

**In-situ upgrading of Napier grass pyrolysis vapour over microporous and hierarchical mesoporous zeolites**

MOHAMMED1, Isah Yakub, ABAKR, Yousif Abdalla and KABIR KAZI, Feroz  
<<http://orcid.org/0000-0002-3121-9086>>

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**Table 1:** Characteristics of Napier grass biomass [18]

Standard used	Property	This study	Strezov et al. [26]	Lee et al. [27]	Braga et al. [28]	Sousa et al. [29]	De Conto et al. [30]
Proximate analysis (wt %)							
BS EN 14774-1	Moisture Content <sup>a</sup>	75.27 ± 0.21	12.40	9.43	10.04	-	10.63
BS EN 15148	Volatile Matter <sup>b</sup>	81.51 ± 0.26	66.90	72.58	65.00	-	72.54
BS EN 14775	Ash Content <sup>b</sup>	1.75 ± 0.04	2.90	9.68	6.90	-	8.26
	Fixed Carbon <sup>c</sup>	16.74 ± 0.05	-	-	14.66	-	19.20
BS EN 14918	HHV(MJ/kg)	18.05 ± 0.07	-	-	15.61	-	15.77
Ultimate analysis (wt%) dry basis							
	Carbon (C)	51.61 ± 0.24	41.6	42.4	44.5	41.85	39.63
	Hydrogen (H)	6.01 ± 0.02	4.83	5.96	5.4	6.77	6.31
	Nitrogen (N)	0.99 ± 0.01	0.43	1.71	1.4	0.72	1.70
	Sulfur (S)	0.32 ± 0.01	-	0.09	-	48.64	0.20
	Oxygen (O) <sup>c</sup>	41.07 ± 0.02	-	45.32	31.8	-	52.16
	O/C (atomic ratio)	0.80	-	-	-	-	-
	H/C (atomic ratio)	0.12	-	-	-	-	-
Structural composition (wt %)							
NREL/TP-510-42618	Cellulose	38.75 ± 2.30		66.59	39.14	-	30.37
	Hemicellulose	19.76 ± 1.68			19.9	-	31.31
	Lignin	26.99 ± 1.29		26.72	6.18	-	26.02
	Extractives	12.07 ± 0.32		-	-	-	14.86
BS EN 15290	Atomic absorption analysis of ash (mg/kg)						
	Sodium (Na)	12.85±1.05	-	-	-	-	-
	Potassium (K)	3079.51±224.80	-	-	-	-	-
	Calcium (Ca)	206.71±13.20	-	-	-	-	-
	Aluminum (Al)	64.67±4.66	-	-	-	-	-
	Iron (Fe)	38.93±4.01	-	-	-	-	-
	Silicon (Si)	206.0±25.13	-	-	-	-	-

Notes: <sup>a</sup> as received at harvest; <sup>b</sup> dry basis; <sup>c</sup> by difference. Values are the means (n =3) ± standard deviations

**Table 2:** Treatment condition and characteristics of zeolite (<sup>a</sup>determined by X-ray fluorescence; <sup>b</sup>Brunauer–Emmett–Teller method; <sup>c</sup>t-plot method; <sup>d</sup>V<sub>meso</sub>=V<sub>pore</sub> -V<sub>micro</sub>)

Catalyst	C <sub>NaOH</sub>	(Si/Al) <sup>a</sup>	(S <sub>BET</sub> ) <sup>b</sup>	(S <sub>micro</sub> ) <sup>c</sup>	(S <sub>meso</sub> ) <sup>c</sup>	(V <sub>pore</sub> )	(V <sub>micro</sub> ) <sup>c</sup>	(V <sub>meso</sub> ) <sup>d</sup>	total acidity
	(mol/L)	(mol/mol)	surface area (m <sup>2</sup> /g)		volume (cm <sup>3</sup> /g)			(mmol/g)	
ZSM-5	0.00	20.76	385.20	356.54	28.66	0.1540	0.1383	0.0157	3.8085
0.2HZSM-5	0.20	13.79	369.43	274.66	114.76	0.2685	0.1039	0.1646	3.0036
0.3HZSM-5	0.30	12.51	374.88	240.23	134.65	0.3670	0.1114	0.2556	2.9635

