15.1.5.2. Problem-2: Multi-component Distillation

Problem Statement:

A continuous fractionating column having 17 stages with total condenser and reboiler is to be designed to separate 27522.2 kmol per hr. of a mixture of 28.19 % methanol, 46.26 % n-butane and 25.55 % i-butene on molar basis. A reflux ratio of 10 mol to 1 mol of product is to be used. The feed enters at bubble point at 1172 kPa and at 10th stage. Overhead product rate coming out of the column is 2043.0 kmol per hr. The pressure at condenser and reboiler are 1115 kPa and 1216 kPa respectively. Simulate the distillation column assuming no pressure drop across the reboiler and condenser to find:

- 1. Conditions of feed, distillate and bottom streams.
- 2. Properties of feed, distillate and bottom streams.
- 3. Composition of distillate and bottom products.
- 4. Temperature, liquid rate and vapor rate profile throughout the column.
- 5. Composition profiles of all the components throughout the column.
- 6. Heat duties required for the condenser and reboiler, temperature of condenser and reboiler.

Column Specifications:

| Total number of trays: | 17 |
|------------------------|------------------------------|
| Feed tray location: | 10 th tray |
| Feed flow rate: | 2752.2 kmol per hr |
| Distillate flow rate: | 2043.0 kmol per hr |
| Feed compositions: | |
| Methanol: | 0.2819 (mole fraction) |
| n-butane: | 0.4626 (mole fraction) |
| i-butene: | 0.2555 (mole fraction) |
| Feed condition: | Saturated liquid at 1172 kPa |

| Reflux ratio: | 10 |
|-----------------------------|----------|
| Reboiler Pressure: | 1216 kPa |
| Condenser Pressure: | 1115 kPa |
| Pressure drop in condenser: | 0 kPa |

Solution steps:

 Open the file as a new case; the following window named as Simulation Basis Manager will be displayed.

| 🕴 Simulation Basis Manager | | | | | | _ 🗆 X |
|----------------------------|-----------------|-------------|-----------|---------------------|--------------|-------|
| Component Lists | | ٦ | | | | 2 |
| Master Component List | <u>V</u> iew | | | | | |
| | Add | | | | | |
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| | Сору | | | | | |
| | | | | | | |
| | Import | | | | | |
| | E <u>x</u> port | | | | | |
| | <u>R</u> efresh | | | | | |
| Components Fluid Pkgs | Hypotheticals | Oil Manager | Reactions | Component Maps | UserProperty | |
| | | | | Enter Simulation En | vironment | |

2. Click the "add" button to select components and fluid package to be used for the simulation of column.

| 🕴 Component List View | | | | _ | |
|-----------------------|--------------------|--|---|---|--|
| Add Component | elected Components | Components Availa <u>Match</u> Sim Name <u>Methane</u> Propane Hutane n-Pentane n-Pentane n-Pentane n-Heptane n-Heptane n-Dec | able in the Component Library C Full Name / Synonym C1 C2 C3 i-C4 i-C5 n-C4 i-C5 C6 C7 C8 C9 C10 C11 C12 C12 C12 C12 C13 C12 C13 C12 C13 C13 C14 C15 C15 C15 C15 C15 C15 C15 C15 | C3H8 C4H10 C4H10 C5H12 C5H12 C5H12 C6H14 C7H16 C8H18 C9H20 C10H22 C10H22 C11H24 | |
| | | 🔽 Show Synonyr | ms 🗖 Cluster | | |
| Selected Component b | у Туре | | | | |
| Delete | Name Compo | nent List - 1 | | | |

3. Select the components and add them from the list by clicking "add pure" button. Here the components selected are methanol, i-butene and n-butane.

| 🕴 Component List View | | |
|---|---|---|
| Add Component Selected Components Traditional Methanol Electrolyte Hypothetical Other Other | <add pure<="" td=""> iB-Acetate iB-C iB-C4oate iB-iE iB-iE <-Substitute-> iB-iE iB-iE iB-iE iB-</add> | View Filters Full Name / Synonym C Formula 2-oate 2-oate C6H1202 3-oate C7H1402 4-oate C8H1602 24-oate C8H1602 1title C4H7N 25 C9H18 26 C10H20 ane C4H10 C5 C9H18 26 C10H20 anoic_Acid C4H802 C4H80 C4H80 |
| Selected Component by Type | | |
| Delete | ame Component List - 1 | |

