

GUÍA 5 y 6 - Destilación Multicomponentes Problema 9 - HYSYS

1° Cuatrimestre - 2025

Enunciado

Se desea obtener a partir de una corriente de hidrocarburos, la cual ha sido previamente despojada de sus componentes más livianos (C1-C2), los siguientes productos:

- **Propano y butanos (C3-C4):**

- ✓ Especificación: contenido de C5+ < 2%

- **Gasolina Estabilizada:**

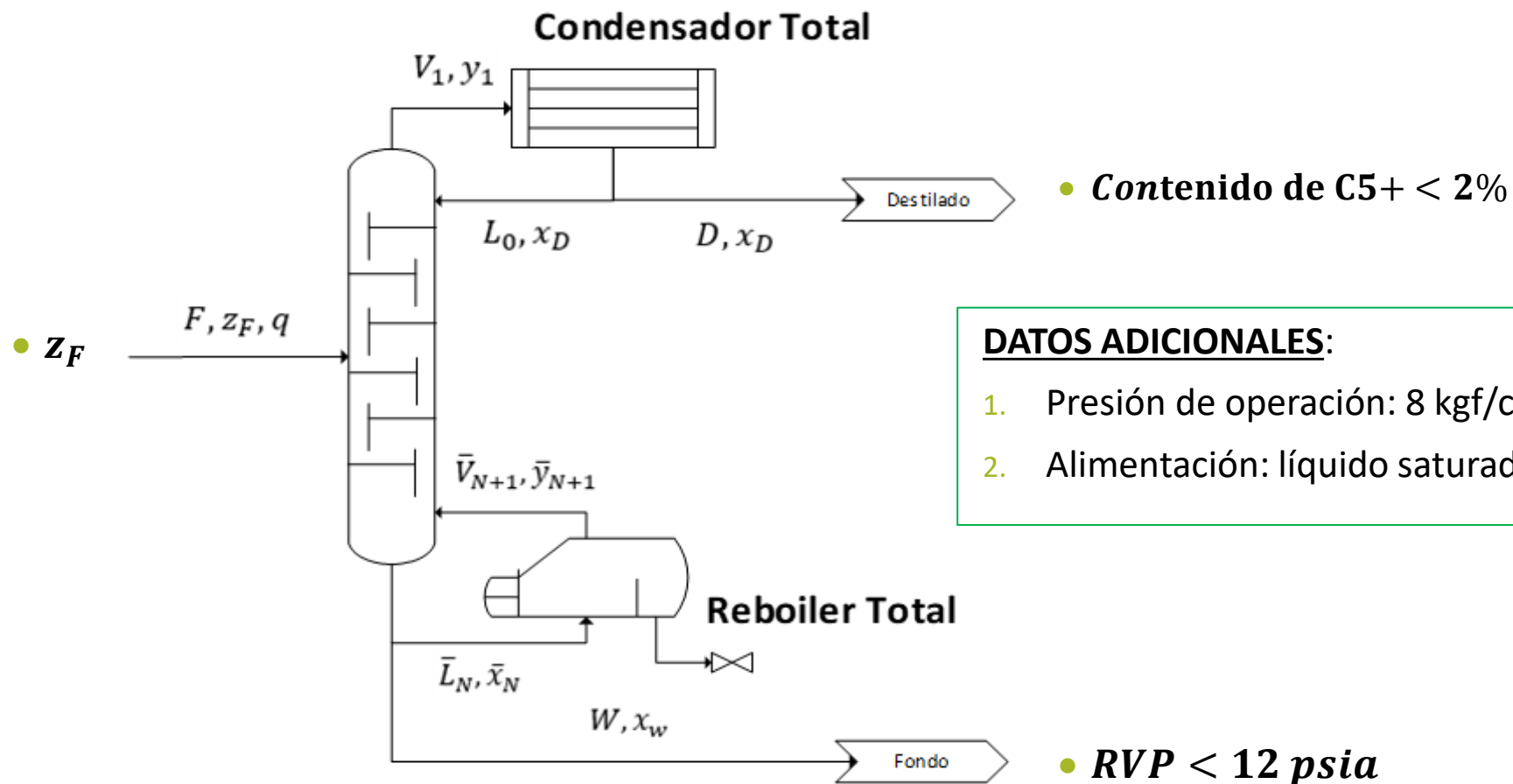
- ✓ Especificación: RVP (presión de vapor Reid) < 12 psia

La composición de la corriente a tratar es:

Se pide:

1. Ingresar al Basis Environment y seleccionar un paquete de propiedades apropiado.
2. Acceda al listado de componentes e ingrese los componentes a emplear en la simulación.
3. Estimar mediante la herramienta shortcut distillation el Nmin, Nop, Rmin, Rop.
4. Verifique cómo se modificarían los valores anteriores eligiendo otros componentes llave.