**Table 3:** Physicochemical properties of in-situ catalytic upgraded bio-oil organic phase

Catalyst	(wt%)	Biomass (g)	Bio-oil organic phase elemental analysis (%)						DOD	HHV (MJ/kg)	PH
			(g)	C	H	N	S	O			
Raw	0.0	0.00	200.00	50.89	6.02	0.88	0.23	41.98	0.00	26.77	2.65
ZSM-5	0.5	1.00	200.00	58.92	6.42	0.85	0.44	33.37	20.51	27.11	2.99
	1.0	2.00	200.00	62.11	6.55	0.95	0.56	29.83	28.94	29.10	2.97
	2.0	4.00	200.00	64.40	6.76	0.53	0.53	27.78	33.83	30.07	2.88
	3.0	6.00	200.00	65.12	6.79	0.97	0.64	26.48	36.92	31.51	2.95
0.2HZSM-5	0.5	1.00	200.00	61.72	6.11	0.78	0.26	31.13	25.85	29.97	2.9
	1.0	2.00	200.00	63.01	6.23	0.81	0.34	29.61	29.47	33.18	2.70
	2.0	4.00	200.00	63.87	6.56	0.91	0.41	28.25	32.71	36.56	2.60
	3.0	6.00	200.00	66.09	6.22	0.87	0.39	26.43	37.04	37.34	2.60
0.3HZSM-5	0.5	1.00	200.00	61.95	6.21	0.81	0.28	30.75	26.75	28.88	2.60
	1.0	2.00	200.00	62.98	6.31	0.88	0.29	29.54	29.63	35.18	2.90
	2.0	4.00	200.00	64.51	6.33	0.96	0.24	27.96	33.40	35.89	3.00
	3.0	6.00	200.00	66.77	6.24	0.79	0.25	25.95	38.18	38.71	3.50

**Table 4:** Group of organic compound in the deoxygenated bio-oil over ZSM-5, 0.2HZSM-5 and 0.3HZSM-5

Composition (%)	ZSM-5 CBR (wt %)			
	0.00	1.00	2.00	3.00
HC	4.67	16.30	22.88	28.89
ARHC	2.53	15.19	11.17	15.69
MARHC	2.18	3.41	17.48	9.93
PHOL	28.15	18.71	33.10	29.55
MPHOL	37.87	14.51	11.30	9.13
AAK	16.88	5.94	1.77	0.69
MEST	4.68	6.33	1.23	0.00
OVAC	3.05	19.62	1.07	6.12
	0.2HZSM-5 CBR (wt %)			
	0.00	1.00	2.00	3.00
HC	4.67	15.46	14.62	12.18
ARHC	2.53	2.60	8.31	14.16
MARHC	2.18	1.20	5.99	0
PHOL	28.15	57.95	54.50	61.41
MPHOL	37.87	4.92	0	0
AAK	16.88	2.18	2.90	5.75
MEST	4.68	4.60	4.13	5.45
OVAC	3.05	11.08	9.56	1.05
	0.3HZSM-5 CBR (wt %)			
	0.00	1.00	2.00	3.00
HC	4.67	9.25	11.55	7.19
ARHC	2.53	8.98	6.31	24.72
MARHC	2.18	9.21	3.09	4.30
PHOL	28.15	61.01	58.14	45.03
MPHOL	37.87	3.83	4.64	0.00
AAK	16.88	0.00	4.31	2.84
MEST	4.68	4.40	0.00	5.84
OVAC	3.05	3.33	11.96	10.08

(HC) hydrocarbons, (ARHC) aromatic hydrocarbons, (MARHC) methoxy aromatics, (PHOL) phenol, (MPHOL) methoxy phenol, (AAK) acids, aldehydes and ketones, (MEST) methyl ester and (OVAC) other value added chemical.

