**SUPLIMENTTRY MATERIALS**

**Table 1**.Compounds other than hydrocarbons identified in pyrolysis oil.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NO | COMPOUNDS NAMES | FORMULAS | RETENTION TIME (min) | (%) AREA |
| 1 | H-Pyrrole, 4-ethyl-2,3-dimethyl | C6H13N | 2.10 | 1.59 |
| 2 | 5,6,7,8-Tetrahydroindolizine | C8H11N | 2.38 | 2.01 |
| 3 | Amino-4-methylpyrrole-3 carbonitrile | C6H7N3 | 2.59 | 2.19 |
| 4 | Methyl 4-O-methyl-d-arabinoside | C6H10OS2 | 3.32 | 0.18 |
| 5 | Diallylmethylsilane | C7H14Si | 3.55 | 0.21 |
| 6 | Oxotetrahydrofuran-2-carboxylic acid | C5H6O4 | 4.09 | 1.74 |
| 7 | 1-Phospha-1-butyne, 3,3-dimethyl | C5H9P | 4.35 | 0.20 |
| 8 | 5,6,7,8-Tetrahydroindolizine | C6H11N | 4.57 | 2.12 |
| 9 | 1H-Indole, 2,3-dihydro- | C8H9N | 5.21 | 2.45 |
| 10 | 4-Methylimidazole-5- | C6H16N20 | 5.48 | 2.47 |
| 11 | 4-Acetonylcycloheptanone | C10H1602 | 6.24 | 2.33 |
| 12 | Phenol, 4-(2-aminoethyl)- | C8H11NO | 6.55 | 2.38 |
| 13 | 1-Propyne, 3-bromo- | C3H3Br | 7.11 | 0.18 |
| 14 | 4-Acetonylcycloheptanone | C10H16O2 | 7.34 | 1.77 |
| 15 | 1,2-Bis (dimethylphosphino) ethane | C6H16P2 | 7.57 | 0.16 |
| 16 | Quinoline, 5,6,7,8-tetrahydro- | C9H11N | 8.33 | 1.34 |
| 17 | Methyl 4-O-methyl-d-arabinoside | C6H14O5 | 8.51 | 1.11 |
| 18 | 3-Ethoxypropionic acid | C6H10O3 | 9.23 | 2.19 |
| 19 | Ethanol, 2,2-diethoxy | C6H14O3 | 9.50 | 2.33 |
| 20 | Naphthalene, 1,2,-tetrahydro-1-nonyl- | C19H30 | 10.20 | 1.49 |
| 21 | 1,4-Dithiane-1-oxide | C4H8OS2 | 10.54 | 0.33 |
| 22 | 3-Oxo-.alpha.-ionol | C13H20O2 | 11.11 | 2.32 |
| 23 | 2,3-Anhydro-d-galactosan | C6H8O4 | 11.47 | 1.44 |
| 24 | Pregna-3,5-dien-9-ol-20-one | C21H30O2 | 12.32 | 1.65 |
| 25 | Quinoline, 5,6,7,8-tetrahydro- | C9H11N | 12.56 | 2.45 |
| 26 | Cyclohexylamine | C6H13N | 13.21 | 2.49 |
| 27 | phenol | C6H6O | 13.54 | 2.55 |
| 28 | pentanone | C5H10O | 14.12 | 2.50 |
| 29 | Cyclohexenyl-ethanone | C8H12O | 14.50 | 2.11 |
| 30 | Ethanol, 2,2-diethoxy | C6H14O3 | 15.33 | 2.10 |
| 31 | Ethanol, 2,2-diethoxy- | C6H14O3 | 15.57 | 1.22 |
| 32 | 1-Propyne, 2-bromo- | C3H3Br | 16.18 | 0.32 |
| 33 | Ethanol, 2,4-diethoxy- | C6H14O3 | 16.49 | 1.22 |
| 34 | 1H-Indole, 2,5-dimethyl- | C10H11N | 17.14 | 2.45 |
| 35 | 3-O-Methyl-d-glucose | C7H14O6 | 17.58 | 2.43 |
| 36 | Ethanol, 2,2-diethoxy- | C6H14O3 | 18.15 | 2.43 |
| 37 | 1H-Indole, 2,6-dimethyl- | C10H11N | 18.56 | 2.09 |
| 38 | Ethanol, 2,2-diethoxy- | C6H14O3 | 19.21 | 1.99 |
| 39 | Furfural | C5H4O2 | 19.49 | 2.01 |
| 40 | 1,3,5-Trisilacyclohexane | C3H12Si3 | 20.18 | 0.20 |
| 41 | Histidine, 1-methyl- | C7H11N3O2 | 20.57 | 2.07 |
| 42 | 4-(Trimethylsilyl) morpholine | C7H17NOSi | 21.16 | 0.10 |
| 43 | Diethyl-phenylsilane | C10H16Si | 21.55 | 0.13 |
| 44 | Tetrahydro-1,3-thiazine-2-thione | C4H7NS2 | 22.09 | 0.23 |
| 45 | Ethanol, 2,2-diethoxy- | C6H14O3 | 22.50 | 2.21 |
| 46 | 4-(Trimethylsilyl) morpholine | C7H17NOSi | 23.16 | 0.22 |
| 47 | 9H-Fluorene, 9-bromo- | C13H9Br | 23.26 | 0.19 |
| 48 | 2,3-Anhydro-d-galactosan | C6H8O4 | 23.44 | 2.10 |
| 49 | Ethanol, 2,2-diethoxy- | C6H14O3 | 23.58 | 2.11 |
| 50 | Pregna-3,5-dien-9-ol-20-one | C21H30O2 | 24.11 | 1.01 |
| 51 | Ethanol, 2,2-diethoxy- | C6H14O3 | 24.40 | 1.99 |
| 52 | Ethanol, 2,2-diethoxy- | C6H14O3 | 24.59 | 1.94 |
| 53 | Glycero-galacto-heptose | C7H14O7 | 25.01 | 2.01 |
| 54 | Glycerol-galacto-heptose | C7H14O7 | 25.17 | 2.11 |
| 55 | Ethanol, 2,2-diethoxy- | C6H14O3 | 25.34 | 1.19 |
| 56 | Methyl 4-methyl-arabinoside | C7H14O5 | 25.56 | 2.22 |
| 57 | 1H-Pyrrole, 4-ethyl-2,3-dimethyl- | C8H13N | 26.23 | 2.10 |
| 58 | 2,5-Diaminotoluene | C7H10N2 | 26.54 | 2.18 |
| 59 | Cyclohexanone | C6H10O | 29.54 | 2.15 |
| 60 | 2,5-Diaminotoluene | C7H10N2 | 33.43 | 2.22 |
| 61 | Pregna-3,5-dien-9-ol-20-one | C21H30O2 | 34.22 | 1.10 |
| 62 | Ethanol, 2,2-diethoxy- | C6H14O3 | 37.05 | 1.16 |

