Table 1

Gas Phase Tests

| Catalyst | Batch # | Composition (wt%) | Gas Phase Run # | Pressure (Psig) | Temp. (°C) | GHSV ($h^{-1}$) | $CO/H_2$ | Usage ($\Delta CO/\Delta H_2$) | $X_{CO+H_2}$ | $X_{CO}$ | $X_{H_2}$ | Bulk Activity, mol syngas/ kg cat/hr | Specific Activity, mol CO/ mol metal/min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $Co/Zr/Al_2O_3$ | 8466-9 | Co 10.8, Zr 8.5 | 8413-25-9 | 300 | 220 | 1043 | 1.0 | 0.61 | 29% | 22 | 37 | 17.6 | 0.06 |
| | | | | 300 | 240 | 1043 | 1.0 | 0.63 | 65 | 49 | 82 | 39.2 | 0.14 |
| | | | | 300 | 260 | 1043 | 1.0 | 0.70 | 72 | 58 | 88 | 43.7 | 0.16 |
| $Co/Zr/SiO_2$ | 8466-18 | Co 3.5, Zr 6.6 | 8413-28-18 | 300 | 220 | 1000 | 0.94 | 0.55 | 28 | 20 | 35 | 31.3 | 0.31 |
| | | | | 300 | 240 | 1000 | 0.94 | 0.50 | 49 | 33 | 63 | 55.4 | 0.51 |
| | | | | 300 | 260 | 1000 | 0.94 | 0.43 | 65 | 40 | 88 | 73.6 | 0.62 |
| $Co/Fe/Zr/SiO_2$ | 8466-22 | Co 3.7, Fe 0.72, Zr 7.3 | 8413-36-22 | 300 | 220 | 1002 | 1.0 | 0.36 | 18 | 9 | 26 | 18.2 | 0.10 |
| | | | | 300 | 240 | 503 | 1.0 | 0.55 | 64 | 44 | 86 | 33.5 | 0.26 |
| | | | | 300 | 240 | 1002 | 1.0 | 0.46 | 46 | 28 | 65 | 48.1 | 0.33 |
| | | | | 300 | 240 | 1518 | 1.0 | 0.47 | 32 | 20 | 44 | 50.6 | 0.35 |
| | | | | 300 | 260 | 1038 | 1.0 | 0.49 | 63 | 40 | 86 | 67.6 | 0.49 |

Table 1 (Cont'd)

Gas Phase Tests

| Catalyst | Batch # | Gas Phase Run # | Selectivity, Wt% | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | $C_{1-}$ | $C_{2-4}$ | $C_{5-11}$ | $C_{12-18}$ | $C_{19-23}$ | $C_{24^+}$ | $C_{5-23}$ |
| $Co/Zr/Al_2O_3$ | 8466-9 | 8413-25-9 | 16 | 22 | 31 | 14 | 8 | 9 | 53 |
| | | | 8 | 12 | 29 | 24 | 13 | 14 | 66 |
| | | | 12 | 12 | 25 | 23 | 12 | 15 | 60 |
| $Co/Zr/SiO_2$ | 8466-18 | 8413-28-18 | 10 | 23 | 49 | 16 | 2 | 0.2 | 67 |
| | | | 10 | 15 | 39 | 25 | 8 | 3 | 72 |
| | | | 15 | 16 | 30 | 21 | 7 | 12 | 58 |
| $Co/Fe/Zr/SiO_2$ | 8466-22 | 8413-36-22 | 14 | 28 | 40 | 12 | 4 | 1 | 56 |
| | | | 12 | 17 | 31 | 21 | 9 | 10 | 61 |
| | | | 9 | 16 | 41 | 26 | 7 | 1 | 74 |
| | | | 20 | 29 | 32 | 8 | 5 | 6 | 45 |
| | | | 15 | 18 | 30 | 18 | 12 | 7 | 60 |

## Table 2

## Gas Phase

| Batch No.: | $Co/Zr/SiO_2$(8466-18) | | | $Co/Zr/Al_2O_3$(8466-4) | | |
|---|---|---|---|---|---|---|
| % Co: | 3.5 | | | 4.0 | | |
| % Zr: | 6.6 | | | 6.4 | | |
| Activation: | Hydrogen | | | | | |
| Conditions: | All runs used 1:1 $CO/H_2$ at 300 psig. | | | | | |
| GHSV, $Hr^{-1}$: | 1000 | | | 1157 | | |
| Temp, °C: | 220 | 240 | 260 | 220 | 240 | 260 |
| Bulk Activity: (mol syngas/kg cat/hr) | 31 | 55 | 74 | 13 | 26 | 34 |
| Specific Activity: (mol CO/mol Co/min) | .31 | .51 | .62 | 0.10 | 0.21 | 0.29 |
| $X_{CO + H_2}$ (%) | 28 | 49 | 65 | 27 | 54 | 69 |
| $X_{CO}$ | 20 | 33 | 40 | 16 | 33 | 46 |
| $X_{H_2}$ | 35 | 63 | 88 | 37 | 76 | 94 |
| Wt% Selectivity: | | | | | | |
| $C_1$ | 10 | 10 | 15 | 16 | 11 | 14 |
| $C_{2-4}$ | 23 | 15 | 16 | 31 | 16 | 13 |
| $C_{5-11}$ | 49 | 39 | 30 | 32 | 29 | 25 |
| $C_{12-18}$ | 16 | 25 | 21 | 8 | 22 | 23 |
| $C_{19-23}$ | 2 | 8 | 7 | 7 | 10 | 12 |
| $C_{24^+}$ | 0.2 | 3 | 12 | 6 | 13 | 14 |
| $C_{5-23}$ | 67 | 72 | 58 | 47 | 61 | 60 |

# Table 3

Comparative Catalyst Test Data

| Catalyst Run No. | Composition, Wt | | P, psig | T, °C | SV, L/g/hr | Feed $CO/H_2$ | Usage $CO/H_2$ | Conv $H_2+CO$ | Conv $H_2$ | Conv CO | Bulk Activity mol syngas/ kg cat/hr | Specific Activity mol CO/ mol metal/min | Hydrocarbon Selectivity, Wt $C_1$ | $C_2$-$C_4$ | $C_5$-$C_{11}$ | $C_{12}$-$C_{18}$ | $C_{19}$-$C_{23}$ | $C_{24}^+$ | Fuels $C_5$-$C_{23}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [a] $Co_4(CO)_8/Zr(OPr)_4^b/Al_2O_3$ 7515-60-C43.4 | Co 3.01 | Zr 6.84 | 309 | 220.9 | 1.65 | 1.05 | 0.57 | 17.8 | 23.2 | 12.6 | 13.1 | 0.12 | 13.6 | 28.9 | 33.2 | 14.3 | 7.6 | 6.4 | 55.1 |
| | | | 305 | 250.8 | 1.64 | 1.57 | 0.67 | 25.3 | 38.9 | 16.6 | 18.5 | 0.19 | 11.5 | 18.4 | 29.2 | 15.3 | 12.5 | 21.1 | 57.0 |
| | | | 305 | 281.0 | 1.64 | 1.57 | 0.59 | 31.7 | 51.2 | 19.4 | 23.2 | 0.22 | 20.6 | 20.2 | 30.4 | 12.1 | 3.9 | 4.8 | 46.4 |
| [a] $Ru_4(CO)_{12}/Zr(OPr)_4/Al_2O_3$ 7807-36-478 | Ru 2.75 | Zr 4.93 | 316 | 241.1 | 2.04 | 1.87 | 0.95 | 7.5 | 10.6 | 5.7 | 6.8 | 0.20 | 9.7 | 11.5 | 12.2 | 20.5 | 18.5 | 27.6 | 51.2 |
| | | | 607 | 281.6 | 2.04 | 1.77 | 0.67 | 25.4 | 45.4 | 14.2 | 23.2 | 0.51 | 14.6 | 13.6 | 37.1 | 20.1 | 9.3 | 5.3 | 66.5 |
| | | | 608 | 276.7 | 0.97 | 1.33 | 0.51 | 39.9 | 61.6 | 23.6 | 17.3 | 0.36 | 9.3 | 10.2 | 36.7 | 27.5 | 8.7 | 7.6 | 72.9 |
| [a] $Co_4(CO)_8/Al_2O_3$ 7827-67-445 | Co 4.71 | | 300 | 239.4 | 2.06 | 1.50 | 0.67 | 16.7 | 25.1 | 11.1 | 15.4 | 0.13 | 9.6 | 11.5 | 23.7 | 22.7 | 15.3 | 17.2 | 61.7 |
| | | | 300 | 240.9 | 1.07 | 1.84 | 0.79 | 21.6 | 34.3 | 14.7 | 10.3 | 0.09 | 7.6 | 9.8 | 24.9 | 22.1 | 14.9 | 20.7 | 61.9 |
| | | | 300 | 238.7 | 2.07 | 2.00 | 0.88 | 14.7 | 23.4 | 10.3 | 13.6 | 0.13 | 7.9 | 9.4 | 20.6 | 25.0 | 18.4 | 18.7 | 64.0 |
| [a] $Fe_3(CO)_{12}/Al_2O_3$ 8315-22-677 | Fe 0.85 | Co 2.60 | 315 | 242.6 | 1.86 | 1.02 | 0.42 | 20.2 | 28.7 | 11.9 | 16.8 | 0.14 | 10.1 | 11.0 | 26.0 | 20.4 | 16.7 | 15.8 | 63.1 |
| | | | 320 | 261.1 | 1.09 | 2.14 | 0.40 | 17.5 | 39.0 | 7.4 | 8.5 | 0.07 | 11.8 | 15.7 | 33.5 | 21.2 | 10.0 | 5.8 | 64.7 |
| | | | 308 | 281.0 | 1.92 | 2.02 | 0.60 | 24.5 | 46.2 | 13.8 | 21.6 | 0.22 | 16.9 | 15.8 | 35.6 | 19.3 | 7.9 | 4.5 | 62.8 |
| [a] $Co_4(CO)_8/Ti(OPr)_4/Al_2O_3$ 7808-1-589 | Co 3.49 | Ti 8.65 | 300 | 239 | 0.90 | 2.02 | 0.80 | 24.0 | 46.0 | 13.1 | 9.6 | 0.10 | 7.1 | 12.3 | 30.4 | 22.8 | 12.6 | 14.8 | 65.8 |
| | | | 600 | 258 | 1.07 | 1.57 | 0.46 | 26.2 | 42.5 | 14.4 | 21.9 | 0.20 | 15.4 | 15.5 | 34.3 | 18.8 | 7.9 | 8.1 | 61.0 |
| | | | 310 | 282 | 1.82 | 1.51 | 0.56 | 20.7 | 34.3 | 11.7 | 16.8 | 0.16 | 24.8 | 15.6 | 30.3 | 16.9 | 9.3 | 3.1 | 56.5 |
| [a] $Co_4(CO)_8/Zr(OPr)_4^R/Al_2O_3$ 7808-33-731 | Co 5.07 | Zr 4.39 | 300 | 239 | 0.86 | 1.95 | 0.41 | 19.4 | 40.7 | 8.5 | 7.5 | 0.04 | 8.0 | 11.3 | 32.9 | 22.5 | 12.2 | 13.1 | 67.6 |
| | | | 305 | 262 | 0.86 | 1.95 | 0.51 | 32.3 | 63.0 | 16.5 | 12.4 | 0.08 | 7.7 | 9.6 | 29.2 | 24.1 | 12.9 | 16.5 | 66.2 |
| | | | 300 | 259 | 1.73 | 0.98 | 0.41 | 35.8 | 50.3 | 21.0 | 27.6 | 0.16 | 14.1 | 12.0 | 34.4 | 19.8 | 9.2 | 10.5 | 63.4 |
| [a] $Fe_2Co_2(CO)_{12}/K/Al_2O_3$ 8305-60-707 | Fe 0.78 | Co 2.44 | K 0.07 | 320 | 240 | 1.6 | 2.01 | 0.64 | 11.9 | 21.9 | 6.9 | 8.4 | 0.10 | 9.8 | 11.7 | 31.0 | 22.1 | 14.6 | 10.8 | 67.7 |
| | | | | 320 | 260 | 1.6 | 2.03 | 0.68 | 20.6 | 37.2 | 12.5 | 14.5 | 0.18 | 10.0 | 11.6 | 34.1 | 24.9 | 12.3 | 7.1 | 78.3 |
| | | | | 296 | 282 | 1.5 | 1.61 | 0.50 | 41.0 | 55.0 | 27.3 | 27.3 | 0.27 | 19.1 | 15.7 | 35.4 | 17.4 | 7.5 | 4.9 | 60.3 |
| [b] $Co_4(CO)_8/Zr(OPr)_4^R/Al_2O_3$ 9523-1-4 | Co 5.07 | Zr 7.82 | 302 | 241 | 2.0 | 0.99 | 0.51 | 42.5 | 56.0 | 29.0 | 35.1 | 0.29 | 7.9 | 13.7 | 37.0 | 23.4 | 8.9 | 9.1 | 69.3 |
| | | | 307 | 258 | 2.0 | 1.48 | 0.53 | 34.5 | 56.0 | 19.9 | 28.7 | 0.24 | 7.2 | 10.8 | 34.1 | 27.9 | 8.6 | 11.4 | 70.5 |
| | | | 302 | 260 | 1.0 | 1.67 | 0.58 | 37.6 | 68.3 | 21.2 | 15.8 | 0.14 | 4.9 | 7.1 | 32.4 | 26.2 | 17.2 | 12.4 | 69.0 |

[a] Synthesis Gas Activation

[b] $H_2$ Activation

TABLE 3 (Continued)

COMPARATIVE CATALYST-TEST DATA

$H_2$ ACTIVATED CATALYSTS

| Catalyst/ Run No. | Composition, Wt. Co | Wt. Zr | P, psig | T, °C | SV, l/g/hr | Feed $CO/H_2$ | Usage $CO/H_2$ | % Conv. $H_2+CO$ | % Conv. $H_2$ | % Conv. CO | Bulk Activity mol syngas/ kg cat/hr | Specific Activity mol CO/ mol metal/min | Hydrocarbon Selectivity, Wt% $C_1$ | $C_2$-$C_4$ | $C_5$-$C_{11}$ | $C_{12}$-$C_{18}$ | $C_{19}$-$C_{23}$ | $C_{24}$°$C_{5-23}$ | Fuels |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $Co(NO_3)_2/Zr(OPr)_4$/ $Al_2O_3$ | 4.25 | 7.10 | 310 | 241 | 1.0 | 2.00 | 0.54 | 20.8 | 40.6 | 10.9 | 11.4 | 0.09 | 5.2 | 4.2 | 11.2 | 16.9 | 23.7 | 38.8 | 51.8 |
| | | | 310 | 260 | 2.0 | 1.58 | 0.60 | 24.8 | 39.9 | 15.3 | 27.7 | 0.24 | 12.0 | 9.1 | 22.7 | 25.8 | 14.1 | 16.3 | 67.6 |
| 7888-85-2 | | | 310 | 281 | 2.0 | 1.00 | 0.50 | 33.4 | 57.2 | 18.2 | 37.2 | 0.30 | 14.9 | 11.2 | 23.7 | 18.9 | 13.4 | 17.9 | 56.0 |
| | Co | Zr | | | | | | | | | | | | | | | | | |
| $Co_2(CO)_8/Zr(OPr)_4$/ $Al_2O_3$ | 12.4 | 12.0 | 303 | 239 | 2.0 | 1.00 | 0.43 | 32.7 | 45.7 | 19.7 | 30.7 | 0.07 | 7.7 | 15.0 | 22.0 | 22.6 | 13.9 | 18.8 | 58.5 |
| | | | 310 | 239 | 2.0 | 2.00 | 0.44 | 14.5 | 30.3 | 6.7 | 13.5 | 0.03 | 8.3 | 13.8 | 22.2 | 21.0 | 15.7 | 19.0 | 58.9 |
| 8521-41-9 | | | 310 | 260 | 1.0 | 1.00 | 0.50 | 45.9 | 61.3 | 30.4 | 21.5 | 0.06 | 15.0 | 14.0 | 27.4 | 20.0 | 9.8 | 13.8 | 57.2 |
| | Co | Zr | | | | | | | | | | | | | | | | | |
| $Co_2(CO)_8/Zr(OPr)_4$/ $SiO_2$ | 4.9 | 9.3 | 310 | 240 | 2.0 | 1.00 | 47 | 40.8 | 55.5 | 26.2 | 36.5 | 23 | 8.1 | 14.5 | 37.4 | 24.9 | 8.2 | 6.9 | 70.5 |
| | | | 310 | 261 | 1.0 | 1.50 | 43 | 42.9 | 75.1 | 21.4 | 19.1 | 12 | 11.0 | 12.9 | 37.4 | 23.3 | 8.0 | 7.4 | 68.7 |
| 8670-11-18 | | | 310 | 282 | 1.0 | 2.00 | 59 | 41.4 | 78.0 | 23.1 | 18.5 | 14 | 13.5 | 15.4 | 32.1 | 23.9 | 9.6 | 5.5 | 65.6 |
| | Co | Zr | | | | | | | | | | | | | | | | | |
| $Co_2(CO)_8/Zr(OP_r)_4$/ $Al_2O_3$ | 5.07 | 7.82 | 302 | 241 | 2.0 | 0.99 | 0.51 | 42.5 | 56.0 | 29.0 | 35.3 | 0.29 | 7.9 | 13.7 | 37.0 | 23.4 | 8.9 | 9.1 | 69.3 |
| | | | 307 | 258 | 2.0 | 1.48 | 0.53 | 34.5 | 56.0 | 19.9 | 28.7 | 0.24 | 7.2 | 10.8 | 34.1 | 27.9 | 8.6 | 11.4 | 70.8 |
| 8523-1-4 | | | 302 | 260 | 1.0 | 1.87 | 0.58 | 37.6 | 68.3 | 21.2 | 15.8 | 0.14 | 4.9 | 7.1 | 26.2 | 26.2 | 17.2 | 18.4 | 69.6 |

TABLE 4

SLURRY SCREENING SUMMARY
7888-85-2

13.9 Wt% (59.7g) $Co(NO_3)_2/Zr(OPr)_4/Al_2O_3$

| Sample No. | Time on Stream h | P psig | T °C | SV, NL/g cat/hr | $\Sigma(CO+H_2)$ | $\Sigma CO$ | $\Sigma H_2$ | Feed $CO/H_2$ | Usage $\Delta CO/\Delta H_2$ | Bulk Activity mol syngas/kg cat/h | Specific Activity mol CO/mol Co/min | Selectivity Wt% | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | $C_1$ | $C_2-C_4$ | $C_5-C_{11}$ | $C_{12}-C_{18}$ | $C_{19}-C_{23}$ | $C_{24}^+$ | $C_5-C_{23}$ |
| 2 | 71.0 | 310 | 239.3 | 2.46 | 18.4 | 7.1 | 22.1 | 1.05 | 0.34 | 15.8 | 0.09 | 10.9 | 6.5 | 12.9 | 19.8 | 21.9 | 28.0 | 54.6 |
| 5 | 94.6 | 310 | 241.4 | 2.49 | 13.9 | 7.5 | 24.1 | 1.59 | 0.49 | 15.5 | 0.12 | 7.6 | 5.1 | 11.6 | 20.7 | 22.4 | 32.6 | 54.7 |
| 8 | 118.9 | 310 | 242.0 | 2.49 | 11.1 | 4.5 | 24.3 | 2.12 | 0.42 | 12.3 | 0.09 | 7.8 | 5.4 | 12.0 | 22.1 | 21.4 | 31.3 | 55.5 |
| 12 | 143.1 | 310 | 241.1 | 1.23 | 20.8 | 10.9 | 40.6 | 1.99 | 0.54 | 11.4 | 0.09 | 5.2 | 4.2 | 11.2 | 16.9 | 23.7 | 38.8 | 51.8 |
| 14 | 167.7 | 312 | 259.1 | 1.23 | 28.4 | 14.0 | 56.99 | 1.99 | 0.49 | 15.6 | 0.12 | 7.0 | 7.2 | 17.9 | 20.6 | 16.9 | 30.4 | 55.4 |
| 16 | 240.3 | 310 | 258.5 | 1.23 | 30.9 | 17.7 | 50.7 | 1.50 | 0.52 | 17.0 | 0.13 | 11.2 | 9.9 | 21.6 | 21.8 | 14.0 | 21.5 | 57.4 |
| 18 | 263.6 | 310 | 260.1 | 2.50 | 24.8 | 15.3 | 39.9 | 1.58 | 0.60 | 27.7 | 0.24 | 12.0 | 9.1 | 22.7 | 25.8 | 14.1 | 16.3 | 62.6 |
| 21 | 287.6 | 310 | 259.4 | 2.47 | 27.2 | 16.4 | 38.4 | 1.05 | 0.45 | 29.9 | 0.21 | 16.5 | 11.1 | 26.5 | 23.8 | 10.6 | 11.5 | 60.9 |
| 24 | 311.3 | 310 | 260.5 | 2.32 | 20.7 | 11.4 | 38.6 | 1.92 | 0.56 | 21.4 | 0.18 | 12.6 | 9.5 | 23.1 | 26.5 | 13.7 | 14.5 | 63.3 |
| 32 | 429.8 | 310 | 280.7 | 2.50 | 33.4 | 18.2 | 57.2 | 1.57 | 0.50 | 37.2 | 0.29 | 14.9 | 11.2 | 23.7 | 18.9 | 13.4 | 17.9 | 56.0 |
| 35 | 452.8 | 310 | 281.6 | 1.23 | 42.4 | 26.4 | 66.2 | 1.49 | 0.59 | 23.4 | 0.20 | 14.1 | 11.0 | 26.4 | 17.5 | 13.2 | 17.8 | 57.1 |
| 38 | 478 | 310 | 280.9 | 2.47 | 38.6 | 25.4 | 52.4 | 1.04 | 0.50 | 42.6 | 0.33 | 18.1 | 12.6 | 28.8 | 18.4 | 10.0 | 12.1 | 57.2 |

## TABLE 5

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co(NO3)2/Zr(OPr)4/Al2O3
SAMPLE NO: 7888+1 +2+2

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 480.0 | T, C : | 239.3 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 13.9 | P, PSIG : | 310 | CO/H2: | 1.05 |
| TIME ON STREAM, HRS : | 71.0 | SV, L/G/HR: | 2.46 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.34 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 14.42 | MOL SYNGAS/KG CAT/HR: | 15.808 |
| %CO CONV. : | 7.12 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 22.10 | MOL CO/MOL METAL/MIN: | 0.093 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 4.16 | H2O: | 5.16 |
| OXYGENATES : | 0.02 | CO : | 85.59 |
| CO2 : | 0.21 | H2 : | 4.87 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 10.88 | C4+ENE : | 2.17 |
| C2+ANE : | 0.00 | C5+C11 : | 12.92 |
| C2+ENE : | 0.74 | C12+C18: | 19.78 |
| C3+ANE : | 0.36 | C19+C23: | 21.91 |
| C3+ENE : | 2.43 | C24+34 : | 22.27 |
| C4 ISO+ANE: | 0.77 | C35+ : | 5.76 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 12.92 |
| DIESEL (C9+C25) : | 53.32 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 101.89 |
| HYDROGEN: | 97.77 |
| OXYGEN : | 101.89 |

## TABLE 6

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888-85-2

SAMPLE NO. 2

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 10.88 | 57.24 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.00 | 0.00 | 0.74 | 2.23 | 0.00 | 0.00 |
| 3 | 0.36 | 0.69 | 2.43 | 4.86 | 0.00 | 0.00 |
| 4 | 0.77 | 1.12 | 2.17 | 3.26 | 0.00 | 0.00 |
| 5 | 0.91 | 1.07 | 2.41 | 2.90 | 0.00 | 0.00 |
| 6 | 1.74 | 1.70 | 0.00 | 0.00 | 0.00 | 0.00 |
| 7 | 0.60 | 0.50 | 0.62 | 0.53 | 0.00 | 0.00 |
| 8 | 0.50 | 0.37 | 0.46 | 0.34 | 0.21 | 0.15 |
| 9 | 0.79 | 0.52 | 0.65 | 0.43 | 0.01 | 0.01 |
| 10 | 0.99 | 0.59 | 0.91 | 0.55 | 0.04 | 0.02 |
| 11 | 1.08 | 0.58 | 0.81 | 0.44 | 0.19 | 0.10 |
| 12 | 1.18 | 0.58 | 0.75 | 0.38 | 0.05 | 0.03 |
| 13 | 1.37 | 0.63 | 0.75 | 0.35 | 0.04 | 0.02 |
| 14 | 1.36 | 0.58 | 0.82 | 0.35 | 0.03 | 0.01 |
| 15 | 1.95 | 0.77 | 0.78 | 0.31 | 0.04 | 0.02 |
| 16 | 3.05 | 1.14 | 0.00 | 0.00 | 0.06 | 0.02 |
| 17 | 3.47 | 1.22 | 0.00 | 0.00 | 0.08 | 0.03 |
| 18 | 3.89 | 1.29 | 0.00 | 0.00 | 0.11 | 0.04 |
| 19 | 4.28 | 1.34 | 0.00 | 0.00 | 0.14 | 0.04 |
| 20 | 4.51 | 1.35 | 0.00 | 0.00 | 0.17 | 0.05 |
| 21 | 4.54 | 1.29 | 0.00 | 0.00 | 0.16 | 0.05 |
| 22 | 4.25 | 1.15 | 0.00 | 0.00 | 0.12 | 0.03 |

TABLE 6 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888-85-2

SAMPLE NO. 2

| CARBON NO. | N-ALKANES | | 1-ALKENE | | BRANCHED ISOMERS | |
|---|---|---|---|---|---|---|
| | WT % | MOLE % | WT % | MOLE % | WT % | MOLE % |
| 23 | 3.61 | 0.94 | 0.00 | 0.00 | 0.12 | 0.03 |
| 24 | 3.18 | 0.79 | 0.00 | 0.00 | 0.00 | 0.00 |
| 25 | 2.98 | 0.71 | 0.00 | 0.00 | 0.00 | 0.00 |
| 26 | 2.77 | 0.64 | 0.00 | 0.00 | 0.00 | 0.00 |
| 27 | 2.47 | 0.55 | 0.00 | 0.00 | 0.00 | 0.00 |
| 28 | 2.30 | 0.49 | 0.00 | 0.00 | 0.00 | 0.00 |
| 29 | 1.29 | 0.27 | 0.00 | 0.00 | 0.07 | 0.01 |
| 30 | 1.21 | 0.24 | 0.00 | 0.00 | 0.13 | 0.03 |
| 31 | 1.52 | 0.29 | 0.00 | 0.00 | 0.16 | 0.03 |
| 32 | 1.83 | 0.34 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 1.12 | 0.20 | 0.00 | 0.00 | 0.05 | 0.01 |
| 34 | 1.05 | 0.19 | 0.00 | 0.00 | 0.15 | 0.03 |
| 35 | 1.43 | 0.24 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 1.36 | 0.23 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.93 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.74 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.73 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | [illegible] | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 7

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : $Co(NO3)2/Zr(OHr)4/Al2O3$
SAMPLE NO: 7888+85+2+5

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 480.0 | T, C : | 241.4 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 13.9 | P, PSIG : | 310 | CO/H2: | 1.59 |
| TIME ON STREAM, HRS : | 94.6 | SV, L/G/HR: | 2.49 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.49 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 13.92 | MOL SYNGAS/KG CAT/HR: | 15.462 |
| %CO CONV. : | 7.48 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 24.13 | MOL CO/MOL METAL/MIN: | 0.118 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 3.41 | H2O: | 4.38 |
| OXYGENATES : | 0.02 | CO : | 88.69 |
| CO2 : | 0.23 | H2 : | 3.28 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 7.60 | C4+ENE : | 1.77 |
| C2+ANE : | 0.00 | C5+C11 : | 11.57 |
| C2+ENE : | 0.58 | C12+C18: | 20.72 |
| C3+ANE : | 0.20 | C19+C23: | 22.35 |
| C3+ENE : | 1.95 | C24+34 : | 27.12 |
| C4 ISO+ANE: | 0.71 | C35+ : | 5.43 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 11.57 |
| DIESEL (C9+C25) : | 54.84 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 99.70 |
| HYDROGEN: | 99.53 |
| OXYGEN : | 99.95 |

TABLE 8

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888+85+2

SAMPLE NO. 5

| CARBON NO. | N+ALKANES WT % | N+ALKANES MOLE % | 1+ALKENE WT % | 1+ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 7.60 | 49.61 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.00 | 0.00 | 0.58 | 2.17 | 0.00 | 0.00 |
| 3 | 0.20 | 0.48 | 1.95 | 4.86 | 0.00 | 0.00 |
| 4 | 0.52 | 0.93 | 1.77 | 3.30 | 0.19 | 0.34 |
| 5 | 0.44 | 0.63 | 2.21 | 3.29 | 0.00 | 0.00 |
| 6 | 1.73 | 2.10 | 0.10 | 0.12 | 0.00 | 0.00 |
| 7 | 0.53 | 0.55 | 0.72 | 0.76 | 0.00 | 0.00 |
| 8 | 0.44 | 0.40 | 0.52 | 0.49 | 0.10 | 0.09 |
| 9 | 0.60 | 0.49 | 0.66 | 0.54 | 0.01 | 0.01 |
| 10 | 0.77 | 0.56 | 0.88 | 0.66 | 0.05 | 0.03 |
| 11 | 0.89 | 0.59 | 0.79 | 0.54 | 0.16 | 0.11 |
| 12 | 1.10 | 0.67 | 0.81 | 0.50 | 0.11 | 0.07 |
| 13 | 1.29 | 0.73 | 0.85 | 0.49 | 0.11 | 0.06 |
| 14 | 1.55 | 0.82 | 0.94 | 0.50 | 0.07 | 0.04 |
| 15 | 1.77 | 0.87 | 0.93 | 0.46 | 0.20 | 0.10 |
| 16 | 3.26 | 1.50 | 0.00 | 0.00 | 0.09 | 0.04 |
| 17 | 3.53 | 1.54 | 0.00 | 0.00 | 0.10 | 0.05 |
| 18 | 3.89 | 1.60 | 0.00 | 0.00 | 0.12 | 0.05 |
| 19 | 4.14 | 1.61 | 0.00 | 0.00 | 0.13 | 0.05 |
| 20 | 4.38 | 1.62 | 0.00 | 0.00 | 0.14 | 0.05 |
| 21 | 4.61 | 1.63 | 0.00 | 0.00 | 0.14 | 0.05 |
| 22 | 4.55 | 1.53 | 0.00 | 0.00 | 0.12 | 0.04 |

TABLE 8 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888-85-2

SAMPLE NO. 5

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 4.00 | 1.29 | 0.00 | 0.00 | 0.13 | 0.04 |
| 24 | 3.59 | 1.11 | 0.00 | 0.00 | 0.02 | 0.01 |
| 25 | 3.36 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 26 | 3.13 | 0.89 | 0.00 | 0.00 | 0.00 | 0.00 |
| 27 | 2.80 | 0.77 | 0.00 | 0.00 | 0.00 | 0.00 |
| 28 | 2.64 | 0.70 | 0.00 | 0.00 | 0.00 | 0.00 |
| 29 | 2.47 | 0.63 | 0.00 | 0.00 | 0.00 | 0.00 |
| 30 | 2.15 | 0.53 | 0.00 | 0.00 | 0.04 | 0.01 |
| 31 | 1.98 | 0.48 | 0.00 | 0.00 | 0.11 | 0.03 |
| 32 | 1.79 | 0.42 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 1.60 | 0.36 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 1.35 | 0.30 | 0.00 | 0.00 | 0.08 | 0.02 |
| 35 | 1.27 | 0.27 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 1.11 | 0.23 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 1.03 | 0.21 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.81 | 0.16 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.71 | 0.13 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.50 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 9

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co(NO3)2/Zr(OPr)4/Al2O3
SAMPLE No: 7888+85+2+8

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 480.0 | T, C : | 242.0 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 13.9 | P, PSIG : | 310 | CO/H2: | 2.12 |
| TIME ON STREAM, HRS : | 118.9 | SV, L/G/HR: | 2.49 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.42 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 11.09 | MOL SYNGAS/KG CAT/HR: | 12.326 |
| %CO CONV. : | 4.86 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 24.27 | MOL CO/MOL METAL/MIN: | 0.095 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 2.38 | H2O: | 3.22 |
| OXYGENATES : | 0.01 | CO : | 91.75 |
| CO2 : | 0.18 | H2 : | 2.46 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 7.79 | C4+ENE : | 1.92 |
| C2+ANE : | 0.00 | C5+C11 : | 12.04 |
| C2+ENE : | 0.63 | C12+C18: | 22.10 |
| C3+ANE : | 0.20 | C19+C23: | 21.39 |
| C3+ENE : | 2.12 | C24+34 : | 25.04 |
| C4 ISO+ANE: | 0.52 | C35+ : | 6.25 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 12.04 |
| DIESEL (C9+C25) : | 54.84 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 100.12 |
| HYDROGEN: | 98.18 |
| OXYGEN : | 100.57 |

