Flash Calculation in Aspen Plus® V8.0

1. Lesson Objective

- Learn how to model a Flash separator and examine different thermodynamic models to see how they compare.
- Flash blocks in Aspen Plus

2. Prerequisites

- Access to Aspen Plus V8.0
- This module builds upon the thermodynamics models found in module 1 of this series. You should complete the exercises in the Thermo_001_TDE which focuses in learning Properties Data Base and Thermodynamic Models in Aspen Plus.
- Files needed (saved in Aspen Plus V8.0): "Thermo_002_FlashModel_Start.bkp" provided with the package

3. Problem

We want to investigate Vapor-Liquid separation at different pressures, temperatures and compositions. Assume you have a feed with an equimolar binary mixture of ethanol and benzene at 1 bar and 25°C. Examine the following flash conditions using the Flash model in Aspen Plus. Use Vapor-Liquid as the Valid Phase in the computation.

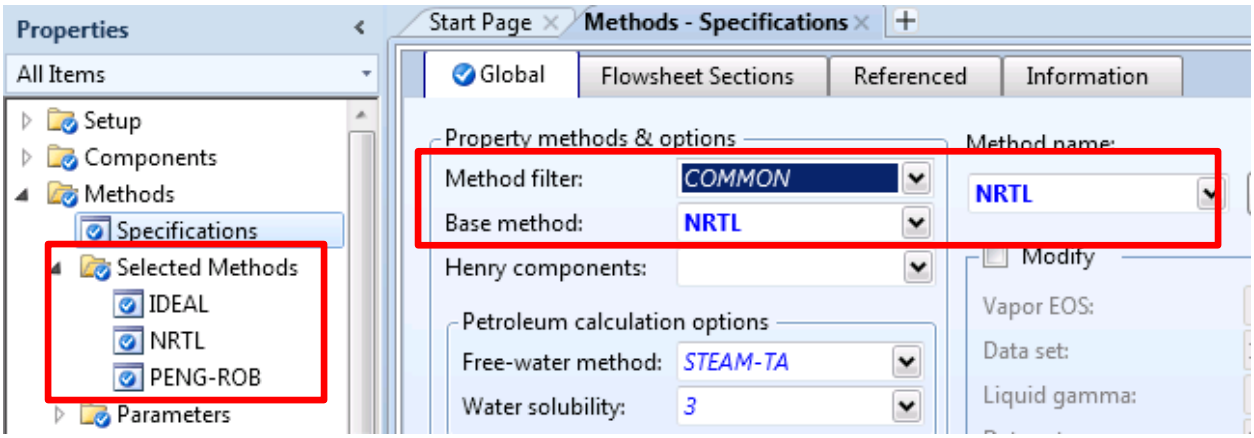
- Condition #1 (**P-V Flash**): At 1 bar and a vapor fraction of 0.5, find the equilibrium temperature and the heat duty.
- Condition #2 (**T-P Flash**): At the temperature determined from Condition #1 and a pressure of 1 bar, verify the flash model results in a vapor fraction of 0.5 at equilibrium.
- Condition #3 (**T-V Flash**): At the temperature of Condition #1, and a vapor fraction of 0.5, verify that the flash model results in an equilibrium pressure of 1 bar.
- Condition #4 (**P-Q Flash**): At 1 bar and with the heat duty determined from Condition #1, verify that the temperature and vapor fraction are consistent with previous conditions.
- Condition #5 (**T-Q Flash**): At the temperature and heat duty determined from Condition #1, verify that the pressure and vapor fraction are consistent with previous conditions.

The examples presented are solely intended to illustrate specific concepts and principles. They may not reflect an industrial application or real situation.

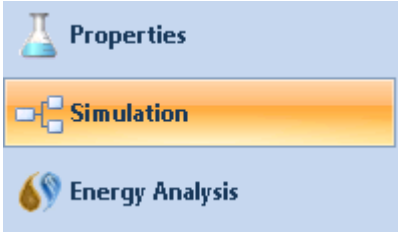
4. Aspen Plus Solution:

4.01. Start **Aspen Plus V8.0**. Open the **Thermo_002_FlashModel_Start.bkp** file. This file will already have the components ethanol and benzene specified.