**Table 5:** Composition of non-condensable gas (nitrogen free basis) collected at 3.0 wt% CBR

Catalyst Type	CBR (wt %)	Gas Composition (vol %) N <sub>2</sub> -free basis			
		CH <sub>4</sub>	H <sub>2</sub>	CO	CO <sub>2</sub>
Raw	0.0	3.36	25.32	13.60	14.04
ZSM-5	3.0	2.34	10.36	22.14	27.95
0.2HZSM-5	3.0	3.26	8.31	33.97	30.32
0.3HZSM-5	3.0	3.01	7.94	37.67	28.07

### Supplementary materials

**Supplementary Table 1:** GC-MS analysis of organic phase bio-oil obtained from non-catalytic pyrolysis

RT (min)	Compound	Formula	Area%
<i>Organic Phase</i>			
3.85	1,3-DIMETHYL-1-CYCLOHEXENE	C <sub>8</sub> H <sub>14</sub>	4.67
4.03	1H-IMIDAZOLE-2-METHANOL	C <sub>4</sub> H <sub>6</sub> ON <sub>2</sub>	3.05
5.13	PHENOL	C <sub>6</sub> H <sub>6</sub> O	8.43
5.76	PHENOL, 2-METHYL-	C <sub>7</sub> H <sub>8</sub> O	4.06
5.93	PHENOL, 3-METHYL-	C <sub>7</sub> H <sub>8</sub> O	4.96
6.06	PHENOL, 2-METHOXY-	C <sub>7</sub> H <sub>8</sub> O <sub>2</sub>	7.65
6.51	PHENOL, 2,4-DIMETHYL-	C <sub>8</sub> H <sub>10</sub> O	2.50
6.64	PHENOL, 3-ETHYL-	C <sub>8</sub> H <sub>10</sub> O	8.20
6.86	CREOSOL	C <sub>8</sub> H <sub>10</sub> O <sub>2</sub>	3.68
7.03	BENZALDEHYDE, 4-METHYL-	C <sub>8</sub> H <sub>8</sub> O	13.41
7.47	PHENOL, 4-ETHYL-2-METHOXY-	C <sub>9</sub> H <sub>12</sub> O <sub>2</sub>	5.39
7.73	2-METHOXY-4-VINYLPHENOL	C <sub>9</sub> H <sub>10</sub> O <sub>2</sub>	6.74
7.96	PHENOL, 2,6-DIMETHOXY-	C <sub>8</sub> H <sub>10</sub> O <sub>3</sub>	8.85
8.57	1,2,3-TRIMETHOXYBENZENE	C <sub>9</sub> H <sub>12</sub> O <sub>3</sub>	2.18
8.63	PHENOL, 2-METHOXY-4-(1-PROPENYL)-, (Z)-	C <sub>10</sub> H <sub>12</sub> O <sub>2</sub>	2.44
9.05	4-ETHYLBIPHENYL	C <sub>14</sub> H <sub>14</sub>	2.53
9.30	4-METHYL-2,5-DIMETHOXYBENZALDEHYDE	C <sub>10</sub> H <sub>12</sub> O <sub>3</sub>	1.74
10.08	PHENOL, 2,6-DIMETHOXY-4-(2-PROPENYL)-	C <sub>11</sub> H <sub>14</sub> O <sub>3</sub>	3.12
10.43	DESASPIDINOL	C <sub>11</sub> H <sub>14</sub> O <sub>4</sub>	1.73
19.06	1,4-BENZENEDICARBOXYLIC ACID, BIS(2-ETHYLHEXYL) ESTER	C <sub>24</sub> H <sub>38</sub> O <sub>4</sub>	4.68