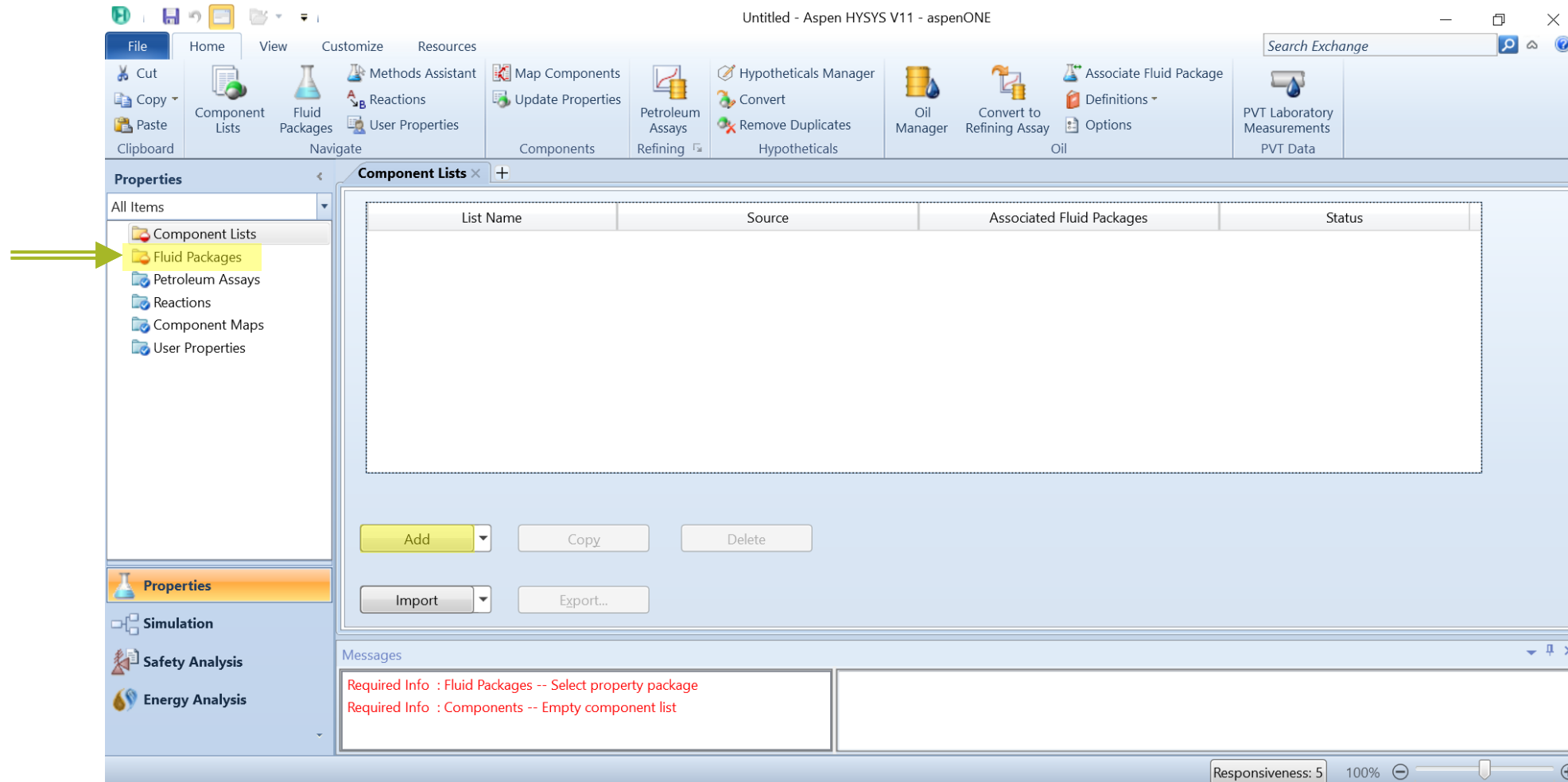
Componente	Composición (%molar)
C1	0,1
C2	0,15
C3	9,75
iC4	12,5
nC4	15
iC5	12,5
nC5	10
nC6	15
nC7	15
nC8	10