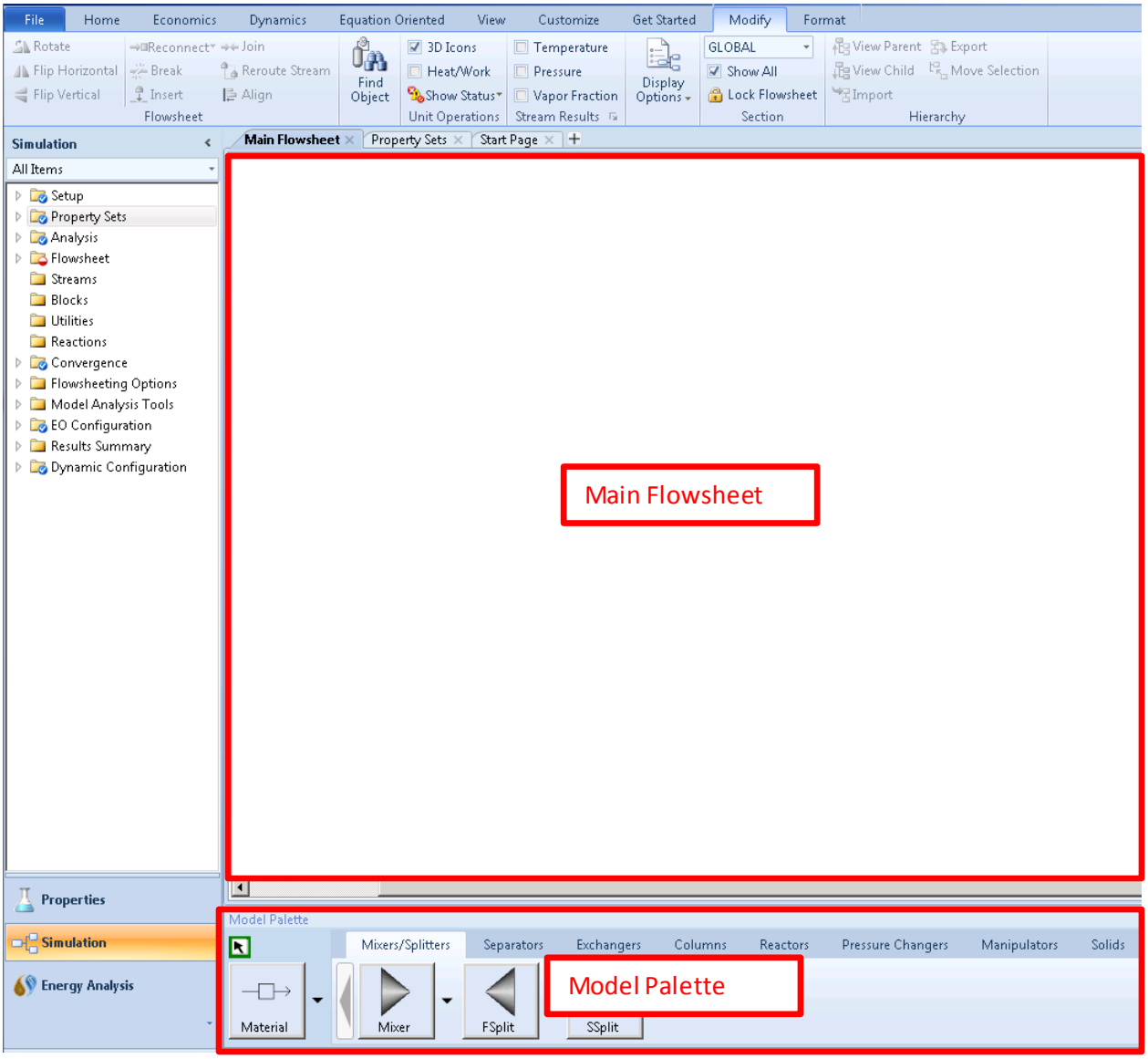
4.02. In the properties environment, go to **Methods | Selected Methods.** You should see three methods are available (**IDEAL**, **NRTL**, **PENG-ROB**) as shown below. Also check that the current base method is set as NRTL.