**Supplementary Table 2:** Compounds detected in the upgraded organic phase oil over ZSM-5

RT (min)	In-situ upgraded samples with ZSM-5 Compound	Formula	GC-MS peak area (%)		
			1.0 wt%	3.0 wt%	2.0 wt%
3.02	2,5-CYCLOOCTADIEN-1-OL	C8H12O	5.48	0.00	0.00
3.02	1-HEXEN-3-YNE, 2-METHYL-	C7H10	0.00	0.00	0.00
3.02	2,3-DIMETHYL-CYCLOHEXA-1,3-DIENE	C8H12	0.00	0.00	0.00
3.02	1-TRIDECENE	C13H26	0.00	7.26	0.00
3.75	2-BUTYNE, 1,4-DICHLORO-	C4H4Cl2	3.05	0.00	1.62
3.79	BICYCLO[2.2.1]HEPT-5-ENE-2,2-DIMETHANOL	C9H14O2	0.00	3.72	0.00
3.86	TRICYCLO[3.2.1.0(2,4)]OCTANE, 3-METHYLENE-	C9H12	2.56	0.00	0.00
4.14	OCTADECANOIC ACID, PHENYL ESTER BICYCLO[2.2.2]OCT-5-EN-2-ONE, 7-SYN-	C24H40O2	4.07	0.00	0.00
4.19	HYDROXY-	C8H10O2	0.00	0.00	0.00
4.54	1,7,7-TRIMETHYLBICYCLO[2.2.1]HEPTAN-2-OL	C10H18O	4.19	0.00	0.00
4.57	5,6-DIBROMO-5-METHYL-HEX-1-ENE	C7H12Br2	0.00	0.00	0.00
4.57	1,1'-BICYCLOHEPTYL CYCLOBUTANECARBOXYLIC ACID, UNDEC-10-	C14H26	0.00	5.12	5.08
4.67	ENYL ESTER CYCLOPENTANE, 1,2-DIMETHYL-3-(1-	C16H28O2	0.00	0.00	0.00
4.77	METHYLETHYL)-	C10H20	0.00	4.59	3.77
4.84	3-UNDECENE, 6-METHYL-, (E)-	C12H24	8.82	0.00	0.00
5.17	TETRADECANE, 1-CHLORO-	C14H29Cl	3.04	0.00	0.00
5.33	2-HYDROXYMETHYL-2-METHYLCYCLOPENTANOL	C7H14O2	0.00	0.00	0.00
5.85	1,1-DIMETHYL-1-SILACYCLO-2,4-HEXADIENE	C7H12Si	1.88	0.00	0.00
5.92	BICYCLO[3.2.0]HEPT-2-ENE, 4-ETHOXY-, EXO- 4A-METHYL-1,2,4A,5,8,8A-HEXAHYDRO-	C9H14O	0.00	0.00	0.00
6.00	NAPHTHALENE	C11H16	15.19	0.00	0.00
6.02	BENZENE, (OCTYLOXY)- PIVALIC ACID, 2-TETRAHYDROFURYL METHYL	C14H22O	0.00	8.29	9.00
6.24	ESTER	C10H18O3	1.88	0.00	0.00

6.64	CYCLOHEXENE, 1,4-DIMETHYL-	C8H14	0.00	0.00	0.00
6.69	PHENOL, 4-BUTYL-	C10H14O	3.31	0.00	0.00
6.72	P-CRESOL	C7H8O	0.00	0.00	0.00
6.75	PHENOL, 2-METHYL-	C7H8O	3.06	3.25	0.00
6.93	PHENOL, 3-METHYL-	C7H8O	0.00	4.06	7.06
7.05	PHENOL, 2-METHOXY-	C7H8O2	4.21	0.00	0.00
7.08	1,3-HEPTADIENE, 2,3-DIMETHYL-	C9H16	0.00	7.23	12.41
7.10	3-HEPTYNE, 2,2-DIMETHYL-	C9H16	0.00	0.00	0.00
7.72	PHENOL, 2-ETHYL-	C8H10O	0.00	8.86	0.00
7.74	PHENOL, 3-ETHYL-	C8H10O	4.35	0.00	1.66
7.91	1-TRIMETHYLSILYLPENT-1-EN-4-YNE	C8H14Si	3.86	0.00	0.00
8.16	BENZOFURAN, 2,3-DIHYDRO-	C8H8O	0.00	0.00	0.00
8.18	1,2-BENZENEDIMETHANOL	C8H10O2	5.14	13.39	24.38
8.70	PHENOL, 4-ETHYL-2-METHOXY-	C9H12O2	5.99	0.00	0.00
8.97	CYCLOHEXENE, 2-ETHENYL-1,3,3-TRIMETHYL-	C11H18	0.00	4.69	0.00
8.99	2-METHOXY-4-VINYLPHENOL	C9H10O2	0.00	0.00	9.09
9.20	PHENOL, 2,6-DIMETHOXY-	C8H10O3	4.31	9.13	0.75
9.90	2,4-DIMETHOXYBENZYL ALCOHOL	C9H12O3	0.00	0.00	0.00
9.90	1,2,4-TRIMETHOXYBENZENE	C9H12O3	0.00	1.64	5.03
9.93	ETHANONE, 1-(2,3,4-TRIHYDROXYPHENYL)-	C8H8O4	2.04	0.00	0.00
10.44	5-TERT-BUTYLPYROGALLOL	C10H14O3	2.85	0.00	0.00
10.44	ETHYL BENZENE	C14H14	0.00	15.69	0.00
10.46	BENZENE, 1,2,3-TRIMETHOXY-5-METHYL-	C10H14O3	0.00	0.00	4.07
10.48	BENZENE, 1,1'-ETHYLIDENE BIS-	C14H14	0.00	0.00	8.40
10.52	BENZENE, [BIS(METHYLTHIO)METHYL]-	C9H12S2	0.00	0.00	2.77
10.54	PHENOL, 4-ETHYL-2-METHOXY-	C9H12O2	0.00	0.00	1.47
10.88	CYCLOOCTASILOXANE, HEXADECAMETHYL- HEPTASILOXANE, 1,1,3,3,5,5,7,7,9,9,11,11,13,13-	C16H48O8Si8	2.95	0.00	0.00
10.97	TETRADECAMETHYL-	C14H44O6Si7	0.75	0.00	0.00

