

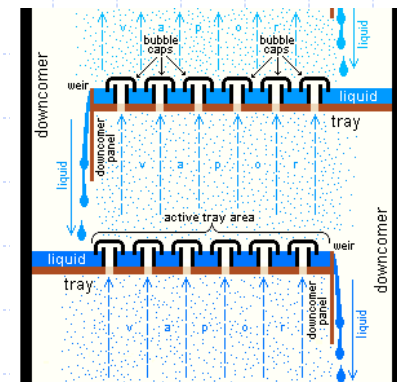
Internal column design Radfrac

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Example: staged column design with Radfrac

- ◆ Separation of a mixture of hydrocarbons by distillation
 - The feed is 0.100 mol fraction ethane, 0.300 mole fraction propane, 0.500 mole fraction n-butane and 0.100 mole fraction n-pentane.
 - The feed is 1.0 kmol/s at 25°C and 15.0 atm.
 - The column has N (Aspen notation) = 35 equilibrium stages and the feed is on stage 16.
 - The column operates at 15.0 atm, has a partial condenser and produces a vapor distillate with $D = 0.400$ kmol/s ($D/F=0.4$).
 - The column has a kettle type reboiler.
 - Reflux ratio is $L/D = 2.5$.
 - Use the Peng-Robinson VLE correlation with standard binary interaction parameters.

Example: staged column design with Radfrac

- ◆ Separation of a mixture of hydrocarbons by distillation
- ◆ Using Radfrac perform the following calculations:
 1. With a base case obtain the column profiles: T, Kij, L/V, compositions. Verify that:
 1. Max. n-C4 mole fraction in the vapor distillate of $y_{D,C4,max} = 0.001$
 2. Max. C3 mole fraction in the liquid bottoms of $x_{Bot,C3,max} = 0.0$
 2. Create a new column internal section for a sieve tray column internal using the following specifications:
 1. Create an auto section and verify that two sections are created (2-15 and 16-34 stage)
 2. Specify Sieve trays with 2 pass (sec.1) and 4 pass (sec.2).
 3. Verify and understand the Design parameters (in the Geometry section).
 4. Estimate D and tray spacing.
 5. Verify hydraulic plots and adjust the geometry, until you have no warnings / errors.
 3. Change the tray type to BubbleCup
 1. Adjust the geometry until you have no warnings / errors.

Example: staged column design with Radfrac

◆ Components

Select components

Component ID	Type	Component name	Alias
ETHANE	Conventional	ETHANE	C2H6
PROPANE	Conventional	PROPANE	C3H8
N-BUTANE	Conventional	N-BUTANE	C4H10-1
N-C5	Conventional	N-PENTANE	C5H12-1

◆ Feed

Mixed | CI Solid | NC Solid | Flash Options | EO Options | Costing | Comments

Specifications

Flash Type: **Temperature** | **Pressure**

State variables

Temperature: 25 C

Pressure: 15 atm

Vapor fraction: []

Total flow basis: Mole

Total flow rate: 1 kmol/sec

Solvent: []

Reference Temperature: []

Volume flow reference temperature: []

Composition

Mole-Frac

Component	Value
ETHANE	0.1
PROPANE	0.3
N-BUTANE	0.5
N-C5	0.1

Method

Global | Flowsheet Sections | Referenced | Comments

Property methods & options

Method filter: COMMON

Base method: PENG-ROB

Henry components: []

Petroleum calculation options

Free-water method: STEAM-TA

Water solubility: 3

Electrolyte calculation options

Chemistry ID: []

Use true components

Method name: PENG-ROB

Methods Assistant...