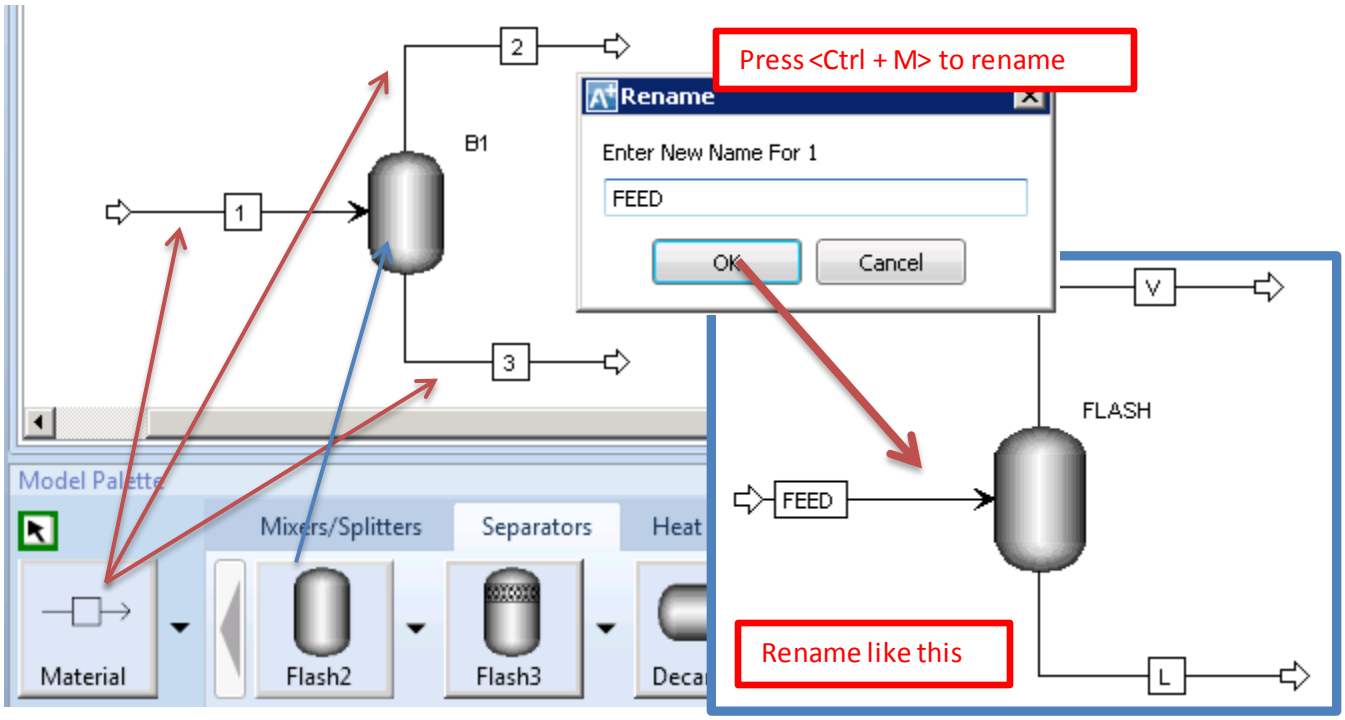
4.03. Go to the simulation environment. Click the **Simulation** button in the bottom left of the screen.



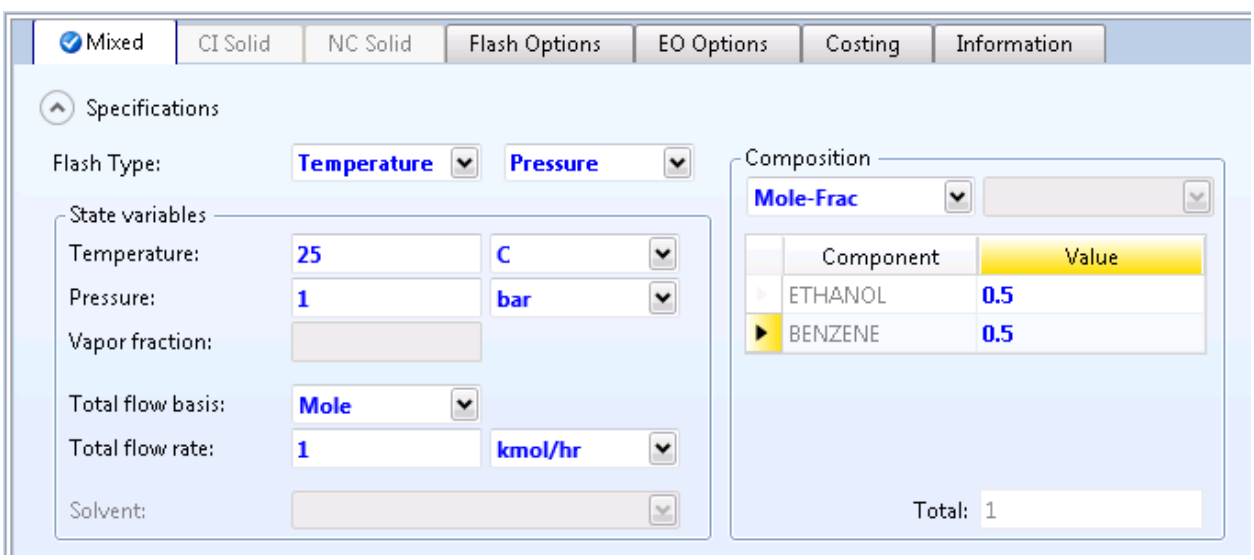
4.04. In the simulation environment you can find **Model Palette** (F10) where you can find all the Aspen Plus models.