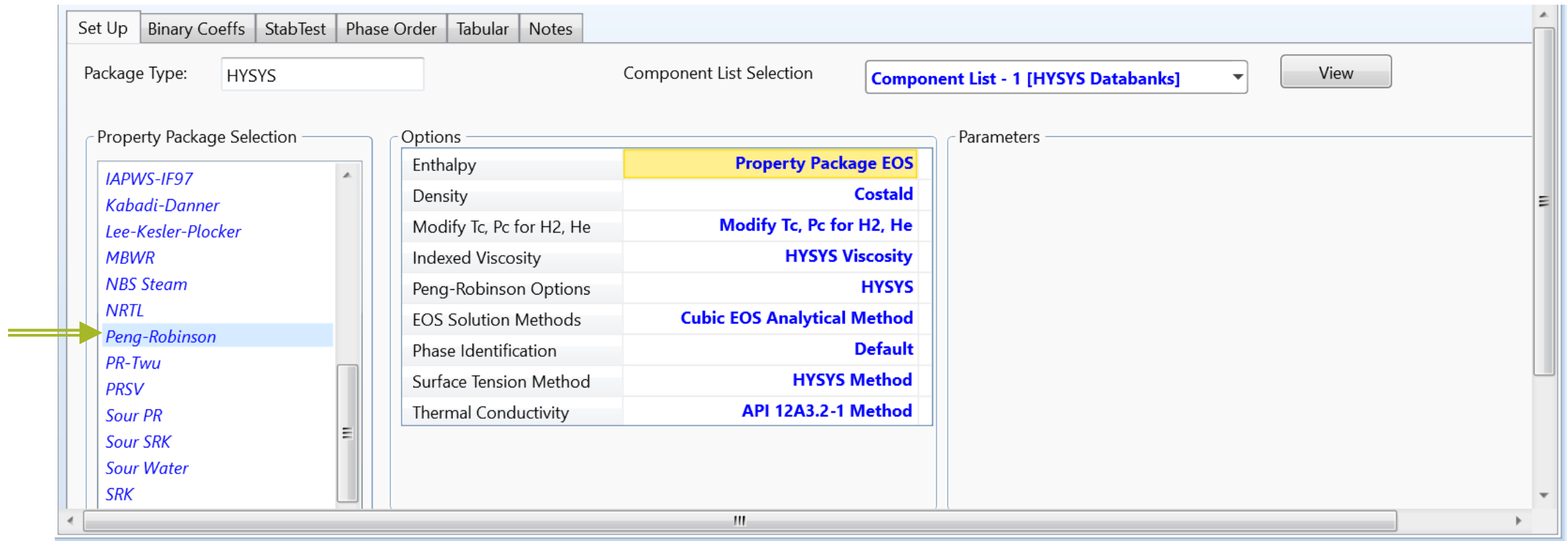
DATOS ADICIONALES:

1. Presión de operación: 8 kgf/cm²g
2. Alimentación: líquido saturado

1. Ingresar al Basis Environment y seleccionar un paquete de propiedades apropiado.



1. Ingresar al Basis Environment y seleccionar un paquete de propiedades apropiado.



2. Acceda al listado de componentes e ingrese los componentes a emplear en la simulación:

The screenshot shows the Aspen HYSYS V11 interface. The main window is titled "Untitled - Aspen HYSYS V11 - aspenONE". The left sidebar shows the "Properties" pane with "Component Lists" selected. The "Component Lists" window is open, showing a table with columns: List Name, Source, Associated Fluid Packages, and Status. The table contains one entry: "Component List - 1" with Source "HYSYS Databanks", Associated Fluid Packages "Basis-1", and Status "Complete". Below this table are buttons for "Add", "Copy", "Import", and "Export...".

