Material Balance

Feed In (pet coke) = 2000 ton/day = 4,000,000 lbm

Oxygen IN ( 95 % O2)= 1965. 83 ton

Steam In = 954.48 ton

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Component** | **Weight Percent** | **lbm** | **lbm-moles** | **Column1** |
| **Carbon** | 83.3 | 3332000 | 277435.47 |  |
| **Hydrogen** | 4 | 160000 | 79207.92 | (H2) |
| **Nitrogen** | 1.49 | 59600 | 2128.57 | (N2) |
| **Sulfur** | 6.14 | 245600 | 7659.44 |  |
| **Oxygen** | 4.44 | 177600 | 5550 | (O2) |
| **V** | 325-2300 | 1300-9200 | 25.52- 180.6 |  |
| **Ni** | 165-580 | 660-2320 | 11.24- 39.52 |  |
| **F** | 11 | 44 | 2.2002 |  |
| **Cu** | 3.5 | 14 | 0.2203 |  |
| **Mg** | 2.4 | 9.6 | 0.3950 |  |
| **Se** | <2 | <8 | 0.1013 |  |
| **Be** | 1.5 | 6 | 0.6658 |  |
| **Pb** | 0.6 | 2.4 | 0.0116 |  |
| **As** | 0.3 | 1.2 | 0.0160 |  |
| **Cd** | 0.1 | 0.4 | 0.0036 |  |
| **Hg** | <0.1 | 0.04 | 0.0002 |  |

Composition of the syngas

|  |  |  |
| --- | --- | --- |
| Component | Volume percent |  |
| CO | 62.63 |  |
| H2 | 26.14 |  |
| CO2 | 2.17 |  |
| H2O | 3.22 |  |
| H2S | 0.77 |  |
| COS | 0.04 |  |
| N2 | 4.94 |  |
| Total | 99.7 |  |

Reference: (<http://www-static.shell.com/static/globalsolutions/downloads/innovation/knowledge_centre/coal_gasification_process_for_us_industry.pdf>)

Only 99.5 % Carbon conversion

0.5 % C unreacted

Carbon out with the ash = (3332000\* 0.005) =166600 lbm

= 13871.77 lbm-moles

* Total Moles of Carbon in Syngas = 0.6263+0.0217+0.0004= 0.6484 lbm
* Total moles of COS = (277435.47-13871.77)-253816.68-8794.22 = 952.8 lbm- moles
* Total moles of sulphur used in COS = 952.8 lbm-moles
* Total moles of H2S in syn gas = 7659.44 -952.8 = 6706.64 lbm-moles
* Moles of H2 produced = (0.2614)/(0.6263)\* 253816.68 =

|  |  |  |  |
| --- | --- | --- | --- |
| Component | Volume percent | lbm-moles | Weight (U.S. ton) |
| CO | 62.63 |  | 3554.70 |
| H2 | 26.14 | 105935.94 | 106.99 |
| CO2 | 2.17 |  | 193.52 |
| H2O | 3.22 | 79207.92 | 713.66 |
| H2S | 0.77 | 6706.64 | 114.30 |
| COS | 0.04 | 952.8 | 28.62 |
| N2 | 4.94 | 2128.57+ (N2 from air= 6466.56) | 120.35 |
| Total | 99.7 |  |  |

* Total amount of oxygen needed =79207.32 + (253816.68 – 105835.94) + (2\*8794.22)+ 952.8 =245729.30 lb-moles of O = 122864.65 lb-moles of O2 = 1965.83 ton
* Moles of water needed = 105935.94 lb-moles = 954. 48 ton
* Moles of N2 in with the oxygen =(0.05/0.95)\* 122864.65 = 6466.56 lb-moles = 90.53 ton