TABLE 10

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888-85-2

SAMPLE NO. 8

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 7.79 | 49.67 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.00 | 0.00 | 0.63 | 2.31 | 0.00 | 0.00 |
| 3 | 0.20 | 0.47 | 2.12 | 5.15 | 0.00 | 0.00 |
| 4 | 0.52 | 0.91 | 1.92 | 3.50 | 0.00 | 0.00 |
| 5 | 0.38 | 0.55 | 2.40 | 3.50 | 0.00 | 0.00 |
| 6 | 1.92 | 2.28 | 0.00 | 0.00 | 0.00 | 0.00 |
| 7 | 0.00 | 0.00 | 1.30 | 1.35 | 0.00 | 0.00 |
| 8 | 0.40 | 0.36 | 0.58 | 0.52 | 0.08 | 0.07 |
| 9 | 0.53 | 0.42 | 0.70 | 0.57 | 0.01 | 0.01 |
| 10 | 0.76 | 0.54 | 1.01 | 0.74 | 0.05 | 0.03 |
| 11 | 0.76 | 0.50 | 0.97 | 0.64 | 0.18 | 0.12 |
| 12 | 1.09 | 0.66 | 1.01 | 0.61 | 0.24 | 0.15 |
| 13 | 1.28 | 0.71 | 1.09 | 0.61 | 0.13 | 0.07 |
| 14 | 1.49 | 0.77 | 1.28 | 0.66 | 0.10 | 0.05 |
| 15 | 1.66 | 0.80 | 1.36 | 0.66 | 0.12 | 0.06 |
| 16 | 1.98 | 0.90 | 1.28 | 0.58 | 0.14 | 0.06 |
| 17 | 3.57 | 1.52 | 0.00 | 0.00 | 0.16 | 0.07 |
| 18 | 3.95 | 1.58 | 0.00 | 0.00 | 0.18 | 0.07 |
| 19 | 4.29 | 1.63 | 0.00 | 0.00 | 0.19 | 0.07 |
| 20 | 4.49 | 1.62 | 0.00 | 0.00 | 0.20 | 0.07 |
| 21 | 3.92 | 1.35 | 0.00 | 0.00 | 0.61 | 0.21 |
| 22 | 3.95 | 1.30 | 0.00 | 0.00 | 0.10 | 0.03 |

TABLE 10 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888-85-2

SAMPLE NO. 8

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 3.61 | 1.14 | 0.00 | 0.00 | 0.03 | 0.01 |
| 24 | 3.25 | 0.98 | 0.00 | 0.00 | 0.00 | 0.00 |
| 25 | 3.12 | 0.90 | 0.00 | 0.00 | 0.00 | 0.00 |
| 26 | 2.95 | 0.82 | 0.00 | 0.00 | 0.00 | 0.00 |
| 27 | 2.76 | 0.74 | 0.00 | 0.00 | 0.00 | 0.00 |
| 28 | 2.61 | 0.68 | 0.00 | 0.00 | 0.00 | 0.00 |
| 29 | 1.81 | 0.45 | 0.00 | 0.00 | 0.00 | 0.00 |
| 30 | 1.77 | 0.43 | 0.00 | 0.00 | 0.00 | 0.00 |
| 31 | 1.66 | 0.39 | 0.00 | 0.00 | 0.08 | 0.02 |
| 32 | 1.70 | 0.39 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 1.68 | 0.37 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 1.64 | 0.35 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 1.63 | 0.34 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 1.37 | 0.28 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.99 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.87 | 0.17 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.78 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.60 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 11

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : $Co(NO3)2/Zr(OPr)4/Al2O3$
SAMPLE NO: 7888↑85↑2↑12

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 480.0 | T, C : | 241.1 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 13.9 | P, PSIG : | 310 | CO/H2: | 1.99 |
| TIME ON STREAM, HRS : | 143.1 | SV, L/G/HR: | 1.23 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.54 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 20.83 | MOL SYNGAS/KG CAT/HR: | 11.408 |
| %CO CONV. : | 10.92 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 40.59 | MOL CO/MOL METAL/MIN: | 0.092 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 4.71 | H2O: | 5.79 |
| OXYGENATES : | 0.02 | CO : | 87.05 |
| CO2 : | 0.34 | H2 : | 2.08 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 5.22 | C4↑ENE : | 1.44 |
| C2↑ANE : | 0.16 | C5↑C11 : | 11.18 |
| C2↑ENE : | 0.34 | C12↑C18: | 16.92 |
| C3↑ANE : | 0.21 | C19↑C23: | 23.73 |
| C3↑ENE : | 1.64 | C24↑34 : | 31.40 |
| C4 ISO↑ANE: | 0.37 | C35+ : | 7.38 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5↑C11): | 11.18 |
| DIESEL (C9↑C25) : | 54.95 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 98.85 |
| HYDROGEN: | 98.57 |
| OXYGEN : | 98.76 |

TABLE 12

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888-85-2

SAMPLE NO. 12

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 5.22 | 41.76 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.16 | 0.69 | 0.34 | 1.57 | 0.00 | 0.00 |
| 3 | 0.21 | 0.60 | 1.64 | 5.00 | 0.00 | 0.00 |
| 4 | 0.37 | 0.83 | 1.44 | 3.29 | 0.00 | 0.00 |
| 5 | 0.27 | 0.48 | 1.76 | 3.21 | 0.00 | 0.00 |
| 6 | 1.73 | 2.57 | 0.03 | 0.04 | 0.00 | 0.00 |
| 7 | 0.52 | 0.66 | 0.69 | 0.90 | 0.02 | 0.02 |
| 8 | 0.49 | 0.55 | 0.53 | 0.61 | 0.06 | 0.07 |
| 9 | 0.62 | 0.62 | 0.73 | 0.74 | 0.03 | 0.03 |
| 10 | 0.73 | 0.66 | 0.94 | 0.86 | 0.15 | 0.13 |
| 11 | 0.83 | 0.68 | 0.81 | 0.67 | 0.25 | 0.21 |
| 12 | 0.89 | 0.67 | 0.78 | 0.59 | 0.05 | 0.04 |
| 13 | 0.95 | 0.66 | 0.88 | 0.62 | 0.07 | 0.05 |
| 14 | 1.08 | 0.70 | 1.00 | 0.66 | 0.05 | 0.03 |
| 15 | 1.22 | 0.73 | 1.07 | 0.65 | 0.06 | 0.04 |
| 16 | 1.76 | 0.99 | 0.79 | 0.45 | 0.06 | 0.04 |
| 17 | 2.86 | 1.53 | 0.00 | 0.00 | 0.08 | 0.04 |
| 18 | 3.19 | 1.61 | 0.00 | 0.00 | 0.09 | 0.04 |
| 19 | 3.73 | 1.78 | 0.00 | 0.00 | 0.08 | 0.04 |
| 20 | 4.38 | 1.99 | 0.00 | 0.00 | 0.07 | 0.03 |
| 21 | 4.96 | 2.15 | 0.00 | 0.00 | 0.07 | 0.03 |
| 22 | 5.21 | 2.15 | 0.00 | 0.00 | 0.07 | 0.03 |

TABLE 12 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888-85-2

SAMPLE NO. 12

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 5.07 | 2.00 | 0.00 | 0.00 | 0.08 | 0.03 |
| 24 | 4.72 | 1.79 | 0.00 | 0.00 | 0.06 | 0.02 |
| 25 | 4.39 | 1.60 | 0.00 | 0.00 | 0.04 | 0.02 |
| 26 | 3.96 | 1.38 | 0.00 | 0.00 | 0.00 | 0.00 |
| 27 | 3.36 | 1.13 | 0.00 | 0.00 | 0.00 | 0.00 |
| 28 | 2.99 | 0.97 | 0.00 | 0.00 | 0.00 | 0.00 |
| 29 | 2.21 | 0.69 | 0.00 | 0.00 | 0.02 | 0.01 |
| 30 | 2.10 | 0.64 | 0.00 | 0.00 | 0.00 | 0.00 |
| 31 | 1.95 | 0.57 | 0.00 | 0.00 | 0.05 | 0.01 |
| 32 | 1.92 | 0.54 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 1.89 | 0.52 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 1.73 | 0.46 | 0.00 | 0.00 | 0.02 | 0.01 |
| 35 | 1.73 | 0.45 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 1.70 | 0.43 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 1.28 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 1.09 | 0.26 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.91 | 0.21 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.67 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 13

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co(NO3)2/Zr(OPr)4/Al2O3
SAMPLE NO: 7888+85+2+14

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 480.0 | T, C : | 259.1 | FEED RATIO, CO/H2: | 1.99 |
| CATALYST LOADING, WT%: | 13.9 | P, PSIG : | 312 | | |
| TIME ON STREAM, HRS : | 167.7 | SV, L/G/HR: | 1.23 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.49 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 28.38 | MOL SYNGAS/KG CAT/HR: | 15.550 |
| %CO CONV. : | 14.04 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 56.99 | MOL CO/MOL METAL/MIN: | 0.118 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 6.20 | H2O: | 8.25 |
| OXYGENATES : | 0.04 | CO : | 82.89 |
| CO2 : | 1.14 | H2 : | 1.49 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 7.03 | C4+ENE : | 2.49 |
| C2+ANE : | 0.52 | C5+C11 : | 17.86 |
| C2+ENE : | 0.58 | C12+C18: | 20.61 |
| C3+ANE : | 0.31 | C19+C23: | 16.93 |
| C3+ENE : | 2.78 | C24+34 : | 23.90 |
| C4 ISO+ANE: | 0.51 | C35+ : | 6.48 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 17.86 |
| DIESEL (C9+C25) : | 51.45 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 99.42 |
| HYDROGEN: | 97.72 |
| OXYGEN : | 100.80 |

TABLE 14

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888+85+2

SAMPLE NO. 14

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 7.03 | 43.56 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.52 | 1.71 | 0.58 | 2.06 | 0.00 | 0.00 |
| 3 | 0.31 | 0.70 | 2.78 | 6.57 | 0.00 | 0.00 |
| 4 | 0.51 | 0.87 | 2.49 | 4.41 | 0.00 | 0.00 |
| 5 | 0.59 | 0.81 | 3.00 | 4.25 | 0.00 | 0.00 |
| 6 | 2.89 | 3.33 | 0.09 | 0.11 | 0.00 | 0.00 |
| 7 | 0.86 | 0.85 | 1.07 | 1.09 | 0.10 | 0.10 |
| 8 | 0.81 | 0.71 | 0.91 | 0.81 | 0.15 | 0.13 |
| 9 | 0.86 | 0.67 | 1.23 | 0.97 | 0.22 | 0.17 |
| 10 | 0.91 | 0.64 | 1.30 | 0.92 | 0.41 | 0.29 |
| 11 | 0.89 | 0.56 | 1.06 | 0.68 | 0.51 | 0.32 |
| 12 | 1.19 | 0.69 | 1.01 | 0.60 | 0.55 | 0.32 |
| 13 | 1.24 | 0.67 | 1.05 | 0.57 | 0.34 | 0.18 |
| 14 | 1.36 | 0.68 | 1.06 | 0.54 | 0.35 | 0.17 |
| 15 | 1.66 | 0.78 | 0.82 | 0.39 | 0.44 | 0.20 |
| 16 | 2.64 | 1.16 | 0.15 | 0.06 | 0.29 | 0.13 |
| 17 | 2.96 | 1.22 | 0.00 | 0.00 | 0.25 | 0.10 |
| 18 | 3.03 | 1.18 | 0.00 | 0.00 | 0.23 | 0.09 |
| 19 | 2.99 | 1.11 | 0.00 | 0.00 | 0.12 | 0.05 |
| 20 | 3.12 | 1.10 | 0.00 | 0.00 | 0.07 | 0.02 |
| 21 | 3.39 | 1.13 | 0.00 | 0.00 | 0.05 | 0.02 |
| 22 | 3.56 | 1.14 | 0.00 | 0.00 | 0.06 | 0.02 |

TABLE 14 (Continued)

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888+85+2

SAMPLE NO. 14

| CARBON NO. | N+ALKANES | | 1+ALKENE | | BRANCHED ISOMERS | |
|---|---|---|---|---|---|---|
| | WT % | MOLE % | WT % | MOLE % | WT % | MOLE % |
| 23 | 3.51 | 1.07 | 0.00 | 0.00 | 0.06 | 0.02 |
| 24 | 3.31 | 0.97 | 0.00 | 0.00 | 0.05 | 0.01 |
| 25 | 3.12 | 0.88 | 0.00 | 0.00 | 0.04 | 0.01 |
| 26 | 2.86 | 0.78 | 0.00 | 0.00 | 0.00 | 0.00 |
| 27 | 2.50 | 0.65 | 0.00 | 0.00 | 0.00 | 0.00 |
| 28 | 2.24 | 0.56 | 0.00 | 0.00 | 0.00 | 0.00 |
| 29 | 1.86 | 0.45 | 0.00 | 0.00 | 0.01 | 0.00 |
| 30 | 1.68 | 0.40 | 0.00 | 0.00 | 0.00 | 0.00 |
| 31 | 1.59 | 0.36 | 0.00 | 0.00 | 0.03 | 0.01 |
| 32 | 1.61 | 0.36 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 1.51 | 0.32 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 1.48 | 0.31 | 0.00 | 0.00 | 0.01 | 0.00 |
| 35 | 1.45 | 0.29 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 1.42 | 0.28 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 1.15 | 0.22 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.99 | 0.18 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.84 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.63 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 15

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : $Co(NO3)2/Zr(OPr)4/Al_2O3$
SAMPLE NO: 7888↑85↑2↑16

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 480.0 | T, C : | 258.5 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 13.9 | P, PSIG : | 310 | CO/H2: | 1.50 |
| TIME ON STREAM, HRS : | 240.3 | SV, L/G/HR: | 1.23 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.52 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 30.88 | MOL SYNGAS/KG CAT/HR: | 16.982 |
| %CO CONV. : | 17.65 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 50.69 | MOL CO/MOL METAL/MIN: | 0.134 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 6.43 | H2O: | 9.04 |
| OXYGENATES : | 0.06 | CO : | 81.20 |
| CO2 : | 0.96 | H2 : | 2.32 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 11.23 | C4↑ENE : | 3.22 |
| C2↑ANE : | 0.88 | C5↑C11 : | 21.64 |
| C2↑ENE : | 0.63 | C12↑C18: | 21.75 |
| C3↑ANE : | 0.56 | C19↑C23: | 13.96 |
| C3↑ENE : | 3.69 | C24↑34 : | 17.56 |
| C4 ISO+ANE: | 0.91 | C35+ : | 3.97 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5↑C11): | 21.64 |
| DIESEL (C9↑C25) : | 49.47 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 95.80 |
| HYDROGEN: | 92.85 |
| OXYGEN : | 97.89 |

## TABLE 16

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888-85-2

SAMPLE NO. 16

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 11.23 | 52.13 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.88 | 2.19 | 0.63 | 1.68 | 0.00 | 0.00 |
| 3 | 0.56 | 0.95 | 3.69 | 6.52 | 0.00 | 0.00 |
| 4 | 0.87 | 1.11 | 3.22 | 4.26 | 0.04 | 0.05 |
| 5 | 1.07 | 1.11 | 3.77 | 4.00 | 0.00 | 0.00 |
| 6 | 3.49 | 3.02 | 0.09 | 0.08 | 0.00 | 0.00 |
| 7 | 1.03 | 0.77 | 1.21 | 0.92 | 0.08 | 0.06 |
| 8 | 0.94 | 0.61 | 0.95 | 0.63 | 0.10 | 0.06 |
| 9 | 1.13 | 0.65 | 1.30 | 0.77 | 0.14 | 0.08 |
| 10 | 1.30 | 0.68 | 1.54 | 0.82 | 0.39 | 0.20 |
| 11 | 1.43 | 0.68 | 1.24 | 0.60 | 0.42 | 0.20 |
| 12 | 1.50 | 0.65 | 1.18 | 0.52 | 0.28 | 0.12 |
| 13 | 1.56 | 0.63 | 1.15 | 0.47 | 0.29 | 0.12 |
| 14 | 1.74 | 0.65 | 0.93 | 0.35 | 0.39 | 0.15 |
| 15 | 1.98 | 0.69 | 0.00 | 0.00 | 1.12 | 0.39 |
| 16 | 2.67 | 0.88 | 0.00 | 0.00 | 0.49 | 0.16 |
| 17 | 2.78 | 0.86 | 0.00 | 0.00 | 0.45 | 0.14 |
| 18 | 2.83 | 0.83 | 0.00 | 0.00 | 0.40 | 0.12 |
| 19 | 2.78 | 0.77 | 0.00 | 0.00 | 0.11 | 0.03 |
| 20 | 2.69 | 0.71 | 0.00 | 0.00 | 0.08 | 0.02 |
| 21 | 2.72 | 0.68 | 0.00 | 0.00 | 0.07 | 0.02 |
| 22 | 2.72 | 0.65 | 0.00 | 0.00 | 0.08 | 0.02 |

TABLE 16 (Continued)

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888-85-2

SAMPLE NO. 16

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 2.62 | 0.60 | 0.00 | 0.00 | 0.08 | 0.02 |
| 24 | 2.45 | 0.54 | 0.00 | 0.00 | 0.07 | 0.01 |
| 25 | 2.29 | 0.48 | 0.00 | 0.00 | 0.06 | 0.01 |
| 26 | 2.06 | 0.42 | 0.00 | 0.00 | 0.04 | 0.01 |
| 27 | 1.82 | 0.35 | 0.00 | 0.00 | 0.03 | 0.01 |
| 28 | 1.56 | 0.29 | 0.00 | 0.00 | 0.03 | 0.01 |
| 29 | 1.37 | 0.25 | 0.00 | 0.00 | 0.02 | 0.00 |
| 30 | 1.28 | 0.23 | 0.00 | 0.00 | 0.01 | 0.00 |
| 31 | 1.22 | 0.21 | 0.00 | 0.00 | 0.02 | 0.00 |
| 32 | 1.18 | 0.19 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 1.04 | 0.17 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 1.01 | 0.16 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 1.01 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.88 | 0.13 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.70 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.57 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.47 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.34 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 17

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co(NO3)2/Zr(OPr)4/Al2O3
SAMPLE NO: 7888+85+2+18

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 480.0 | T, C : | 260.1 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 13.9 | P, PSIG : | 310 | CO/H2: | 1.58 |
| TIME ON STREAM, HRS : | 263.6 | SV, L/G/HR: | 2.50 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.60 | BUL ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 24.83 | MOL SYNGAS/KG CAT/HR: | 27.698 |
| %CO CONV. : | 15.26 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 39.93 | MOL CO/MOL METAL/MIN: | 0.241 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 4.44 | H2O: | 6.88 |
| OXYGENATES : | 0.04 | CO : | 85.43 |
| CO2 : | 0.46 | H2 : | 2.74 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 12.02 | C4+ENE : | 3.06 |
| C2+ANE : | 0.66 | C5+C11 : | 22.66 |
| C2+ENE : | 0.67 | C12+C18: | 25.82 |
| C3+ANE : | 0.47 | C19+C23: | 14.13 |
| C3+ENE : | 3.38 | C24+34 : | 13.33 |
| C4 ISO+ANE: | 0.86 | C35+ : | 2.95 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 22.66 |
| DIESEL (C9+C25) : | 52.17 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 93.70 |
| HYDROGEN: | 92.67 |
| OXYGEN : | 95.98 |

## TABLE 18

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888-85-2

SAMPLE NO. 18

| CARBON NO. | N-ALKANES | | 1-ALKENE | | BRANCHED ISOMERS | |
|---|---|---|---|---|---|---|
| | WT % | MOLE % | WT % | MOLE % | WT % | MOLE % |
| 1 | 12.02 | 53.77 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.66 | 1.57 | 0.67 | 1.72 | 0.00 | 0.00 |
| 3 | 0.47 | 0.76 | 3.38 | 5.76 | 0.00 | 0.00 |
| 4 | 0.76 | 0.94 | 3.06 | 3.91 | 0.10 | 0.12 |
| 5 | 0.99 | 0.98 | 3.92 | 4.01 | 0.00 | 0.00 |
| 6 | 4.23 | 3.52 | 0.10 | 0.08 | 0.00 | 0.00 |
| 7 | 0.00 | 0.00 | 2.64 | 1.93 | 0.07 | 0.05 |
| 8 | 0.88 | 0.55 | 1.12 | 0.72 | 0.07 | 0.04 |
| 9 | 1.04 | 0.58 | 1.27 | 0.72 | 0.07 | 0.04 |
| 10 | 1.24 | 0.62 | 1.60 | 0.82 | 0.16 | 0.08 |
| 11 | 1.42 | 0.65 | 1.45 | 0.67 | 0.40 | 0.18 |
| 12 | 1.66 | 0.70 | 1.47 | 0.62 | 0.39 | 0.16 |
| 13 | 1.74 | 0.68 | 1.44 | 0.57 | 0.38 | 0.15 |
| 14 | 1.83 | 0.66 | 1.39 | 0.51 | 0.39 | 0.14 |
| 15 | 1.97 | 0.67 | 0.00 | 0.00 | 1.64 | 0.55 |
| 16 | 3.11 | 0.99 | 0.00 | 0.00 | 0.53 | 0.17 |
| 17 | 3.24 | 0.97 | 0.00 | 0.00 | 0.58 | 0.17 |
| 18 | 3.72 | 1.05 | 0.00 | 0.00 | 0.34 | 0.10 |
| 19 | 3.69 | 0.99 | 0.00 | 0.00 | 0.34 | 0.09 |
| 20 | 3.08 | 0.78 | 0.00 | 0.00 | 0.24 | 0.06 |
| 21 | 2.44 | 0.59 | 0.00 | 0.00 | 0.12 | 0.03 |
| 22 | 2.13 | 0.49 | 0.00 | 0.00 | 0.07 | 0.02 |

TABLE 18 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888-85-2

SAMPLE NO. 18

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 1.96 | 0.43 | 0.00 | 0.00 | 0.06 | 0.01 |
| 24 | 1.81 | 0.38 | 0.00 | 0.00 | 0.05 | 0.01 |
| 25 | 1.68 | 0.34 | 0.00 | 0.00 | 0.04 | 0.01 |
| 26 | 1.51 | 0.30 | 0.00 | 0.00 | 0.03 | 0.01 |
| 27 | 1.35 | 0.25 | 0.00 | 0.00 | 0.03 | 0.01 |
| 28 | 1.17 | 0.21 | 0.00 | 0.00 | 0.02 | 0.00 |
| 29 | 1.12 | 0.20 | 0.00 | 0.00 | 0.01 | 0.00 |
| 30 | 1.07 | 0.18 | 0.00 | 0.00 | 0.00 | 0.00 |
| 31 | 0.97 | 0.16 | 0.00 | 0.00 | 0.00 | 0.00 |
| 32 | 0.90 | 0.14 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 0.80 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 0.76 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.74 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.65 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.53 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.43 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.35 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.26 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 19

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : $Co(NO3)2/Zr(OPr)4/Al2O3$
SAMPLE NO: 7888+85+2+21

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 480.0 | T, C : | 259.4 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 13.9 | P, PSIG : | 310 | CO/H2: | 1.05 |
| TIME ON STREAM, HRS : | 287.6 | SV, L/G/HR: | 2.47 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.45 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 27.18 | MOL SYNGAS/KG CAT/HR: | 29.936 |
| %CO CONV. : | 16.41 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 38.44 | MOL CO/MOL METAL/MIN: | 0.213 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 6.34 | H2O: | 9.87 |
| OXYGENATES : | 0.08 | CO : | 79.18 |
| CO2 : | 0.54 | H2 : | 3.98 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 16.45 | C4+ENE : | 3.54 |
| C2+ANE : | 1.10 | C5+C11 : | 26.46 |
| C2+ENE : | 0.54 | C12+C18: | 23.82 |
| C3+ANE : | 0.76 | C19+C23: | 10.55 |
| C3+ENE : | 4.07 | C24+34 : | 9.44 |
| C4 ISO+ANE: | 1.20 | C35+ : | 2.07 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 26.46 |
| DIESEL (C9+C25) : | 47.07 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 97.06 |
| HYDROGEN: | 95.07 |
| OXYGEN : | 100.58 |

TABLE 20

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888+85+2

SAMPLE NO. 21

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 16.45 | 59.57 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 1.10 | 2.13 | 0.54 | 1.11 | 0.00 | 0.00 |
| 3 | 0.76 | 0.99 | 4.07 | 5.61 | 0.00 | 0.00 |
| 4 | 1.20 | 1.20 | 3.54 | 3.66 | 0.00 | 0.00 |
| 5 | 1.43 | 1.15 | 4.23 | 3.50 | 0.00 | 0.00 |
| 6 | 4.84 | 3.26 | 0.10 | 0.07 | 0.00 | 0.00 |
| 7 | 1.48 | 0.86 | 1.63 | 0.96 | 0.05 | 0.03 |
| 8 | 1.27 | 0.64 | 1.19 | 0.62 | 0.08 | 0.04 |
| 9 | 1.53 | 0.69 | 1.37 | 0.63 | 0.12 | 0.06 |
| 10 | 1.66 | 0.68 | 1.59 | 0.66 | 0.21 | 0.09 |
| 11 | 1.84 | 0.68 | 1.33 | 0.50 | 0.51 | 0.19 |
| 12 | 1.92 | 0.66 | 1.27 | 0.44 | 0.36 | 0.12 |
| 13 | 1.98 | 0.62 | 1.19 | 0.38 | 0.39 | 0.12 |
| 14 | 2.07 | 0.61 | 0.93 | 0.28 | 0.53 | 0.15 |
| 15 | 2.85 | 0.78 | 0.00 | 0.00 | 0.61 | 0.17 |
| 16 | 2.68 | 0.69 | 0.00 | 0.00 | 0.65 | 0.17 |
| 17 | 2.56 | 0.62 | 0.00 | 0.00 | 0.63 | 0.15 |
| 18 | 2.53 | 0.58 | 0.00 | 0.00 | 0.66 | 0.15 |
| 19 | 2.49 | 0.54 | 0.00 | 0.00 | 0.57 | 0.12 |
| 20 | 2.33 | 0.48 | 0.00 | 0.00 | 0.18 | 0.04 |
| 21 | 1.82 | 0.36 | 0.00 | 0.00 | 0.10 | 0.02 |
| 22 | 1.55 | 0.29 | 0.00 | 0.00 | 0.06 | 0.01 |

TABLE 20 (Continued)

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888-85-2

SAMPLE NO. 21

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 1.40 | 0.25 | 0.00 | 0.00 | 0.05 | 0.01 |
| 24 | 1.28 | 0.22 | 0.00 | 0.00 | 0.04 | 0.01 |
| 25 | 1.19 | 0.20 | 0.00 | 0.00 | 0.03 | 0.01 |
| 26 | 1.07 | 0.17 | 0.00 | 0.00 | 0.02 | 0.00 |
| 27 | 0.96 | 0.15 | 0.00 | 0.00 | 0.02 | 0.00 |
| 28 | 0.83 | 0.12 | 0.00 | 0.00 | 0.02 | 0.00 |
| 29 | 0.80 | 0.11 | 0.00 | 0.00 | 0.01 | 0.00 |
| 30 | 0.75 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 |
| 31 | 0.68 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 |
| 32 | 0.64 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 0.57 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 0.54 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.52 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.45 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.37 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.30 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.24 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.18 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 21

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co(NO3)2/Zr(OPr)4/Al2O3
SAMPLE No: 7888+85+2+24

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 480.0 | T, C : | 260.5 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 13.9 | P, PSIG : | 310 | CO/H2: | 1.92 |
| TIME ON STREAM, HRS : | 311.3 | SV, L/G/HR: | 2.32 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.56 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 20.69 | MOL SYNGAS/KG CAT/HR: | 21.419 |
| %CO CONV. : | 11.35 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 38.60 | MOL CO/MOL METAL/MIN: | 0.178 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 3.71 | H2O: | 6.17 |
| OXYGENATES : | 0.03 | CO : | 87.38 |
| CO2 : | 0.45 | H2 : | 2.26 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 12.57 | C4+ENE : | 3.35 |
| C2+ANE : | 0.65 | C5+C11 : | 23.08 |
| C2+ENE : | 0.77 | C12+C18: | 26.53 |
| C3+ANE : | 0.43 | C19+C23: | 13.72 |
| C4+ANE : | 0.79 | C24+34 : | 12.90 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 23.08 |
| DIESEL (C9+C25) : | 52.65 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 96.34 |
| HYDROGEN: | 96.55 |
| OXYGEN : | 98.99 |

## TABLE 22

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888-85-2

SAMPLE NO. 24

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 12.57 | 54.44 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.65 | 1.51 | 0.77 | 1.89 | 0.00 | 0.00 |
| 3 | 0.43 | 0.67 | 3.59 | 5.92 | 0.00 | 0.00 |
| 4 | 0.75 | 0.89 | 3.35 | 4.14 | 0.00 | 0.00 |
| 5 | 0.95 | 0.91 | 4.24 | 4.20 | 0.00 | 0.00 |
| 6 | 3.94 | 3.17 | 0.09 | 0.08 | 0.00 | 0.00 |
| 7 | 1.00 | 0.69 | 1.52 | 1.07 | 0.08 | 0.05 |
| 8 | 0.88 | 0.54 | 1.16 | 0.72 | 0.08 | 0.05 |
| 9 | 1.11 | 0.60 | 1.40 | 0.77 | 0.10 | 0.06 |
| 10 | 1.24 | 0.61 | 1.71 | 0.85 | 0.21 | 0.10 |
| 11 | 1.40 | 0.62 | 1.49 | 0.67 | 0.47 | 0.21 |
| 12 | 1.52 | 0.66 | 1.51 | 0.62 | 0.42 | 0.17 |
| 13 | 1.73 | 0.65 | 1.50 | 0.57 | 0.43 | 0.16 |
| 14 | 1.81 | 0.63 | 1.51 | 0.53 | 0.46 | 0.16 |
| 15 | 1.96 | 0.64 | 1.33 | 0.44 | 0.56 | 0.18 |
| 16 | 3.26 | 1.00 | 0.00 | 0.00 | 0.62 | 0.19 |
| 17 | 3.24 | 0.94 | 0.00 | 0.00 | 0.66 | 0.19 |
| 18 | 3.24 | 0.88 | 0.00 | 0.00 | 0.65 | 0.18 |
| 19 | 3.56 | 0.92 | 0.00 | 0.00 | 0.32 | 0.08 |
| 20 | 3.11 | 0.76 | 0.00 | 0.00 | 0.25 | 0.06 |
| 21 | 2.42 | 0.57 | 0.00 | 0.00 | 0.14 | 0.03 |
| 22 | 2.00 | 0.45 | 0.00 | 0.00 | 0.08 | 0.02 |

TABLE 22 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888+85+2

SAMPLE NO. 24

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 1.79 | 0.38 | 0.00 | 0.00 | 0.06 | 0.01 |
| 24 | 1.64 | 0.34 | 0.00 | 0.00 | 0.05 | 0.01 |
| 25 | 1.52 | 0.30 | 0.00 | 0.00 | 0.05 | 0.01 |
| 26 | 1.37 | 0.26 | 0.00 | 0.00 | 0.04 | 0.01 |
| 27 | 1.23 | 0.22 | 0.00 | 0.00 | 0.03 | 0.01 |
| 28 | 1.08 | 0.19 | 0.00 | 0.00 | 0.03 | 0.00 |
| 29 | 0.97 | 0.16 | 0.00 | 0.00 | 0.02 | 0.00 |
| 30 | 0.88 | 0.14 | 0.00 | 0.00 | 0.01 | 0.00 |
| 31 | 0.84 | 0.13 | 0.00 | 0.00 | 0.02 | 0.00 |
| 32 | 0.81 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 0.73 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 0.68 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.65 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.56 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.45 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.37 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.30 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.22 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 23

EFFECT OF Co SOURCE,
$Co(NO3)2$ vs. $Co_2(CO)_8$,
ON ACTIVITY AND SELECTIVITY

| COBALT SOURCE | $Co_2(CO)_8$ | | $Co(NO_3)_2$ | |
|---|---|---|---|---|
| Co/Zr | 0.65 | | 0.60 | |
| Run No. | 8523-1-4 | | 7888-85-2 | |
| | $CO/H_2$ = 1.0<br>2.0 NL/g cat/hr<br>300 psig | | | |
| | 240 | 260 | 240 | 260 |
| ACTIVITY | | | | |
| BULK ACTIVITY, mol SYNGAS/kg cat/hr | 35.3 | 38.5 | 15.8 | 29.9 |
| SPECIFIC ACTIVITY, mol CO/mol Co/min | 0.29 | 0.32 | 0.09 | 0.21 |
| U - $DCO/DH_2$ | 0.51 | 0.52 | 0.34 | 0.45 |
| SELECTIVITY | | | | |
| $C_1$ | 7.9 | 10.4 | 10.9 | 16.5 |
| $C_{2-4}$ | 13.7 | 15.0 | 6.5 | 11.1 |
| $C_{5-11}$ | 37.0 | 44.5 | 12.9 | 26.5 |
| $C_{12-18}$ | 23.4 | 25.8 | 19.8 | 23.8 |
| $C_{19-23}$ | 8.9 | 2.0 | 21.9 | 10.6 |
| $C_{24+}$ | 9.1 | 2.3 | 28.0 | 11.5 |
| TOTAL FUELS $C_{5-23}$ | 69.3 | 72.3 | 54.6 | 60.9 |