4. Close the window and the Simulation Basis Manager window appears. Click on the Fluid Pkgs. The following window is displayed.

| | ⊻iew | | FlowSheet | Fluid Pkg To Use |
|------|--------|-----------------|-----------------|-------------------|
| | Add | | Case (Main) | <empty> =</empty> |
| | Delete | | | |
| | Сору | | | |
| | Import | | | |
| | Egport | , <u>D</u> e | fault Fluid Pkg | |
| | | | | · |

5. Click the "Add" button, and select the fluid package to be used for the simulation of column.

| Fluid Package: Basis-1 | | |
|--|---|--------------------------|
| Property Package Selection Amine Pkg Antoine ASME Steam Braun K10 Chao Seader Chien Null Esso Tabular Extended NRTL GCEOS General NRTL Component List Selection Component List - 1 | Property Package Filter All Types EOSs Activity Models Chao Seader Models Vapour Press Models Miscellaneous Types | Advanced Thermodynamics |
| Set Up Parameters Bi | view Nary Coeffs StabTest Phase asis-1 Property Pkg | Order Rxns Tabular Notes |

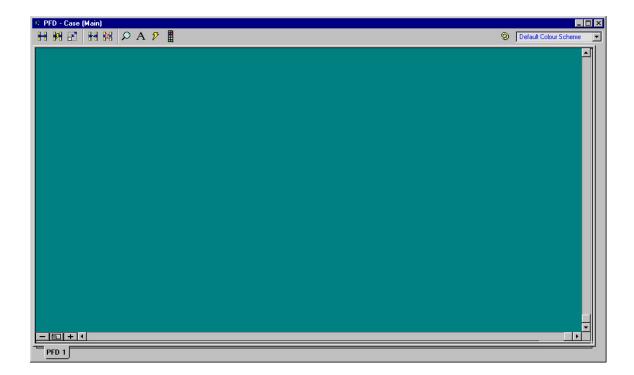
6. Select the required fluid package from the list (here we selected Peng Robinson fluid package as shown in the window below).

| Property Package Select | | EOS Enthalpy Method Specification |
|--------------------------|-----------------------------------|-----------------------------------|
| Margules | Property Package Filter | C Eguation of State |
| MBWR NBS Steam | All Types | C Lee-Kesle <u>r</u> |
| NRTL | C EOSs | Peng Robinson Options |
| OLI_Electrolyte | C Activity Models | |
| Peng Robinson | 📕 📋 🔿 Chao Seader Models | HYSYS |
| PRSV Sour PR | C Vapour Press Models | C Standard |
| Sour SRK | C Miscellaneous Types | |
| SRK | | 🔲 🔲 Use EOS Density |
| UNIQUAC | • | Smooth Liquid Density |
| | | Advanced Thermodynamics |
| Component List Selection | | Import |
| • | | COMThermo Regression |
| Component List - 1 | View | Export |
| · · · | | |
| Set Up Parameters | Binary Coeffs StabTest Phas | e Order Rxns Tabular Notes |
| Set up Parameters | J Binary Coerrs J Stablest J Phas | |
| Delete Name | Basis-1 Property Pkg | Peng Robinson Edit Properti |

7. Close the window and return to the Simulation Basis Manager window (shown below).

| Simulation Basis Manager | | | | | _ 🗆 × |
|-------------------------------------|-------------|-----------|--------------------------|--------------------|-------|
| Current Fluid Packages | | Flowshee | t - Fluid Pkg Asso | ociatio <u>n</u> s | |
| Basis-1 NC: 3 PP: Peng Robinson | ⊻iew | | FlowSheet | Fluid Pkg To Use | |
| | <u>A</u> dd | <u>р</u> | Case (Main) | Basis-1 - | |
| | Delete | | | | |
| | Сору | | | | |
| | Import | | | | |
| | Egport | , Def | ault Fluid Pkg | Basis-1 | |
| Components Fluid Pkgs Hypotheticals | Oil Manager | Reactions | Component Ma | aps UserProperty | |
| | | | Enter Si <u>m</u> ulatio | n Environment | |

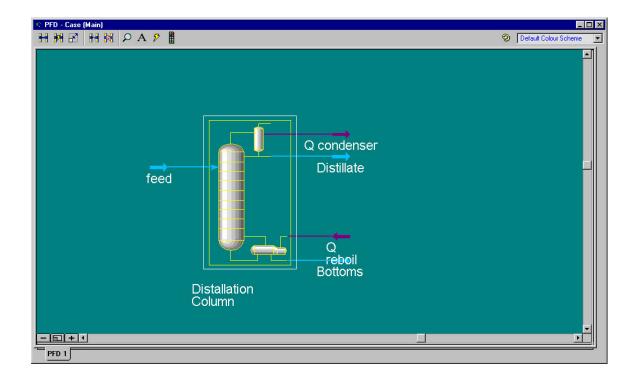
 Click the "Enter Simulation Environment" button. The following window is displayed.



