Ujian : Akhir Semester
Mata Kuliah : Komputasi Teknik Kimia
Kelas A/B : Kelas A/B
Semester : Genap 2015/2016
Prodi : Teknik Kimia

Dosen : A.S. Dwi Saptati, N., S.T., M.T.
Rama Oktavian S.T., M.Sc.

Tanggal : 20 Juni 2016
Waktu : 100 menit
Sifat : Buku tertutup

Type B

Procedure:
1. Work this case study using HYSYS
2. Submit your workbook together with your HYSYS file (.hsc format) to my e-mail (oktavian.rama2@gmail.com) and save your work in one folder with the name following this format: #NIM#Name#Class A/B#TypeA/B/C. Time for doing this simulation in this class is 100 minutes.
3. If you have any question regarding to this assignment, please don’t hesitate to ask me while you are working your cases.

GOOD LUCK AND GIVE YOUR BEST SHOT…MAY GOD BE WITH YOU…
Case Study type B

Total point for this case study is 80

Process Involving Reaction and Separation

Construct an Aspen HYSYS simulation to model the production of cyclohexane via benzene hydrogenation. The simplified flowsheet for this process is shown below. Fresh benzene and hydrogen feed streams are first fed through a heater to bring the streams up to reactor feed temperature and pressure conditions. This feed mixture is then sent to a fixed-bed catalytic reactor where 3 hydrogen molecules react with 1 benzene molecule to form cyclohexane. This simulation will use a conversion reactor block to model this reaction. 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 losses of benzene. Process operating specifications are listed on the following page.
### Feed Streams

<table>
<thead>
<tr>
<th>Benzene Feed (BZFEED)</th>
<th>Composition (mole fraction)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen</td>
<td>-</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>-</td>
</tr>
<tr>
<td>Methane</td>
<td>-</td>
</tr>
<tr>
<td>Benzene</td>
<td>1</td>
</tr>
<tr>
<td>Total Flow (lbmol/hr)</td>
<td>100</td>
</tr>
<tr>
<td>Temperature (°F)</td>
<td>100</td>
</tr>
<tr>
<td>Pressure (psia)</td>
<td>15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hydrogen Feed (H2FEED)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen</td>
<td>97.5</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>0.5</td>
</tr>
<tr>
<td>Methane</td>
<td>2.0</td>
</tr>
<tr>
<td>Benzene</td>
<td>-</td>
</tr>
<tr>
<td>Total Flow (lbmol/hr)</td>
<td>310</td>
</tr>
<tr>
<td>Temperature (°F)</td>
<td>120</td>
</tr>
<tr>
<td>Pressure (psia)</td>
<td>335</td>
</tr>
</tbody>
</table>

### Distillation Column

- Number of stages: 15
- Feed stage: 8
- Reflux Ratio: 1.2
- Cyclohexane recovery: 99.99 mole % in bottoms
- Condenser Pressure: 200 psia
- Reboiler Pressure: 210 psia

### Feed Preheater

- Outlet Temperature: 300 °F
- Outlet Pressure: 330 psia

### Reactor

- Stoichiometry: Benzene + 3H2 → Cyclohexane
- Conversion: 99.8% of benzene
- Outlet temperature: 400°F
- Pressure drop: 15 psi

### Flash Tank

- Temperature: 120°F
- Pressure drop: 5 psi

### Purge Stream

- Purge rate is 8% of vapor recycle stream

### Liquid Split

- 70% of liquid stream goes to distillation column
For the first Tee (TEE-100), Double click on the first Tee block (TEE-100). Go to the Parameters page and enter 0.08 for the Flow Ratio for stream PURGE.

For the second Tee (TEE-101), Double click the second Tee block (TEE-101), In the Parameters tab enter a Flow Ratio of 0.7 for stream ToColumn.