10.98	BRALLOBARBITAL 1,2-DIMETHOXY-4-(1-	C10H11O3N2Br	0.00	0.69	0.00
11.61	METHOXYETHENYL)BENZENE HEPTASILOXANE, 1,1,3,3,5,5,7,7,9,9,11,11,13,13-	C11H14O3	0.00	0.00	3.45
11.90	TETRADECAMETHYL- OCTASILOXANE, 1,1,3,3,5,5,7,7,9,9,11,11,13,13,15,15-	C14H44O6Si7	3.41	0.00	0.00
12.81	HEXADECAMETHYL- SILANE, TRIMETHYL[5-METHYL-2-(1-	C16H50O7Si8	2.12	0.00	0.00
12.91	METHYLETHYL)PHENOXY]- TRISILOXANE, 1,1,1,5,5,5-HEXAMETHYL-3,3-	C13H22OSi	0.00	0.00	0.00
13.75	BIS[(TRIMETHYLSILYL)OXY]- TRISILOXANE, 1,1,1,5,5,5-HEXAMETHYL-3,3-	C12H36O4Si5	1.13	0.00	0.00
15.39	BIS[(TRIMETHYLSILYL)OXY]-	C12H36O4Si5	0.00	2.40	0.00
17.39	2-BROMO-2-CYANO-N,N-DIMETHYLACETAMIDE CYCLOHEXANECARBOXYLIC ACID, 2-	C5H7ON2Br	0.00	0.00	0.00
17.52	METHYLBUTYL ESTER	C12H22O2	0.37	0.00	0.00

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**Supplementary Table 3:** Compounds detected in the upgraded organic phase oil over 0.2HZSM-5

RT	In-situ Upgraded samples 0.2HZSM-5 Compound	formula	GC-MS peak area (%)		
			1.0 wt%	3.0 wt%	2.0 wt%
3.02	Z,Z-6,25-TETRATRIACTONTADIEN-2-ONE 3-CHLOROPROPIONIC ACID, OCTADECYL	C34H64O	0.00	5.75	0.00
3.02	ESTER	C21H41O2Cl	0.00	0.00	4.60
3.02	4-TRIDECENE, (Z)-	C13H26	4.77	0.00	0.00
3.64	PENTANOIC ACID, 2-PROPENYL ESTER	C8H14O2	4.13	5.45	0.00
3.92	1-PENTANOL, 5-(PHENYLMETHOXY)-	C12H18O2	0.00	0.00	3.72
3.92	BENZENE, (PHENOXYMETHYL)-	C13H12O	5.99	0.00	0.00
4.70	1-PENTENE, 2,4-DIMETHYL-	C7H14	0.00	0.00	2.16



