

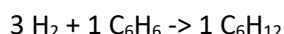
CH 4250: Process Engineering

Assignment 3

Name: _____ Roll No: _____

Develop a flowsheet in Aspen Plus to simulate the following process for the production of cyclohexane via benzene hydrogenation. **Calculate the size of all the equipment in the flowsheet.**

Fresh benzene and hydrogen feed streams are first fed through a heater to bring the streams up to the reactor feed temperature and pressure conditions. This feed is then sent to a fixed-bed catalytic reactor where the following reaction occurs:



The reactor effluent stream is then sent to a flash tank to separate the light and heavy components of the mixture. The vapor stream coming off the flash tank is recycled back to the feed mixture after a small purge stream is removed to prevent impurities from building up in the system. The majority of the liquid stream leaving the flash tank goes to a distillation column to purify the cyclohexane product, while a small portion of the liquid stream is recycled back to the feed mixture to minimize loss of benzene.

Operating specifications:

Feed Streams

Benzene Feed

Benzene mole fraction: 1
Total flow: 100 lbmol/hr
Temperature: 100 °F
Pressure: 15 psia

Hydrogen Feed

Hydrogen mole fraction: 0.900
Nitrogen mole fraction: 0.0abc (**last 3 digits of your roll number**)
Methane mole fraction: 0.1 – 0.0abc
Total flow: 310 lbmol/hr
Temperature: 120 °F
Pressure: 335 psia

Feed preheater

Outlet temperature: 300 °F

Outlet pressure: 330 psia

Reactor

Conversion: 99.8% of benzene

Outlet temperature: 400 °F

Pressure drop: 15 psi

Flash Tank

Temperature: 120 °F

Pressure drop: 5 psi

Distillation Column

Number of stage: 15

Feed stage: 8

Reflux ratio: 1.2

Cyclohexane recovery: 99.99 mole % in bottoms

Condenser Pressure: 200 psi

Purge

Rate: 8% of vapor stream from flash

Liquid Split

Rate: 70% of liquid stream from flash to distillation column

Deliverables (DUE DATE: 13 Feb 2022, 11:00pm)

1. Submit an Excel spreadsheet with the conditions and the size of each equipment.
2. Also submit the Aspen file.

The name of your files should be your Roll Number.