TABLE 24

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co(NO3)2/Zr(OPr)4/AL2O3
SAMPLE No: 7888+85+2+32

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 480.0 | T, C : | 280.7 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 13.9 | P, PSIG : | 310 | CO/H2: | 1.57 |
| TIME ON STREAM, HRS : | 429.8 | SV, L/G/HR: | 2.50 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.50 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 33.39 | MOL SYNGAS/KG CAT/HR: | 37.203 |
| %CO CONV. : | 18.20 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 57.20 | MOL CO/MOL METAL/MIN: | 0.286 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 8.44 | H2O: | 9.76 |
| OXYGENATES : | 0.09 | CO : | 78.65 |
| CO2 : | 1.19 | H2 : | 1.87 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 14.93 | C4+ENE : | 3.48 |
| C2+ANE : | 1.46 | C5+C11 : | 23.67 |
| C2+ENE : | 0.62 | C12+C18: | 18.90 |
| C3+ANE : | 0.62 | C19+C23: | 13.42 |
| C3+ENE : | 4.10 | C24+34 : | 16.21 |
| C4 ISO+ANE: | 0.91 | C35+ : | 1.68 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 23.67 |
| DIESEL (C9+C25) : | 46.11 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 99.79 |
| HYDROGEN: | 99.66 |
| OXYGEN : | 99.23 |

## TABLE 25

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888-85-2

SAMPLE NO. 32

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 14.93 | 57.91 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 1.46 | 3.02 | 0.62 | 1.37 | 0.00 | 0.00 |
| 3 | 0.62 | 0.87 | 4.10 | 6.06 | 0.00 | 0.00 |
| 4 | 0.91 | 0.97 | 3.48 | 3.86 | 0.00 | 0.00 |
| 5 | 1.18 | 1.02 | 3.96 | 3.51 | 0.06 | 0.05 |
| 6 | 3.73 | 2.69 | 0.19 | 0.14 | 0.00 | 0.00 |
| 7 | 1.32 | 0.82 | 1.30 | 0.82 | 0.22 | 0.14 |
| 8 | 1.17 | 0.64 | 1.07 | 0.59 | 0.26 | 0.14 |
| 9 | 1.18 | 0.57 | 1.25 | 0.62 | 0.37 | 0.18 |
| 10 | 1.27 | 0.56 | 1.31 | 0.58 | 0.66 | 0.29 |
| 11 | 1.35 | 0.54 | 1.01 | 0.41 | 0.80 | 0.32 |
| 12 | 1.39 | 0.51 | 0.93 | 0.34 | 0.67 | 0.24 |
| 13 | 1.39 | 0.47 | 0.82 | 0.28 | 0.68 | 0.23 |
| 14 | 1.42 | 0.44 | 0.70 | 0.22 | 0.68 | 0.21 |
| 15 | 1.54 | 0.45 | 0.52 | 0.15 | 0.65 | 0.19 |
| 16 | 1.90 | 0.52 | 0.00 | 0.00 | 0.67 | 0.19 |
| 17 | 1.90 | 0.49 | 0.00 | 0.00 | 0.57 | 0.15 |
| 18 | 1.99 | 0.49 | 0.00 | 0.00 | 0.49 | 0.12 |
| 19 | 2.25 | 0.52 | 0.00 | 0.00 | 0.25 | 0.06 |
| 20 | 2.61 | 0.57 | 0.00 | 0.00 | 0.17 | 0.04 |
| 21 | 2.69 | 0.56 | 0.00 | 0.00 | 0.15 | 0.03 |
| 22 | 2.59 | 0.52 | 0.00 | 0.00 | 0.15 | 0.03 |

TABLE 25 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 388-85-2

SAMPLE NO. 32

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 2.43 | 0.47 | 0.00 | 0.00 | 0.14 | 0.03 |
| 24 | 2.26 | 0.41 | 0.00 | 0.00 | 0.13 | 0.02 |
| 25 | 2.08 | 0.37 | 0.00 | 0.00 | 0.11 | 0.02 |
| 26 | 1.89 | 0.32 | 0.00 | 0.00 | 0.10 | 0.02 |
| 27 | 1.70 | 0.28 | 0.00 | 0.00 | 0.08 | 0.01 |
| 28 | 1.51 | 0.24 | 0.00 | 0.00 | 0.07 | 0.01 |
| 29 | 1.34 | 0.20 | 0.00 | 0.00 | 0.06 | 0.01 |
| 30 | 1.19 | 0.17 | 0.00 | 0.00 | 0.04 | 0.01 |
| 31 | 1.06 | 0.15 | 0.00 | 0.00 | 0.04 | 0.01 |
| 32 | 1.00 | 0.14 | 0.00 | 0.00 | 0.02 | 0.00 |
| 33 | 0.84 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 0.69 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.56 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.41 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.28 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.19 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.14 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.09 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 26

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co(NO3)2/Zr(OPr)4/Al2O3
SAMPLE NO: 7888+85+2+35

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 480.0 | T, C : | 281.6 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 13.9 | P, PSIG : | 310 | CO/H2: | 1.49 |
| TIME ON STREAM, HRS : | 452.8 | SV, L/G/HR: | 1.23 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.59 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 42.38 | MOL SYNGAS/KG CAT/HR: | 23.349 |
| %CO CONV. : | 26.39 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 66.17 | MOL CO/MOL METAL/MIN: | 0.201 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 11.54 | H2O: | 11.02 |
| OXYGENATES : | 0.12 | CO : | 72.55 |
| CO2 : | 3.18 | H2 : | 1.60 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 14.06 | C4+ENE : | 3.27 |
| C2+ANE : | 1.57 | C5+C11 : | 26.40 |
| C2+ENE : | 0.57 | C12+C18: | 17.52 |
| C3+ANE : | 0.67 | C19+C23: | 13.22 |
| C3+ENE : | 4.06 | C24+34 : | 16.01 |
| C4 ISO+ANE: | 0.89 | C35+ : | 1.76 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 26.40 |
| DIESEL (C9+C25) | 45.90 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 98.61 |
| HYDROGEN: | 100.27 |
| OXYGEN : | 95.19 |

TABLE 27

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888+85+2

SAMPLE NO. 35

| CARBON NO. | N+ALKANES WT % | N+ALKANES MOLE % | 1+ALKENE WT % | 1+ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 14.06 | 55.94 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 1.57 | 3.32 | 0.57 | 1.31 | 0.00 | 0.00 |
| 3 | 0.67 | 0.98 | 4.06 | 6.15 | 0.00 | 0.00 |
| 4 | 0.89 | 0.98 | 3.27 | 3.71 | 0.00 | 0.00 |
| 5 | 1.17 | 1.03 | 3.72 | 3.38 | 0.11 | 0.10 |
| 6 | 4.41 | 3.27 | 0.30 | 0.23 | 0.00 | 0.00 |
| 7 | 1.47 | 0.94 | 1.39 | 0.90 | 0.36 | 0.23 |
| 8 | 1.33 | 0.74 | 1.15 | 0.65 | 0.47 | 0.26 |
| 9 | 1.33 | 0.66 | 1.44 | 0.73 | 0.72 | 0.36 |
| 10 | 1.31 | 0.59 | 1.33 | 0.60 | 1.05 | 0.47 |
| 11 | 1.37 | 0.56 | 0.94 | 0.39 | 1.02 | 0.41 |
| 12 | 1.35 | 0.51 | 0.78 | 0.30 | 0.75 | 0.28 |
| 13 | 1.32 | 0.46 | 0.64 | 0.22 | 0.71 | 0.25 |
| 14 | 1.33 | 0.43 | 0.50 | 0.16 | 0.68 | 0.22 |
| 15 | 1.39 | 0.42 | 0.34 | 0.10 | 0.67 | 0.20 |
| 16 | 1.67 | 0.47 | 0.00 | 0.00 | 0.70 | 0.20 |
| 17 | 1.71 | 0.45 | 0.00 | 0.00 | 0.65 | 0.17 |
| 18 | 1.89 | 0.47 | 0.00 | 0.00 | 0.45 | 0.11 |
| 19 | 2.08 | 0.49 | 0.00 | 0.00 | 0.18 | 0.04 |
| 20 | 2.53 | 0.57 | 0.00 | 0.00 | 0.15 | 0.03 |
| 21 | 2.69 | 0.58 | 0.00 | 0.00 | 0.17 | 0.04 |
| 22 | 2.63 | 0.54 | 0.00 | 0.00 | 0.17 | 0.03 |

TABLE 2/ (Continued)

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888-85-2

SAMPLE NO. 35

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 2.47 | 0.48 | 0.00 | 0.00 | 0.16 | 0.03 |
| 24 | 2.27 | 0.43 | 0.00 | 0.00 | 0.14 | 0.03 |
| 25 | 2.11 | 0.38 | 0.00 | 0.00 | 0.12 | 0.02 |
| 26 | 1.85 | 0.32 | 0.00 | 0.00 | 0.10 | 0.02 |
| 27 | 1.64 | 0.27 | 0.00 | 0.00 | 0.08 | 0.01 |
| 28 | 1.44 | 0.23 | 0.00 | 0.00 | 0.06 | 0.01 |
| 29 | 1.27 | 0.20 | 0.00 | 0.00 | 0.05 | 0.01 |
| 30 | 1.15 | 0.17 | 0.00 | 0.00 | 0.03 | 0.00 |
| 31 | 1.11 | 0.16 | 0.00 | 0.00 | 0.02 | 0.00 |
| 32 | 1.01 | 0.14 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 0.85 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 0.70 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.57 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.42 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.30 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.21 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.16 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.10. | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 28

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co(NO3)2/Zr(OPr)4/Al2O3
SAMPLE NO: 7888+85+2+38

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 480.0 | T, C : | 280.9 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 13.9 | P, PSIG : | 310 | CO/H2: | 1.04 |
| TIME ON STREAM, HRS : | 478.0 | SV, L/G/HR: | 2.47 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.50 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 38.64 | MOL SYNGAS/KG CAT/HR: | 42.628 |
| %CO CONV. : | 25.39 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 52.37 | MOL CO/MOL METAL/MIN: | 0.329 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 11.10 | H2O: | 13.15 |
| OXYGENATES : | 0.17 | CO : | 71.14 |
| CO2 : | 1.31 | H2 : | 3.13 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 18.05 | C4+ENE : | 3.57 |
| C2+ANE : | 1.94 | C5+C11 : | 28.84 |
| C2+ENE : | 0.49 | C12+C18: | 18.41 |
| C3+ANE : | 0.96 | C19+C23: | 10.03 |
| C3+ENE : | 4.22 | C24+34 : | 11.18 |
| C4 ISO+ANE: | 1.39 | C35+ : | 0.92 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 28.84 |
| DIESEL (C9+C25) : | 43.47 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 98.24 |
| HYDROGEN: | 98.85 |
| OXYGEN : | 97.94 |

TABLE 29

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888-85-2

SAMPLE NO. 38

| CARBON NO. | N-ALKANES | | 1-ALKENE | | BRANCHED ISOMERS | |
|---|---|---|---|---|---|---|
| | WT % | MOLE % | WT % | MOLE % | WT % | MOLE % |
| 1 | 18.05 | 60.71 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 1.94 | 3.48 | 0.49 | 0.94 | 0.00 | 0.00 |
| 3 | 0.96 | 1.17 | 4.22 | 5.41 | 0.00 | 0.00 |
| 4 | 1.36 | 1.26 | 3.57 | 3.43 | 0.03 | 0.03 |
| 5 | 1.74 | 1.30 | 3.95 | 3.03 | 0.13 | 0.10 |
| 6 | 4.22 | 2.64 | 0.22 | 0.14 | 0.00 | 0.00 |
| 7 | 1.89 | 1.01 | 1.38 | 0.76 | 0.29 | 0.16 |
| 8 | 1.76 | 0.83 | 1.29 | 0.62 | 0.37 | 0.18 |
| 9 | 1.87 | 0.79 | 1.52 | 0.65 | 0.54 | 0.23 |
| 10 | 1.91 | 0.73 | 1.47 | 0.56 | 0.88 | 0.34 |
| 11 | 1.68 | 0.58 | 0.95 | 0.33 | 0.77 | 0.26 |
| 12 | 1.66 | 0.53 | 0.81 | 0.26 | 0.60 | 0.19 |
| 13 | 1.63 | 0.48 | 0.66 | 0.19 | 0.60 | 0.18 |
| 14 | 1.61 | 0.44 | 0.50 | 0.14 | 0.59 | 0.16 |
| 15 | 1.94 | 0.49 | 0.00 | 0.00 | 0.56 | 0.14 |
| 16 | 1.84 | 0.44 | 0.00 | 0.00 | 0.54 | 0.13 |
| 17 | 1.83 | 0.41 | 0.00 | 0.00 | 0.54 | 0.12 |
| 18 | 1.93 | 0.41 | 0.00 | 0.00 | 0.58 | 0.12 |
| 19 | 1.97 | 0.40 | 0.00 | 0.00 | 0.36 | 0.07 |
| 20 | 2.04 | 0.39 | 0.00 | 0.00 | 0.22 | 0.04 |
| 21 | 1.74 | 0.32 | 0.00 | 0.00 | 0.19 | 0.03 |
| 22 | 1.64 | 0.28 | 0.00 | 0.00 | 0.18 | 0.03 |

TABLE 29 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 7888-85-2

SAMPLE NO. 38

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 1.53 | 0.25 | 0.00 | 0.00 | 0.17 | 0.03 |
| 24 | 1.66 | 0.26 | 0.00 | 0.00 | 0.13 | 0.02 |
| 25 | 1.52 | 0.23 | 0.00 | 0.00 | 0.12 | 0.02 |
| 26 | 1.37 | 0.20 | 0.00 | 0.00 | 0.11 | 0.02 |
| 27 | 1.22 | 0.17 | 0.00 | 0.00 | 0.09 | 0.01 |
| 28 | 1.07 | 0.15 | 0.00 | 0.00 | 0.08 | 0.01 |
| 29 | 0.92 | 0.12 | 0.00 | 0.00 | 0.07 | 0.01 |
| 30 | 0.78 | 0.10 | 0.00 | 0.00 | 0.05 | 0.01 |
| 31 | 0.66 | 0.08 | 0.00 | 0.00 | 0.04 | 0.01 |
| 32 | 0.53 | 0.06 | 0.00 | 0.00 | 0.03 | 0.00 |
| 33 | 0.40 | 0.05 | 0.00 | 0.00 | 0.02 | 0.00 |
| 34 | 0.30 | 0.03 | 0.00 | 0.00 | 0.02 | 0.00 |
| 35 | 0.30 | 0.03 | 0.00 | 0.00 | 0.01 | 0.00 |
| 36 | 0.22 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.15 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.11 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.09 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.05 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 30

SLURRY SCREENING SUMMARY
8523-41-9

15.1 Wt% (64.25g) $Co_2(CO)_8/Zr(OPr)_4/Al_2O_3$

| Sample No. | Time on Stream h | P psig | T °C | SV, NL/g cat/hr | %CO+$H_2$ | %CO | %$H_2$ | Feed CO/$H_2$ | Usage ΔCO/ΔH$_2$ | Bulk Activity mol syngas/kg cat/h | Specific Activity mol CO/mol Co/min | Selectivity Wt% | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | $C_1$ | $C_2$-$C_4$ | $C_5$-$C_{11}$ | $C_{12}$-$C_{18}$ | $C_{19}$-$C_{23}$ | $C_{24}^+$ | $C_5$-$C_{23}$ |
| 3 | 22.3 | 303 | 239.1 | 2.10 | 32.7 | 19.7 | 45.7 | 1.00 | 0.43 | 30.7 | 0.07 | 7.7 | 15.0 | 22.0 | 22.6 | 13.9 | 18.8 | 58.5 |
| 5 | 47.5 | 303 | 239.6 | 2.10 | 20.2 | 11.6 | 33.1 | 1.50 | 0.53 | 19.0 | 0.05 | 8.2 | 15.3 | 19.6 | 22.6 | 15.4 | 18.9 | 57.6 |
| 9 | 70.5 | 310 | 238.5 | 2.08 | 14.5 | 6.7 | 30.3 | 2.00 | 0.44 | 13.5 | 0.03 | 8.3 | 13.8 | 22.2 | 21.0 | 15.7 | 19.0 | 58.9 |
| 12 | 94.5 | 307 | 240.5 | 1.04 | 20.8 | 9.0 | 44.5 | 2.01 | 0.41 | 9.7 | 0.02 | 10.3 | 15.0 | 23.2 | 18.1 | 14.2 | 19.2 | 55.5 |
| 16 | 118 | 310 | 239.0 | 1.05 | 33.0 | 20.2 | 45.9 | 1.00 | 0.44 | 15.5 | 0.04 | 11.3 | 14.3 | 23.3 | 17.4 | 14.1 | 19.6 | 54.8 |
| 19 | 142.2 | 310 | 260.2 | 1.05 | 45.9 | 30.4 | 61.3 | 1.00 | 0.50 | 21.5 | 0.06 | 15.0 | 14.0 | 27.4 | 20.0 | 9.8 | 13.8 | 57.2 |
| 22 | 166.5 | 305 | 260.9 | 1.03 | 29.0 | 14.9 | 57.4 | 2.03 | 0.53 | 13.3 | 0.04 | 13.3 | 13.1 | 25.8 | 22.1 | 11.7 | 14.0 | 59.6 |
| 25 | 189.5 | 307 | 261.7 | 2.08 | 21.4 | 11.8 | 40.7 | 2.00 | 0.58 | 19.9 | 0.06 | 16.2 | 15.0 | 25.0 | 22.5 | 11.1 | 10.2 | 58.6 |
| 27 | 262.8 | 310 | 259.6 | 2.10 | 25.6 | 16.1 | 39.8 | 1.50 | 0.61 | 24.0 | 0.07 | 18.5 | 16.6 | 24.7 | 18.8 | 10.6 | 10.8 | 54.1 |
| 30 | 286.7 | 310 | 262.3 | 2.10 | 34.0 | 22.1 | 45.9 | 1.03 | 0.50 | 31.9 | 0.08 | 22.6 | 18.4 | 27.1 | 15.3 | 8.5 | 8.1 | 50.9 |
| 33 | 309.6 | 302 | 261.6 | 2.08 | 56.1 | 50.1 | 59.1 | 0.50 | 0.42 | 52.1 | 0.12 | 27.3 | 20.6 | 28.7 | 12.6 | 5.1 | 5.7 | 46.4 |
| 36 | 335 | 304 | 258.6 | 2.10 | 35.7 | 24.8 | 47.0 | 1.03 | 0.54 | 33.5 | 0.09 | 19.9 | 17.8 | 31.1 | 17.4 | 7.6 | 6.2 | 56.1 |
| 39 | 358.3 | 310 | 261.4 | 2.10 | 50.9 | 34.5 | 67.4 | 1.00 | 0.51 | 47.8 | 0.13 | 24.7 | 18.3 | 31.2 | 16.0 | 4.7 | 5.1 | 51.9 |
| 42 | 430.0 | 310 | 261.6 | 2.10 | 37.3 | 21.6 | 60.8 | 1.50 | 0.53 | 35.0 | 0.10 | 26.0 | 18.5 | 31.6 | 15.0 | 5.1 | 3.8 | 51.7 |
| 47 | 478.8 | 338 | 283.3 | 2.08 | 67.3 | 62.1 | 69.8 | 0.50 | 0.45 | 62.5 | 0.15 | 39.4 | 28.9 | 21.3 | 4.7 | 3.8 | 1.9 | 29.8 |
| 53 | 503.1 | 305 | 281.1 | 1.05 | 55.9 | 30.3 | 73.5 | 1.00 | 0.52 | 26.2 | 0.07 | 29.9 | 22.4 | 32.9 | 11.0 | 3.2 | 0.6 | 47.1 |
| 58 | 575.1 | 320 | 260.1 | 2.01 | 22.1 | 16.2 | 28.5 | 1.10 | 0.62 | 19.8 | 0.06 | 34.5 | 26.6 | 33.7 | 3.4 | 1.7 | 0.1 | 38.8 |
| 61 | 599 | 318 | 242.4 | 2.10 | 14.4 | 9.8 | 19.0 | 1.00 | 0.52 | 13.5 | 0.04 | 27.9 | 17.9 | 38.8 | 9.30 | 6.1 | 0.4 | 54.2 |

TABLE 31

## Mass Balance
## Process Conditions and Product Summary

Catalyst : Co2(CO)8/Zr(OPr)4/Al2O3
Sample No: 8523-41-9-3

| | | | | | |
|---|---|---|---|---|---|
| Reactor Loading, mls : | 450.0 | T, C : | 239.1 | Feed Ratio, | |
| Catalyst Loading, wt%: | 15.1 | P, psig : | 303 | CO/H2: | 1.00 |
| Time on Stream, hrs : | 22.3 | SV, L/G/Hr: | 2.10 | | |

| | | | |
|---|---|---|---|
| Usage Ratio, CO/H2 : | 0.43 | Bulk Activity, | |
| %Overall Conv., CO+H2: | 32.69 | mol syngas/kg cat/hr: | 30.668 |
| %CO Conv. : | 19.65 | Specific Activity, | |
| %H2 Conv. : | 45.74 | mol CO/mol metal/min: | 0.073 |

Weight % Product Distribution:

| | | | |
|---|---|---|---|
| Hydrocarbons: | 9.12 | H2O: | 10.60 |
| Oxygenates : | 0.17 | CO : | 75.85 |
| CO2 : | 0.61 | H2 : | 3.66 |

Hydrocarbon Selectivity, wt%:

| | | | |
|---|---|---|---|
| C1 : | 7.72 | C4-ene : | 3.87 |
| C2-ane : | 2.24 | C5-C11 : | 22.00 |
| C2-ene : | 0.45 | C12-C18: | 22.56 |
| C3-ane : | 1.49 | C19-C23: | 13.89 |
| C3-ene : | 5.17 | C24-34 : | 15.22 |
| C4 iso+ane: | 1.82 | C35+ : | 3.57 |

Fuel Fractions, wt%:

| | |
|---|---|
| Gasoline (C5-C11): | 22.00 |
| Diesel (C9-C25) : | 47.42 |

% Elemental Recovery:

| | |
|---|---|
| Carbon : | 99.93 |
| Hydrogen: | 93.63 |
| Oxygen : | 98.75 |

## TABLE 32

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523+41+9

SAMPLE NO. 3

| CARBON NO. | N+ALKANES WT % | N+ALKANES MOLE % | 1+ALKENE WT % | 1+ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 7.72 | 38.42 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 2.24 | 5.94 | 0.45 | 1.27 | 0.00 | 0.00 |
| 3 | 1.49 | 2.70 | 5.17 | 9.81 | 0.00 | 0.00 |
| 4 | 1.82 | 2.50 | 3.87 | 5.51 | 0.00 | 0.00 |
| 5 | 2.00 | 2.21 | 3.45 | 3.93 | 0.10 | 0.12 |
| 6 | 4.06 | 3.76 | 0.12 | 0.12 | 0.00 | 0.00 |
| 7 | 1.54 | 1.23 | 0.94 | 0.76 | 0.18 | 0.14 |
| 8 | 1.06 | 0.74 | 0.55 | 0.39 | 0.81 | 0.57 |
| 9 | 1.29 | 0.80 | 0.67 | 0.42 | 0.47 | 0.29 |
| 10 | 1.46 | 0.82 | 0.66 | 0.38 | 0.39 | 0.22 |
| 11 | 1.38 | 0.71 | 0.47 | 0.24 | 0.40 | 0.20 |
| 12 | 1.55 | 0.73 | 0.37 | 0.18 | 0.41 | 0.19 |
| 13 | 1.86 | 0.80 | 0.27 | 0.12 | 0.41 | 0.18 |
| 14 | 2.45 | 0.98 | 0.00 | 0.00 | 0.40 | 0.16 |
| 15 | 2.87 | 1.08 | 0.00 | 0.00 | 0.38 | 0.14 |
| 16 | 3.28 | 1.16 | 0.00 | 0.00 | 0.34 | 0.12 |
| 17 | 3.65 | 1.21 | 0.00 | 0.00 | 0.27 | 0.09 |
| 18 | 3.28 | 1.03 | 0.00 | 0.00 | 0.77 | 0.24 |
| 19 | 2.95 | 0.88 | 0.00 | 0.00 | 0.22 | 0.07 |
| 20 | 2.80 | 0.79 | 0.00 | 0.00 | 0.19 | 0.05 |
| 21 | 2.87 | 0.77 | 0.00 | 0.00 | 0.02 | 0.01 |
| 22 | 2.64 | 0.68 | 0.00 | 0.00 | 0.01 | 0.00 |

TABLE 32 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523+41+9

SAMPLE NO. 3

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 2.06 | 0.51 | 0.00 | 0.00 | 0.12 | 0.03 |
| 24 | 1.95 | 0.46 | 0.00 | 0.00 | 0.00 | 0.00 |
| 25 | 1.84 | 0.42 | 0.00 | 0.00 | 0.00 | 0.00 |
| 26 | 1.87 | 0.41 | 0.00 | 0.00 | 0.00 | 0.00 |
| 27 | 1.69 | 0.35 | 0.00 | 0.00 | 0.00 | 0.00 |
| 28 | 1.03 | 0.21 | 0.00 | 0.00 | 0.29 | 0.06 |
| 29 | 0.58 | 0.11 | 0.00 | 0.00 | 0.22 | 0.04 |
| 30 | 0.89 | 0.17 | 0.00 | 0.00 | 0.55 | 0.10 |
| 31 | 0.71 | 0.13 | 0.00 | 0.00 | 0.25 | 0.05 |
| 32 | 0.42 | 0.07 | 0.00 | 0.00 | 0.52 | 0.09 |
| 33 | 0.73 | 0.12 | 0.00 | 0.00 | 0.43 | 0.07 |
| 34 | 0.74 | 0.12 | 0.00 | 0.00 | 0.51 | 0.09 |
| 35 | 1.10 | 0.18 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.95 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.58 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.36 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.32 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.25 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 33

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co2(CO)8/ZR(OPR)4/AL203
SAMPLE NO: 8523+41+9+5

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 239.6 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 15.1 | P, PSIG : | 303 | CO/H2: | 1.50 |
| TIME ON STREAM, HRS : | 47.5 | SV, L/G/HR: | 2.10 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.53 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 20.21 | MOL SYNGAS/KG CAT/HR: | 18.957 |
| %CO CONV. : | 11.63 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 33.08 | MOL CO/MOL METAL/MIN: | 0.052 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 4.81 | H20: | 6.09 |
| OXYGENATES : | 0.07 | CO : | 85.56 |
| CO2 : | 0.39 | H2 : | 3.08 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 8.22 | C4+ENE : | 4.35 |
| C2+ANE : | 2.05 | C5+C11 : | 19.63 |
| C2+ENE : | 0.77 | C12+C18: | 22.55 |
| C3+ANE : | 1.13 | C19+C23: | 15.38 |
| C3+ENE : | 5.52 | C24+34 : | 14.89 |
| C4 ISO+ANE: | 1.45 | C35+ : | 4.04 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 19.63 |
| DIESEL (C9+C25) : | 48.83 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 98.46 |
| HYDROGEN: | 98.39 |
| OXYGEN : | 98.72 |

## TABLE 34

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 5

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 8.22 | 40.17 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 2.05 | 5.35 | 0.77 | 2.14 | 0.00 | 0.00 |
| 3 | 1.13 | 2.01 | 5.52 | 10.26 | 0.00 | 0.00 |
| 4 | 1.45 | 1.96 | 4.35 | 6.07 | 0.00 | 0.00 |
| 5 | 1.76 | 1.91 | 4.28 | 4.78 | 0.00 | 0.00 |
| 6 | 3.06 | 2.78 | 0.10 | 0.09 | 0.00 | 0.00 |
| 7 | 0.98 | 0.77 | 0.92 | 0.74 | 0.07 | 0.05 |
| 8 | 0.64 | 0.44 | 0.51 | 0.35 | 0.62 | 0.42 |
| 9 | 0.97 | 0.59 | 0.68 | 0.42 | 0.33 | 0.20 |
| 10 | 1.15 | 0.63 | 0.88 | 0.49 | 0.18 | 0.10 |
| 11 | 1.33 | 0.67 | 0.72 | 0.37 | 0.43 | 0.22 |
| 12 | 1.48 | 0.68 | 0.64 | 0.30 | 0.41 | 0.19 |
| 13 | 1.67 | 0.71 | 0.52 | 0.22 | 0.47 | 0.20 |
| 14 | 1.95 | 0.77 | 0.38 | 0.15 | 0.49 | 0.19 |
| 15 | 2.63 | 0.97 | 0.00 | 0.00 | 0.50 | 0.18 |
| 16 | 3.00 | 1.04 | 0.00 | 0.00 | 0.48 | 0.17 |
| 17 | 3.43 | 1.12 | 0.00 | 0.00 | 0.45 | 0.15 |
| 18 | 3.45 | 1.06 | 0.00 | 0.00 | 0.60 | 0.18 |
| 19 | 3.27 | 0.95 | 0.00 | 0.00 | 0.33 | 0.10 |
| 20 | 3.15 | 0.87 | 0.00 | 0.00 | 0.25 | 0.07 |
| 21 | 2.99 | 0.79 | 0.00 | 0.00 | 0.11 | 0.03 |
| 22 | 2.67 | 0.67 | 0.00 | 0.00 | 0.10 | 0.03 |

TABLE 34 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 5

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 2.38 | 0.57 | 0.00 | 0.00 | 0.12 | 0.03 |
| 24 | 2.09 | 0.48 | 0.00 | 0.00 | 0.07 | 0.02 |
| 25 | 2.05 | 0.45 | 0.00 | 0.00 | 0.00 | 0.00 |
| 26 | 1.89 | 0.40 | 0.00 | 0.00 | 0.00 | 0.00 |
| 27 | 1.65 | 0.34 | 0.00 | 0.00 | 0.00 | 0.00 |
| 28 | 1.60 | 0.32 | 0.00 | 0.00 | 0.00 | 0.00 |
| 29 | 0.69 | 0.13 | 0.00 | 0.00 | 0.12 | 0.02 |
| 30 | 0.80 | 0.15 | 0.00 | 0.00 | 0.25 | 0.05 |
| 31 | 0.91 | 0.16 | 0.00 | 0.00 | 0.21 | 0.04 |
| 32 | 0.52 | 0.09 | 0.00 | 0.00 | 0.19 | 0.03 |
| 33 | 0.69 | 0.12 | 0.00 | 0.00 | 0.19 | 0.03 |
| 34 | 0.76 | 0.12 | 0.00 | 0.00 | 0.21 | 0.03 |
| 35 | 1.06 | 0.17 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.95 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.65 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.52 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.46 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.41 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 35

## Mass Balance
## Process Conditions and Product Summary

Catalyst : $Co_2(CO)_8/Zn(OPr)_4/Al_2O_3$
Sample No: 8523+41+9+9

| | | | | | |
|---|---|---|---|---|---|
| Reactor Loading, mls : | 450.0 | T, C : | 238.5 | Feed Ratio, | |
| Catalyst Loading, wt%: | 15.1 | P, psig : | 310 | CO/H2: | 2.00 |
| Time on Stream, hrs : | 70.5 | SV, L/G/HR: | 2.08 | | |

| | | | |
|---|---|---|---|
| Usage Ratio, CO/H2 : | 0.44 | Bulk Activity, | |
| %Overall Conv., CO+H2: | 14.54 | mol syngas/kg cat/hr: | 13.507 |
| %CO Conv. : | 6.69 | Specific Activity, | |
| %H2 Conv. : | 30.25 | mol CO/mol metal/min: | 0.033 |

Weight % Product Distribution:

| | | | |
|---|---|---|---|
| Hydrocarbons: | 3.39 | H2O: | 4.17 |
| Oxygenates : | 0.04 | CO : | 89.70 |
| CO2 : | 0.31 | H2 : | 2.39 |

Hydrocarbon Selectivity, wt%:

| | | | |
|---|---|---|---|
| C1 : | 8.29 | C4+ene : | 4.07 |
| C2+ane : | 1.39 | C5+C11 : | 22.18 |
| C2+ene : | 0.95 | C12+C18: | 21.01 |
| C3+ane : | 0.91 | C19+C23: | 15.74 |
| C3+ene : | 5.38 | C24+34 : | 15.65 |
| C4 iso+ane: | 1.11 | C35+ : | 3.33 |

Fuel Fractions, wt%:

| | |
|---|---|
| Gasoline (C5+C11): | 22.18 |
| Diesel (C9+C25) : | 48.40 |

% Elemental Recovery:

| | |
|---|---|
| Carbon : | 100.48 |
| Hydrogen: | 99.04 |
| Oxygen : | 100.49 |