9. Select the distillation column by double clicking it at the Case (main) window Give the name to different streams like feed, distallate, bottoms, Q_{condensor}, Q_{reboiler}. Enter the value of number of trays, feed tray location, etc. and then click "Next" button. Then window related to the pressure will be displayed. Enter the Condenser pressure, reboiler pressure and condenser pressure drop values and the click at the "Next" button. The window related to the temperature at condenser and reboiler will be displayed which is optional. Then again after clicking at "Next" button enter the value of reflux ratio and distillate flow rate. Then click at the "Done". The window showing the whole information about column that we added will be displayed as follows:

| | IDD - HYSYS 3.1 - [Column: Distallation Column / COL1 Fluid Pkg: Basis-1 / Peng Robi lation Flowsheet Loois Window Help | nson] [#] × |
|--|---|--|
| | E = x } | Environment: Case (Main) Mode: Steady State |
| Design Connections Monitor Specs Summary Subcooling Notes | Column Name Distallation Column Sub-Flowsheet Tag COL1 Congenser © Total © Partia Condenser Energy Stream G condenser | quid Outlet |
| Design Param | | Inverced |
| Optional Info : Conde | nser @CDL1 Unknown Duty | www.acd |

 Close the window; the next window will display the distillation column with Feed, Distillate and Bottom streams.



11. Close the Window and double click at the Feed to specify the various conditions of

| 🗃 🖬 🔞 | i 🖿 m [b 🖃 🗠 🌮 | 🐨 👁 👗 🕌 | | Enviro | onment: Case (Main) Mode: Steady State |
|----------------|--|-----------------|---------------------|--------|---|
| | | | | | Mode: Steady State |
| Worksheet | Stream Name | feed | | | |
| Conditions | Vapour / Phase Fraction | <empty></empty> | | | |
| | Temperature [C] | <empty></empty> | | | |
| roperties | Pressure [kPa] | <empty></empty> | | | |
| omposition | Molar Flow [kgmole/h] | <empty></empty> | | | |
| | Mass Flow [kg/h] | <empty></empty> | | | |
| Value | Std Ideal Liq Vol Flow [m3/h] | <empty></empty> | | | |
| ser Variables | Molar Enthalpy [kJ/kgmole] | <empty></empty> | | | |
| otes | Molar Entropy [kJ/kgmole-C] | <empty></empty> | | | |
| | Heat Flow [kJ/h] | <empty></empty> | | | |
| ost Parameters | Liq Vol Flow @Std Cond [m3/h] | <empty></empty> | | | |
| | Fluid Package | Basis-1 | | | |
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| Worksheet A | ttachments Dynamics | | | | |
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| | | U | nknown Compositions | | |
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| Delete | Define from Other Stream | | | | |
| | | | Completed. | | |
| | enser @COL1 Unknown Duty enser @COL1 Not Solved | | | | |

feed.

12. Select the Composition and add the known compositions for various components in the feed.

Here the molar composition of feed is:

Methanol: 0.2819 n-Butane: 0.4626 i-Butene: 0.2555

| loName - HYS'ı File Edit Simul | r 5 3.1 - [teed] Iation Fl <u>o</u> wsheet <u>T</u> ools <u>W</u> in | dow Help | | | |
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| | (<u>r</u> | Mole Fractions | | | |
| vorksheet | Methanol | 0.281900 | | | |
| ditions | n-Butane | 0.462600 | | | |
| perties | i-Butene | 0.255500 | | | |
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| position | | | | | |
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| | Print a Snapshot of the Activ | ve Window | | | |