**Table 2.** Compounds other than hydrocarbons identified in hydrogenated bio-oil

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NO | COMPOUNDS NAMES | FORMULAS | RETENTION TIME (min) | (%) AREA |
| 1 | 12-Methyl-E,E-2,13-octadecadien-1-ol | C19H36O | 2.01 | 0.99 |
| 2 | 1,3-Propanedithiol | C3H8S2 | 2.49 | 0.65 |
| 3 | 1,3-dithio-, S-ethyl ester | C6H10OS2 | 3.23 | 0.87 |
| 4 | 1H-Pyrrole, 4-ethyl-2,3-dimethyl- | C8H13N | 3.44 | 0.56 |
| 5 | 5,6,7,8-Tetrahydroindolizine | C8H11N | 3.59 | 0.50 |
| 6 | 1,3-Propanedithiol | C3H8S2 | 4.21 | 0.31 |
| 7 | 3-Ethoxypropionic acid | C5H10O3 | 4.39 | 1.33 |
| 8 | Ethanol, 2,2-diethoxy- | C6H14O3 | 4.55 | 1.54 |
| 9 | Ethanol, 2,2-diethoxy | C6H14O3 | 5.19 | 1.11 |
| 10 | Cyclohexanone | C6H10O | 5.43 | 1.00 |
| 11 | octanone | C8H16O | 6.10 | 1.10 |
| 12 | Heptanone | C7H14O | 6.32 | 1.08 |
| 13 | Hexenol | C6H12O | 6.58 | 1.46 |
| 14 | Ethanol, 2,2-diethoxy- | C6H14O3 | 7.22 | 1.01 |
| 15 | Ethanol, 2,2-diethoxy- | C6H14O3 | 7.48 | 1.00 |
| 16 | 11-Dodecen-2-one, 7,7-dimethyl- | C14H26O | 8.12 | 1.05 |
| 17 | Diallylmethylsilane | C7H14Si | 8.39 | 0.34 |
| 18 | 5,6,7,8-Tetrahydroindolizine | C8H11N | 8.59 | 1.23 |
| 19 | 1H-Indole, 2,3-dihydro- | C8H9N | 9.33 | 1.29 |
| 20 | Undecenol, 2,10-dimethyl- | C13H26O | 9.55 | 1.01 |
| 21 | camphor | C10 H16 O | 10.29 | 0.41 |
| 22 | 3-Ethoxypropionic acid | C5H10O3 | 10.56 | 1.44 |
| 23 | Methyl isopropylidene- | C9H16O5 | 11.30 | 1.85 |
| 24 | Pregna-3,5-dien-9-ol-20-one | C21H30O2 | 12.44 | 0.78 |
| 25 | Ethanol, 2,2-diethoxy- | C6H14O3 | 13.23 | 1.11 |
| 26 | 4-Methylpyridine | C6H7N | 14.40 | 1.01 |
| 27 | Phenethylamine | C8H11N | 15.22 | 1.14 |
| 28 | 1,5-Diazabicyclonon-5-ene | C7H12N2 | 15.54 | 1.21 |
| 29 | phenol | C6H6O | 16.30 | 2.34 |
| 30 | 4-methylphenol | C7H8O | 17.33 | 1.22 |
| 31 | Pregna-3,5-dien-9-ol-20-one | C21H30O2 | 18.10 | 0.32 |
| 32 | Ethanol, 2,2-diethoxy- | C6H14O3 | 20.31 | 1.22 |
| 32 | Diallylmethylsilane | C7H14Si | 21.11 | 0.29 |
| 34 | Oxotetrahydrofuran-2-carboxylic acid | C5H6O4 | 22.58 | 1.11 |
| 35 | Pregna-3,5-dien-9-ol-20-one | C21H30O2 | 23.34 | 0.43 |
| 36 | Quinoline, 5,6,7,8-tetrahydro- | C9H11N | 24.58 | 1.10 |
| 37 | Cyclohexylamine | C6H13N | 25.55 | 1.06 |
| 38 | Ethanol, 2,2-diethoxy- | C6H14O3 | 26.39 | 1.35 |
| 39 | Methyl 4-methyl-arabinoside | C7H14O5 | 37.05 | 1.18 |