## TABLE 36

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523+41+9

SAMPLE NO. 9

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 8.29 | 40.87 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 1.39 | 3.66 | 0.95 | 2.69 | 0.00 | 0.00 |
| 3 | 0.91 | 1.63 | 5.38 | 10.11 | 0.00 | 0.00 |
| 4 | 1.11 | 1.51 | 4.07 | 5.73 | 0.00 | 0.00 |
| 5 | 1.33 | 1.46 | 4.17 | 4.71 | 0.00 | 0.00 |
| 6 | 4.36 | 4.00 | 0.14 | 0.13 | 0.00 | 0.00 |
| 7 | 1.35 | 1.07 | 1.33 | 1.07 | 0.08 | 0.07 |
| 8 | 0.66 | 0.45 | 0.76 | 0.53 | 0.74 | 0.51 |
| 9 | 0.98 | 0.60 | 0.91 | 0.57 | 0.41 | 0.25 |
| 10 | 1.11 | 0.61 | 1.09 | 0.62 | 0.18 | 0.10 |
| 11 | 1.22 | 0.62 | 0.89 | 0.45 | 0.45 | 0.23 |
| 12 | 1.31 | 0.61 | 0.80 | 0.38 | 0.39 | 0.18 |
| 13 | 1.41 | 0.60 | 0.68 | 0.29 | 0.46 | 0.20 |
| 14 | 1.60 | 0.64 | 0.54 | 0.22 | 0.51 | 0.20 |
| 15 | 2.29 | 0.85 | 0.00 | 0.00 | 0.53 | 0.20 |
| 16 | 2.57 | 0.90 | 0.00 | 0.00 | 0.53 | 0.19 |
| 17 | 2.97 | 0.98 | 0.00 | 0.00 | 0.53 | 0.17 |
| 18 | 3.41 | 1.06 | 0.00 | 0.00 | 0.50 | 0.16 |
| 19 | 3.11 | 0.92 | 0.00 | 0.00 | 0.55 | 0.16 |
| 20 | 3.10 | 0.87 | 0.00 | 0.00 | 0.39 | 0.11 |
| 21 | 2.94 | 0.78 | 0.00 | 0.00 | 0.29 | 0.08 |
| 22 | 2.72 | 0.69 | 0.00 | 0.00 | 0.14 | 0.04 |

TABLE 36 (Continued)

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523+41+9

SAMPLE NO. 9

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 2.25 | 0.55 | 0.00 | 0.00 | 0.25 | 0.06 |
| 24 | 2.21 | 0.52 | 0.00 | 0.00 | 0.07 | 0.02 |
| 25 | 2.13 | 0.48 | 0.00 | 0.00 | 0.00 | 0.00 |
| 26 | 1.91 | 0.41 | 0.00 | 0.00 | 0.00 | 0.00 |
| 27 | 1.74 | 0.36 | 0.00 | 0.00 | 0.00 | 0.00 |
| 28 | 1.23 | 0.25 | 0.00 | 0.00 | 0.14 | 0.03 |
| 29 | 1.12 | 0.22 | 0.00 | 0.00 | 0.15 | 0.03 |
| 30 | 0.97 | 0.18 | 0.00 | 0.00 | 0.21 | 0.04 |
| 31 | 0.85 | 0.15 | 0.00 | 0.00 | 0.14 | 0.03 |
| 32 | 0.64 | 0.11 | 0.00 | 0.00 | 0.16 | 0.03 |
| 33 | 0.73 | 0.12 | 0.00 | 0.00 | 0.12 | 0.02 |
| 34 | 0.94 | 0.16 | 0.00 | 0.00 | 0.19 | 0.03 |
| 35 | 0.45 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.78 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.53 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.39 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.39 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.30 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 37

## MASS BALANCE
## PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : $Co_2(CO)_8/Zr(OPr)_4/Al_2O_3$
SAMPLE NO: 8523+41+9+12

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 240.5 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 15.1 | P, PSIG : | 307 | CO/H2: | 2.01 |
| TIME ON STREAM, HRS : | 94.5 | SV, L/G/HR: | 1.04 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.41 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 20.82 | MOL SYNGAS/KG CAT/HR: | 9.661 |
| %CO CONV. : | 9.03 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 44.49 | MOL CO/MOL METAL/MIN: | 0.022 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 4.42 | H2O: | 5.76 |
| OXYGENATES : | 0.06 | CO : | 87.22 |
| CO2 : | 0.65 | H2 : | 1.89 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 10.26 | C4+ENE : | 4.26 |
| C2+ANE : | 2.10 | C5+C11 : | 23.21 |
| C2+ENE : | 0.71 | C12+C18: | 18.14 |
| C3+ANE : | 1.06 | C19+C23: | 14.21 |
| C3+ENE : | 5.61 | C24+34 : | 15.71 |
| C4 ISO+ANE: | 1.23 | C35+ : | 3.50 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 23.21 |
| DIESEL (C9+C25) : | 43.87 |

% ELEMENTAL F

| | |
|---|---|
| CARBON : | 100.49 |
| HYDROGEN: | 95.38 |
| OXYGEN : | 101.21 |

TABLE 38

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523+41+9

SAMPLE NO. 12

| CARBON NO. | N+ALKANES WT % | N+ALKANES MOLE % | 1+ALKENE WT % | 1+ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 10.26 | 5.36 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 2.10 | 4.95 | 0.71 | 1.79 | 0.00 | 0.00 |
| 3 | 1.06 | 1.71 | 5.61 | 9.46 | 0.00 | 0.00 |
| 4 | 1.23 | 1.50 | 4.26 | 5.38 | 0.00 | 0.00 |
| 5 | 1.47 | 1.45 | 4.01 | 4.06 | 0.08 | 0.08 |
| 6 | 4.82 | 3.97 | 0.15 | 0.13 | 0.00 | 0.00 |
| 7 | 1.67 | 1.18 | 1.30 | 0.94 | 0.10 | 0.07 |
| 8 | 1.04 | 0.65 | 0.79 | 0.50 | 0.57 | 0.35 |
| 9 | 1.15 | 0.64 | 0.93 | 0.52 | 0.12 | 0.07 |
| 10 | 1.23 | 0.61 | 1.10 | 0.56 | 0.24 | 0.12 |
| 11 | 1.21 | 0.55 | 0.80 | 0.37 | 0.41 | 0.18 |
| 12 | 1.27 | 0.53 | 0.72 | 0.30 | 0.35 | 0.15 |
| 13 | 1.35 | 0.52 | 0.61 | 0.24 | 0.40 | 0.15 |
| 14 | 1.42 | 0.51 | 0.50 | 0.18 | 0.43 | 0.15 |
| 15 | 2.04 | 0.68 | 0.00 | 0.00 | 0.44 | 0.15 |
| 16 | 2.23 | 0.70 | 0.00 | 0.00 | 0.42 | 0.13 |
| 17 | 2.49 | 0.73 | 0.00 | 0.00 | 0.39 | 0.11 |
| 18 | 2.64 | 0.74 | 0.00 | 0.00 | 0.44 | 0.12 |
| 19 | 2.73 | 0.72 | 0.00 | 0.00 | 0.30 | 0.08 |
| 20 | 2.81 | 0.70 | 0.00 | 0.00 | 0.22 | 0.05 |
| 21 | 2.82 | 0.67 | 0.00 | 0.00 | 0.10 | 0.02 |
| 22 | 2.63 | 0.60 | 0.00 | 0.00 | 0.10 | 0.02 |

TABLE 38 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 12

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 2.40 | 0.52 | 0.00 | 0.00 | 0.11 | 0.02 |
| 24 | 2.14 | 0.45 | 0.00 | 0.00 | 0.08 | 0.02 |
| 25 | 2.03 | 0.41 | 0.00 | 0.00 | 0.07 | 0.02 |
| 26 | 1.96 | 0.38 | 0.00 | 0.00 | 0.00 | 0.00 |
| 27 | 1.73 | 0.32 | 0.00 | 0.00 | 0.00 | 0.00 |
| 28 | 1.29 | 0.23 | 0.00 | 0.00 | 0.11 | 0.02 |
| 29 | 1.05 | 0.18 | 0.00 | 0.00 | 0.09 | 0.02 |
| 30 | 1.02 | 0.17 | 0.00 | 0.00 | 0.12 | 0.02 |
| 31 | 1.04 | 0.17 | 0.00 | 0.00 | 0.10 | 0.02 |
| 32 | 1.09 | 0.17 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 0.76 | 0.12 | 0.00 | 0.00 | 0.05 | 0.01 |
| 34 | 0.88 | 0.13 | 0.00 | 0.00 | 0.09 | 0.01 |
| 35 | 0.92 | 0.13 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.80 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.57 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.45 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.43 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.33 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 39

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : $Co_2(CO)_8/Zr(OPr)_4/Al_2O_3$
SAMPLE NO: 8523:41+9+16

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 239.0 | FEED RATIO | |
| CATALYST LOADING, WT%: | 15.1 | P, PSIG : | 310 | CO/H2: | 1.00 |
| TIME ON STREAM, HRS : | 118.0 | SV, L/G/HR: | 1.05 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.44 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 33.04 | MOL SYNGAS/KG CAT/HR: | 15.508 |
| %CO CONV. : | 20.23 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 45.85 | MOL CO/MOL METAL/MIN: | 0.038 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 9.64 | H2O: | 11.34 |
| OXYGENATES : | 0.16 | CO : | 74.44 |
| CO2 : | 0.81 | H2 : | 3.61 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 11.30 | C4+ENE : | 3.32 |
| C2+ANE : | 2.45 | C5+C11 : | 23.27 |
| C2+ENE : | 0.30 | C12+C18: | 17.40 |
| C3+ANE : | 1.74 | C19+C23: | 14.08 |
| C3+ENE : | 4.51 | C24+34 : | 15.87 |
| C4 ISO+ANE: | 2.04 | C35+ : | 3.73 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 23.27 |
| DIESEL (C9+C25) : | 44.66 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 100.69 |
| HYDROGEN: | 97.01 |
| OXYGEN : | 99.90 |

TABLE 40

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 16

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 11.30 | 48.65 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 2.45 | 5.63 | 0.30 | 0.73 | 0.00 | 0.00 |
| 3 | 1.74 | 2.73 | 4.51 | 7.39 | 0.00 | 0.00 |
| 4 | 1.97 | 2.34 | 3.32 | 4.08 | 0.06 | 0.07 |
| 5 | 2.10 | 2.01 | 2.81 | 2.77 | 0.12 | 0.12 |
| 6 | 4.14 | 3.32 | 0.11 | 0.09 | 0.00 | 0.00 |
| 7 | 1.71 | 1.18 | 0.90 | 0.63 | 0.18 | 0.12 |
| 8 | 1.38 | 0.83 | 0.67 | 0.41 | 0.55 | 0.33 |
| 9 | 1.68 | 0.90 | 0.84 | 0.46 | 0.52 | 0.28 |
| 10 | 1.83 | 0.89 | 0.83 | 0.41 | 0.44 | 0.21 |
| 11 | 1.55 | 0.69 | 0.55 | 0.25 | 0.38 | 0.17 |
| 12 | 1.55 | 0.63 | 0.43 | 0.18 | 0.39 | 0.16 |
| 13 | 1.60 | 0.60 | 0.32 | 0.12 | 0.40 | 0.15 |
| 14 | 1.91 | 0.67 | 0.00 | 0.00 | 0.39 | 0.14 |
| 15 | 1.99 | 0.65 | 0.00 | 0.00 | 0.35 | 0.12 |
| 16 | 2.13 | 0.65 | 0.00 | 0.00 | 0.32 | 0.10 |
| 17 | 2.31 | 0.66 | 0.00 | 0.00 | 0.35 | 0.10 |
| 18 | 2.58 | 0.70 | 0.00 | 0.00 | 0.37 | 0.10 |
| 19 | 2.70 | 0.69 | 0.00 | 0.00 | 0.19 | 0.05 |
| 20 | 2.86 | 0.70 | 0.00 | 0.00 | 0.10 | 0.02 |
| 21 | 2.79 | 0.65 | 0.00 | 0.00 | 0.10 | 0.02 |
| 22 | 2.66 | 0.59 | 0.00 | 0.00 | 0.10 | 0.02 |

TABLE 40 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 16

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 2.48 | 0.53 | 0.00 | 0.00 | 0.11 | 0.02 |
| 24 | 2.27 | 0.46 | 0.00 | 0.00 | 0.10 | 0.02 |
| 25 | 2.12 | 0.42 | 0.00 | 0.00 | 0.09 | 0.02 |
| 26 | 1.84 | 0.35 | 0.00 | 0.00 | 0.06 | 0.01 |
| 27 | 1.59 | 0.29 | 0.00 | 0.00 | 0.05 | 0.01 |
| 28 | 1.32 | 0.23 | 0.00 | 0.00 | 0.09 | 0.01 |
| 29 | 1.09 | 0.18 | 0.00 | 0.00 | 0.08 | 0.01 |
| 30 | 1.03 | 0.17 | 0.00 | 0.00 | 0.09 | 0.01 |
| 31 | 1.06 | 0.17 | 0.00 | 0.00 | 0.08 | 0.01 |
| 32 | 1.09 | 0.17 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 0.89 | 0.13 | 0.00 | 0.00 | 0.05 | 0.01 |
| 34 | 0.82 | 0.12 | 0.00 | 0.00 | 0.08 | 0.01 |
| 35 | 0.87 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.85 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.63 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.53 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.48 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.37 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 41

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co2(CO)8/ZR(OPR)4/AL203
SAMPLE NO: 8523+41+9+19

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 260.2 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 15.1 | P, PSIG : | 310 | CO/H2: | 1.00 |
| TIME ON STREAM, HRS : | 142.2 | SV, L/G/HR: | 1.05 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.50 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 45.87 | MOL SYNGAS/KG CAT/HR: | 21.534 |
| %CO CONV. : | 30.42 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 61.33 | MOL CO/MOL METAL/MIN: | 0.057 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 13.23 | H2O: | 15.41 |
| OXYGENATES : | 0.18 | CO : | 64.86 |
| CO2 : | 3.74 | H2 : | 2.57 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 15.04 | C4+ENE : | 2.88 |
| C2+ANE : | 3.06 | C5+C11 : | 27.36 |
| C2+ENE : | 0.23 | C12+C18: | 19.98 |
| C3+ANE : | 2.04 | C19+C23: | 9.78 |
| C3+ENE : | 3.78 | C24+34 : | 11.20 |
| C4 ISO+ANE: | 2.07 | C35+ : | 2.59 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 27.36 |
| DIESEL (C9+C25) : | 44.26 |

% ELEMENTAL RECOVERY: CARBON : 99.91
HYDROGEN: 98.18
OXYGEN : 100.53

TABLE 42

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523+41+9

SAMPLE NO. 19

| CARBON NO. | N+ALKANES WT % | N+ALKANES MOLE % | 1+ALKENE WT % | 1+ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 15.04 | 55.18 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 3.06 | 5.98 | 0.23 | 0.48 | 0.00 | 0.00 |
| 3 | 2.04 | 2.72 | 3.78 | 5.28 | 0.00 | 0.00 |
| 4 | 2.02 | 2.05 | 2.88 | 3.02 | 0.05 | 0.05 |
| 5 | 2.33 | 1.90 | 2.71 | 2.27 | 0.17 | 0.14 |
| 6 | 4.22 | 2.88 | 0.18 | 0.12 | 0.00 | 0.00 |
| 7 | 2.17 | 1.28 | 0.74 | 0.44 | 0.22 | 0.13 |
| 8 | 2.02 | 1.04 | 0.76 | 0.40 | 0.47 | 0.24 |
| 9 | 2.53 | 1.16 | 0.93 | 0.43 | 0.64 | 0.29 |
| 10 | 2.60 | 1.07 | 0.79 | 0.33 | 0.56 | 0.23 |
| 11 | 2.18 | 0.82 | 0.59 | 0.22 | 0.55 | 0.21 |
| 12 | 2.10 | 0.73 | 0.49 | 0.17 | 0.54 | 0.19 |
| 13 | 2.11 | 0.67 | 0.31 | 0.10 | 0.61 | 0.20 |
| 14 | 2.34 | 0.69 | 0.01 | 0.00 | 0.62 | 0.18 |
| 15 | 2.31 | 0.64 | 0.04 | 0.01 | 0.58 | 0.16 |
| 16 | 2.29 | 0.59 | 0.07 | 0.02 | 0.49 | 0.13 |
| 17 | 2.22 | 0.54 | 0.07 | 0.02 | 0.41 | 0.10 |
| 18 | 1.99 | 0.46 | 0.06 | 0.01 | 0.32 | 0.07 |
| 19 | 1.96 | 0.43 | 0.00 | 0.00 | 0.11 | 0.02 |
| 20 | 1.97 | 0.41 | 0.00 | 0.00 | 0.06 | 0.01 |
| 21 | 1.93 | 0.38 | 0.00 | 0.00 | 0.07 | 0.01 |
| 22 | 1.83 | 0.35 | 0.00 | 0.00 | 0.07 | 0.01 |

TABLE 42 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 19

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 1.70 | 0.31 | 0.00 | 0.00 | 0.08 | 0.01 |
| 24 | 1.55 | 0.27 | 0.00 | 0.00 | 0.07 | 0.01 |
| 25 | 1.45 | 0.24 | 0.00 | 0.00 | 0.06 | 0.01 |
| 26 | 1.27 | 0.20 | 0.00 | 0.00 | 0.05 | 0.01 |
| 27 | 1.26 | 0.19 | 0.00 | 0.00 | 0.00 | 0.00 |
| 28 | 0.96 | 0.14 | 0.00 | 0.00 | 0.07 | 0.01 |
| 29 | 0.82 | 0.12 | 0.00 | 0.00 | 0.05 | 0.01 |
| 30 | 0.77 | 0.11 | 0.00 | 0.00 | 0.07 | 0.01 |
| 31 | 0.77 | 0.10 | 0.00 | 0.00 | 0.06 | 0.01 |
| 32 | 0.60 | 0.08 | 0.00 | 0.00 | 0.04 | 0.01 |
| 33 | 0.61 | 0.08 | 0.00 | 0.00 | 0.03 | 0.00 |
| 34 | 0.59 | 0.07 | 0.00 | 0.00 | 0.05 | 0.01 |
| 35 | 0.64 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.57 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.45 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.37 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.33 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.24 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 43

## MASS BALANCE
## PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : $Co_2(CO)_8/Zr(OPr)_4/Al_2O_3$
SAMPLE NO: 8523+41+9+22

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS | : 450.0 | T, C | : 260.9 | FEED RATIO, | |
| CATALYST LOADING, WT% | : 15.1 | P, PSIG | : 305 | CO/H2: | 2.03 |
| TIME ON STREAM, HRS | : 166.5 | SV, L/G/HR: | 1.03 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 | : 0.53 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2 | : 28.97 | MOL SYNGAS/KG CAT/HR: | 13.304 |
| %CO CONV. | : 14.94 | SPECIFIC ACTIVITY, | |
| %H2 CONV. | : 57.41 | MOL CO/MOL METAL/MIN: | 0.036 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 6.19 | H2O: | 7.51 |
| OXYGENATES : | 0.09 | CO : | 83.05 |
| CO2 : | 1.70 | H2 : | 1.46 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 | : 13.30 | C4+ENE | : 3.31 |
| C2+ANE | : 2.53 | C5+C11 | : 25.82 |
| C2+ENE | : 0.56 | C12+C18: | 22.11 |
| C3+ANE | : 1.05 | C19+C23: | 11.71 |
| C3+ENE | : 4.54 | C24+34 | : 11.69 |
| C4 ISO+ANE: | 1.09 | C35+ | : 2.29 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 25.82 |
| DIESEL (C9+C25) : | 47.06 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 98.63 |
| HYDROGEN: | 96.88 |
| OXYGEN : | 99.30 |

## TABLE 44

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 22

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 13.30 | 52.67 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 2.53 | 5.34 | 0.56 | 1.26 | 0.00 | 0.00 |
| 3 | 1.05 | 1.52 | 4.54 | 6.85 | 0.00 | 0.00 |
| 4 | 1.09 | 1.19 | 3.31 | 3.74 | 0.00 | 0.00 |
| 5 | 1.35 | 1.19 | 3.07 | 2.78 | 0.08 | 0.07 |
| 6 | 4.47 | 3.29 | 0.22 | 0.17 | 0.00 | 0.00 |
| 7 | 2.00 | 1.27 | 1.32 | 0.85 | 0.23 | 0.15 |
| 8 | 1.75 | 0.97 | 1.06 | 0.60 | 0.39 | 0.22 |
| 9 | 1.65 | 0.81 | 1.21 | 0.61 | 0.52 | 0.25 |
| 10 | 1.69 | 0.75 | 1.10 | 0.50 | 0.73 | 0.32 |
| 11 | 1.56 | 0.63 | 0.74 | 0.30 | 0.70 | 0.29 |
| 12 | 1.62 | 0.60 | 0.71 | 0.27 | 0.51 | 0.19 |
| 13 | 1.71 | 0.59 | 0.58 | 0.20 | 0.6. | 0.21 |
| 14 | 1.90 | 0.61 | 0.40 | 0.13 | 0.69 | 0.22 |
| 15 | 2.40 | 0.72 | 0.00 | 0.00 | 0.76 | 0.23 |
| 16 | 2.54 | 0.71 | 0.00 | 0.00 | 0.78 | 0.22 |
| 17 | 2.73 | 0.72 | 0.00 | 0.00 | 0.75 | 0.20 |
| 18 | 2.75 | 0.69 | 0.00 | 0.00 | 0.68 | 0.17 |
| 19 | 2.59 | 0.61 | 0.00 | 0.00 | 0.37 | 0.09 |
| 20 | 2.33 | 0.52 | 0.00 | 0.00 | 0.16 | 0.04 |
| 21 | 2.10 | 0.45 | 0.00 | 0.00 | 0.12 | 0.03 |
| 22 | 2.01 | 0.41 | 0.00 | 0.00 | 0.09 | 0.02 |

TABLE 44 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 22

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 1.84 | 0.36 | 0.00 | 0.00 | 0.09 | 0.02 |
| 24 | 1.66 | 0.31 | 0.00 | 0.00 | 0.08 | 0.02 |
| 25 | 1.54 | 0.28 | 0.00 | 0.00 | 0.07 | 0.01 |
| 26 | 1.34 | 0.23 | 0.00 | 0.00 | 0.06 | 0.01 |
| 27 | 1.18 | 0.20 | 0.00 | 0.00 | 0.05 | 0.01 |
| 28 | 1.02 | 0.16 | 0.00 | 0.00 | 0.08 | 0.01 |
| 29 | 0.86 | 0.13 | 0.00 | 0.00 | 0.06 | 0.01 |
| 30 | 0.81 | 0.12 | 0.00 | 0.00 | 0.07 | 0.01 |
| 31 | 0.77 | 0.11 | 0.00 | 0.00 | 0.06 | 0.01 |
| 32 | 0.75 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 0.58 | 0.08 | 0.00 | 0.00 | 0.03 | 0.00 |
| 34 | 0.56 | 0.07 | 0.00 | 0.00 | 0.04 | 0.01 |
| 35 | 0.59 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.52 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.40 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.31 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.28 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.20 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 45

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : $Co_2(CO)_8/Zr(OPr)_4/Al_2O_3$
SAMPLE NO: 8523+41+9+25

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS | : 450.0 | T, C | : 261.7 | FEED RATIO, | |
| CATALYST LOADING, WT% | : 15.1 | P, PSIG | : 307 | CO/H2 | : 2.00 |
| TIME ON STREAM, HRS | : 189.5 | SV, L/G/HR | : 2.08 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 | : 0.58 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2 | : 21.41 | MOL SYNGAS/KG CAT/HR | : 19.884 |
| %CO CONV. | : 11.75 | SPECIFIC ACTIVITY, | |
| %H2 CONV. | : 40.70 | MOL CO/MOL METAL/MIN | : 0.058 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS | : 4.01 | H2O | : 5.49 |
| OXYGENATES | : 0.06 | CO | : 87.58 |
| CO2 | : 0.76 | H2 | : 2.10 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 | : 16.17 | C4+ENE | : 3.85 |
| C2+ANE | : 2.84 | C5+C11 | : 24.95 |
| C2+ENE | : 0.76 | C12+C18 | : 22.46 |
| C3+ANE | : 1.14 | C19+C23 | : 11.10 |
| C3+ENE | : 5.28 | C24+34 | : 8.58 |
| C4 ISO+ANE | : 1.23 | C35+ | : 1.64 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11) | : 24.95 |
| DIESEL (C9+C25) | : 45.58 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON | : 96.64 |
| HYDROGEN | : 95.68 |
| OXYGEN | : 97.87 |

TABLE 46

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 25

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 16.17 | 56.33 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 2.84 | 5.27 | 0.76 | 1.51 | 0.00 | 0.00 |
| 3 | 1.14 | 1.44 | 5.28 | 7.01 | 0.00 | 0.00 |
| 4 | 1.23 | 1.18 | 3.85 | 3.84 | 0.00 | 0.00 |
| 5 | 1.54 | 1.19 | 3.73 | 2.97 | 0.00 | 0.00 |
| 6 | 4.56 | 2.95 | 0.21 | 0.14 | 0.00 | 0.00 |
| 7 | 1.49 | 0.83 | 1.35 | 0.77 | 0.16 | 0.09 |
| 8 | 1.25 | 0.61 | 0.93 | 0.46 | 0.20 | 0.10 |
| 9 | 1.32 | 0.58 | 1.07 | 0.48 | 0.31 | 0.14 |
| 10 | 1.58 | 0.62 | 1.20 | 0.48 | 0.57 | 0.22 |
| 11 | 1.73 | 0.62 | 0.97 | 0.35 | 0.78 | 0.28 |
| 12 | 1.75 | 0.58 | 0.88 | 0.29 | 0.55 | 0.18 |
| 13 | 1.76 | 0.53 | 0.72 | 0.22 | 0.62 | 0.19 |
| 14 | 1.80 | 0.51 | 0.53 | 0.15 | 0.69 | 0.19 |
| 15 | 2.25 | 0.59 | 0.00 | 0.00 | 0.73 | 0.19 |
| 16 | 2.31 | 0.57 | 0.00 | 0.00 | 0.80 | 0.20 |
| 17 | 2.51 | 0.58 | 0.00 | 0.00 | 0.87 | 0.20 |
| 18 | 2.73 | 0.60 | 0.00 | 0.00 | 0.95 | 0.21 |
| 19 | 2.68 | 0.56 | 0.00 | 0.00 | 0.81 | 0.17 |
| 20 | 2.22 | 0.44 | 0.00 | 0.00 | 0.46 | 0.09 |
| 21 | 1.75 | 0.33 | 0.00 | 0.00 | 0.18 | 0.03 |
| 22 | 1.49 | 0.27 | 0.00 | 0.00 | 0.11 | 0.02 |

TABLE 46 (Continued)

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523-41-9

SAMPLE NO. 25

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 1.32 | 0.23 | 0.00 | 0.00 | 0.09 | 0.02 |
| 24 | 1.23 | 0.20 | 0.00 | 0.00 | 0.07 | 0.01 |
| 25 | 1.12 | 0.18 | 0.00 | 0.00 | 0.06 | 0.01 |
| 26 | 0.99 | 0.15 | 0.00 | 0.00 | 0.05 | 0.01 |
| 27 | 0.86 | 0.13 | 0.00 | 0.00 | 0.04 | 0.01 |
| 28 | 0.75 | 0.11 | 0.00 | 0.00 | 0.05 | 0.01 |
| 29 | 0.63 | 0.09 | 0.00 | 0.00 | 0.05 | 0.01 |
| 30 | 0.58 | 0.08 | 0.00 | 0.00 | 0.05 | 0.01 |
| 31 | 0.56 | 0.07 | 0.00 | 0.00 | 0.04 | 0.01 |
| 32 | 0.47 | 0.06 | 0.00 | 0.00 | 0.02 | 0.00 |
| 33 | 0.46 | 0.06 | 0.00 | 0.00 | 0.02 | 0.00 |
| 34 | 0.45 | 0.05 | 0.00 | 0.00 | 0.02 | 0.00 |
| 35 | 0.43 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.37 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.28 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.22 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.19 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.14 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 47

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : $Co_2(CO)_8/Zr(OPr)_4/Al_2O_3$
SAMPLE No: 8523+41+9+27

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 259.6 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 15.1 | P, PSIG : | 310 | CO/H2: | 1.50 |
| TIME ON STREAM, HRS : | 262.8 | SV, L/G/HR: | 2.10 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.61 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 25.61 | MOL SYNGAS/KG CAT/HR: | 24.021 |
| %CO CONV. : | 16.12 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 39.84 | MOL CO/MOL METAL/MIN: | 0.072 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 5.11 | H2O: | 6.80 |
| OXYGENATES : | 0.06 | CO : | 84.39 |
| CO2 : | 0.75 | H2 : | 2.88 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 18.47 | C4+ENE : | 3.99 |
| C2+ANE : | 3.32 | C5+C11 : | 24.70 |
| C2+ENE : | 0.57 | C12+C18: | 18.83 |
| C3+ANE : | 1.60 | C19+C23: | 10.56 |
| C3+ENE : | 5.36 | C24+34 : | 9.10 |
| C4 ISO+ANE: | 1.82 | C35+ : | 1.67 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 24.70 |
| DIESEL (C9+C25) : | 40.94 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 94.24 |
| HYDROGEN: | 94.34 |
| OXYGEN : | 95.39 |

## TABLE 48

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523-41-9

SAMPLE NO. 27

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 18.47 | 58.99 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 3.32 | 5.65 | 0.57 | 1.05 | 0.00 | 0.00 |
| 3 | 1.60 | 1.86 | 5.36 | 6.52 | 0.00 | 0.00 |
| 4 | 1.75 | 1.54 | 3.99 | 3.64 | 0.07 | 0.06 |
| 5 | 2.13 | 1.51 | 3.73 | 2.72 | 0.14 | 0.10 |
| 6 | 4.41 | 2.62 | 0.18 | 0.11 | 0.00 | 0.00 |
| 7 | 1.73 | 0.89 | 1.00 | 0.52 | 0.14 | 0.07 |
| 8 | 1.38 | 0.62 | 0.72 | 0.33 | 0.18 | 0.08 |
| 9 | 1.60 | 0.64 | 0.83 | 0.34 | 0.29 | 0.12 |
| 10 | 1.74 | 0.63 | 0.94 | 0.34 | 0.35 | 0.13 |
| 11 | 1.78 | 0.58 | 0.77 | 0.25 | 0.66 | 0.22 |
| 12 | 1.78 | 0.54 | 0.69 | 0.21 | 0.48 | 0.14 |
| 13 | 1.77 | 0.49 | 0.52 | 0.15 | 0.56 | 0.15 |
| 14 | 1.78 | 0.46 | 0.35 | 0.09 | 0.60 | 0.15 |
| 15 | 1.99 | 0.48 | 0.00 | 0.00 | 0.62 | 0.15 |
| 16 | 1.92 | 0.43 | 0.00 | 0.00 | 0.65 | 0.15 |
| 17 | 1.98 | 0.42 | 0.00 | 0.00 | 0.55 | 0.12 |
| 18 | 2.01 | 0.40 | 0.00 | 0.00 | 0.60 | 0.12 |
| 19 | 2.15 | 0.41 | 0.00 | 0.00 | 0.52 | 0.10 |
| 20 | 2.20 | 0.40 | 0.00 | 0.00 | 0.41 | 0.07 |
| 21 | 1.87 | 0.32 | 0.00 | 0.00 | 0.19 | 0.03 |
| 22 | 1.58 | 0.26 | 0.00 | 0.00 | 0.13 | 0.02 |

TABLE 48 (Continued)

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 27

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 1.40 | 0.22 | 0.00 | 0.00 | 0.11 | 0.02 |
| 24 | 1.26 | 0.19 | 0.00 | 0.00 | 0.10 | 0.02 |
| 25 | 1.15 | 0.17 | 0.00 | 0.00 | 0.09 | 0.01 |
| 26 | 1.02 | 0.14 | 0.00 | 0.00 | 0.07 | 0.01 |
| 27 | 0.91 | 0.12 | 0.00 | 0.00 | 0.05 | 0.01 |
| 28 | 0.79 | 0.10 | 0.00 | 0.00 | 0.06 | 0.01 |
| 29 | 0.68 | 0.09 | 0.00 | 0.00 | 0.05 | 0.01 |
| 30 | 0.63 | 0.08 | 0.00 | 0.00 | 0.05 | 0.01 |
| 31 | 0.58 | 0.07 | 0.00 | 0.00 | 0.04 | 0.00 |
| 32 | 0.50 | 0.06 | 0.00 | 0.00 | 0.03 | 0.00 |
| 33 | 0.50 | 0.05 | 0.00 | 0.00 | 0.02 | 0.00 |
| 34 | 0.49 | 0.05 | 0.00 | 0.00 | 0.02 | 0.00 |
| 35 | 0.46 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.39 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.30 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.23 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.17 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.11 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 49

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co2(CO)8/Zr(OPr)4/Al2O3
SAMPLE No: 8523+41+9+30