4.90	ETHYLBENZENE	C8H10	0.00	1.47	0.00
4.99	P-XYLENE	C8H10	2.96	0.00	2.60
5.24	P-XYLENE	C8H10	0.00	1.97	0.00
5.48	2,3,4-HEXATRIENE, 2,5-DIMETHYL-	C8H12	0.00	0.00	1.82
6.00	BENZENE, 1,2,3-TRIMETHYL-	C9H12	4.11	0.00	0.00
6.05	N-VINYLMIDAZOLE	C5H6N2	9.56	1.05	11.08
6.26	BENZENE, 1,2,4-TRIMETHYL-	C9H12	1.23	1.14	0.00
6.66	1-METHOXY-1,3-CYCLOHEXADIENE	C7H10O	0.00	0.00	1.20
6.77	BENZENE, 2-METHYL-	C7H8O	7.19	9.57	7.24
6.95	P-CRESOL	C7H8O	7.38	8.94	7.60
7.31	PHENOL, 2,6-DIMETHYL-	C8H10O	0.00	2.70	2.13
7.36	PHENOL, 2-ETHYL-5-METHYL-	C9H12O	0.00	2.21	3.38
7.51	PHENOL, 3-ETHYL-	C8H10O	2.19	3.27	2.74
7.63	PHENOL, 2,5-DIMETHYL-	C8H10O	5.86	8.17	5.97
7.77	PHENOL, 2-ETHYL-	C8H10O	17.37	16.46	17.05
8.03	PHENOL, 3-ETHYL-5-METHYL-	C9H12O	0.00	4.36	3.85
8.04	PHENOL, 2-ETHYL-6-METHYL-	C9H12O	3.25	0.00	0.00
8.28	PHENOL, 3-(1-METHYLETHYL)-	C9H12O	3.81	4.79	4.18
8.38	PHENOL, 3-ETHYL-5-METHYL-	C9H12O	7.45	10.51	7.20
8.94	ETHYLTETRAMETHYLCYCLOPENTADIENE 1,3-CYCLOHEXADIENE, 1,3,5,5,6,6-	C12H18	3.33	4.60	3.67
9.31	HEXAMETHYL-	C12H20	3.84	4.46	3.13
9.55	TETRADECANE, 1-BROMO- 1-ETHYL-1(1-	C14H29Br	0.00	0.00	2.31
9.55	CYCLOBUTYLIDENETHYL)CYCLOBUTANE 3,7-BENZOFURANDIOL, 2,3-DIHYDRO-2,2-	C12H20	2.68	3.12	0.00
9.96	DIMETHYL-	C10H12O3	2.90	0.00	0.00
10.25	NONADECANE, 1-BROMO-	C19H39Br	0.00	0.00	2.38

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**Supplementary Table 4:** Compounds detected in the upgraded organic phase oil over 0.3HZSM-5

RT	In-situ Upgraded samples with 0.3HZSM-5 Compound	Formula	GC-MS peak area (%)		
			2.0wt%	1.0wt%	3.0wt%
3.02	1-HEXEN-3-ONE	C6H10O	4.31	0.00	0.00
3.02	1-HEXADECANOL, 2-METHYL-	C17H36O	0.00	3.33	0.00
3.02	CYCLODODECANOL, 1-ETHENYL-	C14H26O	0.00	0.00	4.04
3.63	ISOBUTYL NONYL CARBONATE	C14H28O3	0.00	4.40	0.00
3.63	PENTANOIC ACID, 2-PROPENYL ESTER	C8H14O2	0.00	0.00	5.84
3.64	BENZENE, 1-ETHOXY-4,4-DIMETHYL-	C9H18O	3.09	0.00	0.00
3.91	TOLUENE	C7H8	0.00	0.00	4.87
3.92	PHENOL, 2-(PHENYLMETHOXY)-	C13H12O2	4.64	0.00	0.00
3.92	PHENOL, 5-(PHENYLMETHOXY)-	C12H18O2	0.00	3.83	0.00
4.11	CYCLOHEXANOL, 1-ETHENYL-	C8H14O	0.00	0.00	2.84
4.80	BENZENE, 1-ETHOXY-4,4-DIMETHYL-	C9H18O	0.00	0.00	2.32
4.98	P-XYLENE	C8H10	2.06	4.02	3.46
5.22	BICYCLO[2.1.1]HEXAN-2-OL, 2-ETHENYL-	C8H12O	0.21	0.00	0.00
5.24	ETHYLBENZENE	C8H10	0.00	1.56	2.25
5.47	2,3,4-HEXATRIENE, 2,5-DIMETHYL-	C8H12	1.10	0.00	0.00
5.99	BENZENE, 1,2,4-TRIMETHYL-	C9H12	0.00	0.00	12.77
6.03	N-VINYLMIDAZOLE	C5H6N2	10.69	0.00	6.03
6.04	BENZENE, (OCTYLOXY)-	C14H22O	0.00	9.21	0.00
6.25	BENZENE, 1,2,3-TRIMETHYL- CYCLOHEXAN-1-ETHANOL, 1-	C9H12	0.00	0.00	1.37
6.65	HYDROXYMETHYL-	C9H18O2	1.06	0.00	0.00
6.76	PHENOL, 2-METHYL-	C7H8O	6.45	6.86	5.63
6.95	P-CRESOL	C7H8O	7.55	7.07	5.93
7.15	BENZENE, 2-BUTENYL-	C10H12	0.00	1.17	0.00
7.30	PHENOL, 2,6-DIMETHYL-	C8H10O	1.47	1.87	0.00
7.36	PHENOL, 3-(1-METHYLETHYL)-	C9H12O	2.37	0.00	0.00