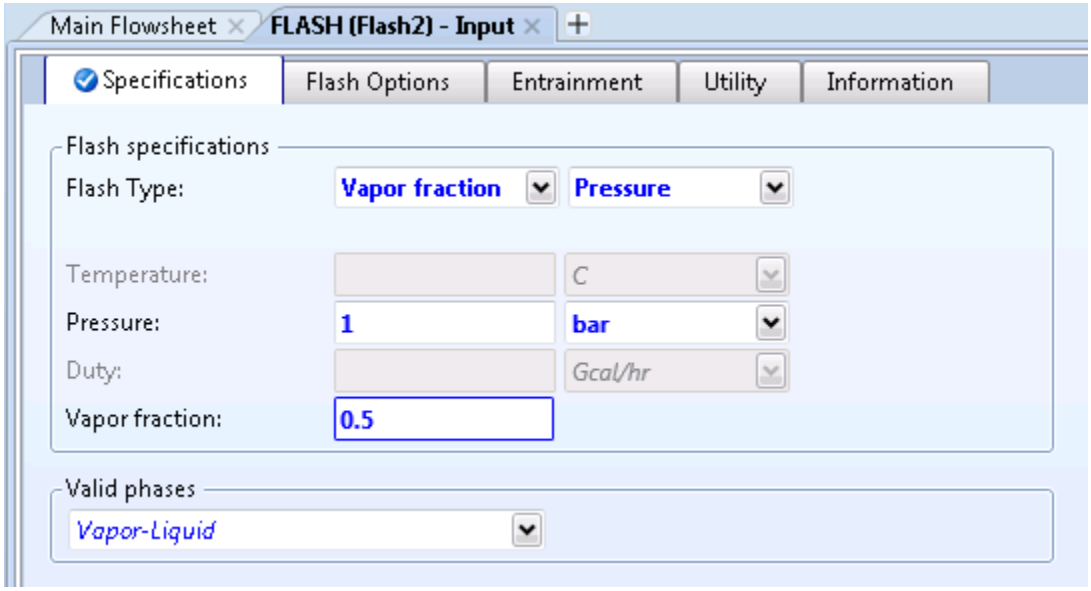
4.05. In the **Separators** tab in the **Model Palette**, find the **Flash2** model and drop it onto the flowsheet. The Flash2 block is a model for a flash tank. The '2' in the name is the number of effluent streams: one is a vapor stream, and the other is a liquid stream. Select **Material stream** button and connect material streams to the inlet and outlet ports of Flash2. Once you've completed connecting the ports, the flowsheet should be similar to below. Right clicking anywhere on the flowsheet will cancel insert mode and bring back the main cursor. You can edit the names of streams and blocks by pressing **Ctrl + M**.



4.06. You should see Required Input Incomplete in the bottom left corner. This is because the simulation requires further input and is not yet ready to run. To complete the required input you need to enter the information for the material feed stream and the Flash2 block. To specify the feed stream information navigate to **Streams | FEED | Input** using the navigation pane, or you can double click on the stream on the main flowsheet. Enter the following information for the feed stream.