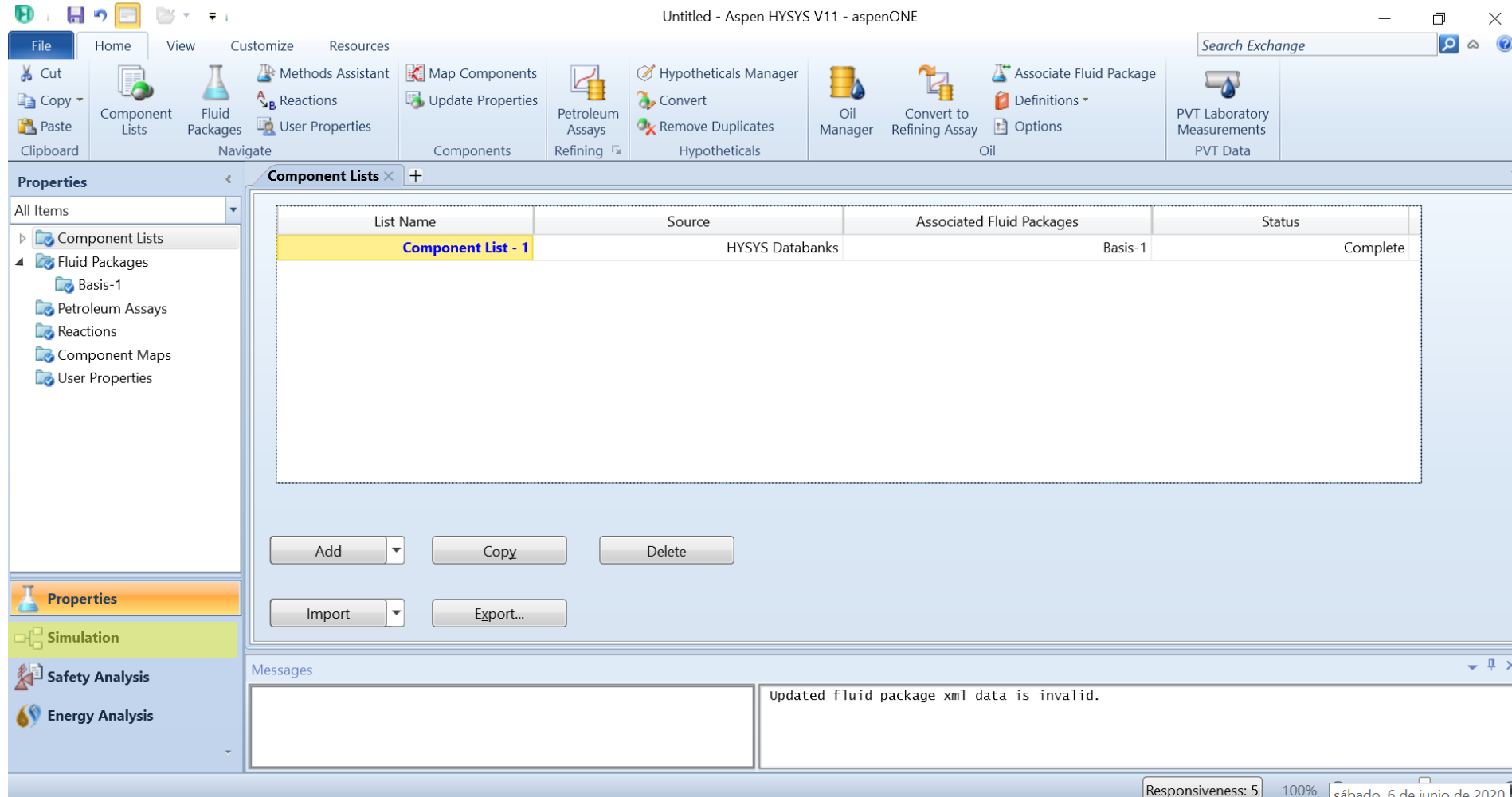
The "Component List View: Component List - 1 [HYSYS Databanks]" dialog is open. It shows a table of components from the "Source Databank: HYSYS". The table has columns: Component, Type, and Group. The components listed are: Methane, Ethane, Propane, i-Butane, n-Butane, i-Pentane, n-Pentane, n-Hexane, n-Heptane, and n-Octane, all of which are "Pure Component" type.

On the right side of the dialog, there are search options: "Select:" set to "Pure Components", "Filter:" set to "All Families", and "Search by:" set to "Full Name/Synonym". Below these is a search input field.

At the bottom right of the dialog is a table with columns: Simulation Name, Full Name / Synonym, and Formula. The table lists various alkanes from n-Nonane to n-C22.

At the bottom of the dialog, there are buttons for "< Add", "Replace", and "Remove". The status bar at the bottom indicates "Status: OK".

3. Estimar mediante la herramienta shortcut distillation el N_{min} , N_{op} , R_{min} , R_{op} :



3. Estimar mediante la herramienta shortcut distillation el Nmin, Nop, Rmin, Rop:

The screenshot displays the Aspen HYSYS V11 software interface. The main window shows a flowsheet with a single unit, a distillation column labeled T-100. Three streams are connected to the column: Stream 1 enters from the left, Stream 2 exits from the top, and Stream 3 exits from the bottom. The interface includes a ribbon menu at the top with tabs like File, Home, Economics, Dynamics, Equation Oriented, View, Customize, Resources, Flowsheet/Modify, and Format. A left sidebar contains a project tree with folders like Workbook, UnitOps, Streams, Stream Analysis, Equipment Design, Model Analysis, Data Tables, Strip Charts, Case Studies, and Data Fits. A right sidebar shows a model palette with various unit operation icons. The bottom status bar indicates 'Solver (Main) - Ready' and 'View Convergence'.