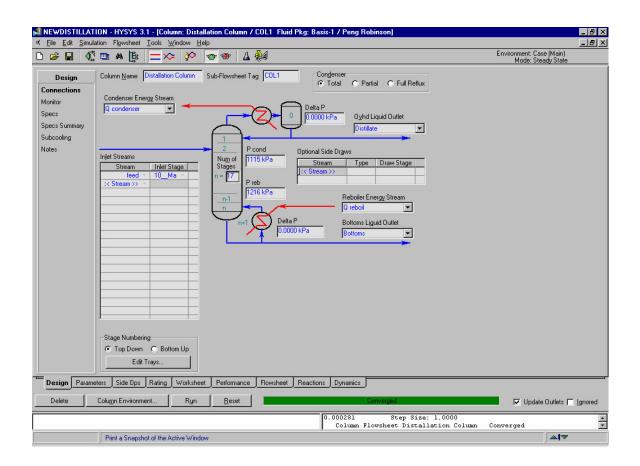
13. Select the Conditions and add the known properties of feed.

Here Feed properties are: Feed flow rate: 2752.2 kmol per hr Vapor/Phase Fraction: 0.0 (as feed is saturated liquid) Pressure: 12 atm With this information the HYSYS will automatically simulate for rest of the feed

properties.

| 🖻 🔒 🐧 | [;] ■ # [5 <mark>=</mark> ≫ ≫ | 👁 👁 🔺 🖗 | | | Environn M | nent: Case (Main) ode: Steady State |
|----------------|---|------------------|------------------|--------------|---------------|--|
| Worksheet | Stream Name | feed | Liquid Phase | Vapour Phase | | |
| onditions | Vapour / Phase Fraction | 0.00000 | 1.00000 | 0.00000 | | |
| | Temperature [C] | 93.055 | 93.055 | 93.055 | | |
| operties | Pressure [kPa] | 1215.9 2752.2 | 1215.9 2752.2 | 1215.9 | | |
| omposition | Molar Flow (kgmole/h) Mass Flow (kg/h) | 1.3832e+005 | 1.3832e+005 | 0.00000 | | |
| Value | Std Ideal Lig Vol Flow [m3/h] | 224.68 | 224.68 | 0.00000 | | |
| ser Variables | Molar Enthalpy [kJ/kgmole] | -1.344e+005 | -1.344e+005 | -9.911e+004 | | |
| | Molar Entropy [kJ/kgmole-C] | 96.610 | 96.610 | 150.79 | | |
| otes | Heat Flow [kJ/h] | -3.7001e+08 | -3.7001e+08 | 0.0000e-01 | | |
| ost Parameters | Lig Vol Flow @Std Cond [m3/h] | 219.09 | 219.09 | 0.00000 | | |
| | Fluid Package | Basis-1 | | | | |
| | | | | | | |
| Worksheet A | Ittachments Dynamics Define from Other Stream | | OK | | | ¢ |

14. Close the feed window; double click at the Distillation Column, all the specifications of distillation column will be displayed. At this stage also we can change the specifications if needed. Now click at the "Run" button to simulate the Distillation column.



Results:

1. **Condition of feed, distillates and bottoms:** Click on "work sheet" button, select "Conditions". This window will display the conditions of Feed, Distillate and Bottom products.

| Worksheet | Name | feed @COL1 | Distillate @COL | Bottoms @COL | |
|-----------------------|-------------------------------------|----------------|-----------------|-------------------|--|
| | Vapour | 0.0000 | 0.0000 | 0.0000 | |
| Conditions | Temperature [C] | 93.05 | 81.95 | 147.1 | |
| Properties | Pressure [kPa] | 1216 | 1115 | 1216 | |
| Compositions | Molar Flow [kgmole/h] | 2752 | 2043 | 709.1 | |
| | Mass Flow [kg/h] | 1.383e+005 | 1.156e+005 | 2.272e+004 | |
| PF Specs | Std Ideal Lig Vol Flow [m3/h] | 224.7 | 196.1 | 28.55 | |
| | Molar Enthalpy [kJ/kgmole] | -1.344e+005 | -1.041e+005 | -2.267e+005 | |
| | Molar Entropy [kJ/kgmole-C] | 96.61 | 101.6 | 58.70 | |
| | Heat Flow [kJ/h] | -3.700e+008 | -2.127e+008 | -1.607e+008 | |
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2. **Properties of feed, distillate and Bottoms:** Click on the "Properties", this window will display the properties of feed, distillate and bottom products.

