Cyclohexanone	8.846	1.380	---
1-Hexanone, 5-methyl-1-phenyl-	11.085	---	0.097
2-Octanone	12.192	0.100	---
Cycloheptanone	13.179	1.615	---
Acetophenone	15.138	0.117	---
4-Cyclopentene-1,2,3-trione, 4,5-dihydroxy-	16.091	0.113	---
Cyclooctanone	17.297	0.473	---
2-Tridecanone	30.666	0.361	---
1-Decen-3-one	33.488	0.123	---
5-Hexadecanone	36.211	0.188	---
2-Pentadecanone	36.875	0.345	---
2-Heptadecanone	42.861	3.250	---
1-Decen-3-one	46.255	0.201	---
3-Octadecanone	46.435	0.273	---
2-Nonadecanone	50.494	0.629	---
2-Hexanone	53.252	0.131	---
1-Hexadecanone, 1-cyclopentyl-	56.220	0.136	---
6-Undecanone	56.568	0.447	---
7-Tridecanone	59.701	0.318	---
Sub Total		11.327	1.211
Aldehydes			
Formaldehyde	2.019	---	2.123
Benzaldehyde	11.194	0.109	---
Octanal	12.716	0.198	---
Decanal	20.516	0.151	---
Dodecanal	27.835	0.480	---
Tetradecanal	34.376	0.112	---
Sub Total		1.050	2.123
Nitrogen compounds			
(2-Aziridinylethyl)amine	0.425	0.304	---
(2-Aziridinylethyl)amine	0.566	0.349	---
(2-Aziridinylethyl)amine	0.628	0.327	---
(2-Aziridinylethyl)amine	0.721	0.608	---
(2-Aziridinylethyl)amine	0.758	0.469	---
2-Propanamine	0.812	0.342	---
(2-Aziridinylethyl)amine	0.979	0.232	---
(2-Aziridinylethyl)amine	0.985	0.228	---

1,2-Ethanediamine, N,N'-dimethyl-	1.02	0.159	---
Nitrous oxide	1.067	0.185	---
2-Propanamine	1.215	0.112	---
(2-Aziridinylethyl)amine	1.582	---	1.837
(2-Aziridinylethyl)amine	1.691	---	2.625
Epinephrine	2.067	2.389	---
Nitrous oxide	2.282	0.149	---
1,2,4,5-Tetrazine, 3,6-dipropyl-	2.298	0.151	---
Fumaronitrile	3.288	---	0.311
Benzonitrile	11.972	---	0.657
Ethylamine,	19.965	0.186	---
2-((p-bromo-.alpha.-methyl-.alpha.-phenylbenzyl)oxy)-N,N-dimethyl-			
Ethylamine,	23.726	0.126	---
2-((p-bromo-.alpha.-methyl-.alpha.-phenylbenzyl)oxy)-N,N-dimethyl-			
4-Piperidinone, 2,2,6,6-tetramethyl-1-nitroso-	23.997	0.114	---
Undecanenitrile	30.458	0.195	---
2,5-Piperazinedione, 3-(phenylmethyl)-	33.122	0.241	---
Gephyrotoxin 195b'	42.812	0.440	---
5-Hexynoic acid, 2-amino-4-methyl-	42.84	0.171	---
Benzamide,	43.862	0.100	---
N-[2-(4,5-dihydro-3-phenyl-1H-pyrazol-1-yl)-2-phenylethyl]-			
2-Ethyl-5-undecyl-.delta.1--pyrroline	50.507	0.204	---
Dodecanamide	53.107	0.970	---
Butan-2-one, 4-[pyrrolidin-2-one-5-yl]-	59.516	0.276	---
Sub Total		9.028	5.431
Unresolved Area		19.520	4.861
Total Area		100.00	100.00