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 262.3 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 15.1 | P, PSIG : | 310 | CO/H2: | 1.03 |
| TIME ON STREAM, HRS : | 286.7 | SV, L/G/HR: | 2.10 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.50 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 33.97 | MOL SYNGAS/KG CAT/HR: | 31.867 |
| %CO CONV. : | 22.42 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 45.90 | MOL CO/MOL METAL/MIN: | 0.085 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 9.17 | H2O: | 11.74 |
| OXYGENATES : | 0.16 | CO : | 74.02 |
| CO2 : | 1.34 | H2 : | 3.57 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 22.55 | C4+ENE : | 3.65 |
| C2+ANE : | 4.13 | C5+C11 : | 27.13 |
| C2+ENE : | 0.31 | C12+C18: | 15.26 |
| C3+ANE : | 2.74 | C19+C23: | 8.48 |
| C3+ENE : | 4.82 | C24+34 : | 7.19 |
| C4 ISO+ANE: | 2.83 | C35+ : | 0.91 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 27.13 |
| DIESEL (C9+C25) : | 35.66 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 97.12 |
| HYDROGEN: | 98.70 |
| OXYGEN : | 98.63 |

TABLE 50

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 30

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 22.55 | 62.65 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 4.13 | 6.13 | 0.31 | 0.50 | 0.00 | 0.00 |
| 3 | 2.74 | 2.77 | 4.82 | 5.10 | 0.00 | 0.00 |
| 4 | 2.76 | 2.11 | 3.65 | 2.90 | 0.07 | 0.05 |
| 5 | 3.12 | 1.92 | 3.48 | 2.21 | 0.24 | 0.15 |
| 6 | 4.56 | 2.36 | 0.18 | 0.10 | 0.00 | 0.00 |
| 7 | 2.25 | 1.00 | 0.69 | 0.31 | 0.17 | 0.08 |
| 8 | 1.71 | 0.67 | 0.64 | 0.25 | 0.33 | 0.13 |
| 9 | 2.07 | 0.72 | 0.74 | 0.26 | 0.55 | 0.19 |
| 10 | 2.29 | 0.72 | 0.72 | 0.23 | 0.47 | 0.15 |
| 11 | 1.89 | 0.54 | 0.53 | 0.15 | 0.50 | 0.14 |
| 12 | 1.78 | 0.47 | 0.44 | 0.12 | 0.47 | 0.12 |
| 13 | 1.70 | 0.41 | 0.29 | 0.07 | 0.49 | 0.12 |
| 14 | 1.83 | 0.41 | 0.00 | 0.00 | 0.49 | 0.11 |
| 15 | 1.68 | 0.35 | 0.00 | 0.00 | 0.47 | 0.10 |
| 16 | 1.55 | 0.31 | 0.00 | 0.00 | 0.43 | 0.09 |
| 17 | 1.46 | 0.27 | 0.00 | 0.00 | 0.38 | 0.07 |
| 18 | 1.44 | 0.25 | 0.00 | 0.00 | 0.35 | 0.06 |
| 19 | 1.55 | 0.26 | 0.00 | 0.00 | 0.27 | 0.04 |
| 20 | 1.80 | 0.28 | 0.00 | 0.00 | 0.23 | 0.04 |
| 21 | 1.65 | 0.25 | 0.00 | 0.00 | 0.19 | 0.03 |
| 22 | 1.36 | 0.19 | 0.00 | 0.00 | 0.13 | 0.02 |

TABLE 50 (Continued)

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 30

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 1.18 | 0.16 | 0.00 | 0.00 | 0.11 | 0.01 |
| 24 | 1.05 | 0.14 | 0.00 | 0.00 | 0.09 | 0.01 |
| 25 | 0.94 | 0.12 | 0.00 | 0.00 | 0.08 | 0.01 |
| 26 | 0.83 | 0.10 | 0.00 | 0.00 | 0.06 | 0.01 |
| 27 | 0.71 | 0.08 | 0.00 | 0.00 | 0.05 | 0.01 |
| 28 | 0.62 | 0.07 | 0.00 | 0.00 | 0.06 | 0.01 |
| 29 | 0.53 | 0.06 | 0.00 | 0.00 | 0.03 | 0.00 |
| 30 | 0.47 | 0.05 | 0.00 | 0.00 | 0.03 | 0.00 |
| 31 | 0.44 | 0.04 | 0.00 | 0.00 | 0.01 | 0.00 |
| 32 | 0.42 | 0.04 | 0.00 | 0.00 | 0.01 | 0.00 |
| 33 | 0.40 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 0.35 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.29 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.22 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.16 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.10 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.08 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 51

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co2(CO)8/Zr(OPr)4/Al2O3
SAMPLE NO: 8523+41+9+33

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS | : 450.0 | T, C | : 261.6 | FEED RATIO, | |
| CATALYST LOADING, WT% | : 15.5 | P, PSIG | : 302 | CO/H2 | : 0.50 |
| TIME ON STREAM, HRS | : 309.6 | SV, L/G/HR | : 2.08 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 | : 0.42 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2 | : 56.10 | MOL SYNGAS/KG CAT/HR | : 52.111 |
| %CO CONV. | : 50.06 | SPECIFIC ACTIVITY, | |
| %H2 CONV. | : 59.13 | MOL CO/MOL METAL/MIN | : 0.123 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS | : 20.80 | H2O | : 25.48 |
| OXYGENATES | : 0.65 | CO | : 45.08 |
| CO2 | : 2.72 | H2 | : 5.26 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 | : 27.26 | C4+ENE | : 2.69 |
| C2+ANE | : 4.88 | C5+C11 | : 28.66 |
| C2+ENE | : 0.12 | C12+C18 | : 12.61 |
| C3+ANE | : 5.26 | C19+C23 | : 5.13 |
| C3+ENE | : 2.95 | C24+34 | : 4.85 |
| C4 ISO+ANE | : 4.78 | C35+ | : 0.82 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11) | : 28.66 |
| DIESEL (C9+C25) | : 29.61 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON | : 96.54 |
| HYDROGEN | : 93.23 |
| OXYGEN | : 98.19 |

TABLE 52

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523+41+9

SAMPLE NO. 33

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 27.26 | 66.18 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 4.88 | 6.32 | 0.12 | 0.16 | 0.00 | 0.00 |
| 3 | 5.26 | 4.65 | 2.95 | 2.73 | 0.00 | 0.00 |
| 4 | 4.68 | 3.14 | 2.69 | 1.86 | 0.10 | 0.07 |
| 5 | 4.73 | 2.55 | 2.13 | 1.18 | 0.34 | 0.18 |
| 6 | 4.43 | 2.00 | 0.20 | 0.09 | 0.00 | 0.00 |
| 7 | 2.93 | 1.14 | 0.29 | 0.12 | 0.00 | 0.00 |
| 8 | 2.29 | 0.78 | 0.42 | 0.14 | 0.47 | 0.16 |
| 9 | 2.94 | 0.89 | 0.43 | 0.13 | 0.74 | 0.23 |
| 10 | 2.78 | 0.76 | 0.29 | 0.08 | 0.57 | 0.16 |
| 11 | 2.10 | 0.52 | 0.15 | 0.04 | 0.44 | 0.11 |
| 12 | 1.96 | 0.45 | 0.00 | 0.00 | 0.40 | 0.09 |
| 13 | 1.75 | 0.37 | 0.00 | 0.00 | 0.36 | 0.08 |
| 14 | 1.60 | 0.31 | 0.01 | 0.00 | 0.33 | 0.06 |
| 15 | 1.47 | 0.27 | 0.01 | 0.00 | 0.30 | 0.06 |
| 16 | 1.34 | 0.23 | 0.00 | 0.00 | 0.28 | 0.05 |
| 17 | 1.21 | 0.20 | 0.00 | 0.00 | 0.25 | 0.04 |
| 18 | 1.10 | 0.17 | 0.00 | 0.00 | 0.23 | 0.04 |
| 19 | 1.03 | 0.15 | 0.00 | 0.00 | 0.18 | 0.03 |
| 20 | 1.01 | 0.14 | 0.00 | 0.00 | 0.11 | 0.01 |
| 21 | 0.95 | 0.12 | 0.00 | 0.00 | 0.09 | 0.01 |
| 22 | 0.86 | 0.11 | 0.00 | 0.00 | 0.08 | 0.01 |

TABLE 52 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523-41-9

SAMPLE NO. 33

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 0.77 | 0.09 | 0.00 | 0.00 | 0.07 | 0.01 |
| 24 | 0.69 | 0.08 | 0.00 | 0.00 | 0.06 | 0.01 |
| 25 | 0.62 | 0.07 | 0.00 | 0.00 | 0.06 | 0.01 |
| 26 | 0.55 | 0.06 | 0.00 | 0.00 | 0.05 | 0.00 |
| 27 | 0.48 | 0.05 | 0.00 | 0.00 | 0.04 | 0.00 |
| 28 | 0.42 | 0.04 | 0.00 | 0.00 | 0.06 | 0.01 |
| 29 | 0.37 | 0.03 | 0.00 | 0.00 | 0.04 | 0.00 |
| 30 | 0.33 | 0.03 | 0.00 | 0.00 | 0.03 | 0.00 |
| 31 | 0.29 | 0.03 | 0.00 | 0.00 | 0.02 | 0.00 |
| 32 | 0.26 | 0.02 | 0.00 | 0.00 | 0.02 | 0.00 |
| 33 | 0.23 | 0.02 | 0.00 | 0.00 | 0.01 | 0.00 |
| 34 | 0.23 | 0.02 | 0.00 | 0.00 | 0.01 | 0.00 |
| 35 | 0.23 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.19 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.15 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.11 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.09 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 53

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co2(CO)8/Zr(OPr)4/Al2O3
SAMPLE NO: 8523-41-9-36

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 258.6 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 15.1 | P, PSIG : | 308 | CO/H2: | 1.03 |
| TIME ON STREAM, HRS : | 335.0 | SV, L/G/HR: | 2.10 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.54 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 35.71 | MOL SYNGAS/KG CAT/HR: | 33.499 |
| %CO CONV. : | 24.79 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 46.99 | MOL CO/MOL METAL/MIN: | 0.093 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 8.44 | H2O: | 11.63 |
| OXYGENATES : | 0.20 | CO : | 75.14 |
| CO2 : | 0.92 | H2 : | 3.67 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 19.87 | C4=ENE : | 4.04 |
| C2=ANE : | 3.39 | C5=C11 : | 31.13 |
| C2=ENE : | 0.38 | C12=C18: | 17.41 |
| C3=ANE : | 2.25 | C19=C23: | 7.55 |
| C3=ENE : | 5.16 | C24=34 : | 5.38 |
| C4 ISO=ANE: | 2.64 | C35+ : | 0.80 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5=C11): | 31.13 |
| DIESEL (C9=C25) : | 36.75 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 92.32 |
| HYDROGEN: | 93.29 |
| OXYGEN : | 94.65 |

## TABLE 54

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 36

| CARBON NO. | N†ALKANES | | 1†ALKENE | | BRANCHED ISOMERS | |
|---|---|---|---|---|---|---|
| | WT % | MOLE % | WT % | MOLE % | WT % | MOLE % |
| 1 | 19.87 | 59.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 3.39 | 5.36 | 0.38 | 0.64 | 0.00 | 0.00 |
| 3 | 2.25 | 2.43 | 5.16 | 5.84 | 0.00 | 0.00 |
| 4 | 2.57 | 2.11 | 4.04 | 3.42 | 0.07 | 0.05 |
| 5 | 3.02 | 1.99 | 3.91 | 2.65 | 0.24 | 0.16 |
| 6 | 6.25 | 3.45 | 0.24 | 0.14 | 0.00 | 0.00 |
| 7 | 2.80 | 1.33 | 1.10 | 0.53 | 0.22 | 0.11 |
| 8 | 2.14 | 0.89 | 0.84 | 0.35 | 0.22 | 0.09 |
| 9 | 2.25 | 0.84 | 0.88 | 0.33 | 0.37 | 0.14 |
| 10 | 2.47 | 0.83 | 0.84 | 0.28 | 0.37 | 0.12 |
| 11 | 2.04 | 0.62 | 0.57 | 0.18 | 0.37 | 0.11 |
| 12 | 2.01 | 0.56 | 0.49 | 0.14 | 0.38 | 0.11 |
| 13 | 1.97 | 0.51 | 0.39 | 0.10 | 0.40 | 0.10 |
| 14 | 2.16 | 0.52 | 0.00 | 0.00 | 0.47 | 0.11 |
| 15 | 2.01 | 0.45 | 0.00 | 0.00 | 0.48 | 0.11 |
| 16 | 1.88 | 0.39 | 0.00 | 0.00 | 0.47 | 0.10 |
| 17 | 1.77 | 0.35 | 0.00 | 0.00 | 0.45 | 0.09 |
| 18 | 1.69 | 0.32 | 0.00 | 0.00 | 0.41 | 0.08 |
| 19 | 1.69 | 0.30 | 0.00 | 0.00 | 0.30 | 0.05 |
| 20 | 1.65 | 0.28 | 0.00 | 0.00 | 0.27 | 0.05 |
| 21 | 1.33 | 0.21 | 0.00 | 0.00 | 0.18 | 0.03 |
| 22 | 1.04 | 0.16 | 0.00 | 0.00 | 0.11 | 0.02 |

TABLE 54 (Continued)

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 36

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 0.89 | 0.13 | 0.00 | 0.00 | 0.08 | 0.01 |
| 24 | 0.79 | 0.11 | 0.00 | 0.00 | 0.07 | 0.01 |
| 25 | 0.70 | 0.09 | 0.00 | 0.00 | 0.06 | 0.01 |
| 26 | 0.62 | 0.08 | 0.00 | 0.00 | 0.05 | 0.01 |
| 27 | 0.55 | 0.07 | 0.00 | 0.00 | 0.05 | 0.01 |
| 28 | 0.47 | 0.06 | 0.00 | 0.00 | 0.06 | 0.01 |
| 29 | 0.41 | 0.05 | 0.00 | 0.00 | 0.04 | 0.00 |
| 30 | 0.36 | 0.04 | 0.00 | 0.00 | 0.03 | 0.00 |
| 31 | 0.31 | 0.03 | 0.00 | 0.00 | 0.02 | 0.00 |
| 32 | 0.27 | 0.03 | 0.00 | 0.00 | 0.01 | 0.00 |
| 33 | 0.26 | 0.03 | 0.00 | 0.00 | 0.01 | 0.00 |
| 34 | 0.24 | 0.02 | 0.00 | 0.00 | 0.01 | 0.00 |
| 35 | 0.22 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.18 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.14 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.11 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.08 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.06 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 55

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co(CO)8/ZR/AL203
SAMPLE NO: 8523+41+9+39

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 281.4 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 15.1 | P, PSIG : | 310 | CO/H2: | 1.00 |
| TIME ON STREAM, HRS : | 358.3 | SV, L/G/HR: | 2.10 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.51 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 50.92 | MOL SYNGAS/KG CAT/HR: | 47.810 |
| %CO CONV. : | 34.46 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 67.39 | MOL CO/MOL METAL/MIN: | 0.128 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 13.66 | H20: | 16.89 |
| OXYGENATES : | 0.34 | CO : | 63.09 |
| CO2 : | 3.78 | H2 : | 2.24 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 24.71 | C4+ENE : | 3.59 |
| C2+ANE : | 4.26 | C5+C11 : | 31.19 |
| C2+ENE : | 0.30 | C12+C18: | 16.03 |
| C3+ANE : | 2.72 | C19+C23: | 4.71 |
| C3+ENE : | 4.49 | C24+34 : | 4.48 |
| C4 ISO+ANE: | 2.87 | C35+ : | 0.67 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 31.19 |
| DIESEL (C9+C25) : | 34.02 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 95.63 |
| HYDROGEN: | 96.20 |
| OXYGEN : | 98.06 |

## TABLE 56

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523+41+9

SAMPLE NO. 39

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 24.71 | 64.37 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 4.26 | 5.92 | 0.30 | 0.45 | 0.00 | 0.00 |
| 3 | 2.72 | 2.57 | 4.49 | 4.46 | 0.00 | 0.00 |
| 4 | 2.82 | 2.03 | 3.59 | 2.67 | 0.05 | 0.04 |
| 5 | 3.31 | 1.92 | 3.54 | 2.11 | 0.29 | 0.17 |
| 6 | 4.73 | 2.29 | 0.39 | 0.19 | 0.00 | 0.00 |
| 7 | 2.39 | 0.99 | 0.73 | 0.31 | 0.47 | 0.19 |
| 8 | 2.03 | 0.74 | 0.71 | 0.27 | 0.67 | 0.24 |
| 9 | 2.54 | 0.83 | 0.82 | 0.27 | 1.04 | 0.34 |
| 10 | 2.19 | 0.64 | 0.68 | 0.20 | 1.03 | 0.30 |
| 11 | 1.99 | 0.53 | 0.45 | 0.12 | 1.19 | 0.32 |
| 12 | 1.84 | 0.45 | 0.35 | 0.09 | 0.85 | 0.21 |
| 13 | 1.69 | 0.38 | 0.24 | 0.06 | 0.80 | 0.18 |
| 14 | 1.73 | 0.37 | 0.00 | 0.00 | 0.75 | 0.16 |
| 15 | 1.59 | 0.31 | 0.00 | 0.00 | 0.67 | 0.13 |
| 16 | 1.45 | 0.27 | 0.00 | 0.00 | 0.61 | 0.11 |
| 17 | 1.36 | 0.24 | 0.00 | 0.00 | 0.51 | 0.09 |
| 18 | 1.21 | 0.20 | 0.00 | 0.00 | 0.38 | 0.06 |
| 19 | 0.92 | 0.14 | 0.00 | 0.00 | 0.18 | 0.03 |
| 20 | 0.86 | 0.13 | 0.00 | 0.00 | 0.09 | 0.01 |
| 21 | 0.88 | 0.12 | 0.00 | 0.00 | 0.07 | 0.01 |
| 22 | 0.82 | 0.11 | 0.00 | 0.00 | 0.07 | 0.01 |

TABLE 56 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523-41-9

SAMPLE NO. 39

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 0.74 | 0.09 | 0.00 | 0.00 | 0.07 | 0.01 |
| 24 | 0.65 | 0.08 | 0.00 | 0.00 | 0.06 | 0.01 |
| 25 | 0.58 | 0.07 | 0.00 | .00 | 0.05 | 0.01 |
| 26 | 0.50 | 0.06 | 0.00 | 0.00 | 0.05 | 0.01 |
| 27 | 0.44 | 0.05 | 0.00 | 0.00 | 0.04 | 0.00 |
| 28 | 0.38 | 0.04 | 0.00 | 0.00 | 0.06 | 0.01 |
| 29 | 0.33 | 0.03 | 0.00 | 0.00 | 0.04 | 0.00 |
| 30 | 0.30 | 0.03 | 0.00 | 0.00 | 0.03 | 0.00 |
| 31 | 0.26 | 0.02 | 0.00 | 0.00 | 0.02 | 0.00 |
| 32 | 0.22 | 0.02 | 0.00 | 0.00 | 0.02 | 0.00 |
| 33 | 0.21 | 0.02 | 0.00 | 0.00 | 0.01 | 0.00 |
| 34 | 0.20 | 0.02 | 0.00 | 0.00 | 0.01 | 0.00 |
| 35 | 0.18 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.15 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.12 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.09 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.07 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 57

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co2(CO)8/ZR/AL203
SAMPLE NO: 8523+41+9+42

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS | 450.0 | T, C | 281.6 | FEED RATIO, | |
| CATALYST LOADING, W:% | 15.1 | P, PSIG | 310 | CO/H2: | 1.50 |
| TIME ON STREAM, HRS | 430.0 | SV, L/G/HR: | 2.10 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 | 0.53 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2 | 37.28 | MOL SYNGAS/KG CAT/HR: | 34.964 |
| %CO CONV. | 21.62 | SPECIFIC ACTIVITY, | |
| %H2 CONV. | 60.78 | MOL CO/MOL METAL/MIN: | 0.096 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 7.91 | H20: | 10.05 |
| OXYGENATES : | 0.21 | CO : | 77.58 |
| CO2 : | 2.41 | H2 : | 1.85 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 | 26.03 | C4+ENE | 4.18 |
| C2+ANE | 4.09 | C5+C11 | 31.59 |
| C2+ENE | 0.56 | C12+C18: | 14.95 |
| C3+ANE | 1.91 | C19+C23: | 5.14 |
| C3+ENE | 5.55 | C24+34 | 3.37 |
| C4 ISO+ANE: | 2.18 | C35+ | 0.46 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 31.59 |
| DIESEL (C9+C25) : | 31.40 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 95.46 |
| HYDROGEN: | 93.75 |
| OXYGEN : | 97.41 |

## TABLE 58

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523-41-9

SAMPLE NO. 42

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 26.03 | 65.20 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 4.09 | 5.47 | 0.56 | 0.80 | 0.00 | 0.00 |
| 3 | 1.91 | 1.74 | 5.55 | 5.30 | 0.00 | 0.00 |
| 4 | 2.13 | 1.47 | 4.18 | 2.99 | 0.05 | 0.04 |
| 5 | 2.65 | 1.47 | 4.33 | 2.48 | 0.24 | 0.13 |
| 6 | 6.15 | 2.87 | 0.44 | 0.21 | 0.00 | 0.00 |
| 7 | 2.65 | 1.06 | 1.11 | 0.45 | 0.42 | 0.17 |
| 8 | 1.97 | 0.69 | 0.87 | 0.31 | 0.44 | 0.15 |
| 9 | 1.81 | 0.57 | 0.96 | 0.30 | 0.72 | 0.23 |
| 10 | 1.81 | 0.51 | 0.83 | 0.24 | 1.06 | 0.30 |
| 11 | 1.64 | 0.42 | 0.55 | 0.14 | 0.93 | 0.24 |
| 12 | 1.55 | 0.37 | 0.45 | 0.11 | 0.69 | 0.16 |
| 13 | 1.46 | 0.32 | 0.35 | 0.08 | 0.67 | 0.15 |
| 14 | 1.64 | 0.33 | 0.00 | 0.00 | 0.65 | 0.13 |
| 15 | 1.48 | 0.28 | 0.00 | 0.00 | 0.60 | 0.11 |
| 16 | 1.33 | 0.24 | 0.00 | 0.00 | 0.57 | 0.10 |
| 17 | 1.23 | 0.21 | 0.00 | 0.00 | 0.54 | 0.09 |
| 18 | 1.23 | 0.19 | 0.00 | 0.00 | 0.51 | 0.08 |
| 19 | 1.24 | 0.19 | 0.00 | 0.00 | 0.45 | 0.07 |
| 20 | 1.00 | 0.14 | 0.00 | 0.00 | 0.28 | 0.04 |
| 21 | 0.74 | 0.10 | 0.00 | 0.00 | 0.14 | 0.02 |
| 22 | 0.60 | 0.08 | 0.00 | 0.00 | 0.08 | 0.01 |

TABLE 58 (Continued)

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 42

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 0.53 | 0.07 | 0.00 | 0.00 | 0.07 | 0.01 |
| 24 | 0.47 | 0.06 | 0.00 | 0.00 | 0.06 | 0.01 |
| 25 | 0.42 | 0.05 | 0.00 | 0.00 | 0.05 | 0.01 |
| 26 | 0.37 | 0.04 | 0.00 | 0.00 | 0.05 | 0.01 |
| 27 | 0.32 | 0.03 | 0.00 | 0.00 | 0.04 | 0.00 |
| 28 | 0.28 | 0.03 | 0.00 | 0.00 | 0.05 | 0.01 |
| 29 | 0.25 | 0.02 | 0.00 | 0.00 | 0.04 | 0.00 |
| 30 | 0.22 | 0.02 | 0.00 | 0.00 | 0.03 | 0.00 |
| 31 | 0.19 | 0.02 | 0.00 | 0.00 | 0.02 | 0.00 |
| 32 | 0.17 | 0.01 | 0.00 | 0.00 | 0.02 | 0.00 |
| 33 | 0.16 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| 34 | 0.14 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| 35 | 0.14 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.11 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.08 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 59

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co2(CO)8/ZR/AL203
SAMPLE NO: 8523+41+9+47

| | | | | | |
|---|---|---|---|---|---|
| REACTOR L[illegible]NG, MLS : | 450.0 | T, C : | 283.3 | FEED RATIO, | |
| CATALYST L[illegible]DING, WT%: | 15.1 | P, PSIG : | 338 | CO/H2: | 0.50 |
| TIME ON STREAM, HRS : | 478.8 | SV, L/G/HR: | 2.08 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.45 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 67.25 | MOL SYNGAS/KG CAT/HR: | 62.458 |
| %CO CONV. : | 62.08 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 69.84 | MOL CO/MOL METAL/MIN: | 0.153 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 24.98 | H2O: | 30.19 |
| OXYGENATES : | 0.64 | CO : | 33.70 |
| CO2 : | 6.68 | H2 : | 3.82 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 39.36 | C4+ENE : | 3.31 |
| C2+ANE : | 7.79 | C5+C11 : | 21.29 |
| C2+ENE : | 0.17 | C12+C18: | 4.70 |
| C3+ANE : | 7.58 | C19+C23: | 3.77 |
| C3+ENE : | 3.60 | C24+34 : | 1.67 |
| C4 ISO+ANE: | 6.49 | C35+ : | 0.28 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 21.29 |
| DIESEL (C9+C25) : | 14.89 |

% ELEMENTAL RECOVERY: CARBON : 96.12
HYDROGEN: 96.48
OXYGEN : 100.82

## TABLE 60

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 47

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 39.36 | 71.77 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 7.79 | 7.57 | 0.17 | 0.18 | 0.00 | 0.00 |
| 3 | 7.58 | 5.03 | 3.60 | 2.50 | 0.00 | 0.00 |
| 4 | 6.33 | 3.19 | 3.31 | 1.72 | 0.15 | 0.08 |
| 5 | 5.34 | 2.16 | 2.18 | 0.91 | 0.59 | 0.24 |
| 6 | 2.87 | 0.97 | 0.26 | 0.09 | 0.00 | 0.00 |
| 7 | 1.77 | 0.52 | 0.40 | 0.12 | 0.00 | 0.00 |
| 8 | 1.32 | 0.34 | 0.22 | 0.06 | 0.48 | 0.12 |
| 9 | 1.52 | 0.35 | 0.21 | 0.05 | 0.64 | 0.15 |
| 10 | 1.35 | 0.28 | 0.16 | 0.03 | 0.68 | 0.14 |
| 11 | 0.89 | 0.17 | 0.05 | 0.01 | 0.38 | 0.07 |
| 12 | 0.77 | 0.13 | 0.00 | 0.00 | 0.30 | 0.05 |
| 13 | 0.64 | 0.10 | 0.00 | 0.00 | 0.24 | 0.04 |
| 14 | 0.54 | 0.08 | 0.00 | 0.00 | 0.20 | 0.03 |
| 15 | 0.45 | 0.06 | 0.00 | 0.00 | 0.17 | 0.02 |
| 16 | 0.37 | 0.05 | 0.00 | 0.00 | 0.14 | 0.02 |
| 17 | 0.32 | 0.04 | 0.00 | 0.00 | 0.12 | 0.01 |
| 18 | 0.32 | 0.04 | 0.00 | 0.00 | 0.11 | 0.01 |
| 19 | 0.55 | 0.06 | 0.00 | 0.00 | 0.15 | 0.02 |
| 20 | 0.84 | 0.09 | 0.00 | 0.00 | 0.27 | 0.03 |
| 21 | 0.73 | 0.07 | 0.00 | 0.00 | 0.23 | 0.02 |
| 22 | 0.49 | 0.05 | 0.00 | 0.00 | 0.11 | 0.01 |

TABLE 60 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523+41+9

SAMPLE NO. 47

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 0.34 | 0.03 | 0.00 | 0.00 | 0.06 | 0.01 |
| 24 | 0.26 | 0.02 | 0.00 | 0.00 | 0.04 | 0.00 |
| 25 | 0.22 | 0.02 | 0.00 | 0.00 | 0.03 | 0.00 |
| 26 | 0.18 | 0.01 | 0.00 | 0.00 | 0.02 | 0.00 |
| 27 | 0.15 | 0.01 | 0.00 | 0.00 | 0.02 | 0.00 |
| 28 | 0.13 | 0.01 | 0.00 | 0.00 | 0.03 | 0.00 |
| 29 | 0.11 | 0.01 | 0.00 | 0.00 | 0.02 | 0.00 |
| 30 | 0.10 | 0.01 | 0.00 | 0.00 | 0.02 | 0.00 |
| 31 | 0.09 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| 32 | 0.07 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| 33 | 0.07 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| 34 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 61

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : $Co_2(CO)_8/ZrO_2/Al_2O_3$
SAMPLE NO: 8523+41+9+53

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS | : 450.0 | T, C | : 281.1 | FEED RATIO, | |
| CATALYST LOADING, WT% | : 15.1 | P, PSIG | : 305 | CO/H2: | 1.0( |
| TIME ON STREAM, HRS | : 503.1 | SV, L/G/HR: | 1.05 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 | : 0.52 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2 | : 55.92 | MOL SYNGAS/KG CAT/HR: | 26.240 |
| %CO CONV. | : 38.27 | SPECIFIC ACTIVITY, | |
| %H2 CONV. | : 73.53 | MOL CO/MOL METAL/MIN: | 0.071 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 14.49 | H20: | 17.89 |
| OXYGENATES | : 0.30 | CO | : 60.22 |
| CO2 | : 5.25 | H2 | : 1.85 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 | : 29.86 | C4+ENE | : 4.91 |
| C2+ANE | : 4.55 | C5+C11 | : 32.92 |
| C2+ENE | : 0.49 | C12+C18: | 10.99 |
| C3+ANE | : 2.96 | C19+C23: | 3.24 |
| C3+ENE | : 6.23 | C24+34 | : 0.50 |
| C4 ISO+ANE: | 3.28 | C35+ | : 0.07 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 32.92 |
| DIESEL (C9+C25) | : 25.82 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON | : 93.77 |
| HYDROGEN: | 93.89 |
| OXYGEN | : 97.30 |

## TABLE 62

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 53

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 29.86 | 66.63 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 4.55 | 5.42 | 0.49 | 0.62 | 0.00 | 0.00 |
| 3 | 2.96 | 2.40 | 6.23 | 5.30 | 0.00 | 0.00 |
| 4 | 3.22 | 1.98 | 4.91 | 3.13 | 0.06 | 0.04 |
| 5 | 3.81 | 1.89 | 4.57 | 2.33 | 0.34 | 0.17 |
| 6 | 4.84 | 2.01 | 0.45 | 0.19 | 0.00 | 0.00 |
| 7 | 2.36 | 0.84 | 0.84 | 0.31 | 0.62 | 0.22 |
| 8 | 2.08 | 0.65 | 0.83 | 0.27 | 0.78 | 0.24 |
| 9 | 2.52 | 0.70 | 0.90 | 0.26 | 1.05 | 0.29 |
| 10 | 2.11 | 0.53 | 0.68 | 0.17 | 0.89 | 0.22 |
| 11 | 1.86 | 0.42 | 0.41 | 0.09 | 0.98 | 0.22 |
| 12 | 1.68 | 0.35 | 0.27 | 0.06 | 0.62 | 0.13 |
| 13 | 1.52 | 0.29 | 0.17 | 0.03 | 0.50 | 0.10 |
| 14 | 1.45 | 0.26 | 0.00 | 0.00 | 0.41 | 0.07 |
| 15 | 1.21 | 0.20 | 0.00 | 0.00 | 0.33 | 0.06 |
| 16 | 0.96 | 0.15 | 0.00 | 0.00 | 0.26 | 0.04 |
| 17 | 0.73 | 0.11 | 0.00 | 0.00 | 0.19 | 0.03 |
| 18 | 0.55 | 0.08 | 0.00 | 0.00 | 0.15 | 0.02 |
| 19 | 0.60 | 0.08 | 0.00 | 0.00 | 0.16 | 0.02 |
| 20 | 0.78 | 0.10 | 0.00 | 0.00 | 0.26 | 0.03 |
| 21 | 0.60 | 0.07 | 0.00 | 0.00 | 0.23 | 0.03 |
| 22 | 0.32 | 0.04 | 0.00 | 0.00 | 0.10 | 0.01 |

TABLE 62 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 53

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 0.16 | 0.02 | 0.00 | 0.00 | 0.04 | 0.00 |
| 24 | 0.09 | 0.01 | 0.00 | 0.00 | 0.02 | 0.00 |
| 25 | 0.07 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| 26 | 0.05 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| 27 | 0.04 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| 28 | 0.04 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| 29 | 0.03 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| 30 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 31 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 32 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 63

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : $Co_2(CO)_8/ZrO_2/Al_2O_3$
SAMPLE NO: 8523+41+9+58