**Table 3**. Change in density of hydrogenated bio-oil at different temperatures

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| T (°C) | volume (mL) | mass (g) | ρ (g mL-1) | T (K) | 1/K | ln ρ |
| -10 | 11.290 | 10 | 0.8857 | 263 | 0.003802 | -0.11241 |
| 0 | 11.362 | 10 | 0.8801 | 273 | 0.003663 | -0.11565 |
| 10 | 11.410 | 10 | 0.8764 | 283 | 0.003534 | -0.11866 |
| 20 | 11.452 | 10 | 0.8656 | 293 | 0.003413 | -0.12155 |
| 30 | 11.792 | 10 | 0.8480 | 303 | 0.003323 | -0.12451 |
| 40 | 11.885 | 10 | 0.8413 | 313 | 0.003195 | -0.12729 |
| 50 | 11.910 | 10 | 0.8396 | 323 | 0.003096 | -0.12896 |

**Table 4**. Change in viscosity of hydrogenated bio-oil at different temperatures

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| T (°C) | Flow Time (s) | η (mm2/s) | T (K) | 1/K | ln η |
| -10 | 370 | 4.4228 | 263 | 0.003802 | 1.48678327 |
| 0 | 330 | 3.3433 | 273 | 0.003663 | 1.20697436 |
| 10 | 286 | 2.5681 | 283 | 0.003534 | 0.94780622 |
| 20 | 243 | 2.0375 | 293 | 0.003413 | 0.711723572 |
| 30 | 205 | 1.7557 | 303 | 0.003321 | 0.50512943 |
| 40 | 171 | 0.8634 | 313 | 0.003195 | 0.21026093 |
| 50 | 149 | 0.8001 | 323 | 0.003096 | 0.09540108 |

**Table 5**. Change in viscosity of aviation kerosene at different temperatures

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| T(oC) | Flow  Time (s) | η (mm2/s) | T(K) | 1/K | Lnη |
| **-10** | 309 | 4.5217 | 263 | 0.003802 | 1.508733 |
| **0** | 259 | 3.8745 | 273 | 0.003759 | 1.354365 |
| **10** | 236 | 3.1979 | 283 | 0.003731 | 1.162401 |
| **20** | 208 | 2.4792 | 293 | 0.003704 | 0.907815 |
| **30** | 188 | 1.7493 | 303 | 0.003663 | 0.558873 |
| **40** | 175 | 1.0845 | 313 | 0.003597 | 0.080473 |
| **50** | 152 | 0.8589 | 323 | 0.003534 | -0.15373 |

**Table 6**. Change in density of aviation kerosene at different temperatures.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| T (°C) | volume (mL) | mass(g) | ρ (g mL-1) | T (K) | 1/K | ln p |
| -10 | 11.655 | 10 | 0.8581 | 263 | 0.0038023 | -0.15154 |
| 0 | 11.774 | 10 | 0.8494 | 273 | 0.003663 | -0.17207 |
| 10 | 11.980 | 10 | 0.8349 | 283 | 0.003534 | -0.19109 |
| 20 | 12.143 | 10 | 0.8237 | 293 | 0.003413 | -0.20892 |
| 30 | 12.481 | 10 | 0.8014 | 303 | 0.003311 | -0.22558 |
| 40 | 12.771 | 10 | 0.7832 | 313 | 0.003195 | -0.24106 |
| 50 | 12.965 | 10 | 0.7715 | 323 | 0.003096 | -0.25565 |