Modify

EOS: ESPRSTD

Data set: 1

Liquid gamma: []

Data set: []

Liquid molar enthalpy: HLMX106

Liquid molar volume: VLMX20

Heat of mixing

Poynting correction

Use liquid reference state enthalpy

Example: staged column design with Radfrac

Setup

Configuration Streams Pressure Condenser Reboiler

Feed streams

Name	Stage	Convention
FEED	16	Above-Stage

Configuration Streams Pressure Condenser Reboiler 3-Phase Comments

Setup options

Calculation type: *Equilibrium*

Number of stages: 35 Stage Wizard

Condenser: *Partial-Vapor*

Reboiler: *Kettle*

Valid phases: *Vapor-Liquid*

Convergence: *Standard*

Operating specifications

Reflux ratio: *Mole* 2.5

Distillate to feed ratio: *Mole* 0.4

Free water reflux ratio: 0 Feed Basis

Internals

Sections

Status: Active

Column description: *Sieve tray column internal* Input Complete

Add New Auto Section Duplicate Import Template Export Template View Internals Summary

Name	Start Stage	End Stage	Mode	Internal Type	Tray/Packing Type	Tray Details		Packing Details		
						Number of Passes	Number of Downcomers	Vendor	Material	Dimensi
CS-1	2	15	<i>Interactive sizing</i>	<i>Trayed</i>	<i>SIEVE</i>	2				
CS-2	16	34	<i>Interactive sizing</i>	<i>Trayed</i>	<i>SIEVE</i>	4				

Don't update pressure drop
 Update pressure drop from top stage
 Update pressure drop from bottom stage
 Include static vapor head in pressure drop calculations
 Calculate pressure drop across sump

Sump

Diameter: 4.53006 meter

Liquid residence time: 0.0166667 hr

Liquid level: meter

Example: packed column design with Radfrac

- ◆ Separation of a mixture of hydrocarbons by distillation
 - The feed is 0.100 mol fraction ethane, 0.300 mole fraction propane, 0.500 mole fraction n-butane and 0.100 mole fraction n-pentane.
 - The feed is 1.0 kmol/s at 25°C and 15.0 atm.
 - The column has N (Aspen notation) = 35 equilibrium stages and the feed is on stage 16.
 - The column operates at 15.0 atm, has a partial condenser and produces a vapor distillate with $D = 0.400$ kmol/s ($D/F=0.4$).
 - The column has a kettle type reboiler.
 - Reflux ratio is $L/D = 2.5$.
 - Use the Peng-Robinson VLE correlation with standard binary interaction parameters.
- ◆ Data are the same as for the example done for staged column

Example: packed column design with Radfrac

- ◆ Separation of a mixture of hydrocarbons by distillation
- ◆ Using Radfrac open the file used for staged column design and perform the following calculations:
 1. Verify the base case reported in the old file, and in particular that:
 1. Max. n-C4 mole fraction in the vapor distillate of $y_{D,C4,max} = 0.001$
 2. Max. C3 mole fraction in the liquid bottoms of $x_{Bot,C3,max} = 0.001$
 2. Create a new column internal section (INT-2) for a packed column internal (leave the INT-1 internal section of the tray design), using the following specifications:
 1. Create an auto section and verify that two sections are created (2-15 and 16-34 stage)
 2. Specify packed column – interactive sizing with pall rings.
 3. Verify and understand the Design parameters (in the Geometry section) and specify packed height per stage (HETP) in geometry section (.5 m for pall rings)
 4. Estimate D and tray spacing.
 5. Verify hydraulic plots and adjust the geometry, until you have no warnings / errors.
 3. Change the packing to Mellapack
 1. Verify and understand the Design parameters (in the Geometry section) and specify packed height per stage (HETP) in geometry section (.2 m for mellapack)
 2. Adjust the geometry until you have no warnings / errors.
 4. Add design specifications to obtain the desired purities:
 1. Max. n-C4 mole fraction in the vapor distillate of $y_{D,C4,max} = 0.001$
 2. Max. C3 mole fraction in the liquid bottoms of $x_{Bot,C3,max} = 0.001$

Example: packed column design with Radfrac

◆ Components

Select components

Component ID	Type	Component name	Alias
ETHANE	Conventional	ETHANE	C2H6
PROPANE	Conventional	PROPANE	C3H8
N-BUTANE	Conventional	N-BUTANE	C4H10-1
N-C5	Conventional	N-PENTANE	C5H12-1

