**Tanks** *(not shown on the flowsheet)*

TK-801: Storage tank for benzene.

There are two tanks. One feeds Stream 1 and the other is in a filling mode.

Each tank is 450 m3.

TK-802: Storage tank for propylene.

There are two tanks. One feeds Stream 1 and the other is in a filling mode.

Each tank is 450 m3.

**Pumps** *(efficiency assumed to be independent of flowrate*)

P-801 A/B: Centrifugal, 75% efficient, driver rated at 25.796 kW. Benzene feed pump.

P-802 A/B: Centrifugal, 75% efficient , driver rated at 7.4359 kW. Propylene feed pump.

P-803 A/B: Centrifugal, 75% efficient , driver rated at 2.4000 kW.

P-804 A/B: Centrifugal, 75% efficient, driver rated at 0.3082 kW.

P-805 A/B: Centrifugal, 75% efficient, driver rated at 3.3000 kW.

**Heat Exchangers** *(all one pass on each side with negligible tube wall resistance unless otherwise*

*noted. hi refers to the tube side.)*

E-801: HPS in shell.

Q = 13,315.5 MJ/hr, A = 20.8m2 in two zones

Desubcooling zone: A = 13.5 m2, U = 600 W/m2 oC, hi = 667 W/m3 oC.

Vaporizing zone: A= 7.3 m2, U = 1500 W/m2 oC with equal resistance on both sides.

E-802: Condenser for flash unit V-802. Process stream in shell, 1-2 configuration.

Q = -13,443 MJ/hr, A = 533 m2.

E-803: Total condenser for T-801, condensing fluid (CW) in shell.

Qc = -5,702.58 MJ/hr, A = 151m2, U = 450 W/m2 oC and all resistance is on the water side.

E-804: Reboiler for T-801. Uses MPS.

Qr is 71,00 MJ/hr, A = 405 m2, U = 750 W/m2 oC approximately equal resistances.

E-805: Total condenser for T-802, condensing fluid (CW) in shell.

Qc = 5,295.1 MJ/hr, A = 24 m2, U = 750 W/m2 oC, approximately equal resistances.

E-806: Reboiler for T-802. HPS.

Qr is 5,520 MJ/hr, A = 64 m2, U = 750 W/m2 oC. Approximately equal resistances.

**Fired Heater**

H-801: Q = 3,960.97 MJ/hr of heat added to fluid

Capacity 10,000 MJ/hr, added to fluid

65% efficiency.

**Reactor**

R-801: Shell and tube packed bed reactor with kieselguhr-supported phosphoric acid

catalyst. Boiler feed water in shell produces HPS.

Reactor is 6 m long, diameter of 1.18 m volume = 6.56 m3.

Exchange area = 342 m2, 234 tubes, each 6 m long, 2.26 cm ID.

U = 65 W/m2 oC, all resistance on the reactor side.

Q = -10,165.9 MJ/hr.

Produces 93.45 kmol/hr of cumene and 2.79 kmol/hr of P-diisopropyl benzene by consuming benzene and propylene.

All reactions occur in the gas phase, and products are fully vaporized.

**Distillation Columns**

T-801: Removes the benzene impurity overhead for recycle.

MPS in the reboiler (E-804)

CW in the condenser (E-803), returned at maximum allowable temperature.

Reflux ratio = 0.3

13 trays, 100% efficient

24 in spacing, 3 in weirs

Diameter = 1.13 m, and 75% of the total area is active

Qr = 7,100 MJ/hr, Qc = -5,702.58 MJ/hr.

T-802: Removes the cumene product overhead.

HPS in the reboiler (E-806)

CW in the condenser (E-805), returned at the maximum allowable temperature.

Reflux ratio = 0.6.

18 trays, 100% efficient trays

24 in spacing, 3 in weirs.

Diameter = 1.26 M, 75% of the total area is active.

Qc = -5,295.1 MJ/hr, Qr = 5,520 MJ/hr.

**Vessels**

V-801: Benzene feed drum, horizontal.

Length = 4.2 m, diameter = 1.4 m, volume = 6.47 m3.

V-802: A flash drum, 90oC, vertical.

Height = 5.2 m, diameter = 1 m, volume = 4.08 m3.

V-803: T-801's reflux drum, horizontal.

Length = 4 m, diameter = 1.6 m, volume = 8.04 m3.

V-804: T-802's reflux drum, horizontal.

Length = 6.5 m, diameter = 1.6 m, volume = 13.07 m3.