7.36	PHENOL, 2-ETHYL-5-METHYL-	C9H12O	0.00	2.07	0.00
7.50	PHENOL, 2-ETHYL-	C8H10O	2.44	2.37	0.00
7.62	PHENOL, 2,5-DIMETHYL-	C8H10O	5.22	5.59	4.69
7.76	PHENOL, 3-ETHYL-	C8H10O	17.68	14.02	13.54
8.02	PHENOL, 2-ETHYL-4-METHYL-	C9H12O	0.00	2.69	3.42
8.03	PHENOL, 2-ETHYL-6-METHYL-	C9H12O	2.39	0.00	0.00
8.27	PHENOL, 3-(1-METHYLETHYL)-	C9H12O	3.55	3.01	3.31
8.36	PHENOL, 3-ETHYL-5-METHYL-	C9H12O	6.69	6.86	5.06
8.53	BENZENEMETHANOL, 4-ETHYL-	C9H12O	2.32	0.00	0.00
8.53	PHENOL, 2-PROPYL-	C9H12O	0.00	2.15	0.00
8.86	PHENOL, 2,4,6-TRIMETHYL-	C9H12O	0.00	1.25	0.00
8.71	PHENOL, 2-ETHYL-4,5-DIMETHYL-	C10H14O	0.00	1.29	0.00
8.81	THYMOL	C10H14O	0.00	0.91	0.00
8.92	ETHYLTETRAMETHYLCYCLOPENTADIENE	C11H18	2.75	0.00	0.00
8.94	2,5-DIETHYLPHENOL	C10H14O	0.00	2.99	3.45
9.02	1H-INDENE, 2,3-DIHYDRO-4,5,7- TRIMETHYL-	C12H16	0.00	2.22	0.00
9.02	BENZENE, 1-(1-METHYLETHENYL)-2-(1- METHYLETHYL)-	C12H16	2.50	0.00	0.00
9.29	1,3-CYCLOHEXADIENE, 1,3,5,5,6,6- HEXAMETHYL-	C12H20	2.35	2.81	2.52
9.53	1-ETHYL-1(1- CYCLOBUTYLIDENETHYL)CYCLOBUTANE	C12H20	0.00	3.53	0.00
9.54	BENZENE, 1-METHOXY-4-(1- METHYLPROPYL)-	C11H16O	0.00	0.00	1.98
9.54	TRIDECANE, 1-BROMO- BENZENE, 2-(2-BUTENYL)-1,3,5-	C13H27Br	2.61	0.00	0.00
9.84	TRIMETHYL-	C13H18	1.75	0.00	0.00
9.95	HEPTADECANE, 1-BROMO-	C17H35Br	2.75	0.00	0.00
10.24	TRIDECANE, 1-BROMO-	C13H27Br	0.00	2.05	0.00
10.25	DODECANE, 1,12-DIBROMO-	C12H24Br2	0.00	0.00	2.49
11.53	OCTADECANE, 1-CHLORO-	C18H37Cl	0.00	0.87	2.18

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