3. Estimar mediante la herramienta shortcut distillation el Nmin, Nop, Rmin, Rop:

Luego de cargar los datos de la corriente de entrada a la Shortcut:

Design

Connections
Parameters
User Variables
Notes

Components

Component	Mole Fraction
Light Key in Bottoms	<empty>
Heavy Key in Distillate	<empty>

Pressures

Condenser Pressure	<empty>
Reboiler Pressure	<empty>

Reflux Ratios

External Reflux Ratio	<empty>
Minimum Reflux Ratio	<empty>

ESPECIFICACIONES:

1. Tope: C5+ < 2%
2. Fondo: RVP < 12 psia

Messages

Required Info : T-100 -- Requires an energy stream
Required Info : T-100 -- Unknown Key Components
Required Info : T-100 -- Unknown Key Component Spec

Requires an energy stream

Saving case C:\Users\teamdj\AppData\Local\Temp\AutoRecovery save of NoName (0x30a08).ahc...
Completed.

Solver (Main) - Ready View Convergence

Responsiveness: 5 100%

3. Estimar mediante la herramienta shortcut distillation el Nmin, Nop, Rmin, Rop:

Se deben agregar las corrientes de energía que generan el ΔT requerido

Este dato no lo tenemos; nos piden RVP < 12 psia.
Propuse un valor y después fui verificando con la corriente de FONDO.

Este dato no lo tenemos; nos piden C5+ < 2 %
Tomé un valor y después fui verificando con la corriente de TOPE.

Por ahora no nos vamos a preocupar por el DP de la columna.

Propuse un $R_{op}=1,5 R_{min}$ para cerrar el Shortcut

Component	Mole Fraction
n-Butane	0.0700
i-Pentane	0.0150

Pressures	
Condenser Pressure	8.000 kg/cm ² g
Reboiler Pressure	8.000 kg/cm ² g

Reflux Ratios	
External Reflux Ratio	<empty>
Minimum Reflux Ratio	1.057

3. Estimar mediante la herramienta shortcut distillation el Nmin, Nop, Rmin, Rop:

Flowsheet Case (Main) - Solver Active

Shortcut Column: T-100

Performance

Trays	
Minimum Number of Trays	6.381
Actual Number of Trays	12.490
Optimal Feed Stage	8.488

Temperatures	
Condenser [C]	45.88
Reboiler [C]	139.7

Flows	
Rectify Vapour [Mscmd_*]	0.833
Rectify Liquid [Mscmd_*]	0.513
Stripping Vapour [Mscmd_*]	0.833
Stripping Liquid [Mscmd_*]	1.513
Condenser Duty [kW]	-7480.684
Reboiler Duty [kW]	10080.662