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 260.1 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 15.1 | P, PSIG : | 320 | CO/H2: | 1.10 |
| TIME ON STREAM, HRS : | 575.1 | SV, L/G/HR: | 2.01 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.62 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 22.07 | MOL SYNGAS/KG CAT/HR: | 19.816 |
| %CO CONV. : | 16.20 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 28.51 | MOL CO/MOL METAL/MIN: | 0.060 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 5.03 | H2O: | 3.74 |
| OXYGENATES : | 0.03 | CO : | 85.54 |
| CO2 : | 0.91 | H2 : | 4.75 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 34.53 | C4+ENE : | 6.53 |
| C2+ANE : | 4.52 | C5+C11 : | 33.69 |
| C2+ENE : | 1.10 | C12+C18: | 3.38 |
| C3+ANE : | 2.37 | C19+C23: | 1.74 |
| C3+ENE : | 8.62 | C24+34 : | 0.11 |
| C4 ISO+ANE: | 3.38 | C35+ : | 0.01 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 33.69 |
| DIESEL (C9+C25) : | 9.38 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 93.72 |
| HYDROGEN: | 92.09 |
| OXYGEN : | 90.66 |

TABLE 64

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 58

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 34.53 | 67.76 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 4.52 | 4.74 | 1.10 | 1.24 | 0.00 | 0.00 |
| 3 | 2.37 | 1.69 | 8.62 | 6.44 | 0.00 | 0.00 |
| 4 | 3.28 | 1.78 | 6.53 | 3.66 | 0.10 | 0.05 |
| 5 | 3.54 | 1.54 | 6.27 | 2.81 | 0.00 | 0.00 |
| 6 | 9.84 | 3.59 | 0.32 | 0.12 | 0.00 | 0.00 |
| 7 | 3.58 | 1.12 | 2.16 | 0.69 | 0.25 | 0.08 |
| 8 | 2.13 | 0.59 | 1.21 | 0.34 | 0.20 | 0.06 |
| 9 | 1.38 | 0.34 | 0.71 | 0.18 | 0.12 | 0.03 |
| 10 | 0.91 | 0.20 | 0.44 | 0.10 | 0.11 | 0.02 |
| 11 | 0.32 | 0.07 | 0.12 | 0.03 | 0.07 | 0.01 |
| 12 | 0.38 | 0.07 | 0.12 | 0.02 | 0.08 | 0.02 |
| 13 | 0.39 | 0.07 | 0.10 | 0.02 | 0.08 | 0.01 |
| 14 | 0.39 | 0.06 | 0.07 | 0.01 | 0.09 | 0.01 |
| 15 | 0.41 | 0.06 | 0.00 | 0.00 | 0.08 | 0.01 |
| 16 | 0.36 | 0.05 | 0.00 | 0.00 | 0.08 | 0.01 |
| 17 | 0.32 | 0.04 | 0.00 | 0.00 | 0.07 | 0.01 |
| 18 | 0.29 | 0.04 | 0.00 | 0.00 | 0.07 | 0.01 |
| 19 | 0.28 | 0.03 | 0.00 | 0.00 | 0.07 | 0.01 |
| 20 | 0.34 | 0.04 | 0.00 | 0.00 | 0.11 | 0.01 |
| 21 | 0.33 | 0.04 | 0.00 | 0.00 | 0.16 | 0.02 |
| 22 | 0.20 | 0.02 | 0.00 | 0.00 | 0.12 | 0.01 |

TABLE 64 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 58

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 0.08 | 0.01 | 0.00 | 0.00 | 0.04 | 0.00 |
| 24 | 0.03 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| 25 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 26 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 27 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 28 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 29 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 32 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 66

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523-41-9

SAMPLE NO. 63

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 27.46 | 66.47 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.00 | 0.00 | 1.39 | 1.92 | 0.00 | 0.00 |
| 3 | 1.67 | 1.47 | 7.27 | 6.70 | 0.00 | 0.00 |
| 4 | 2.11 | 1.41 | 5.50 | 3.80 | 0.00 | 0.00 |
| 5 | 2.54 | 1.36 | 5.68 | 3.14 | 0.00 | 0.00 |
| 6 | 8.56 | 3.85 | 0.00 | 0.00 | 0.00 | 0.00 |
| 7 | 3.71 | 1.44 | 2.73 | 1.08 | 0.16 | 0.06 |
| 8 | 2.85 | 0.97 | 2.20 | 0.76 | 0.16 | 0.06 |
| 9 | 2.53 | 0.77 | 1.81 | 0.56 | 0.17 | 0.05 |
| 10 | 2.33 | 0.64 | 1.52 | 0.42 | 0.23 | 0.06 |
| 11 | 0.95 | 0.24 | 0.53 | 0.13 | 0.17 | 0.04 |
| 12 | 1.02 | 0.23 | 0.44 | 0.10 | 0.21 | 0.05 |
| 13 | 1.02 | 0.22 | 0.32 | 0.07 | 0.12 | 0.02 |
| 14 | 1.08 | 0.21 | 0.19 | 0.04 | 0.13 | 0.03 |
| 15 | 1.18 | 0.21 | 0.00 | 0.00 | 0.13 | 0.02 |
| 16 | 1.08 | 0.19 | 0.00 | 0.00 | 0.14 | 0.02 |
| 17 | 1.00 | 0.16 | 0.00 | 0.00 | 0.15 | 0.02 |
| 18 | 0.92 | 0.14 | 0.00 | 0.00 | 0.17 | 0.03 |
| 19 | 0.88 | 0.13 | 0.00 | 0.00 | 0.19 | 0.03 |
| 20 | 1.06 | 0.15 | 0.00 | 0.00 | 0.32 | 0.04 |
| 21 | 1.13 | 0.15 | 0.00 | 0.00 | 0.53 | 0.07 |
| 22 | 0.82 | 0.10 | 0.00 | 0.00 | 0.48 | 0.06 |

TABLE 66 (Continued)

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8523†41†9

SAMPLE NO. 63

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 0.43 | 0.05 | 0.00 | 0.00 | 0.25 | 0.03 |
| 24 | 0.17 | 0.02 | 0.00 | 0.00 | 0.07 | 0.01 |
| 25 | 0.09 | 0.01 | 0.00 | 0.00 | 0.02 | 0.00 |
| 26 | 0.02 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| 27 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 28 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 29 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 32 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 67

SLURRY SCREENING SUMMARY
M670-11-18
14.2 Wt% (79.0g) $Co_2(CO)_8$/Zr(OPr)$_4$/SiO$_2$

| Sample No. | Time on Stream h | P psig | T °C | SV, NL/g cat/hr | %CO+$H_2$ | %CO | %$H_2$ | Feed CO/$H_2$ | Usage $\Delta CO/\Delta H_2$ | Bulk Activity mol syngas/kg cat/h | Specific Activity mol CO/mol Co/min | Selectivity Wt% $C_1$ | $C_2$-$C_4$ | $C_5$-$C_{11}$ | $C_{12}$-$C_{18}$ | $C_{19}$-$C_{23}$ | $C_{24}^+$ | $C_5$-$C_{23}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | 43 | 310 | 240 | 2.0 | 40.8 | 26.2 | 55.5 | 1.0 | 0.47 | 36.5 | 0.234 | 8.1 | 14.5 | 37.4 | 24.9 | 8.2 | 6.9 | 70.5 |
| 12 | 67 | 310 | 242 | 2.0 | 36.4 | 21.3 | 59.1 | 1.5 | 0.54 | 32.5 | 0.229 | 5.7 | 9.8 | 31.0 | 28.7 | 12.8 | 12.0 | 72.5 |
| 14 | 91 | 310 | 241 | 2.0 | 30.1 | 16.1 | 58.3 | 2.0 | 0.55 | 26.9 | 0.192 | 6.7 | 11.6 | 26.9 | 25.0 | 15.1 | 14.7 | 67.0 |
| 18 | 140 | 310 | 241 | 1.0 | 34.8 | 15.4 | 73.9 | 2.0 | 0.42 | 15.6 | 0.092 | 5.7 | 10.5 | 29.8 | 22.5 | 14.9 | 16.6 | 67.2 |
| 21 | 211 | 313 | 238 | 1.0 | 31.2 | 12.4 | 59.4 | 1.5 | 0.31 | 13.9 | 0.066 | 7.0 | 11.0 | 26.2 | 20.5 | 13.8 | 20.5 | 61.5 |
| 24 | 235 | 310 | 239 | 1.0 | 36.8 | 16.3 | 57.4 | 1.0 | 0.28 | 16.4 | 0.073 | 7.8 | 11.1 | 31.1 | 21.5 | 12.8 | 15.7 | 65.4 |
| 26 | 331 | 310 | 262 | 1.0 | 41.5 | 23.1 | 60.0 | 1.0 | 0.39 | 18.5 | 0.104 | 7.6 | 9.4 | 42.8 | 31.9 | 5.3 | 3.2 | 79.8 |
| 30 | 355 | 310 | 261 | 1.0 | 42.9 | 21.4 | 75.1 | 1.5 | 0.43 | 19.1 | 0.115 | 11.0 | 12.9 | 37.4 | 23.3 | 8.0 | 7.4 | 68.7 |
| 33 | 378 | 310 | 260 | 2.0 | 25.0 | 5.5 | 54.3 | 1.5 | 0.15 | 22.3 | 0.059 | 12.4 | 15.6 | 33.3 | 22.5 | 9.0 | 7.2 | 64.8 |
| 36 | 402 | 315 | 262 | 2.0 | 36.8 | 22.1 | 66.2 | 2.0 | 0.67 | 32.5 | 0.261 | 9.4 | 12.1 | 32.9 | 26.2 | 11.2 | 8.2 | 70.3 |
| 39 | 426 | 315 | 262 | 2.0 | 50.2 | 33.4 | 66.9 | 1.0 | 0.50 | 44.8 | 0.299 | 15.6 | 17.8 | 33.1 | 20.9 | 7.0 | 5.6 | 61.0 |
| 42 | 498 | 312 | 261 | 2.0 | 59.0 | 41.4 | 76.1 | 1.0 | 0.55 | 52.7 | 0.375 | 20.5 | 19.3 | 37.0 | 17.0 | 3.9 | 2.3 | 57.9 |
| 45 | 523 | 316 | 262 | 2.0 | 46.8 | 29.5 | 72.6 | 1.5 | 0.61 | 41.7 | 0.317 | 15.2 | 16.1 | 36.2 | 20.4 | 6.6 | 3.5 | 65.2 |
| 48 | 570 | 315 | 260 | 2.0 | 39.6 | 23.5 | 72.1 | 2.0 | 0.66 | 35.3 | 0.262 | 15.9 | 16.6 | 37.5 | 19.5 | 7.0 | 3.5 | 64.0 |
| 51 | 594 | 310 | 278 | 1.0 | 61.8 | 42.1 | 81.5 | 1.0 | 0.52 | 27.6 | 0.188 | 19.5 | 19.1 | 40.4 | 16.6 | 3.2 | 1.2 | 60.2 |
| 54 | 667 | 310 | 262 | 1.0 | 41.4 | 23.1 | 76.0 | 2.0 | 0.59 | 18.5 | 0.144 | 13.5 | 15.4 | 32.1 | 23.9 | 9.6 | 5.5 | 65.6 |
| 57 | 690 | 308 | 260 | 2.0 | 37.4 | 24.2 | 50.5 | 1.0 | 0.48 | 33.4 | 0.217 | 18.1 | 20.9 | 37.2 | 17.7 | 5.0 | 0.9 | 59.9 |
| 60 | 714 | 312 | 240 | 2.0 | 20.6 | 12.6 | 28.5 | 1.0 | 0.44 | 18.4 | 0.113 | 17.5 | 24.0 | 38.2 | 12.9 | 6.2 | 0.8 | 57.3 |

## TABLE 68

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co2(CO)8/ZR/SIO2
SAMPLE NO: 8670+11+18+9

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 239.9 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 19.2 | P, PSIG : | 310 | CO/H2: | 1.0 |
| TIME ON STREAM, HRS : | 43.0 | SV, L/G/HR: | 2.00 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.47 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 40.82 | MOL SYNGAS/KG CAT/HR: | 36.456 |
| %CO CONV. : | 26.18 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 55.46 | MOL CO/MOL METAL/MIN: | 0.234 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 12.08 | H2O: | 15.27 |
| OXYGENATES : | 0.27 | CO : | 68.06 |
| CO2 : | 1.40 | H2 : | 2.93 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 8.08 | C4+ENE : | 3.22 |
| C2+ANE : | 1.95 | C5+C11 : | 37.38 |
| C2+ENE : | 0.00 | C12+C18: | 24.93 |
| C3+ANE : | 2.29 | C19+C23: | 8.22 |
| C3+ENE : | 3.57 | C24+34 : | 5.83 |
| C4 ISO+ANE: | 3.44 | C35+ : | 1.08 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 37.38 |
| DIESEL (C9+C25) : | 48.62 |

% ELEMENTAL RECOVERY: CARBON : 100.71
HYDROGEN: 100.64
OXYGEN : 101.71

## TABLE 69

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670-11-18

SAMPLE NO. 9

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 8.08 | 37.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 1.95 | 4.77 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 2.29 | 3.83 | 3.57 | 6.25 | 0.00 | 0.00 |
| 4 | 3.35 | 4.25 | 3.22 | 4.22 | 0.09 | 0.11 |
| 5 | 4.12 | 4.20 | 3.32 | 3.48 | 0.31 | 0.31 |
| 6 | 6.08 | 5.19 | 0.20 | 0.18 | 0.00 | 0.00 |
| 7 | 4.02 | 2.95 | 0.83 | 0.62 | 0.25 | 0.18 |
| 8 | 3.35 | 2.16 | 0.76 | 0.50 | 0.48 | 0.31 |
| 9 | 3.57 | 2.05 | 0.71 | 0.41 | 0.52 | 0.30 |
| 10 | 3.96 | 2.05 | 0.60 | 0.31 | 0.50 | 0.26 |
| 11 | 2.78 | 1.31 | 0.48 | 0.23 | 0.56 | 0.26 |
| 12 | 3.21 | 1.38 | 0.00 | 0.00 | 0.69 | 0.30 |
| 13 | 3.15 | 1.26 | 0.00 | 0.00 | 0.70 | 0.28 |
| 14 | 3.14 | 1.17 | 0.00 | 0.00 | 0.70 | 0.26 |
| 15 | 3.11 | 1.08 | 0.00 | 0.00 | 0.63 | 0.22 |
| 16 | 2.97 | 0.97 | 0.00 | 0.00 | 0.61 | 0.20 |
| 17 | 2.78 | 0.85 | 0.00 | 0.00 | 0.48 | 0.15 |
| 18 | 2.37 | 0.68 | 0.00 | 0.00 | 0.42 | 0.12 |
| 19 | 2.04 | 0.56 | 0.00 | 0.00 | 0.19 | 0.05 |
| 20 | 1.74 | 0.45 | 0.00 | 0.00 | 0.14 | 0.04 |
| 21 | 1.48 | 0.37 | 0.00 | 0.00 | 0.11 | 0.03 |
| 22 | 1.27 | 0.30 | 0.00 | 0.00 | 0.09 | 0.02 |

TABLE 69 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670+11+18

SAMPLE NO. 9

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 1.09 | 0.25 | 0.00 | 0.00 | 0.08 | 0.02 |
| 24 | 0.93 | 0.20 | 0.00 | 0.00 | 0.05 | 0.01 |
| 25 | 0.79 | 0.16 | 0.00 | 0.00 | 0.03 | 0.01 |
| 26 | 0.67 | 0.13 | 0.00 | 0.00 | 0.00 | 0.00 |
| 27 | 0.53 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 |
| 28 | 0.49 | 0.09 | 0.00 | 0.00 | 0.02 | 0.00 |
| 29 | 0.45 | 0.08 | 0.00 | 0.00 | 0.02 | 0.00 |
| 30 | 0.27 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 31 | 0.42 | 0.07 | 0.00 | 0.00 | 0.03 | 0.00 |
| 32 | 0.37 | 0.06 | 0.00 | 0.00 | 0.03 | 0.00 |
| 33 | 0.34 | 0.05 | 0.00 | 0.00 | 0.04 | 0.01 |
| 34 | 0.32 | 0.05 | 0.00 | 0.00 | 0.04 | 0.01 |
| 35 | 0.31 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.25 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.20 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.14 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.13 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.05 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 70

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co2(CO)8/ZR/SIO2
SAMPLE NO: 8670†11†18†12

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 241.7 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 19.2 | P, PSIG : | 310 | CO/H2: | 1.50 |
| TIME ON STREAM, HRS : | 67.0 | SV, L/G/HR: | 2.00 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.54 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 36.43 | MOL SYNGAS/KG CAT/HR: | 32.520 |
| %CO CONV. : | 21.32 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 59.09 | MOL CO/MOL METAL/MIN: | 0.229 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 8.97 | H2O: | 13.34 |
| OXYGENATES : | 0.09 | CO : | 74.85 |
| CO2 : | 0.89 | H2 : | 1.85 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 5.72 | C4†ENE : | 2.90 |
| C2†ANE : | 1.26 | C5†C11 : | 30.97 |
| C2†ENE : | 0.00 | C12†C18: | 28.66 |
| C3†ANE : | 0.99 | C19†C23: | 12.82 |
| C3†ENE : | 3.05 | C24†34 : | 10.08 |
| C4 ISO+ANE: | 1.59 | C35+ : | 1.96 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5†C11): | 30.97 |
| DIESEL (C9†C25) : | 57.68 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 97.92 |
| HYDROGEN: | 105.14 |
| OXYGEN : | 101.75 |

TABLE 71

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670†11†18

SAMPLE NO. 12

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 5.72 | 33.07 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 1.26 | 3.90 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 0.99 | 2.08 | 3.05 | 6.72 | 0.00 | 0.00 |
| 4 | 1.54 | 2.46 | 2.90 | 4.78 | 0.05 | 0.08 |
| 5 | 2.11 | 2.71 | 2.95 | 3.89 | 0.08 | 0.10 |
| 6 | 4.20 | 4.51 | 0.22 | 0.24 | 0.00 | 0.00 |
| 7 | 2.53 | 2.34 | 1.12 | 1.06 | 0.36 | 0.34 |
| 8 | 2.48 | 2.02 | 1.16 | 0.96 | 0.63 | 0.51 |
| 9 | 2.91 | 2.10 | 1.18 | 0.86 | 0.78 | 0.56 |
| 10 | 3.12 | 2.03 | 0.97 | 0.64 | 0.53 | 0.35 |
| 11 | 2.46 | 1.46 | 0.67 | 0.40 | 0.53 | 0.31 |
| 12 | 2.59 | 1.41 | 0.65 | 0.36 | 0.53 | 0.29 |
| 13 | 2.76 | 1.39 | 0.43 | 0.22 | 0.67 | 0.33 |
| 14 | 3.24 | 1.51 | 0.00 | 0.00 | 0.69 | 0.32 |
| 15 | 3.52 | 1.54 | 0.00 | 0.00 | 0.73 | 0.32 |
| 16 | 3.76 | 1.54 | 0.00 | 0.00 | 0.65 | 0.27 |
| 17 | 3.84 | 1.48 | 0.00 | 0.00 | 0.58 | 0.22 |
| 18 | 3.50 | 1.28 | 0.00 | 0.00 | 0.53 | 0.19 |
| 19 | 3.13 | 1.08 | 0.00 | 0.00 | 0.28 | 0.10 |
| 20 | 2.71 | 0.89 | 0.00 | 0.00 | 0.19 | 0.06 |
| 21 | 2.33 | 0.73 | 0.00 | 0.00 | 0.16 | 0.05 |
| 22 | 2.01 | 0.60 | 0.00 | 0.00 | 0.14 | 0.04 |

TABLE 71 (Continued)

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670†11†18

SAMPLE NO. 12

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 1.74 | 0.50 | 0.00 | 0.00 | 0.13 | 0.04 |
| 24 | 1.52 | 0.42 | 0.00 | 0.00 | 0.10 | 0.03 |
| 25 | 1.39 | 0.36 | 0.00 | 0.00 | 0.06 | 0.02 |
| 26 | 1.20 | 0.30 | 0.00 | 0.00 | 0.05 | 0.01 |
| 27 | 1.16 | 0.28 | 0.00 | 0.00 | 0.00 | 0.00 |
| 28 | 0.84 | 0.20 | 0.00 | 0.00 | 0.06 | 0.01 |
| 29 | 0.68 | 0.15 | 0.00 | 0.00 | 0.06 | 0.01 |
| 30 | 0.65 | 0.14 | 0.00 | 0.00 | 0.08 | 0.02 |
| 31 | 0.61 | 0.13 | 0.00 | 0.00 | 0.06 | 0.01 |
| 32 | 0.47 | 0.10 | 0.00 | 0.00 | 0.06 | 0.01 |
| 33 | 0.46 | 0.09 | 0.00 | 0.00 | 0.06 | 0.01 |
| 34 | 0.46 | 0.09 | 0.00 | 0.00 | 0.06 | 0.01 |
| 35 | 0.51 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.44 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.34 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.26 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.24 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.18 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 72

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co2(CO)8/ZR/SIO2
SAMPLE NO: 8670+11+18+14

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 241.4 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 19.2 | P, PSIG : | 310 | CO/H2: | 2.00 |
| TIME ON STREAM, HRS : | 91.0 | SV, L/G/HR: | 2.00 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.55 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 30.13 | MOL SYNGAS/KG CAT/HR: | 26.918 |
| %CO CONV. : | 16.08 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 58.26 | MOL CO/MOL METAL/MIN: | 0.192 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 5.19 | H2O: | 5.28 |
| OXYGENATES : | 0.02 | CO : | 87.23 |
| CO2 : | 0.74 | H2 : | 1.55 |

HYDROCARRON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 6.74 | C4+ENE : | 3.97 |
| C2+ANE : | 1.21 | C5+C11 : | 26.89 |
| C2+ENE : | 0.00 | C12+C18: | 25.02 |
| C3+ANE : | 0.87 | C19+C23: | 15.07 |
| C3+ENE : | 4.10 | C24+34 : | 12.31 |
| C4 ISO+ANE: | 1.44 | C35+ : | 2.37 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 26.89 |
| DIESEL (C9+C25) : | 52.06 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 94.19 |
| HYDROGEN: | 79.74 |
| OXYGEN : | 92.74 |

TABLE 73

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670†11†18

SAMPLE NO. 14

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 6.74 | 36.35 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 1.21 | 3.49 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 0.87 | 1.71 | 4.10 | 8.43 | 0.00 | 0.00 |
| 4 | 1.44 | 2.14 | 3.97 | 6.11 | 0.00 | 0.00 |
| 5 | 2.05 | 2.45 | 4.59 | 5.66 | 0.07 | 0.09 |
| 6 | 4.76 | 4.77 | 0.21 | 0.22 | 0.00 | 0.00 |
| 7 | 2.46 | 2.12 | 1.23 | 1.08 | 0.21 | 0.18 |
| 8 | 1.98 | 1.50 | 0.91 | 0.70 | 0.28 | 0.21 |
| 9 | 1.91 | 1.29 | 0.74 | 0.50 | 0.18 | 0.12 |
| 10 | 1.85 | 1.12 | 0.75 | 0.46 | 0.26 | 0.16 |
| 11 | 1.48 | 0.82 | 0.49 | 0.28 | 0.48 | 0.27 |
| 12 | 1.73 | 0.88 | 0.60 | 0.31 | 0.45 | 0.23 |
| 13 | 1.96 | 0.92 | 0.45 | 0.21 | 0.59 | 0.28 |
| 14 | 2.57 | 1.12 | 0.00 | 0.00 | 0.67 | 0.29 |
| 15 | 2.82 | 1.15 | 0.00 | 0.00 | 0.73 | 0.30 |
| 16 | 3.17 | 1.21 | 0.00 | 0.00 | 0.77 | 0.29 |
| 17 | 3.49 | 1.25 | 0.00 | 0.00 | 0.83 | 0.30 |
| 18 | 3.42 | 1.16 | 0.00 | 0.00 | 0.77 | 0.26 |
| 19 | 3.33 | 1.07 | 0.00 | 0.00 | 0.39 | 0.13 |
| 20 | 3.05 | 0.93 | 0.00 | 0.00 | 0.35 | 0.10 |
| 21 | 2.73 | 0.80 | 0.00 | 0.00 | 0.27 | 0.08 |
| 22 | 2.42 | 0.67 | 0.00 | 0.00 | 0.22 | 0.06 |

TABLE 73 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670†11†18

SAMPLE NO. 14

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 2.13 | 0.57 | 0.00 | 0.00 | 0.19 | 0.05 |
| 24 | 1.87 | 0.48 | 0.00 | 0.00 | 0.15 | 0.04 |
| 25 | 1.69 | 0.42 | 0.00 | 0.00 | 0.12 | 0.03 |
| 26 | 1.46 | 0.34 | 0.00 | 0.00 | 0.07 | 0.02 |
| 27 | 1.24 | 0.28 | 0.00 | 0.00 | 0.05 | 0.01 |
| 28 | 1.06 | 0.23 | 0.00 | 0.00 | 0.07 | 0.01 |
| 29 | 0.89 | 0.19 | 0.00 | 0.00 | 0.05 | 0.01 |
| 30 | 0.82 | 0.17 | 0.00 | 0.00 | 0.06 | 0.01 |
| 31 | 0.76 | 0.15 | 0.00 | 0.00 | 0.05 | 0.01 |
| 32 | 0.63 | 0.12 | 0.00 | 0.00 | 0.02 | 0.00 |
| 33 | 0.60 | 0.11 | 0.00 | 0.00 | 0.03 | 0.01 |
| 34 | 0.58 | 0.10 | 0.00 | 0.00 | 0.03 | 0.01 |
| 35 | 0.57 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.55 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.44 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.34 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.28 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.19 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 74

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co2(CO)8/ZR/SIO2
SAMPLE NO: 8670+11+18+18

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 240.8 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 19.2 | P, PSIG : | 310 | CO/H2: | 2.00 |
| TIME ON STREAM, HRS : | 188.0 | SV, L/G/HR: | 1.00 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.42 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 34.84 | MOL SYNGAS/KG CAT/HR: | 15.556 |
| %CO CONV. : | 15.36 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 73.85 | MOL CO/MOL METAL/MIN: | 0.092 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 7.93 | H2O: | 10.58 |
| OXYGENATES : | 0.13 | CO : | 78.78 |
| CO2 : | 1.72 | H2 : | 0.87 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 5.70 | C4+ENE : | 3.49 |
| C2+ANE : | 1.19 | C5+C11 : | 29.83 |
| C2+ENE : | 0.21 | C12+C18: | 22.49 |
| C3+ANE : | 0.70 | C19+C23: | 14.90 |
| C3+ENE : | 3.80 | C24+34 : | 14.13 |
| C4 ISO+ANE: | 1.15 | C35+ : | 2.41 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 29.83 |
| DIESEL (C9+C25) : | 52.91 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 102.74 |
| HYDROGEN: | 99.53 |
| OXYGEN : | 104.76 |

TABLE 75

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8862†1†31

SAMPLE NO. 18

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 5.70 | 32.87 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 1.19 | 3.67 | 0.21 | 0.68 | 0.00 | 0.00 |
| 3 | 0.70 | 1.48 | 3.80 | 8.33 | 0.00 | 0.00 |
| 4 | 1.11 | 1.76 | 3.49 | 5.75 | 0.04 | 0.06 |
| 5 | 1.58 | 2.03 | 3.80 | 5.01 | 0.07 | 0.09 |
| 6 | 4.90 | 5.25 | 0.21 | 0.23 | 0.00 | 0.00 |
| 7 | 2.45 | 2.26 | 1.45 | 1.37 | 0.24 | 0.22 |
| 8 | 2.33 | 1.88 | 1.13 | 0.93 | 0.42 | 0.34 |
| 9 | 2.16 | 1.56 | 1.33 | 0.97 | 0.60 | 0.43 |
| 10 | 2.15 | 1.40 | 1.29 | 0.85 | 0.77 | 0.50 |
| 11 | 1.62 | 0.96 | 0.71 | 0.42 | 0.60 | 0.36 |
| 12 | 1.70 | 0.92 | 0.62 | 0.34 | 0.42 | 0.23 |
| 13 | 1.82 | 0.91 | 0.54 | 0.27 | 0.45 | 0.23 |
| 14 | 1.99 | 0.93 | 0.44 | 0.21 | 0.48 | 0.22 |
| 15 | 2.55 | 1.11 | 0.00 | 0.00 | 0.49 | 0.21 |
| 16 | 2.85 | 1.16 | 0.00 | 0.00 | 0.45 | 0.18 |
| 17 | 3.25 | 1.25 | 0.00 | 0.00 | 0.45 | 0.17 |
| 18 | 3.42 | 1.24 | 0.00 | 0.00 | 0.57 | 0.21 |
| 19 | 3.48 | 1.20 | 0.00 | 0.00 | 0.15 | 0.05 |
| 20 | 3.30 | 1.08 | 0.00 | 0.00 | 0.15 | 0.05 |
| 21 | 2.70 | 0.84 | 0.00 | 0.00 | 0.21 | 0.07 |
| 22 | 2.41 | 0.72 | 0.00 | 0.00 | 0.16 | 0.05 |

TABLE 75 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8862†1†31

SAMPLE NO. 18

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 2.18 | 0.62 | 0.00 | 0.00 | 0.16 | 0.04 |
| 24 | 2.14 | 0.58 | 0.00 | 0.00 | 0.10 | 0.03 |
| 25 | 1.96 | 0.51 | 0.00 | 0.00 | 0.09 | 0.02 |
| 26 | 1.68 | 0.42 | 0.00 | 0.00 | 0.08 | 0.02 |
| 27 | 1.47 | 0.36 | 0.00 | 0.00 | 0.06 | 0.02 |
| 28 | 1.27 | 0.30 | 0.00 | 0.00 | 0.07 | 0.02 |
| 29 | 1.08 | 0.24 | 0.00 | 0.00 | 0.06 | 0.01 |
| 30 | 0.95 | 0.21 | 0.00 | 0.00 | 0.06 | 0.01 |
| 31 | 0.86 | 0.18 | 0.00 | 0.00 | 0.06 | 0.01 |
| 32 | 0.73 | 0.15 | 0.00 | 0.00 | 0.03 | 0.01 |
| 33 | 0.66 | 0.13 | 0.00 | 0.00 | 0.03 | 0.01 |
| 34 | 0.64 | 0.12 | 0.00 | 0.00 | 0.03 | 0.01 |
| 35 | 0.62 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.53 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.42 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.34 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.29 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.22 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 76

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : $Co_2(CO)_8/ZrSiO_2$
SAMPLE NO: 8670+11+18+21

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 237.5 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 19.2 | P, PSIG : | 313 | CO/H2: | 1.5 |
| TIME ON STREAM, HRS : | 211.0 | SV, L/G/HR: | 1.00 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.31 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 31.16 | MOL SYNGAS/KG CAT/HR: | 13.905 |
| %CO CONV. : | 12.37 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 59.35 | MOL CO/MOL METAL/MIN: | 0.066 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 9.92 | H20: | 9.99 |
| OXYGENATES : | 0.23 | CO : | 76.96 |
| CO2 : | 1.21 | H2 : | 1.70 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 7.00 | C4+ENE : | 3.17 |
| C2+ANE : | 1.44 | C5+C11 : | 26.17 |
| C2+ENE : | 0.17 | C12+C18: | 20.56 |
| C3+ANE : | 0.98 | C19+C23: | 14.80 |
| C3+ENE : | 3.80 | C24+34 : | 16.70 |
| C4 ISO+ANE: | 1.43 | C35+ : | 3.78 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 26.17 |
| DIESEL (C9+C25) : | 49.22 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 110.98 |
| HYDROGEN: | 105.51 |
| OXYGEN : | 107.23 |

## TABLE 77

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670411418

SAMPLE NO. 21

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 7.00 | 38.28 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 1.44 | 4.20 | 0.17 | 0.54 | 0.00 | 0.00 |
| 3 | 0.98 | 1.96 | 3.80 | 7.92 | 0.00 | 0.00 |
| 4 | 1.40 | 2.12 | 3.17 | 4.95 | 0.03 | 0.05 |
| 5 | 1.65 | 2.01 | 3.00 | 3.75 | 0.15 | 0.18 |
| 6 | 4.66 | 4.75 | 0.16 | 0.16 | 0.00 | 0.00 |
| 7 | 2.70 | 2.36 | 0.99 | 0.88 | 0.16 | 0.14 |
| 8 | 2.12 | 1.63 | 0.86 | 0.67 | 0.46 | 0.35 |
| 9 | 2.04 | 1.39 | 0.88 | 0.61 | 0.64 | 0.43 |
| 10 | 2.15 | 1.33 | 0.77 | 0.48 | 0.57 | 0.35 |
| 11 | 1.40 | 0.78 | 0.37 | 0.21 | 0.44 | 0.25 |
| 12 | 1.53 | 0.79 | 0.31 | 0.16 | 0.42 | 0.22 |
| 13 | 1.96 | 0.93 | 0.00 | 0.00 | 0.47 | 0.22 |
| 14 | 2.11 | 0.94 | 0.00 | 0.00 | 0.48 | 0.21 |
| 15 | 2.31 | 0.95 | 0.00 | 0.00 | 0.47 | 0.19 |
| 16 | 2.59 | 1.00 | 0.00 | 0.00 | 0.49 | 0.19 |
| 17 | 3.02 | 1.10 | 0.00 | 0.00 | 0.51 | 0.19 |
| 18 | 3.49 | 1.20 | 0.00 | 0.00 | 0.40 | 0.14 |
| 19 | 3.29 | 1.07 | 0.00 | 0.00 | 0.20 | 0.07 |
| 20 | 2.87 | 0.89 | 0.00 | 0.00 | 0.23 | 0.07 |
| 21 | 2.72 | 0.80 | 0.00 | 0.00 | 0.22 | 0.06 |
| 22 | 2.53 | 0.71 | 0.00 | 0.00 | 0.20 | 0.06 |