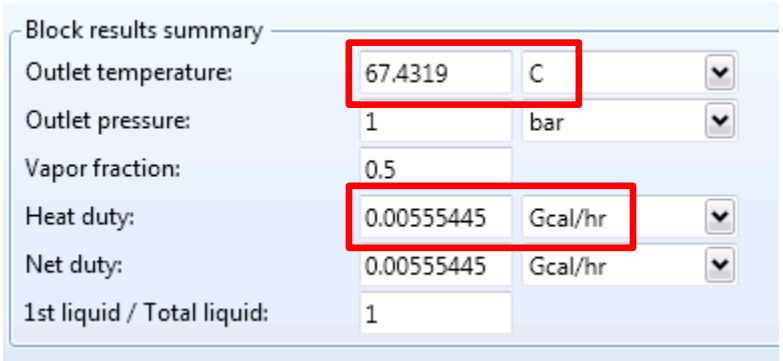


4.07. **For Condition #1** (Compute the temperature to get 0.5 vapor fraction at 1 bar), go to **Blocks | FLASH | Input,** and enter the following information:



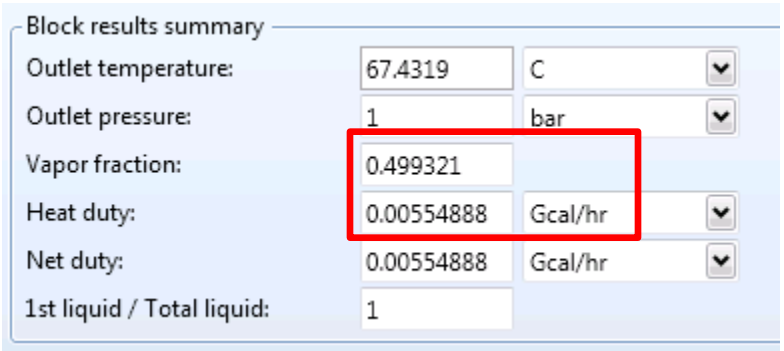
4.08. You will notice that in the status bar, the **Required Input Incomplete** warning has changed to **Required Input Complete**. You are all set. Open the **Control Panel** and run the simulation (**F5**).

4.09. The simulation will complete with no errors or warnings. Notice **Results Available** in the status bar. To check the calculation results, go to **Blocks | FLASH | Results**. Compare your results with what is shown below. If you don't have the same (or very close) results, please check that the Base method is NRTL and double check the feed and flash conditions that you have entered.

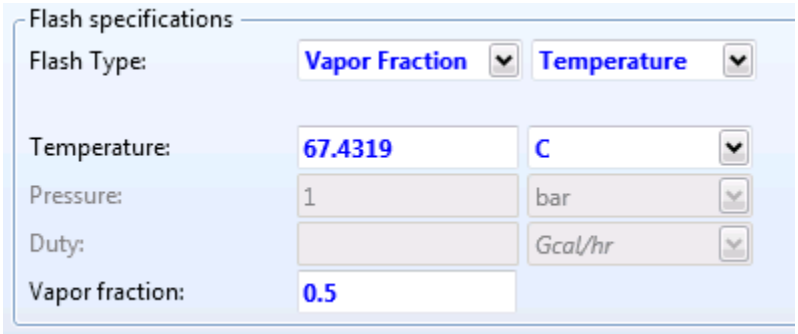


4.10. **For Condition #2** (Compute vapor fraction at 1 bar and at the temperature obtained in Condition #1), go to **Blocks | FLASH | Input**, and enter information as shown below:

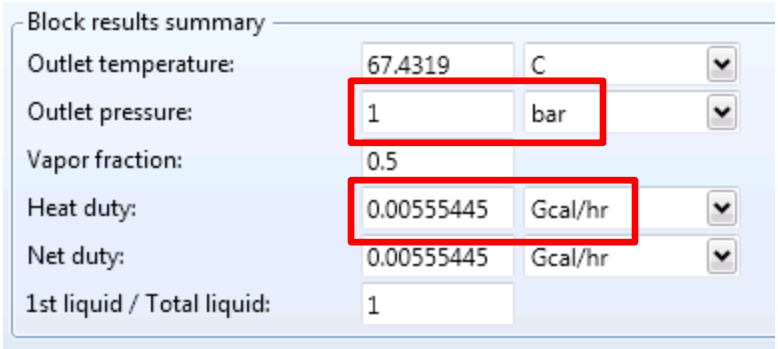
Run the simulation (**F5**) and check the results. The calculated vapor fraction is very close to the one in Condition #1.