Como el problema no informa caudales, propuse un caudal molar de 1 MMSMCD

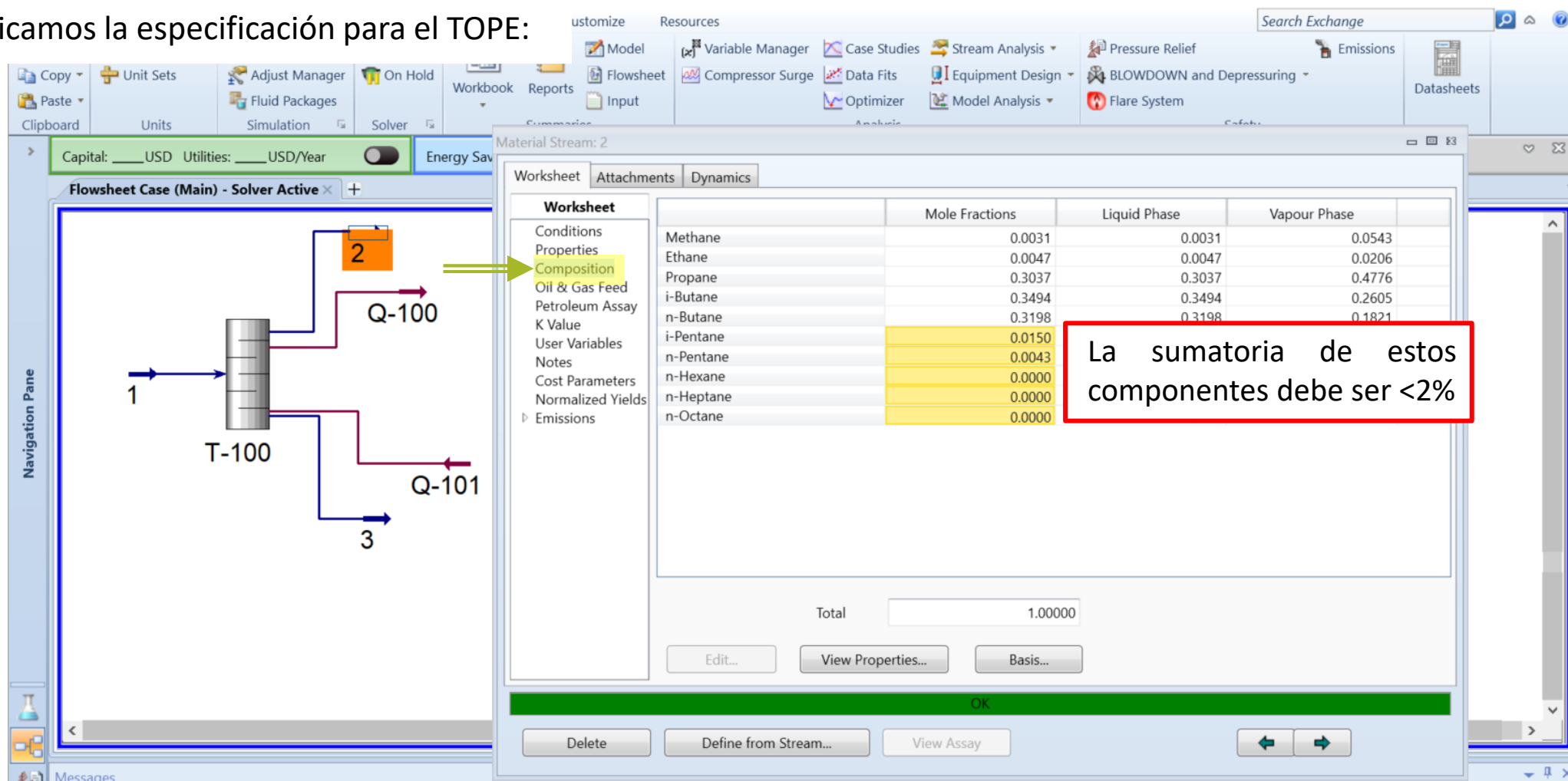
Nmin no se modifica al cambiar Rop; cambia el Nop

Las T extremas nos sirven para tener idea de los servicios que podremos usar para obtenerlas.

Como veníamos adelantando, los Q de Condensador y Reboiler no son iguales... ¿¿Por qué??

3. Estimar mediante la herramienta shortcut distillation el Nmin, Nop, Rmin, Rop:

Verificamos la especificación para el TOPE:



Material Stream: 2

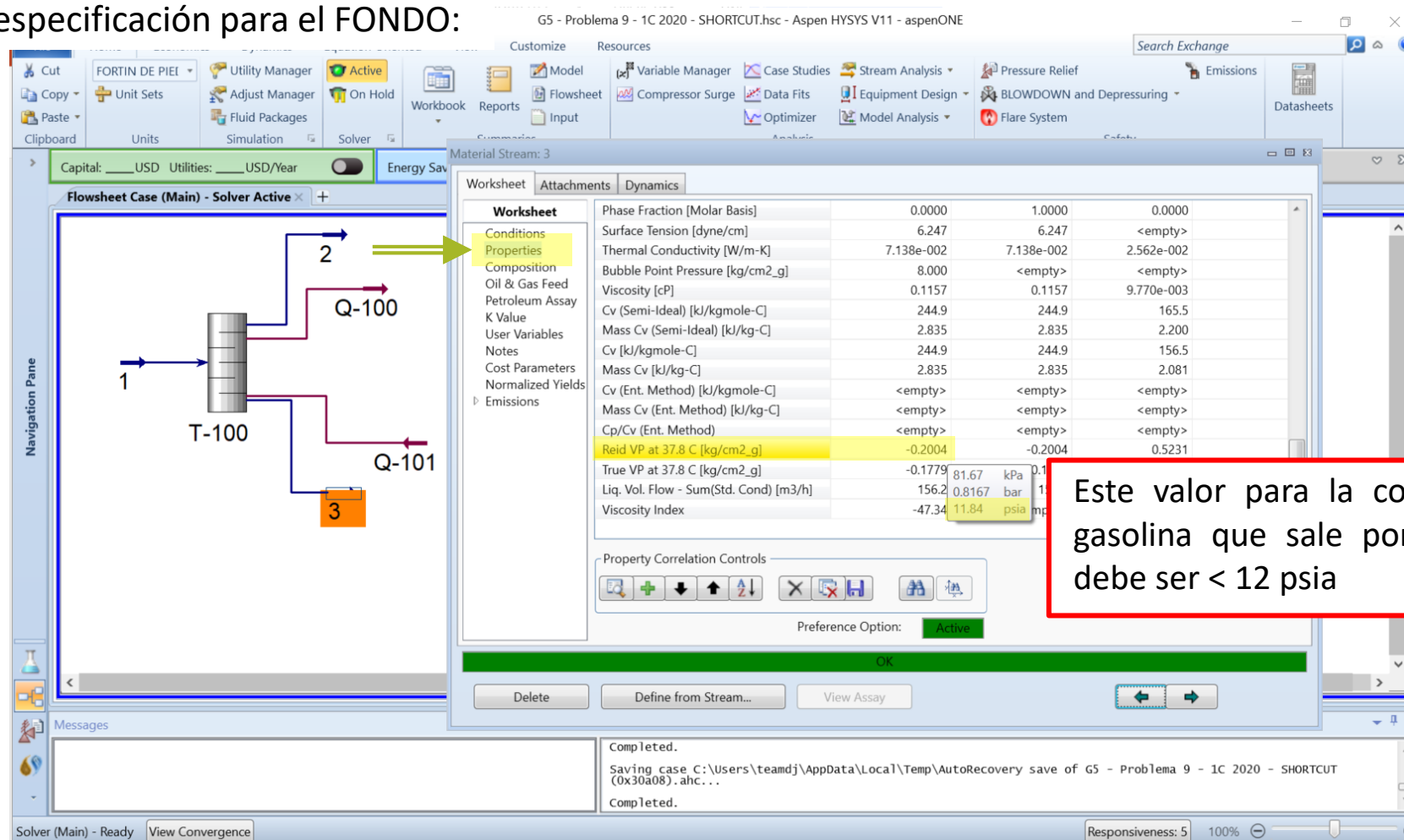
	Mole Fractions	Liquid Phase	Vapour Phase
Methane	0.0031	0.0031	0.0543
Ethane	0.0047	0.0047	0.0206
Propane	0.3037	0.3037	0.4776
i-Butane	0.3494	0.3494	0.2605
n-Butane	0.3198	0.3198	0.1821
i-Pentane	0.0150		
n-Pentane	0.0043		
n-Hexane	0.0000		
n-Heptane	0.0000		
n-Octane	0.0000		

Total: 1.00000

La sumatoria de estos componentes debe ser <2%

3. Estimar mediante la herramienta shortcut distillation el N_{min} , N_{op} , R_{min} , R_{op} :

Verificamos la especificación para el FONDO:



Este valor para la corriente de gasolina que sale por el fondo debe ser < 12 psia

3. Estimar mediante la herramienta shortcut distillation el Nmin, Nop, Rmin, Rop:

En resumen:

Rmin	Nmin	Rop	Nop
1,06	6,38	3	8,94
		2	10,72
		1,8	11,45
		1,6	12,49
		1,4	14,11
		1,2	17,03
		1,1	20,7

4. Verifique como se modificarían los valores anteriores eligiendo otros componentes llave

Components		
	Component	Mole Fraction
Light Key in Bottoms	n-Butane	0.0700
Heavy Key in Distillate	i-Pentane	0.0150

Pressures	
Condenser Pressure	8.000 kg/cm2_g
Reboiler Pressure	8.000 kg/cm2_g

Reflux Ratios	
External Reflux Ratio	1.600
Minimum Reflux Ratio	1.057

Minimum Number of Trays	6.381
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Temperatures	
Condenser [C]	45.88
Reboiler [C]	139.7

RVP = 11,8 psia

C5+ = 1,93%

Components		
	Component	Mole Fraction
Light Key in Bottoms	i-Butane	0.0700
Heavy Key in Distillate	i-Pentane	0.0150

Pressures	
Condenser Pressure	8.000 kg/cm2_g
Reboiler Pressure	8.000 kg/cm2_g

Reflux Ratios	
External Reflux Ratio	1.250
Minimum Reflux Ratio	0.822

Minimum Number of Trays	4.427
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Temperatures	
Condenser [C]	38.13
Reboiler [C]	124.1