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|---|------------------------------------|-----------------|-----------------|-------------------|---------------------------------|--------|-------------------------------|-----------------|
| Worksheet | Name | feed | Distillate | Bottoms | | | | |
| | Vapour Fraction | 0.00000 | 0.00000 | 0.00000 | | | | |
| onditions | Temperature [C] | 93.055 | 81.949 | 147.13 | | | | |
| roperties | Pressure [kPa] | 1215.9 | 1114.6 | 1215.9 | | | | |
| ompositions | Actual Vol. Flow [m3/h] | 262.23 | 229.20 | 35.725 | | | | |
| • | Mass Enthalpy [kJ/kg] | -2675.1 | -1840.1 | -7074.4 | | | | |
| F Specs | Mass Entropy [kJ/kg·C] | 1.9224 | 1.7958 | 1.8320 | | | | |
| | Molecular Weight | 50.256 | 56.578 | 32.042 | | | | |
| | Molar Density [kgmole/m3] | 10.495 | 8.9139 | 19.849 | | | | |
| | Mass Density [kg/m3] | 527.45 | 504.33 | 636.00 | | | | |
| | Liq Mass Density @Std Cond [kg/m3] | 631.32 | 594.04 | 796.39 | | | | |
| | Molar Heat Capacity [kJ/kgmole-C] | 160.86 | 169.45 | 145.62 | | | | |
| | Mass Heat Capacity [kJ/kg·C] | 3.2009 | 2.9949 | 4.5446 | | | | |
| | Thermal Conductivity [W/m-K] | 8.5556e-002 | 7.3559e-002 | 0.12321 | | | | |
| | Viscosity [cP] | 0.10983 | 9.7996e-002 | 0.13693 | | | | |
| | Surface Tension [dyne/cm] | 8.5906 | 6.0993 | 11.140 | | | | |
| | Specific Heat [kJ/kgmole-C] | 160.86 | 169.45 | 145.62 | | | | |
| | Z Factor | 3.8050e-002 | 4.2351e-002 | 1.7530e-002 | | | | |
| | Vap. Frac. (molar basis) | 0.00000 | 0.00000 | 0.00000 | | | | |
| | Vap. Frac. (mass basis) | 0.00000 | 0.00000 | 0.00000 | | | | |
| | Vap. Frac. (Volume Basis) | 0.00000 | 0.00000 | 0.00000 | | | | |
| | Molar Volume [m3/kgmole] | 9.5282e-002 | 0.11218 | 5.0380e-002 | | | | |
| | Act. Gas Flow [ACT_m3/h] | <empty></empty> | <empty></empty> | <empty></empty> | | | | |
| | Act. Liq. Flow [m3/s] | 7.2843e-002 | 6.3667e-002 | 9.9236e-003 | | | | |
| | Liq Vol Flow @Std Cond [m3/h] | 219.09 | 194.59 | 28.530 | | | | |
| | Std. Gas Flow [STD_m3/h] | 65074 | 48308 | 16767 | | | | |
| | Watson K | 12.967 | 13.345 | 10.625 | | | | |
| | Kinematic Viscosity [cSt] | 0.20822 | 0.19431 | 0.21530 | | | | |
| | Cp/Cv | 1.3206 | 1.3212 | 1.0606 | | | | |
| | Lower Heating Value [kJ/kgmole] | 2.0551e+006 | 2.5470e+006 | 6.3810e+005 | | | | |
| | Mass Lower Heating Value [kJ/kg] | 40893 | 45017 | 19915 | | | | |
| | Liquid Fraction | 1.0000 | 1.0000 | 1.0000 | | | | |
| | Partial Pressure of CO2 [kPa] | 0.00000 | 0.00000 | 0.00000 | | | | |
| | Avg. Liq. Density [kgmole/m3] | 12.249 | 10.417 | 24.834 | | | | |
| | Heat Of Vap. [kJ/kgmole] | 20201 | 17088 | 29789 | | | | |
| | herrichael norb | 301.05 | 202.02 | 000.00 | | | | |
| Design Paran | neters Side Ops Rating Workshee | t Performance | Flowsheet Re | eactions Dynamics | J | | | |
| Delete | Column Environment Run | <u>R</u> eset | | | Converged | | 🔽 Update | Outlets 🔲 Ignor |
| 200 | | | | 0.000281 | Step Size: | 1 0000 | | |
| | | | | | step size: lowsheet Distall: | | Converged | |

| Worksheet | | feed | Distillate | Bottoms | |
|--------------|-------------------------------|-------------------|------------------|-------------------|---|
| | Methanol | 0.2 | 319 0.0327 | 1.0000 | |
| Conditions | n-Butane | 0.4 | 626 0.6232 | 0.0000 | |
| Properties | i-Butene | 0.2 | 555 0.3442 | 0.0000 | |
| Compositions | | | | | |
| PF Specs | | | | | |
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| Design Param | eters Side Ops Rating ₩ | orksheet Performa | nce Flowsheet Re | eactions Dynamics | |

3. Composition of Distillate and Bottom products: Click on the "Compositions", this

window will display the compositions of feed, distillate as well as bottom products.