4.11. **For Condition #3** (Compute pressure at the temperature obtained in Condition #1 with 0.5 vapor fraction), go to **Blocks | FLASH | Input**, and enter data as below:

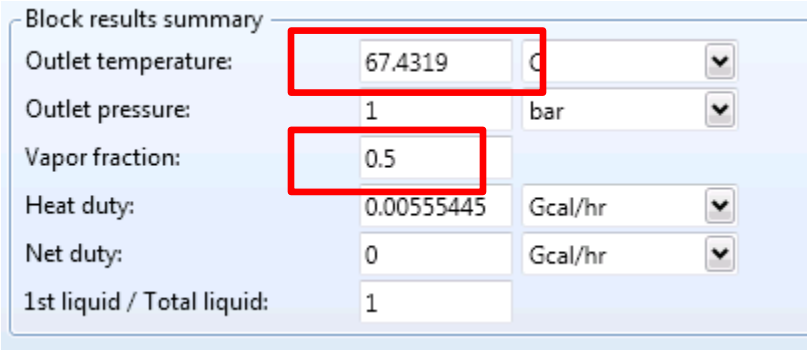


Run the simulation (**F5**) and check the results. The calculated pressure is 1 bar.

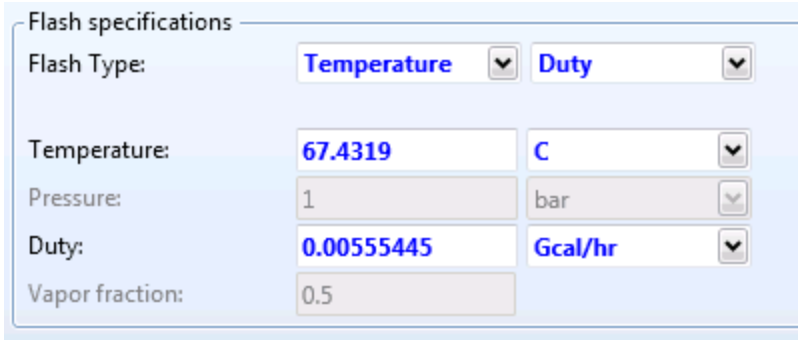


4.12. **For Condition #4** (Compute temperature and vapor fraction at 1 bar and using the heat duty obtained in Condition #1), go to **Blocks | FLASH | Input**, and enter the information as shown below:

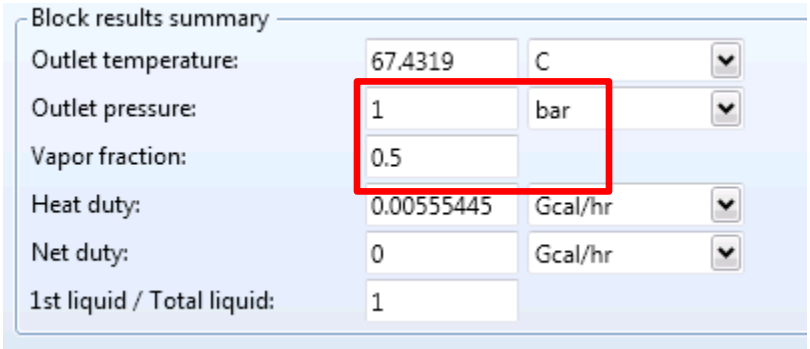
Run the simulation (**F5**) and check the results.



4.13. **For Condition #5** (Compute pressure and vapor fraction at the temperature and heat duty obtained in Condition #1), go to **Blocks | FLASH | Input**, and enter the information as shown below:



Run the simulation and check the results.



5. Conclusion

You have gone through the five flash methods which are most common in Aspen Plus. Here is a brief summary.

Flash Method	T (C)	P (bar)	V (-)	Q (Gcal/hr)
P-V Flash	67.43186	1	0.5	0.00555445
T-P Flash	67.4319	1	0.499321	0.00554888
T-V Flash	67.4319	1	0.5	0.00555445
P-Q Flash (or P-H)	67.4319	1	0.5	0.00555445
T-Q Flash (or T-H)	67.4319	1	0.5	0.00555445

Specified	Computed

Feed Condition: ETHANOL/BEZENE (Equimolar mixture) at 1 bar and 25 Celsius.

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