**Formic acid production plant (FAPP).**

*Figure 1.* Simulation of the FAPP.

**Table 1**

Main parameters for the FAPP simulation.

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **value** | | |
| **Base case** | **BGCC case** | **Study case** |
| CO2 flow (kg/h) | 729.526 | 4478.43 | 1492.81 |
| H2 flow (kg/h) | 40.604 | 249.26 | 83.08 |
| Triethylamine flow (kg/h) | 4233.43 | 32817.91 | 8660.95 |
| Methanol flow (kg/h) | 205.63 | 1262.82 | 420.94 |
| Water flow (kg/h) | 205.63 | 420.9408 | 151.512 |
| Compressors outlet pressure (bar) | 105 | 105 | 105 |
| Reactor conversion (%) | 42.91 | 42.91 | 42.91 |
| Valve V-1 outlet pressure (bar) | 70 | 70 | 70 |
| Flash operational conditions (bar/°C) | (100/50.16) | (100/50.16) | (100/50.16) |
| Valves V-2,3 outlet pressure (bar) | 1 | 1 | 1 |
| Pump P-1 outlet pressure (bar) | 105 | 105 | 105 |
| Heater H-1 outlet temperature °C | 50 | 50 | 50 |
| Heater H-2 outlet temperature °C | 50 | 50 | 50 |
| Compressor C-3 outlet pressure (bar) | 105 | 105 | 105 |
| Heater H-3 outlet temperature °C | 25 | 25 | 25 |
| Separator S-2 operational conditions (bar/°C) | 1/25 | 1/25 | 1/25 |
| Distillation tower DT-1 operational conditions (stages/r) | (20/1.1) | (25/1.1) | (20/1.1) |
| Distillation tower DT-2 operational conditions (stages/r) | (10/0.7) | (20/0.7) | (12/0.7) |

**Methanol production plant (MPP).**

*Figure 2.* Simulation of the MPP.

**Table 2**

Main parameters for the MPP simulation.

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **value** | | |
| **Base case** | **BGCC case** | **Study case** |
| CO2 flow (kg/h) | 17209.15 | 4478.88 | 1492.81 |
| H2 flow (kg/h) | 2658.87 | 616.26 | 205.72 |
| Reactor operational conditions (bar/°C) | 50/250 | 50/250 | 50/250 |
| CO2 compressors C-1 outlet pressure (bar) | 50 | 50 | 50 |
| H2 compressors C-2 outlet pressure (bar) | 45 | 45 | 45 |
| Heater H-1 outlet temperature °C | 225 | 225 | 225 |
| Heater H-2 outlet temperature °C | 250 | 250 | 250 |
| Cooler CO-1 outlet temperature °C | 93.9 | 93.3 | 93.3 |
| Cooler CO-2 outlet temperature °C | 31 | 31 | 31 |
| Flash S-1 operational conditions (bar/°C) | (45/30) | (45/30) | (45/30) |
| Stripper T-1 operational conditions (stages/r) | (4/0.659) | (4/0.659) | (2/0.659) |
| Valve V-1 outlet pressure (bar) | 5 | 5 | 5 |
| Distillation tower DT-1 operational conditions (stages/r) | (30/0.934) | (18/0.934) | (15/0.934) |

**Syngas production plant (SynPP) by hydrogenation.**

**

*Figure 3.* Simulation of the SynPP by CO2 hydrogenation.

**Table 3**

Main parameters for the SynPP by CO2 hydrogenation simulation.

|  |  |  |
| --- | --- | --- |
| **Parameter** | **value** | |
| **Base case** | **BGCC case** |
| CO2 flow (kmol/h) | 35.61 | 101.76 |
| H2 flow (kmol/h) | 160.82 | 349.57 |
| Heater H-1 outlet temperature °C | 530 | 530 |
| H2 flow to the stripper ST-1 (kmol/h) | 125.21 | 342.91 |
| Exchanger HE-1 outlet temperature °C | 361.7 | 361.7 |
| Exchanger HE-2 outlet temperature °C | 443.7 | 443.7 |
| Exchanger HE-3 outlet temperature °C | 515 | 515 |
| Reactor operational conditions (bar/°C) | 1/530 | 1/530 |
| Cooler CO-1 outlet temperature °C | 25 | 25 |
| Absorber A-1 stages | 12 | 15 |
| Stripper stages | 2 | 4 |
| W-IN stream flow (kmol/h) | 422.21 | 1206.52 |
| Pump P-1 outlet pressure (bar) | 7 | 7 |
| Separator S-2 operational conditions (bar/°C) | 7/31.12 | 7/31.12 |

**Syngas production plant (SynPP) by dry reforming of methane (DRM).**



*Figure 4.* Simulation of the SynPP by DRM.

**Table 4**

Main parameters for the SynPP by DRM.

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **value** | | |
| **Base case** | **BGCC case** | **Study Case** |
| CO2 flow (kmol/h) | 141.69 | 101.43 | 33.91 |
| CH4 flow (kmol/h) | 142.54 | 100.94 | 34.12 |
| Reactor RX operational conditions (bar/°C) | 1.97/873 | 1.97/873 | 1.97/873 |
| Heater H-1 outlet temperature °C | 873 | 873 | 873 |
| Cooler CO-1 outlet temperature °C | 25 | 25 | 25 |
| Flash S-1 operational conditions (bar/°C) | 1/25 | 1/25 | 1/25 |