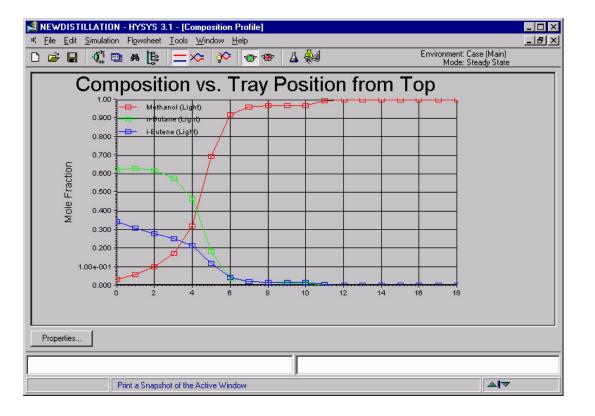
4. **Temperature, Vapor and Liquid Profiles throughout the column:** Click on "performance" button, select "Column profiles", this window will display temperature, vapor rate and liquid rate at all trays inside the distillation column.

| <u>Eile E</u> dit <u>S</u> imul | ation Fl <u>o</u> wsheet | <u>I</u> ools <u>W</u> indow | <u>H</u> elp | | | | | | | Ŀ |
|---------------------------------|--------------------------|------------------------------|----------------|--------------------|--------------------|------------|-------------------|----------------|-----------------------------|------------------------|
| 🖻 🖬 🕻 | 🖱 A 📴 | = ∞ ≫ | • 🐨 👁 | ⊿ 🖗 | | | | Env | vironment: Cas Mode: Ste | se (Main) ady State |
| Performance | Reflux Ratio | 10.00 | | | | | | Basis | | |
| Summary | Reboil Ratio | 18.01 | Flows | C Energy | | | | Molar | C M <u>a</u> ss | ⊂ Liq <u>V</u> ol |
| Column Profiles | (° | Temperature | Pressure | Net Liquid | Net Vapour | Net Feed | Net Draws | | | |
| Feeds/Products | | [C] | [kPa] | [kgmole/h] | [kgmole/h] | [kgmole/h] | [kgmole/h] | | ļ | |
| Plots | Condenser | 81.95 | 1115 | 20430.9 | | | 2043.1 | | | |
| | 1_Main TS | 82.85 | 1115 | 20087.9 | 22474.0 | | | | | |
| | 2Main TS | 84.38 | 1121 | 19579.9 | 22131.0 | | | | - | |
| | 3Main TS | 86.67 | 1127 | 18607.2 | 21623.0 | | | | | |
| | 4_Main TS | 90.93 | 1134 | 16455.8 | 20650.3 | | | | | |
| | 5Main TS | 101.9 | 1140 | 12336.3 | 18498.9 | | | | | |
| | 6Main TS | 125.2 | 1146 | 11177.4 | 14379.4 | | | | | |
| | 7Main TS | 135.2 | 1153 | 11206.1 | 13220.5 | | | | - | |
| | 8_Main TS | 137.2 | 1159 | 11224.2 | 13249.2 | | | | | |
| | 9_Main TS | 137.7 | 1165 | 11235.3 | 13267.3 | 0750.0 | | | | |
| | 10_Main TS | 137.9 | 1172 | 13295.5 | 13278.4 | 2752.2 | | | | |
| | 11_Main TS | 144.6 | 1178 | 13391.2 | 12586.4 | | | | | |
| | 12Main TS | 145.8 | 1184 | 13416.5 | 12682.1 | | | | | |
| | 13Main TS 14 Main TS | 146.2 146.5 | 1191 1197 | 13430.7 13443.4 | 12707.4 12721.6 | | | | | |
| | 14Main TS | 146.5 | 1203 | 13443.4 | 12721.6 | | | | | |
| | 16 Main TS | 146.7 | 1203 | 13455.5 | 12734.3 | | | | - | |
| | 17 Main TS | 146.5 | 1210 | 13466.5 | 12746.7 | | | | | |
| | Reboiler | 147.1 | 1216 | 13482.5 | 12759.2 | | 709.11 | | | |
| | | 147.1 | 1216 | | 12113.4 | | 705.11 | | | |
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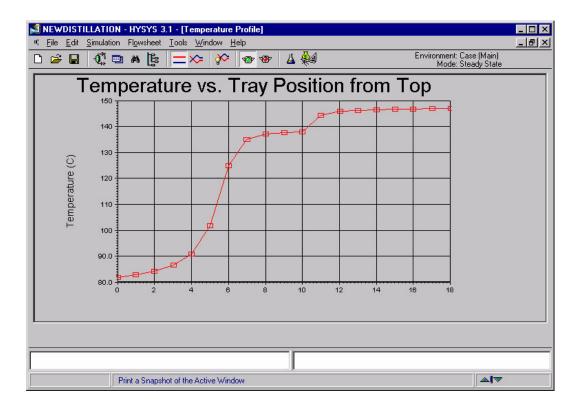
 Composition profiles: Click on "Plot" options, select "Compositions and click on "View Tables" (or on View Graphs), this window will display compositions of all components at each tray inside the column in form of table (or graph).