◆ Feed

Mixed | CI Solid | NC Solid | Flash Options | EO Options | Costing | Comments

Specifications

Flash Type: **Temperature** | **Pressure**

State variables

Temperature: 25 C

Pressure: 15 atm

Vapor fraction: []

Total flow basis: Mole

Total flow rate: 1 kmol/sec

Solvent: []

Reference Temperature: []

Volume flow reference temperature: []

Composition

Mole-Frac

Component	Value
ETHANE	0.1
PROPANE	0.3
N-BUTANE	0.5
N-C5	0.1

Method

Global | Flowsheet Sections | Referenced | Comments

Property methods & options

Method filter: COMMON

Base method: PENG-ROB

Henry components: []

Petroleum calculation options

Free-water method: STEAM-TA

Water solubility: 3

Electrolyte calculation options

Chemistry ID: []

Use true components

Method name: PENG-ROB

Methods Assistant...

Modify

EOS: ESPRSTD

Data set: 1

Liquid gamma: []

Data set: []

Liquid molar enthalpy: HLMX106

Liquid molar volume: VLMX20

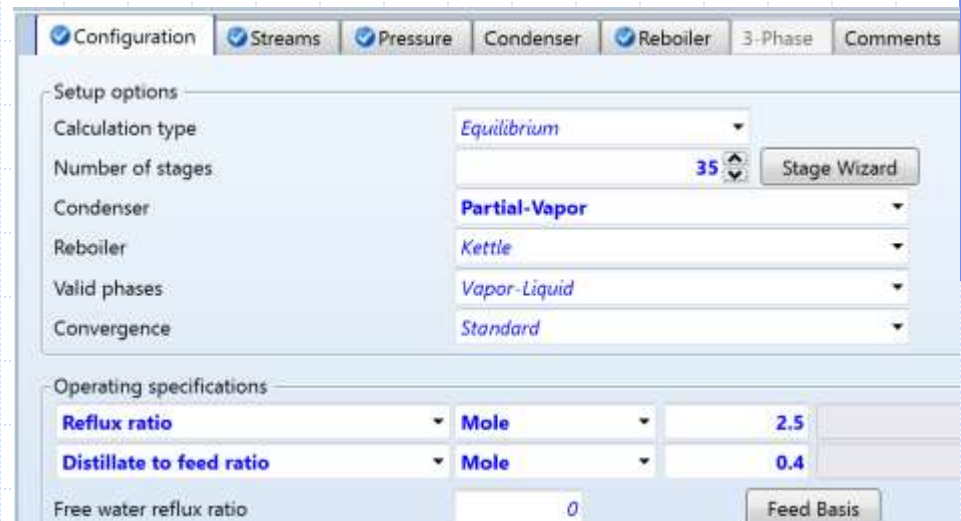
Heat of mixing

Poynting correction

Use liquid reference state enthalpy

Example: packed column design with Radfrac

Setup



Internals

Status: Active

Column description: [input Complete]

Buttons: Add New, Auto Section, Duplicate, Import Template, Export Template, View Internals Summary

Name	Start Stage	End Stage	Mode	Internal Type	Tray/Packing Type	Tray Details		Packing Details		
						Number of Passes	Number of Downcomers	Vendor	Material	Dimension
CS-1	2	15	Rating	Packed	PALL			MTL	METAL	0.625-IN OR
CS-2	16	34	Rating	Packed	PALL			MTL	METAL	0.625-IN OR

Don't update pressure drop
 Update pressure drop from top stage
 Update pressure drop from bottom stage
 Include static vapor head in pressure drop calculations.
 Calculate pressure drop across sump

Sump

Diameter: 2.34009 meter

Liquid residence time: 0.0156667 hr

Liquid level: meter

Example: packed column design with Radfrac

◆ Hydraulic plots