TABLE 77 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670-11-18

SAMPLE NO. 21

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 2.34 | 0.63 | 0.00 | 0.00 | 0.19 | 0.05 |
| 24 | 2.16 | 0.56 | 0.00 | 0.00 | 0.16 | 0.04 |
| 25 | 2.15 | 0.54 | 0.00 | 0.00 | 0.12 | 0.03 |
| 26 | 1.91 | 0.46 | 0.00 | 0.00 | 0.10 | 0.03 |
| 27 | 1.68 | 0.39 | 0.00 | 0.00 | 0.09 | 0.02 |
| 28 | 1.45 | 0.32 | 0.00 | 0.00 | 0.09 | 0.02 |
| 29 | 1.26 | 0.27 | 0.00 | 0.00 | 0.07 | 0.02 |
| 30 | 1.13 | 0.23 | 0.00 | 0.00 | 0.06 | 0.01 |
| 31 | 1.10 | 0.22 | 0.00 | 0.00 | 0.05 | 0.01 |
| 32 | 1.07 | 0.21 | 0.00 | 0.00 | 0.02 | 0.00 |
| 33 | 1.03 | 0.19 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 0.98 | 0.18 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.90 | 0.16 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.80 | 0.14 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.67 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.56 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.48 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.37 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 78

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co2(CO)8/ZR/SIO2
SAMPLE No: 8670+11+18+24

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 239.0 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 19.2 | P, PSIG : | 310 | CO/H2: | 1.00 |
| TIME ON STREAM, HRS : | 235.0 | SV, L/G/HR: | 1.00 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.28 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 36.77 | MOL SYNGAS/KG CAT/HR: | 16.408 |
| %CO CONV. : | 16.27 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 57.36 | MOL CO/MOL METAL/MIN: | 0.073 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 12.97 | H2O: | 14.25 |
| OXYGENATES : | 0.22 | CO : | 68.17 |
| CO2 : | 1.92 | H2 : | 2.47 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 7.80 | C4+ENE : | 2.80 |
| C2+ANE : | 1.61 | C5+C11 : | 31.04 |
| C2+ENE : | 0.13 | C12+C18: | 21.53 |
| C3+ANE : | 1.26 | C19+C23: | 12.83 |
| C3+ENE : | 3.51 | C24+34 : | 13.47 |
| C4 ISO+ANE: | 1.76 | C35+ : | 2.25 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 31.04 |
| DIESEL (C9+C25) : | 50.59 |

% ELEMENTAL RECOVERY: CARBON : 116.75
HYDROGEN: 106.33
OXYGEN : 114.14

TABLE 79

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670†11†18

SAMPLE NO. 24

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 7.80 | 39.88 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 1.61 | 4.40 | 0.13 | 0.38 | 0.00 | 0.00 |
| 3 | 1.26 | 2.35 | 3.51 | 6.84 | 0.00 | 0.00 |
| 4 | 1.72 | 2.42 | 2.80 | 4.09 | 0.04 | 0.06 |
| 5 | 1.77 | 2.01 | 2.48 | 2.90 | 0.15 | 0.17 |
| 6 | 5.33 | 5.07 | 0.23 | 0.22 | 0.00 | 0.00 |
| 7 | 3.15 | 2.58 | 1.10 | 0.92 | 0.22 | 0.18 |
| 8 | 2.78 | 2.00 | 0.94 | 0.69 | 0.49 | 0.35 |
| 9 | 2.91 | 1.86 | 1.06 | 0.69 | 0.70 | 0.45 |
| 10 | 3.01 | 1.73 | 0.88 | 0.51 | 0.78 | 0.45 |
| 11 | 2.00 | 1.05 | 0.44 | 0.23 | 0.61 | 0.32 |
| 12 | 2.05 | 0.99 | 0.32 | 0.16 | 0.62 | 0.30 |
| 13 | 2.35 | 1.04 | 0.00 | 0.00 | 0.59 | 0.26 |
| 14 | 2.40 | 0.99 | 0.00 | 0.00 | 0.55 | 0.23 |
| 15 | 2.52 | 0.97 | 0.00 | 0.00 | 0.50 | 0.19 |
| 16 | 2.65 | 0.96 | 0.00 | 0.00 | 0.48 | 0.17 |
| 17 | 2.89 | 0.98 | 0.00 | 0.00 | 0.48 | 0.16 |
| 18 | 2.71 | 0.87 | 0.00 | 0.00 | 0.42 | 0.14 |
| 19 | 2.67 | 0.82 | 0.00 | 0.00 | 0.20 | 0.06 |
| 20 | 2.56 | 0.74 | 0.00 | 0.00 | 0.20 | 0.06 |
| 21 | 2.40 | 0.66 | 0.00 | 0.00 | 0.18 | 0.05 |
| 22 | 2.23 | 0.59 | 0.00 | 0.00 | 0.17 | 0.05 |

TABLE 79 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670*11*18

SAMPLE NO. 24

| CARBON NO. | N*ALKANES WT % | N*ALKANES MOLE % | 1*ALKENE WT % | 1*ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 2.06 | 0.52 | 0.00 | 0.00 | 0.16 | 0.04 |
| 24 | 1.89 | 0.46 | 0.00 | 0.00 | 0.13 | 0.03 |
| 25 | 1.72 | 0.40 | 0.00 | 0.00 | 0.11 | 0.02 |
| 26 | 1.60 | 0.36 | 0.00 | 0.00 | 0.07 | 0.02 |
| 27 | 1.39 | 0.30 | 0.00 | 0.00 | 0.06 | 0.01 |
| 28 | 1.20 | 0.25 | 0.00 | 0.00 | 0.06 | 0.01 |
| 29 | 1.04 | 0.21 | 0.00 | 0.00 | 0.04 | 0.01 |
| 30 | 0.93 | 0.18 | 0.00 | 0.00 | 0.03 | 0.01 |
| 31 | 0.83 | 0.16 | 0.00 | 0.00 | 0.03 | 0.01 |
| 32 | 0.85 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 0.79 | 0.14 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 0.71 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.63 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.52 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.40 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.31 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.24 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.16 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 80

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : $Co_2(CO)_8/ZrO_2/SiO_2$
SAMPLE NO: 8670+11+18+26

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS | 450.0 | T, C | 262.4 | FEED RATIO, CO/H2: | 1.0 |
| CATALYST LOADING, WT% | 19.2 | P, PSIG | 310 | | |
| TIME ON STREAM, HRS | 331.0 | SV, L/G/HR | 1.00 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 | 0.39 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2 | 41.54 | MOL SYNGAS/KG CAT/HR | 18.536 |
| %CO CONV. | 23.14 | SPECIFIC ACTIVITY, | |
| %H2 CONV. | 60.01 | MOL CO/MOL METAL/MIN | 0.104 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS | 19.56 | H2O | 13.80 |
| OXYGENATES | 0.21 | CO | 58.51 |
| CO2 | 5.76 | H2 | 2.16 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 | 7.65 | C4+ENE | 2.18 |
| C2+ANE | 1.77 | C5+C11 | 42.57 |
| C2+ENE | 0.11 | C12+C18 | 31.93 |
| C3+ANE | 1.21 | C19+C23 | 5.28 |
| C3+ENE | 2.49 | C24+34 | 2.75 |
| C4 ISO+ANE | 1.61 | C35+ | 0.45 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11) | 42.57 |
| DIESEL (C9+C25) | 61.83 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON | 132.26 |
| HYDROGEN | 127.05 |
| OXYGEN | 114.85 |

## TABLE 81

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670†11†18

SAMPLE NO. 26

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 7.65 | 37.96 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 1.77 | 4.68 | 0.11 | 0.31 | 0.00 | 0.00 |
| 3 | 1.21 | 2.19 | 2.49 | 4.71 | 0.00 | 0.00 |
| 4 | 1.58 | 2.16 | 2.18 | 3.09 | 0.04 | 0.05 |
| 5 | 2.10 | 2.42 | 2.32 | 2.63 | 0.19 | 0.21 |
| 6 | 4.58 | 4.23 | 0.46 | 0.44 | 0.00 | 0.00 |
| 7 | 2.64 | 2.09 | 0.73 | 0.59 | 0.59 | 0.47 |
| 8 | 3.08 | 2.15 | 1.00 | 0.71 | 1.03 | 0.72 |
| 9 | 4.75 | 2.94 | 1.39 | 0.87 | 1.96 | 1.22 |
| 10 | 4.98 | 2.78 | 1.20 | 0.68 | 2.01 | 1.13 |
| 11 | 4.48 | 2.28 | 0.93 | 0.48 | 2.06 | 1.05 |
| 12 | 4.13 | 1.93 | 0.75 | 0.36 | 1.84 | 0.86 |
| 13 | 4.31 | 1.86 | 0.00 | 0.00 | 1.62 | 0.70 |
| 14 | 3.79 | 1.52 | 0.00 | 0.00 | 1.36 | 0.55 |
| 15 | 3.32 | 1.24 | 0.00 | 0.00 | 1.17 | 0.44 |
| 16 | 2.88 | 1.01 | 0.00 | 0.00 | 1.00 | 0.35 |
| 17 | 2.43 | 0.81 | 0.00 | 0.00 | 0.81 | 0.27 |
| 18 | 1.93 | 0.60 | 0.00 | 0.00 | 0.59 | 0.19 |
| 19 | 1.48 | 0.44 | 0.00 | 0.00 | 0.31 | 0.09 |
| 20 | 1.09 | 0.31 | 0.00 | 0.00 | 0.20 | 0.06 |
| 21 | 0.80 | 0.22 | 0.00 | 0.00 | 0.13 | 0.04 |
| 22 | 0.62 | 0.16 | 0.00 | 0.00 | 0.09 | 0.02 |

TABLE 81 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670+11+18

SAMPLE NO. 26

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 0.49 | 0.12 | 0.00 | 0.00 | 0.06 | 0.01 |
| 24 | 0.41 | 0.10 | 0.00 | 0.00 | 0.05 | 0.01 |
| 25 | 0.36 | 0.08 | 0.00 | 0.00 | 0.04 | 0.01 |
| 26 | 0.31 | 0.07 | 0.00 | 0.00 | 0.03 | 0.01 |
| 27 | 0.27 | 0.06 | 0.00 | 0.00 | 0.03 | 0.01 |
| 28 | 0.23 | 0.05 | 0.00 | 0.00 | 0.02 | 0.00 |
| 29 | 0.20 | 0.04 | 0.00 | 0.00 | 0.02 | 0.00 |
| 30 | 0.18 | 0.03 | 0.00 | 0.00 | 0.02 | 0.00 |
| 31 | 0.16 | 0.03 | 0.00 | 0.00 | 0.01 | 0.00 |
| 32 | 0.14 | 0.02 | 0.00 | 0.00 | 0.01 | 0.00 |
| 33 | 0.12 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 0.12 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.11 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.10 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.08 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.07 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.05 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.04 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 82

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co2(CO)8/ZR/SIO2
SAMPLE NO: 8670+11+18+30

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 261.0 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 19.2 | P, PSIG : | 310 | CO/H2: | 1.50 |
| TIME ON STREAM, HRS : | 355.0 | SV, L/G/HR: | 1.00 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.43 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 42.89 | MOL SYNGAS/KG CAT/HR: | 19.139 |
| %CO CONV. : | 21.45 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 75.06 | MOL CO/MOL METAL/MIN: | 0.115 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 9.77 | H20: | 13.18 |
| OXYGENATES : | 0.11 | CO : | 70.55 |
| CO2 : | 5.33 | H2 : | 1.07 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 11.02 | C4+ENE : | 3.49 |
| C2+ANE : | 2.25 | C5+C11 : | 37.46 |
| C2+ENE : | 0.23 | C12+C18: | 23.26 |
| C3+ANE : | 1.27 | C19+C23: | 7.99 |
| C3+ENE : | 3.93 | C24+34 : | 6.47 |
| C4 ISO+ANE: | 1.70 | C35+ : | 0.93 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 37.46 |
| DIESEL (C9+C25) : | 48.80 |

% ELEMENTAL RECOVERY: CARBON : 103.68
HYDROGEN: 97.02
OXYGEN : 109.01

TABLE 83

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670†11†18

SAMPLE NO. 30

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 11.02 | 45.76 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 2.25 | 4.98 | 0.23 | 0.53 | 0.00 | 0.00 |
| 3 | 1.27 | 1.91 | 3.93 | 6.22 | 0.00 | 0.00 |
| 4 | 1.67 | 1.91 | 3.49 | 4.14 | 0.04 | 0.04 |
| 5 | 2.30 | 2.12 | 3.57 | 3.39 | 0.21 | 0.19 |
| 6 | 5.72 | 4.41 | 0.33 | 0.26 | 0.00 | 0.00 |
| 7 | 3.26 | 2.17 | 1.32 | 0.89 | 0.38 | 0.26 |
| 8 | 3.09 | 1.80 | 1.19 | 0.71 | 0.50 | 0.29 |
| 9 | 3.27 | 1.70 | 1.34 | 0.70 | 0.88 | 0.46 |
| 10 | 3.36 | 1.57 | 1.17 | 0.55 | 1.24 | 0.58 |
| 11 | 2.61 | 1.11 | 0.73 | 0.31 | 0.99 | 0.42 |
| 12 | 2.57 | 1.00 | 0.60 | 0.24 | 0.72 | 0.28 |
| 13 | 3.01 | 1.09 | 0.00 | 0.00 | 0.76 | 0.27 |
| 14 | 2.82 | 0.95 | 0.00 | 0.00 | 0.76 | 0.26 |
| 15 | 2.63 | 0.82 | 0.00 | 0.00 | 0.74 | 0.23 |
| 16 | 2.47 | 0.73 | 0.00 | 0.00 | 0.65 | 0.19 |
| 17 | 2.32 | 0.64 | 0.00 | 0.00 | 0.63 | 0.17 |
| 18 | 2.03 | 0.53 | 0.00 | 0.00 | 0.54 | 0.14 |
| 19 | 1.82 | 0.45 | 0.00 | 0.00 | 0.24 | 0.06 |
| 20 | 1.60 | 0.38 | 0.00 | 0.00 | 0.20 | 0.05 |
| 21 | 1.39 | 0.31 | 0.00 | 0.00 | 0.18 | 0.04 |
| 22 | 1.22 | 0.26 | 0.00 | 0.00 | 0.15 | 0.03 |

TABLE 83 (Continued)

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670+11+18

SAMPLE NO. 30

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 1.06 | 0.22 | 0.00 | 0.00 | 0.13 | 0.03 |
| 24 | 0.94 | 0.18 | 0.00 | 0.00 | 0.11 | 0.02 |
| 25 | 0.83 | 0.16 | 0.00 | 0.00 | 0.10 | 0.02 |
| 26 | 0.73 | 0.13 | 0.00 | 0.00 | 0.08 | 0.01 |
| 27 | 0.64 | 0.11 | 0.00 | 0.00 | 0.07 | 0.01 |
| 28 | 0.56 | 0.09 | 0.00 | 0.00 | 0.05 | 0.01 |
| 29 | 0.4[illegible] | 0.08 | 0.00 | 0.00 | 0.04 | 0.01 |
| 30 | 0.42 | 0.07 | 0.00 | 0.00 | 0.04 | 0.01 |
| 31 | 0.37 | 0.06 | 0.00 | 0.00 | 0.02 | 0.00 |
| 32 | 0.35 | 0.05 | 0.00 | 0.00 | 0.01 | 0.00 |
| 33 | 0.34 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 0.30 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.26 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.21 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.17 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.13 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.10 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.06 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 8A

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co2(CO)8/ZR/SIO2
SAMPLE No: 8670+11+18+33

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 260.0 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 19.2 | P, PSIG : | 310 | CO/H2: | 1.5( |
| TIME ON STREAM, HRS : | 378.0 | SV, L/G/HR: | 2.00 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.15 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 25.01 | MOL SYNGAS/KG CAT/HR: | 22.324 |
| %CO CONV. : | 5.46 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 54.33 | MOL CO/MOL METAL/MIN: | 0.059 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 8.76 | H2O: | 10.40 |
| OXYGENATES : | 0.16 | CO : | 76.67 |
| CO2 : | 2.23 | H2 : | 1.76 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 12.45 | C4+ENE : | 4.23 |
| C2+ANE : | 2.79 | C5+C11 : | 33.33 |
| C2+ENE : | 0.00 | C12+C18: | 22.50 |
| C3+ANE : | 1.63 | C19+C23: | 8.98 |
| C3+ENE : | 4.63 | C24+34 : | 6.65 |
| C4 ISO+ANE: | 2.31 | C35+ : | 0.50 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 33.33 |
| DIESEL (C9+C25) : | 44.65 |

| | | |
|---|---|---|
| % ELEMENTAL RECOVERY: | CARBON : | 117.55 |
| | HYDROGEN: | 113.78 |
| | OXYGEN : | 118.14 |

## TABLE 85

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670+11+18

SAMPLE NO. 33

| CARBON NO. | N+ALKANES WT % | N+ALKANES MOLE % | 1+ALKENE WT % | 1+ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 12.45 | 47.68 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 2.79 | 5.70 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 1.63 | 2.27 | 4.63 | 6.76 | 0.00 | 0.00 |
| 4 | 2.24 | 2.37 | 4.23 | 4.62 | 0.06 | 0.07 |
| 5 | 3.01 | 2.56 | 4.56 | 3.99 | 0.30 | 0.25 |
| 6 | 6.05 | 4.31 | 0.38 | 0.28 | 0.00 | 0.00 |
| 7 | 2.92 | 1.79 | 1.15 | 0.72 | 0.39 | 0.24 |
| 8 | 2.25 | 1.21 | 0.89 | 0.49 | 0.41 | 0.22 |
| 9 | 2.36 | 1.13 | 0.88 | 0.43 | 0.53 | 0.25 |
| 10 | 2.28 | 0.98 | 0.91 | 0.40 | 0.72 | 0.31 |
| 11 | 1.99 | 0.78 | 0.56 | 0.22 | 0.82 | 0.32 |
| 12 | 2.01 | 0.73 | 0.52 | 0.19 | 0.66 | 0.24 |
| 13 | 2.49 | 0.83 | 0.00 | 0.00 | 0.69 | 0.23 |
| 14 | 2.50 | 0.77 | 0.00 | 0.00 | 0.71 | 0.22 |
| 15 | 2.53 | 0.73 | 0.00 | 0.00 | 0.75 | 0.22 |
| 16 | 2.57 | 0.70 | 0.00 | 0.00 | 0.80 | 0.22 |
| 17 | 2.51 | 0.64 | 0.00 | 0.00 | 0.82 | 0.21 |
| 18 | 2.24 | 0.54 | 0.00 | 0.00 | 0.70 | 0.17 |
| 19 | 2.03 | 0.46 | 0.00 | 0.00 | 0.37 | 0.08 |
| 20 | 1.77 | 0.38 | 0.00 | 0.00 | 0.29 | 0.06 |
| 21 | 1.52 | 0.31 | 0.00 | 0.00 | 0.23 | 0.05 |
| 22 | 1.30 | 0.26 | 0.00 | 0.00 | 0.18 | 0.04 |

TABLE 85 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670†11†18

SAMPLE NO. 33

| CARBON NO. | n-ALKANES WT % | n-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 1.13 | 0.21 | 0.00 | 0.00 | 0.15 | 0.03 |
| 24 | 1.00 | 0.18 | 0.00 | 0.00 | 0.13 | 0.02 |
| 25 | 0.90 | 0.16 | 0.00 | 0.00 | 0.11 | 0.02 |
| 26 | 0.78 | 0.13 | 0.00 | 0.00 | 0.10 | 0.02 |
| 27 | 0.68 | 0.11 | 0.00 | 0.00 | 0.08 | 0.01 |
| 28 | 0.60 | 0.09 | 0.00 | 0.00 | 0.07 | 0.01 |
| 29 | 0.52 | 0.08 | 0.00 | 0.00 | 0.06 | 0.01 |
| 30 | 0.45 | 0.06 | 0.00 | 0.00 | 0.05 | 0.01 |
| 31 | 0.37 | 0.05 | 0.00 | 0.00 | 0.04 | 0.01 |
| 32 | 0.29 | 0.04 | 0.00 | 0.00 | 0.02 | 0.00 |
| 33 | 0.22 | 0.03 | 0.00 | 0.00 | 0.01 | 0.00 |
| 34 | 0.16 | 0.02 | 0.00 | 0.00 | 0.01 | 0.00 |
| 35 | 0.14 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.13 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.09 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.06 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.05 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 86

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : $Co_2(CO)_8/ZrO_2/SiO_2$
SAMPLE NO: 8670↑11↑18↑36

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 262.0 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 19.2 | P, PSIG : | 315 | CO/H2: | 2.00 |
| TIME ON STREAM, HRS : | 402.0 | SV, L/G/HR: | 2.00 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.67 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 36.76 | MOL SYNGAS/KG CAT/HR: | 32.503 |
| %CO CONV. : | 22.06 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 66.16 | MOL CO/MOL METAL/MIN: | 0.261 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 7.04 | H2O: | 10.29 |
| OXYGENATES : | 0.09 | CO : | 79.54 |
| CO2 : | 1.80 | H2 : | 1.23 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 9.39 | C4↑ENE : | 3.65 |
| C2↑ANE : | 1.93 | C5↑C11 : | 32.96 |
| C2↑ENE : | 0.29 | C12↑C18: | 26.21 |
| C3↑ANE : | 0.92 | C19↑C23: | 11.18 |
| C3↑ENE : | 3.97 | C24↑34 : | 7.60 |
| C4 ISO+ANE: | 1.33 | C35+ : | 0.57 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5↑C11): | 32.96 |
| DIESEL (C9↑C25) : | 53.25 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 92.66 |
| HYDROGEN: | 96.72 |
| OXYGEN : | 95.93 |

TABLE 87

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670+11+18

SAMPLE NO. 36

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 9.39 | 42.82 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 1.93 | 4.70 | 0.29 | 0.77 | 0.00 | 0.00 |
| 3 | 0.92 | 1.52 | 3.97 | 6.90 | 0.00 | 0.00 |
| 4 | 1.29 | 1.62 | 3.65 | 4.75 | 0.04 | 0.06 |
| 5 | 1.86 | 1.88 | 4.18 | 4.36 | 0.19 | 0.19 |
| 6 | 4.39 | 3.72 | 0.35 | 0.30 | 0.00 | 0.00 |
| 7 | 2.40 | 1.75 | 1.30 | 0.97 | 0.55 | 0.40 |
| 8 | 2.31 | 1.48 | 1.27 | 0.83 | 0.75 | 0.48 |
| 9 | 2.28 | 1.30 | 1.43 | 0.83 | 0.98 | 0.56 |
| 10 | 2.28 | 1.17 | 1.28 | 0.67 | 1.26 | 0.65 |
| 11 | 2.02 | 0.95 | 0.80 | 0.38 | 1.08 | 0.50 |
| 12 | 2.08 | 0.89 | 0.70 | 0.30 | 0.77 | 0.33 |
| 13 | 2.17 | 0.86 | 0.58 | 0.25 | 0.79 | 0.31 |
| 14 | 2.78 | 1.02 | 0.00 | 0.00 | 0.84 | 0.31 |
| 15 | 2.77 | 0.95 | 0.00 | 0.00 | 0.88 | 0.30 |
| 16 | 2.94 | 0.95 | 0.00 | 0.00 | 1.03 | 0.33 |
| 17 | 3.09 | 0.94 | 0.00 | 0.00 | 1.02 | 0.31 |
| 18 | 2.84 | 0.82 | 0.00 | 0.00 | 0.93 | 0.27 |
| 19 | 2.55 | 0.70 | 0.00 | 0.00 | 0.50 | 0.14 |
| 20 | 2.22 | 0.57 | 0.00 | 0.00 | 0.38 | 0.10 |
| 21 | 1.88 | 0.46 | 0.00 | 0.00 | 0.29 | 0.07 |
| 22 | 1.59 | 0.37 | 0.00 | 0.00 | 0.23 | 0.05 |

TABLE 87 (Continued)

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670†11†18

SAMPLE NO. 36

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 1.35 | 0.30 | 0.00 | 0.00 | 0.19 | 0.04 |
| 24 | 1.16 | 0.25 | 0.00 | 0.00 | 0.15 | 0.03 |
| 25 | 1.02 | 0.21 | 0.00 | 0.00 | 0.12 | 0.03 |
| 26 | 0.88 | 0.18 | 0.00 | 0.00 | 0.11 | 0.02 |
| 27 | 0.77 | 0.15 | 0.00 | 0.00 | 0.09 | 0.02 |
| 28 | 0.67 | 0.12 | 0.00 | 0.00 | 0.08 | 0.01 |
| 29 | 0.58 | 0.10 | 0.00 | 0.00 | 0.06 | 0.01 |
| 30 | 0.50 | 0.09 | 0.00 | 0.00 | 0.06 | 0.01 |
| 31 | 0.42 | 0.07 | 0.00 | 0.00 | 0.04 | 0.01 |
| 32 | 0.34 | 0.05 | 0.00 | 0.00 | 0.02 | 0.00 |
| 33 | 0.26 | 0.04 | 0.00 | 0.00 | 0.01 | 0.00 |
| 34 | 0.26 | 0.04 | 0.00 | 0.00 | 0.01 | 0.00 |
| 35 | 0.20 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.14 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.10 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.06 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.05 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 88

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co2(CO)8/ZR/SIO2
SAMPLE NO: 8670+11+18+39

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 262.0 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 19.2 | P, PSIG : | 315 | CO/H2: | 1.0 |
| TIME ON STREAM, HRS : | 426.0 | SV, L/G/HR: | 2.00 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.50 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 50.16 | MOL SYNGAS/KG CAT/HR: | 44.796 |
| %CO CONV. : | 33.41 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 66.91 | MOL CO/MOL METAL/MIN: | 0.299 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 13.83 | H2O: | 17.21 |
| OXYGENATES : | 0.35 | CO : | 62.83 |
| CO2 : | 3.56 | H2 : | 2.23 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 15.55 | C4+ENE : | 3.66 |
| C2+ANE : | 3.52 | C5+C11 : | 33.08 |
| C2+ENE : | 0.10 | C12+C18: | 20.93 |
| C3+ANE : | 2.88 | C19+C23: | 7.05 |
| C3+ENE : | 4.02 | C24+34 : | 5.09 |
| C4 ISO+ANE: | 3.62 | C35+ : | 0.51 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 33.08 |
| DIESEL (C9+C25) : | 42.43 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 97.75 |
| HYDROGEN: | 97.10 |
| OXYGEN : | 100.02 |

TABLE 89

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670+11+18

SAMPLE NO. 39

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 15.55 | 52.46 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 3.52 | 6.33 | 0.10 | 0.19 | 0.00 | 0.00 |
| 3 | 2.88 | 3.53 | 4.02 | 5.17 | 0.00 | 0.00 |
| 4 | 3.55 | 3.30 | 3.66 | 3.53 | 0.07 | 0.07 |
| 5 | 4.21 | 3.16 | 3.64 | 2.80 | 0.41 | 0.31 |
| 6 | 4.15 | 2.61 | 0.28 | 0.18 | 0.00 | 0.00 |
| 7 | 2.79 | 1.50 | 0.61 | 0.34 | 0.41 | 0.22 |
| 8 | 2.53 | 1.20 | 0.67 | 0.32 | 0.54 | 0.26 |
| 9 | 3.00 | 1.27 | 0.73 | 0.31 | 0.80 | 0.34 |
| 10 | 3.19 | 1.21 | 0.68 | 0.26 | 0.94 | 0.36 |
| 11 | 2.33 | 0.80 | 0.39 | 0.14 | 0.77 | 0.27 |
| 12 | 2.26 | 0.72 | 0.33 | 0.11 | 0.79 | 0.25 |
| 13 | 2.41 | 0.71 | 0.00 | 0.00 | 0.74 | 0.22 |
| 14 | 2.31 | 0.63 | 0.00 | 0.00 | 0.77 | 0.21 |
| 15 | 2.23 | 0.57 | 0.00 | 0.00 | 0.81 | 0.21 |
| 16 | 2.16 | 0.52 | 0.00 | 0.00 | 0.79 | 0.19 |
| 17 | 2.12 | 0.48 | 0.00 | 0.00 | 0.76 | 0.17 |
| 18 | 1.77 | 0.38 | 0.00 | 0.00 | 0.69 | 0.15 |
| 19 | 1.55 | 0.31 | 0.00 | 0.00 | 0.36 | 0.07 |
| 20 | 1.39 | 0.27 | 0.00 | 0.00 | 0.24 | 0.05 |
| 21 | 1.19 | 0.22 | 0.00 | 0.00 | 0.19 | 0.03 |
| 22 | 1.00 | 0.17 | 0.00 | 0.00 | 0.16 | 0.03 |

TABLE 89 (Continued)

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670†11†18

SAMPLE NO. 39

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 0.86 | 0.14 | 0.00 | 0.00 | 0.13 | 0.02 |
| 24 | 0.75 | 0.12 | 0.00 | 0.00 | 0.11 | 0.02 |
| 25 | 0.67 | 0.10 | 0.00 | 0.00 | 0.09 | 0.01 |
| 26 | 0.58 | 0.09 | 0.00 | 0.00 | 0.08 | 0.01 |
| 27 | 0.50 | 0.07 | 0.00 | 0.00 | 0.07 | 0.01 |
| 28 | 0.44 | 0.06 | 0.00 | 0.00 | 0.05 | 0.01 |
| 29 | 0.38 | 0.05 | 0.00 | 0.00 | 0.04 | 0.01 |
| 30 | 0.33 | 0.04 | 0.00 | 0.00 | 0.04 | 0.00 |
| 31 | 0.27 | 0.03 | 0.00 | 0.00 | 0.03 | 0.00 |
| 32 | 0.23 | 0.03 | 0.00 | 0.00 | 0.01 | 0.00 |
| 33 | 0.21 | 0.02 | 0.00 | 0.00 | 0.01 | 0.00 |
| 34 | 0.20 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.16 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.12 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.09 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.06 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 90

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : $Co_2(CO)_8/ZrO_2/SiO_2$
SAMPLE NO: 8670†11†18†42

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 281.0 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 19.2 | P, PSIG : | 312 | CO/H2: | 1.00 |
| TIME ON STREAM, HRS : | 498.0 | SV, L/G/HR: | 2.00 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.55 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 58.97 | MOL SYNGAS/KG CAT/HR: | 52.668 |
| %CO CONV. : | 41.85 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 76.10 | MOL CO/MOL METAL/MIN: | 0.375 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 17.47 | H2O: | 17.78 |
| OXYGENATES : | 0.24 | CO : | 53.46 |
| CO2 : | 9.47 | H2 : | 1.57 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 20.47 | C4†ENE : | 3.64 |
| C2†ANE : | 4.39 | C5†C11 : | 37.04 |
| C2†ENE : | 0.13 | C12†C18: | 16.96 |
| C3†ANE : | 3.97 | C19†C23: | 3.92 |
| C3†ENE : | 3.30 | C24†34 : | 2.11 |
| C4 ISO+ANE: | 3.86 | C35+ : | 0.22 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5†C11): | 37.04 |
| DIESEL (C9†C25) : | 34.20 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 101.52 |
| HYDROGEN: | 101.57 |
| OXYGEN : | 101.53 |

TABLE 91

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670↑11↑18

SAMPLE NO. 42

| CARBON NO. | N↑ALKANES WT % | N↑ALKANES MOLE % | 1↑ALKENE WT % | 1↑ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 20.47 | 57.96 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 4.39 | 6.62 | 0.13 | 0.21 | 0.00 | 0.00 |
| 3 | 3.97 | 4.09 | 3.30 | 3.56 | 0.00 | 0.00 |
| 4 | 3.83 | 2.99 | 3.64 | 2.94 | 0.03 | 0.02 |
| 5 | 4.37 | 2.75 | 3.35 | 2.17 | 0.53 | 0.33 |
| 6 | 5.69 | 3.00 | 1.07 | 0.58 | 0.00 | 0.00 |
| 7 | 3.53 | 1.60 | 0.60 | 0.28 | 0.81 | 0.37 |
| 8 | 2.42 | 0.96 | 0.55 | 0.22 | 1.47 | 0.58 |
| 9 | 2.60 | 0.92 | 0.42 | 0.15 | 1.64 | 0.58 |
| 10 | 2.72 | 0.87 | 0.00 | 0.00 | 1.70 | 0.54 |
| 11 | 1.76 | 0.51 | 0.00 | 0.00 | 1.80 | 0.52 |
| 12 | 1.84 | 0.49 | 0.00 | 0.00 | 1.40 | 0.37 |
| 13 | 1.71 | 0.42 | 0.00 | 0.00 | 1.30 | 0.32 |
| 14 | 1.50 | 0.34 | 0.00 | 0.00 | 1.08 | 0.25 |
| 15 | 1.30 | 0.28 | 0.00 | 0.00 | 0.98 | 0.21 |
| 16 | 1.14 | 0.23 | 0.00 | 0.00 | 0.89 | 0.18 |
| 17 | 1.15 | 0.22 | 0.00 | 0.00 | 0.85 | 0.16 |
| 18 | 1.08 | 0.19 | 0.00 | 0.00 | 0.72 | 0.13 |
| 19 | 0.91 | 0.15 | 0.00 | 0.00 | 0.43 | 0.07 |
| 20 | 0.70 | 0.11 | 0.00 | 0.00 | 0.26 | 0.04 |
| 21 | 0.53 | 0.08 | 0.00 | 0.00 | 0.13 | 0.02 |
| 22 | 0.43 | 0.06 | 0.00 | 0.00 | 0.10 | 0.01 |