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Similarly we can find the plot for liquid, vapor and temperature profiles throughout the column after clicking at "View Graph" button for respective profiles. For example the result of Temperature profile will be displayed as follows:



6. **Boiler and Condenser duties and temperatures:** Click on "Feeds/Products", this window will display all the loads and properties related to the condenser and reboiler.

| ondenser Main TS Main TS Main TS Main TS Main TS Main TS Main TS | Stream Q condenser Distillate | Type Energy Draw | Duty [kJ/h] 3.8399e+008 | Phase | Flows [kgmole/h] | Enthalpy [kJ/kgmole] | Temp [C] | Basis @ M | Environme Mor fola <u>r</u> Ot | de: Steady | State |
|---|-------------------------------------|---|--|---|--|--|---|--|--|--|---|
| Main TS Main TS Main TS Main TS Main TS Main TS Main TS | Q condenser | Energy | [kJ/h] | Phase | | | | | fola <u>r</u> O f | Mass (|) Liq⊻ol |
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| | feed | Feed | | Liquid | 2752.2 | -1.344e+005 | 93.05 | _ | | | _ |
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| 7Main TS | | | | | | | | | | | |
| eboiler | Q reboil Bottoms | Energy Draw | 3.8049e+008 | Liquid | 709.11 | -2.267e+005 | 147.1 | | | | |
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| 1234567 | Side Ops F | Main TS feed Main TS Main TS Main TS Main TS Main TS Main TS eboiler Q reboil Bottoms | Main TS feed Feed Main TS Main TS Draw Soller Side Ops _ Rating Worksheet Perfore | Main TS feed Feed Main TS | Main TS feed Feed Liquid Main TS | Main TS feed Feed Liquid 2752.2 Main TS Image: Constraint of the second se | Main TS feed Feed Liquid 2752.2 -1.344e+005 Main TS Image: Constraint of the second se | Main TS feed Feed Liquid 2752.2 1.344e+005 93.05 Main TS Image: Converged Image: Converged Image: Converged Image: Converged Main TS Image: Converged Image: Converged Image: Converged Image: Converged Main TS Image: Converged Image: Converged Image: Converged Image: Converged | Main TS feed Feed Liquid 2752.2 -1.344e+005 93.05 Main TS Main TS <td>Main TS feed Feed Liquid 2752.2 -1.344e+005 93.05 Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Boltoms Energy 38049e+008 Liquid 709.11 -2.267e+005 147.1 Side Dps Rating Worksheet Performance Flowsheet Energit To Main To<!--</td--><td>Main TS feed Feed Liquid 2752.2 -1.344e+005 93.05 </td></td> | Main TS feed Feed Liquid 2752.2 -1.344e+005 93.05 Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Main TS Boltoms Energy 38049e+008 Liquid 709.11 -2.267e+005 147.1 Side Dps Rating Worksheet Performance Flowsheet Energit To Main To </td <td>Main TS feed Feed Liquid 2752.2 -1.344e+005 93.05 </td> | Main TS feed Feed Liquid 2752.2 -1.344e+005 93.05 |