RVP = 17,9 psia

C5+ = 2,1%

Components		
	Component	Mole Fraction
Light Key in Bottoms	n-Butane	0.0700
Heavy Key in Distillate	n-Pentane	0.0150

Pressures	
Condenser Pressure	8.000 kg/cm2_g
Reboiler Pressure	8.000 kg/cm2_g

Reflux Ratios	
External Reflux Ratio	1.300
Minimum Reflux Ratio	0.860

Minimum Number of Trays	4.742
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Temperatures	
Condenser [C]	47.24
Reboiler [C]	139.2

RVP = 12,18 psia

C5+ = 5,46%

4. Verifique como se modificarían los valores anteriores eligiendo otros componentes llave
Si llevamos al extremo cada columna para cumplir las especificaciones:

Components

	Component	Mole Fraction
Light Key in Bottoms	n-Butane	0.0700
Heavy Key in Distillate	i-Pentane	0.0150

Pressures

Condenser Pressure	8.000 kg/cm2_g
Reboiler Pressure	8.000 kg/cm2_g

Reflux Ratios

External Reflux Ratio	1.600
Minimum Reflux Ratio	1.057

Minimum Number of Trays

Minimum Number of Trays	6.381
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Temperatures

Condenser [C]	45.88
Reboiler [C]	139.7

RVP = 11,8 psia

C5+ = 1,93%

Components

	Component	Mole Fraction
Light Key in Bottoms	i-Butane	0.0200
Heavy Key in Distillate	i-Pentane	0.0150

Pressures

Condenser Pressure	8.000 kg/cm2_g
Reboiler Pressure	8.000 kg/cm2_g

Reflux Ratios

External Reflux Ratio	1.600
Minimum Reflux Ratio	1.052

Minimum Number of Trays

Minimum Number of Trays	6.328
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Temperatures

Condenser [C]	45.77
Reboiler [C]	139.4

RVP = 11,96 psia

C5+ = 1,94%

Components

	Component	Mole Fraction
Light Key in Bottoms	n-Butane	0.0700
Heavy Key in Distillate	n-Pentane	0.0042

Pressures

Condenser Pressure	8.000 kg/cm2_g
Reboiler Pressure	8.000 kg/cm2_g

Reflux Ratios

External Reflux Ratio	1.600
Minimum Reflux Ratio	1.058

Minimum Number of Trays

Minimum Number of Trays	6.400
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Temperatures

Condenser [C]	45.88
Reboiler [C]	139.7

RVP = 11,8 psia

C5+ = 1,9%

4. Verifique como se modificarían los valores anteriores eligiendo otros componentes llave
Tomando llaves más alejadas :

Components		
	Component	Mole Fraction
Light Key in Bottoms	n-Butane	0.0700
Heavy Key in Distillate	i-Pentane	0.0150

Components		
	Component	Mole Fraction
Light Key in Bottoms	Propane	0.0001
Heavy Key in Distillate	n-Butane	0.2130

Components		
	Component	Mole Fraction
Light Key in Bottoms	i-Pentane	0.1870
Heavy Key in Distillate	n-Hexane	0.0000

Pressures	
Condenser Pressure	8.000 kg/cm2_g
Reboiler Pressure	8.000 kg/cm2_g

Pressures	
Condenser Pressure	8.000 kg/cm2_g
Reboiler Pressure	8.000 kg/cm2_g

Pressures	
Condenser Pressure	8.000 kg/cm2_g
Reboiler Pressure	8.000 kg/cm2_g

Reflux Ratios	
External Reflux Ratio	1.600
Minimum Reflux Ratio	1.057

Reflux Ratios	
External Reflux Ratio	0.003
Minimum Reflux Ratio	0.002

Reflux Ratios	
External Reflux Ratio	0.410
Minimum Reflux Ratio	0.276

Minimum Number of Trays	6.381
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Minimum Number of Trays	9.170
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Minimum Number of Trays	8.640
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Temperatures	
Condenser [C]	45.88
Reboiler [C]	139.7

Temperatures	
Condenser [C]	40.28
Reboiler [C]	130.8

Temperatures	
Condenser [C]	49.03
Reboiler [C]	149.6

RVP = 11,8 psia

C5+ = 1,93%

RVP = 14,9 psia

C5+ = 0,09%

¿Qué significa que no pueda alcanzar las especificaciones?

RVP = 8,7 psia

C5+ = 2,5%



¿PREGUNTAS?