TABLE 91 (Continued)

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670*11*18

SAMPLE NO. 42

| CARBON NO. | N*ALKANES WT % | N*ALKANES MOLE % | 1*ALKENE WT % | 1*ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 0.36 | 0.05 | 0.00 | 0.00 | 0.07 | 0.01 |
| 24 | 0.31 | 0.04 | 0.00 | 0.00 | 0.06 | 0.01 |
| 25 | 0.27 | 0.03 | 0.00 | 0.00 | 0.05 | 0.01 |
| 26 | 0.23 | 0.03 | 0.00 | 0.00 | 0.04 | 0.01 |
| 27 | 0.20 | 0.02 | 0.00 | 0.00 | 0.03 | 0.00 |
| 28 | 0.17 | 0.02 | 0.00 | 0.00 | 0.03 | 0.00 |
| 29 | 0.15 | 0.02 | 0.00 | 0.00 | 0.02 | 0.00 |
| 30 | 0.13 | 0.01 | 0.00 | 0.00 | 0.02 | 0.00 |
| 31 | 0.11 | 0.01 | 0.00 | 0.00 | 0.02 | 0.00 |
| 32 | 0.09 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| 33 | 0.07 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| 34 | 0.07 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.07 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE 92

### MASS BALANCE
### PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : $Co_2(CO)_8/ZR/SiO_2$
SAMPLE NO: 8670+11+18+45

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 282.0 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 19.2 | P, PSIG : | 316 | CO/H2: | 1.5 |
| TIME ON STREAM, HRS : | 523.0 | SV, L/G/HR: | 2.00 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.61 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 46.75 | MOL SYNGAS/KG CAT/HR: | 41.738 |
| %CO CONV. : | 29.51 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 72.61 | MOL CO/MOL METAL/MIN: | 0.317 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 11.75 | H2O: | 13.39 |
| OXYGENATES : | 0.16 | CO : | 67.29 |
| CO2 : | 6.16 | H2 : | 1.24 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 15.21 | C4+ENE : | 3.98 |
| C2+ANE : | 3.26 | C5+C11 : | 38.16 |
| C2+ENE : | 0.22 | C12+C18: | 20.38 |
| C3+ANE : | 2.21 | C19+C23: | 6.56 |
| C3+ENE : | 4.05 | C24+34 : | 3.21 |
| C4 ISO+ANE: | 2.43 | C35+ : | 0.34 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 38.16 |
| DIESEL (C9+C25) : | 41.24 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 98.64 |
| HYDROGEN: | 104.47 |
| OXYGEN : | 100.63 |

TABLE 93

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670†11†18

SAMPLE NO. 45

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 15.21 | 51.67 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 3.26 | 5.91 | 0.22 | 0.42 | 0.00 | 0.00 |
| 3 | 2.21 | 2.73 | 4.05 | 5.24 | 0.00 | 0.00 |
| 4 | 2.37 | 2.22 | 3.98 | 3.86 | 0.06 | 0.06 |
| 5 | 3.10 | 2.34 | 4.12 | 3.19 | 0.32 | 0.25 |
| 6 | 6.50 | 4.11 | 1.00 | 0.65 | 0.00 | 0.00 |
| 7 | 3.10 | 1.69 | 0.86 | 0.48 | 1.34 | 0.73 |
| 8 | 2.41 | 1.15 | 0.75 | 0.37 | 1.45 | 0.69 |
| 9 | 2.21 | 0.94 | 0.67 | 0.29 | 1.67 | 0.71 |
| 10 | 1.97 | 0.75 | 0.65 | 0.25 | 2.02 | 0.77 |
| 11 | 1.74 | 0.61 | 0.51 | 0.18 | 1.77 | 0.62 |
| 12 | 1.69 | 0.54 | 0.45 | 0.14 | 1.48 | 0.47 |
| 13 | 1.65 | 0.49 | 0.35 | 0.10 | 1.33 | 0.39 |
| 14 | 1.83 | 0.50 | 0.00 | 0.00 | 1.20 | 0.33 |
| 15 | 1.66 | 0.43 | 0.00 | 0.00 | 1.14 | 0.29 |
| 16 | 1.50 | 0.36 | 0.00 | 0.00 | 1.08 | 0.26 |
| 17 | 1.48 | 0.34 | 0.00 | 0.00 | 1.06 | 0.24 |
| 18 | 1.46 | 0.31 | 0.00 | 0.00 | 1.00 | 0.21 |
| 19 | 1.39 | 0.28 | 0.00 | 0.00 | 0.65 | 0.13 |
| 20 | 1.16 | 0.22 | 0.00 | 0.00 | 0.46 | 0.09 |
| 21 | 0.92 | 0.17 | 0.00 | 0.00 | 0.31 | 0.06 |
| 22 | 0.73 | 0.13 | 0.00 | 0.00 | 0.21 | 0.04 |

TABLE 93 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670-11-18

SAMPLE NO. 45

| CARBON NO. | N-ALKANES | | 1-ALKENE | | BRANCHED ISOMERS | |
|---|---|---|---|---|---|---|
| | WT % | MOLE % | WT % | MOLE % | WT % | MOLE % |
| 23 | 0.58 | 0.10 | 0.00 | 0.00 | 0.15 | 0.02 |
| 24 | 0.49 | 0.08 | 0.00 | 0.00 | 0.11 | 0.02 |
| 25 | 0.41 | 0.06 | 0.00 | 0.00 | 0.09 | 0.01 |
| 26 | 0.35 | 0.05 | 0.00 | 0.00 | 0.07 | 0.01 |
| 27 | 0.30 | 0.04 | 0.00 | 0.00 | 0.06 | 0.01 |
| 28 | 0.26 | 0.04 | 0.00 | 0.00 | 0.05 | 0.01 |
| 29 | 0.22 | 0.03 | 0.00 | 0.00 | 0.04 | 0.01 |
| 30 | 0.19 | 0.02 | 0.00 | 0.00 | 0.03 | 0.00 |
| 31 | 0.16 | 0.02 | 0.00 | 0.00 | 0.02 | 0.00 |
| 32 | 0.14 | 0.02 | 0.00 | 0.00 | 0.02 | 0.00 |
| 33 | 0.11 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| 34 | 0.09 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| 35 | 0.09 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.08 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.06 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 94

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : $Co_2(CO)_8/ZrO_2/SiO_2$
SAMPLE NO: 8670+11+18+48

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 280.0 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 19.2 | P, PSIG : | 315 | CO/H2: | 2.03 |
| TIME ON STREAM, HRS : | 570.0 | SV, L/G/HR: | 2.00 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.66 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 39.55 | MOL SYNGAS/KG CAT/HR: | 35.292 |
| %CO CONV. : | 23.51 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 72.11 | MOL CO/MOL METAL/MIN: | 0.282 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 7.93 | H20: | 10.15 |
| OXYGENATES : | 0.10 | CO : | 76.09 |
| CO2 : | 4.76 | H2 : | 0.98 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 15.88 | C4+ENE : | 4.46 |
| C2+ANE : | 3.26 | C5+C11 : | 37.52 |
| C2+ENE : | 0.36 | C12+C18: | 19.48 |
| C3+ANE : | 1.66 | C19+C23: | 7.01 |
| C3+ENE : | 5.05 | C24+34 : | 3.18 |
| C4 ISO+ANE: | 1.79 | C35+ : | 0.35 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 37.52 |
| DIESEL (C9+C25) : | 40.04 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 95.10 |
| HYDROGEN: | 98.94 |
| OXYGEN : | 98.52 |

TABLE 95

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670*11*18

SAMPLE NO. 48

| CARBON NO. | N*ALKANES WT % | N*ALKANES MOLE % | 1*ALKENE WT % | 1*ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 15.88 | 52.57 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 3.26 | 5.75 | 0.36 | 0.67 | 0.00 | 0.00 |
| 3 | 1.66 | 2.00 | 5.05 | 6.37 | 0.00 | 0.00 |
| 4 | 1.79 | 1.63 | 4.46 | 4.22 | 0.00 | 0.00 |
| 5 | 2.44 | 1.79 | 4.45 | 3.37 | 0.24 | 0.18 |
| 6 | 7.10 | 4.37 | 0.97 | 0.61 | 0.00 | 0.00 |
| 7 | 3.16 | 1.67 | 1.13 | 0.61 | 1.12 | 0.59 |
| 8 | 2.29 | 1.06 | 0.92 | 0.44 | 1.25 | 0.58 |
| 9 | 1.94 | 0.80 | 0.87 | 0.37 | 1.49 | 0.62 |
| 10 | 1.70 | 0.64 | 0.82 | 0.31 | 1.89 | 0.70 |
| 11 | 1.53 | 0.52 | 0.59 | 0.20 | 1.63 | 0.55 |
| 12 | 1.50 | 0.47 | 0.53 | 0.17 | 1.35 | 0.42 |
| 13 | 1.45 | 0.42 | 0.45 | 0.13 | 1.21 | 0.35 |
| 14 | 1.73 | 0.46 | 0.00 | 0.00 | 1.11 | 0.30 |
| 15 | 1.59 | 0.40 | 0.00 | 0.00 | 1.06 | 0.26 |
| 16 | 1.49 | 0.35 | 0.00 | 0.00 | 1.05 | 0.25 |
| 17 | 1.43 | 0.32 | 0.00 | 0.00 | 1.07 | 0.24 |
| 18 | 1.37 | 0.29 | 0.00 | 0.00 | 1.08 | 0.23 |
| 19 | 1.36 | 0.27 | 0.00 | 0.00 | 0.74 | 0.15 |
| 20 | 1.19 | 0.22 | 0.00 | 0.00 | 0.58 | 0.11 |
| 21 | 0.95 | 0.17 | 0.00 | 0.00 | 0.40 | 0.07 |
| 22 | 0.74 | 0.13 | 0.00 | 0.00 | 0.27 | 0.05 |

TABLE 95 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670+11+18

SAMPLE NO. 48

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 0.59 | 0.10 | 0.00 | 0.00 | 0.19 | 0.03 |
| 24 | 0.47 | 0.07 | 0.00 | 0.00 | 0.12 | 0.02 |
| 25 | 0.40 | 0.06 | 0.00 | 0.00 | 0.10 | 0.01 |
| 26 | 0.34 | 0.05 | 0.00 | 0.00 | 0.08 | 0.01 |
| 27 | 0.29 | 0.04 | 0.00 | 0.00 | 0.07 | 0.01 |
| 28 | 0.24 | 0.03 | 0.00 | 0.00 | 0.05 | 0.01 |
| 29 | 0.21 | 0.03 | 0.00 | 0.00 | 0.04 | 0.01 |
| 30 | 0.18 | 0.02 | 0.00 | 0.00 | 0.03 | 0.00 |
| 31 | 0.15 | 0.02 | 0.00 | 0.00 | 0.03 | 0.00 |
| 32 | 0.13 | 0.01 | 0.00 | 0.00 | 0.02 | 0.00 |
| 33 | 0.11 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| 34 | 0.10 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| 35 | 0.10 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.08 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.06 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 96

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co2(CO)8/ZR/SiO2
SAMPLE NO: 8670+11+18+51

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 278.0 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 19.2 | P, PSIG : | 310 | CO/H2: | 1.0 |
| TIME ON STREAM, HRS : | 596.0 | SV, L/G/HR: | 1.00 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.52 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 61.77 | MOL SYNGAS/KG CAT/HR: | 27.602 |
| %CO CONV. : | 42.07 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 81.47 | MOL CO/MOL METAL/MIN: | 0.188 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 17.24 | H2O: | 17.67 |
| OXYGENATES : | 0.22 | CO : | 48.67 |
| CO2 : | 15.09 | H2 : | 1.11 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 19.54 | C4+ENE : | 3.71 |
| C2+ANE : | 4.44 | C5+C11 : | 40.39 |
| C2+ENE : | 0.12 | C12+C18: | 16.60 |
| C3+ANE : | 3.88 | C19+C23: | 3.18 |
| C3+ENE : | 3.27 | C24+34 : | 1.11 |
| C4 ISO+ANE: | 3.65 | C35+ : | 0.11 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 40.39 |
| DIESEL (C9+C25) : | 34.54 |

% ELEMENTAL RECOVERY: CARBON : 109.12
HYDROGEN: 102.38
OXYGEN : 113.69

TABLE 97

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670*11*18

SAMPLE NO. 51

| CARBON NO. | N*ALKANES WT % | N*ALKANES MOLE % | 1*ALKENE WT % | 1*ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 19.54 | 56.28 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 4.44 | 6.83 | 0.12 | 0.20 | 0.00 | 0.00 |
| 3 | 3.88 | 4.06 | 3.27 | 3.59 | 0.00 | 0.00 |
| 4 | 3.58 | 2.84 | 3.71 | 3.05 | 0.07 | 0.06 |
| 5 | 4.01 | 2.57 | 3.47 | 2.28 | 0.46 | 0.30 |
| 6 | 7.17 | 3.84 | 0.85 | 0.47 | 0.00 | 0.00 |
| 7 | 4.24 | 1.96 | 0.56 | 0.26 | 0.59 | 0.27 |
| 8 | 2.77 | 1.12 | 0.53 | 0.22 | 1.40 | 0.57 |
| 9 | 2.99 | 1.08 | 0.40 | 0.15 | 1.79 | 0.64 |
| 10 | 3.11 | 1.01 | 0.00 | 0.00 | 2.01 | 0.65 |
| 11 | 1.90 | 0.56 | 0.39 | 0.12 | 1.75 | 0.52 |
| 12 | 1.74 | 0.47 | 0.33 | 0.09 | 1.62 | 0.44 |
| 13 | 1.57 | 0.39 | 0.25 | 0.06 | 1.43 | 0.36 |
| 14 | 1.53 | 0.36 | 0.00 | 0.00 | 1.24 | 0.29 |
| 15 | 1.24 | 0.27 | 0.00 | 0.00 | 1.07 | 0.23 |
| 16 | 0.97 | 0.20 | 0.00 | 0.00 | 0.87 | 0.18 |
| 17 | 0.22 | 0.04 | 0.00 | 0.00 | 1.30 | 0.25 |
| 18 | 0.70 | 0.13 | 0.00 | 0.00 | 0.54 | 0.10 |
| 19 | 0.64 | 0.11 | 0.00 | 0.00 | 0.36 | 0.06 |
| 20 | 0.54 | 0.09 | 0.00 | 0.00 | 0.27 | 0.04 |
| 21 | 0.42 | 0.07 | 0.00 | 0.00 | 0.19 | 0.03 |
| 22 | 0.32 | 0.05 | 0.00 | 0.00 | 0.13 | 0.02 |

TABLE 97 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670†11†18

SAMPLE NO. 51

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 0.23 | 0.03 | 0.00 | 0.00 | 0.08 | 0.01 |
| 24 | 0.18 | 0.02 | 0.00 | 0.00 | 0.05 | 0.01 |
| 25 | 0.15 | 0.02 | 0.00 | 0.00 | 0.04 | 0.00 |
| 26 | 0.12 | 0.01 | 0.00 | 0.00 | 0.03 | 0.00 |
| 27 | 0.10 | 0.01 | 0.00 | 0.00 | 0.02 | 0.00 |
| 28 | 0.08 | 0.01 | 0.00 | 0.00 | 0.02 | 0.00 |
| 29 | 0.07 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| 30 | 0.06 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| 31 | 0.05 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| 32 | 0.04 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| 33 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 98

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co2(CO)8/ZR/SIO2
SAMPLE NO: 8670+11+18+54

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS : | 450.0 | T, C : | 282.0 | FEED RATIO, | |
| CATALYST LOADING, WT%: | 19.2 | P, PSIG : | 310 | CO/H2: | 2.00 |
| TIME ON STREAM, HRS : | 667.0 | SV, L/G/HR: | 1.00 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 : | 0.59 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2: | 41.39 | MOL SYNGAS/KG CAT/HR: | 18.484 |
| %CO CONV. : | 23.11 | SPECIFIC ACTIVITY, | |
| %H2 CONV. : | 78.01 | MOL CO/MOL METAL/MIN: | 0.138 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 9.66 | H2O: | 10.39 |
| OXYGENATES : | 0.15 | CO : | 71.26 |
| CO2 : | 7.82 | H2 : | 0.73 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 : | 13.49 | C4+ENE : | 4.37 |
| C2+ANE : | 2.85 | C5+C11 : | 32.13 |
| C2+ENE : | 0.31 | C12+C18: | 23.93 |
| C3+ANE : | 1.57 | C19+C23: | 9.55 |
| C3+ENE : | 4.78 | C24+34 : | 5.01 |
| C4 ISO+ANE: | 1.55 | C35+ : | 0.46 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11): | 32.13 |
| DIESEL (C9+C25) : | 47.72 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 102.73 |
| HYDROGEN: | 106.17 |
| OXYGEN : | 105.17 |

TABLE 99

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670†11†18

SAMPLE NO. 54

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 13.49 | 50.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 2.85 | 5.64 | 0.31 | 0.66 | 0.00 | 0.00 |
| 3 | 1.57 | 2.12 | 4.78 | 6.75 | 0.00 | 0.00 |
| 4 | 1.55 | 1.59 | 4.37 | 4.63 | 0.00 | 0.00 |
| 5 | 2.18 | 1.79 | 4.60 | 3.90 | 0.20 | 0.16 |
| 6 | 5.06 | 3.49 | 0.56 | 0.39 | 0.00 | 0.00 |
| 7 | 2.49 | 1.47 | 0.69 | 0.42 | 0.62 | 0.36 |
| 8 | 1.92 | 1.00 | 0.63 | 0.33 | 0.83 | 0.43 |
| 9 | 1.84 | 0.85 | 0.72 | 0.34 | 1.29 | 0.60 |
| 10 | 1.71 | 0.71 | 0.82 | 0.35 | 1.90 | 0.79 |
| 11 | 1.68 | 0.64 | 0.66 | 0.25 | 1.77 | 0.67 |
| 12 | 1.64 | 0.57 | 0.61 | 0.21 | 1.36 | 0.48 |
| 13 | 1.67 | 0.54 | 0.52 | 0.17 | 1.24 | 0.40 |
| 14 | 1.70 | 0.51 | 0.42 | 0.13 | 1.15 | 0.34 |
| 15 | 2.12 | 0.59 | 0.00 | 0.00 | 1.16 | 0.33 |
| 16 | 2.17 | 0.57 | 0.00 | 0.00 | 1.28 | 0.34 |
| 17 | 2.17 | 0.54 | 0.00 | 0.00 | 1.46 | 0.36 |
| 18 | 1.80 | 0.42 | 0.00 | 0.00 | 1.48 | 0.35 |
| 19 | 1.72 | 0.38 | 0.00 | 0.00 | 0.79 | 0.18 |
| 20 | 1.60 | 0.34 | 0.00 | 0.00 | 0.67 | 0.14 |
| 21 | 1.38 | 0.28 | 0.00 | 0.00 | 0.54 | 0.11 |
| 22 | 1.15 | 0.22 | 0.00 | 0.00 | 0.42 | 0.08 |

TABLE 99 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670+11+18

SAMPLE NO. 54

| CARBON NO. | NORMAL ALKANES WT % | NORMAL ALKANES MOLE % | 1-ALKENE WT % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 0.94 | 0.17 | 0.00 | 0.00 | 0.32 | 0.06 |
| 24 | 0.77 | 0.13 | 0.00 | 0.00 | 0.25 | 0.04 |
| 25 | 0.66 | 0.11 | 0.00 | 0.00 | 0.19 | 0.03 |
| 26 | 0.53 | 0.09 | 0.00 | 0.00 | 0.15 | 0.02 |
| 27 | 0.45 | 0.07 | 0.00 | 0.00 | 0.12 | 0.02 |
| 28 | 0.37 | 0.06 | 0.00 | 0.00 | 0.10 | 0.01 |
| 29 | 0.31 | 0.05 | 0.00 | 0.00 | 0.08 | 0.01 |
| 30 | 0.26 | 0.04 | 0.00 | 0.00 | 0.06 | 0.01 |
| 31 | 0.21 | 0.03 | 0.00 | 0.00 | 0.04 | 0.01 |
| 32 | 0.17 | 0.02 | 0.00 | 0.00 | 0.03 | 0.00 |
| 33 | 0.13 | 0.02 | 0.00 | 0.00 | 0.02 | 0.00 |
| 34 | 0.10 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| 35 | 0.11 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.11 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.09 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.07 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.05 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 100

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : Co2(CO)8/ZR/SIO2
SAMPLE NO: 8670+11+18+57

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS | 450.0 | T, C | 260.0 | FEED RATIO, CO/H2: | 1.0 |
| CATALYST LOADING, WT% | 19.2 | P, PSIG | 308 | | |
| TIME ON STREAM, HRS | 690.0 | SV, L/G/HR | 2.00 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 | 0.48 | BULK ACTIVITY, MOL SYNGAS/KG CAT/HR | 33.381 |
| %OVERALL CONV., CO+H2 | 37.38 | | |
| %CO CONV. | 24.25 | SPECIFIC ACTIVITY, MOL CO/MOL METAL/MIN | 0.217 |
| %H2 CONV. | 50.51 | | |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS | 10.45 | H2O | 14.21 |
| OXYGENATES | 0.40 | CO | 70.04 |
| CO2 | 1.63 | H2 | 3.27 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 | 18.31 | C4+ENE | 4.31 |
| C2+ANE | 4.13 | C5+C11 | 37.24 |
| C2+ENE | 0.00 | C12+C18 | 17.68 |
| C3+ANE | 3.36 | C19+C23 | 5.01 |
| C3+ENE | 4.81 | C24+34 | 0.80 |
| C4 ISO+ANE | 4.29 | C35+ | 0.05 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5+C11) | 37.24 |
| DIESEL (C9+C25) | 34.30 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON | 99.12 |
| HYDROGEN | 101.80 |
| OXYGEN | 102.21 |

## TABLE 101

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670†11†18

SAMPLE NO. 57

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 18.31 | 54.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 4.13 | 6.51 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 3.36 | 3.61 | 4.81 | 5.41 | 0.00 | 0.00 |
| 4 | 4.17 | 3.39 | 4.31 | 3.64 | 0.12 | 0.10 |
| 5 | 4.98 | 3.26 | 4.15 | 2.80 | 0.48 | 0.32 |
| 6 | 7.30 | 4.01 | 0.39 | 0.22 | 0.00 | 0.00 |
| 7 | 3.72 | 1.76 | 0.79 | 0.38 | 0.43 | 0.20 |
| 8 | 2.68 | 1.11 | 0.66 | 0.28 | 0.47 | 0.20 |
| 9 | 2.70 | 1.00 | 0.59 | 0.22 | 0.66 | 0.24 |
| 10 | 2.81 | 0.93 | 0.51 | 0.17 | 0.64 | 0.21 |
| 11 | 2.26 | 0.68 | 0.10 | 0.03 | 0.92 | 0.28 |
| 12 | 2.17 | 0.60 | 0.31 | 0.09 | 0.71 | 0.20 |
| 13 | 2.23 | 0.57 | 0.00 | 0.00 | 0.69 | 0.18 |
| 14 | 1.99 | 0.47 | 0.00 | 0.00 | 0.65 | 0.16 |
| 15 | 1.76 | 0.39 | 0.00 | 0.00 | 0.63 | 0.14 |
| 16 | 1.57 | 0.33 | 0.00 | 0.00 | 0.67 | 0.14 |
| 17 | 1.45 | 0.29 | 0.00 | 0.00 | 0.78 | 0.15 |
| 18 | 1.26 | 0.23 | 0.00 | 0.00 | 0.80 | 0.15 |
| 19 | 1.07 | 0.19 | 0.00 | 0.00 | 0.69 | 0.12 |
| 20 | 0.83 | 0.14 | 0.00 | 0.00 | 0.53 | 0.09 |
| 21 | 0.59 | 0.09 | 0.00 | 0.00 | 0.33 | 0.05 |
| 22 | 0.39 | 0.06 | 0.00 | 0.00 | 0.20 | 0.03 |

TABLE 101 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670†11†18

SAMPLE NO. 57

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 0.25 | 0.04 | 0.00 | 0.00 | 0.12 | 0.02 |
| 24 | 0.16 | 0.02 | 0.00 | 0.00 | 0.07 | 0.01 |
| 25 | 0.13 | 0.02 | 0.00 | 0.00 | 0.04 | 0.01 |
| 26 | 0.08 | 0.01 | 0.00 | 0.00 | 0.03 | 0.00 |
| 27 | 0.06 | 0.01 | 0.00 | 0.00 | 0.02 | 0.00 |
| 28 | 0.04 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| 29 | 0.03 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| 30 | 0.03 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| 31 | 0.02 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| 32 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 102

MASS BALANCE
PROCESS CONDITIONS AND PRODUCT SUMMARY

CATALYST : $Co_2(CO)_8$/ZR/$SiO_2$
SAMPLE NO: 8670↑11↑18↑60

| | | | | | |
|---|---|---|---|---|---|
| REACTOR LOADING, MLS | 450.0 | T, C | 240.0 | FEED RATIO, | |
| CATALYST LOADING, WT% | 19.2 | P, PSIG | 312 | CO/H2: | 1.00 |
| TIME ON STREAM, HRS | 714.0 | SV, L/G/HR: | 2.00 | | |

| | | | |
|---|---|---|---|
| USAGE RATIO, CO/H2 | 0.44 | BULK ACTIVITY, | |
| %OVERALL CONV., CO+H2 | 20.58 | MOL SYNGAS/KG CAT/HR: | 18.381 |
| %CO CONV. | 12.65 | SPECIFIC ACTIVITY, | |
| %H2 CONV. | 28.51 | MOL CO/MOL METAL/MIN: | 0.113 |

WEIGHT % PRODUCT DISTRIBUTION:

| | | | |
|---|---|---|---|
| HYDROCARBONS: | 5.49 | H2O: | 7.54 |
| OXYGENATES : | 0.22 | CO : | 81.52 |
| CO2 : | 0.47 | H2 : | 4.76 |

HYDROCARBON SELECTIVITY, WT%:

| | | | |
|---|---|---|---|
| C1 | 17.94 | C4↑ENE | 5.74 |
| C2↑ANE | 4.06 | C5↑C11 | 38.17 |
| C2↑ENE | 0.00 | C12↑C18 | 12.85 |
| C3↑ANE | 3.12 | C19↑C23 | 6.21 |
| C3↑ENE | 6.58 | C24↑34 | 0.76 |
| C4 ISO+ANE | 4.54 | C35+ | 0.02 |

FUEL FRACTIONS, WT%:

| | |
|---|---|
| GASOLINE (C5↑C11): | 38.17 |
| DIESEL (C9↑C25) : | 28.58 |

% ELEMENTAL RECOVERY:

| | |
|---|---|
| CARBON : | 99.27 |
| HYDROGEN: | 98.76 |
| OXYGEN : | 100.73 |

TABLE 103

HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670+11+18

SAMPLE NO. 60

| CARBON NO. | N-ALKANES WT % | N-ALKANES MOLE % | 1-ALKENE W. % | 1-ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 1 | 17.94 | 51.90 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 4.06 | 6.27 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 3.12 | 3.28 | 6.58 | 7.25 | 0.00 | 0.00 |
| 4 | 4.39 | 3.50 | 5.74 | 4.75 | 0.15 | 0.12 |
| 5 | 4.90 | 3.15 | 5.48 | 3.62 | 0.30 | 0.19 |
| 6 | 8.61 | 4.63 | 0.27 | 0.15 | 0.00 | 0.00 |
| 7 | 3.96 | 1.84 | 1.27 | 0.60 | 0.30 | 0.14 |
| 8 | 2.70 | 1.10 | 0.96 | 0.39 | 0.38 | 0.15 |
| 9 | 2.35 | 0.85 | 0.87 | 0.32 | 0.46 | 0.17 |
| 10 | 2.23 | 0.73 | 0.68 | 0.23 | 0.28 | 0.09 |
| 11 | 1.52 | 0.45 | 0.40 | 0.12 | 0.27 | 0.08 |
| 12 | 1.39 | 0.38 | 0.32 | 0.09 | 0.23 | 0.06 |
| 13 | 1.28 | 0.32 | 0.22 | 0.06 | 0.22 | 0.06 |
| 14 | 1.40 | 0.33 | 0.00 | 0.00 | 0.23 | 0.05 |
| 15 | 1.36 | 0.30 | 0.00 | 0.00 | 0.29 | 0.06 |
| 16 | 1.36 | 0.28 | 0.00 | 0.00 | 0.43 | 0.09 |
| 17 | 1.34 | 0.27 | 0.00 | 0.00 | 0.63 | 0.12 |
| 18 | 1.32 | 0.24 | 0.00 | 0.00 | 0.79 | 0.14 |
| 19 | 1.22 | 0.21 | 0.00 | 0.00 | 0.78 | 0.14 |
| 20 | 1.01 | 0.17 | 0.00 | 0.00 | 0.70 | 0.11 |
| 21 | 0.74 | 0.12 | 0.00 | 0.00 | 0.52 | 0.08 |
| 22 | 0.47 | 0.07 | 0.00 | 0.00 | 0.31 | 0.05 |

TABLE 103 (Continued)

## HYDROCARBON PRODUCT DISTRIBUTION

RUN NO. 8670†11†18

SAMPLE NO. 60

| CARBON NO. | N†ALKANES WT % | N†ALKANES MOLE % | 1†ALKENE WT % | 1†ALKENE MOLE % | BRANCHED ISOMERS WT % | BRANCHED ISOMERS MOLE % |
|---|---|---|---|---|---|---|
| 23 | 0.30 | 0.04 | 0.00 | 0.00 | 0.16 | 0.02 |
| 24 | 0.19 | 0.03 | 0.00 | 0.00 | 0.09 | 0.01 |
| 25 | 0.13 | 0.02 | 0.00 | 0.00 | 0.05 | 0.01 |
| 26 | 0.08 | 0.01 | 0.00 | 0.00 | 0.03 | 0.00 |
| 27 | 0.05 | 0.01 | 0.00 | 0.00 | 0.02 | 0.00 |
| 28 | 0.03 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| 29 | 0.02 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| 30 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 31 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 32 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLE 104

EFFECT OF ALUMINA vs. SILICA SUPPORT ON HYDROCARBON SELECTIVITY OF $Co_2(CO)_8/Zr(OPr)_4$

| | Alumina | | Silica | |
|---|---|---|---|---|
| Run Number | 8523-1-4 | | 8670-11-18 | |
| Space Velocity, NL/g cat/hr | 2.0 | | 2.0 | |
| $CO/H_2$ | 1.0 | 1.5 | 1.0 | 1.5 |
| Pressure, psig | 300 | 300 | 300 | 300 |
| Temperature, $^oC$ | 240 | 260 | 240 | 260 |
| Wt% | | | | |
| $C_1$ | 7.9 | 7.2 | 8.1 | 5.7 |
| $C_{2-4}$ | 13.7 | 10.8 | 14.5 | 9.8 |
| $C_{5-11}$ | 37.0 | 34.1 | 37.4 | 31.0 |
| $C_{12-18}$ | 23.4 | 27.9 | 24.9 | 28.7 |
| $C_{19-23}$ | 8.9 | 8.6 | 8.2 | 12.8 |
| $C_{24+}$ | 9.1 | 11.4 | 6.9 | 12.0 |
| $C_{5-23}$ | 69.3 | 70.6 | 70.5 | 72.5 |

## TABLE 105

## KINETIC RATE EXPRESSIONS

$$-rCO + H_2 = K_1 C_{H_2}^{a} \; C_{CO}^{b}$$

$$-rCO + H_2 = \frac{K_1 C_{H_2} \; C_{CO}}{C_{CO} + K_2 \; C_{H_2O}}$$

$$-rCO + H_2 = \frac{K_1 C_{CO} \; C_{H_2}^{2}}{C_{H_2O} + K_2 \; C_{CO} \; C_{H_2}}$$

$$-rCO + H_2 = \frac{K_1 C_{H_2} \; C_{CO}}{C_{CO} + K_2 \; C_{CO_2}}$$

$$-rCO + H_2 = \frac{K_1 C_{H_2} \; C_{CO}}{C_{CO} + K_2 \; C_{CO_2} + K_3 \; C_{H_2O}}$$