Aspen Plus® Getting Started!

Chemical Engineering Guy

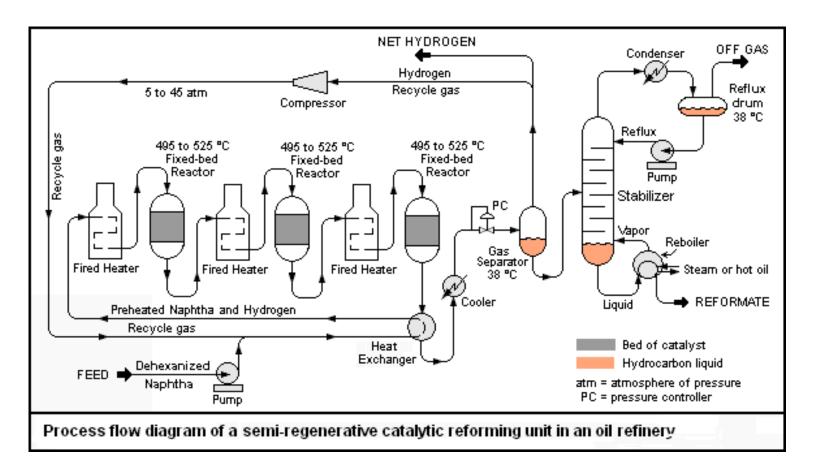
Chemical Che

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Solve this!

Change:

- All T of Reactors
- Feed Composition
- No. of Plates in Distl. Col
- T of Heat Ex
- Gas Sep. T
- Compressor P
- Utility Costs









And this....









Why Process Modeling/Simulation?

- Makes us easier/faster work
- Multiple and Simultaneous Simulations
- Different Real-Life Scenarios
 - Change on raw/feed materials scenario
- Pricing and Costs calculation
 - Raw Materials
 - Plant Cost
 - Utilities
- How it would behave under different conditions
 - High/Low Pressure
 - Humidity Changes
 - Temperature change (cool/warm days/seasons)





Which companies model?

- Mainly:
 - Petrochemical
 - Pharmaceutical
 - Fine chemicals
- Other commodities such as:
 - Sulfuric acids
 - Chlorine/Caustic industry
 - Solvents
 - Coatings
 - Many more...







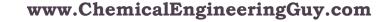
Other Advantages...

Excelent for your curriculum as an engineer

Perfect for analytical/numerical minds

Good for debuging and fixing "what if" scenarios



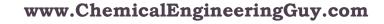




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- 2. Our Chemical Process!
- 3. Setting up the Physical Property Environment
- 4. Simulation Environment I The Flowsheet
- 5. Simulation Environment II Unit Operations
- 6. Running, Results & Analysis
- 7. Case Studies (A,B,C,D)
- 8. Conclusion





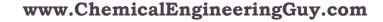


Course Objectives

Introductory Knowledge of Processes Modeling

- Setting the adequate Physical Properties
- General Flowsheet Concepts
- Basic Flowsheet "manipulation"
- Common Unit Operations
- Minimum Requirements to set up & run a Simulation
- Analyze several changes in process conditions
- Create an interest in Process Modeling







Contact

- Please contact me if required (doubts, questions, comments, suggestions)
 - <u>Contact@ChemicalEngineeringGuy.com</u>
- More courses...



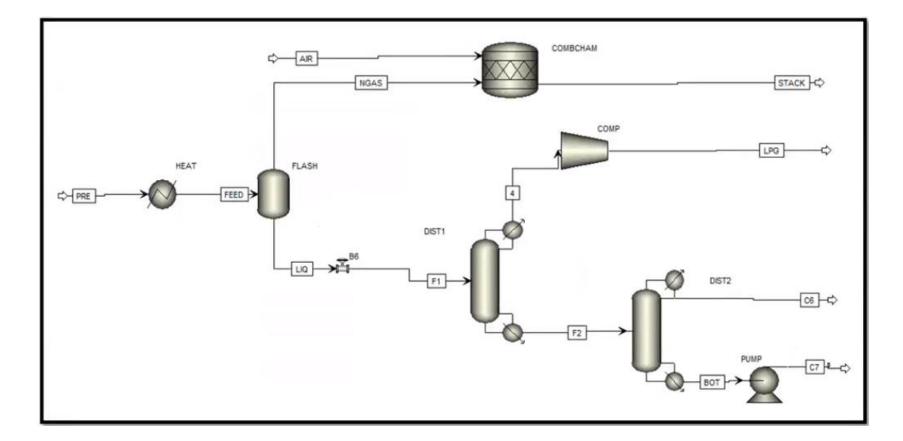


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2. Our Chemical Process!

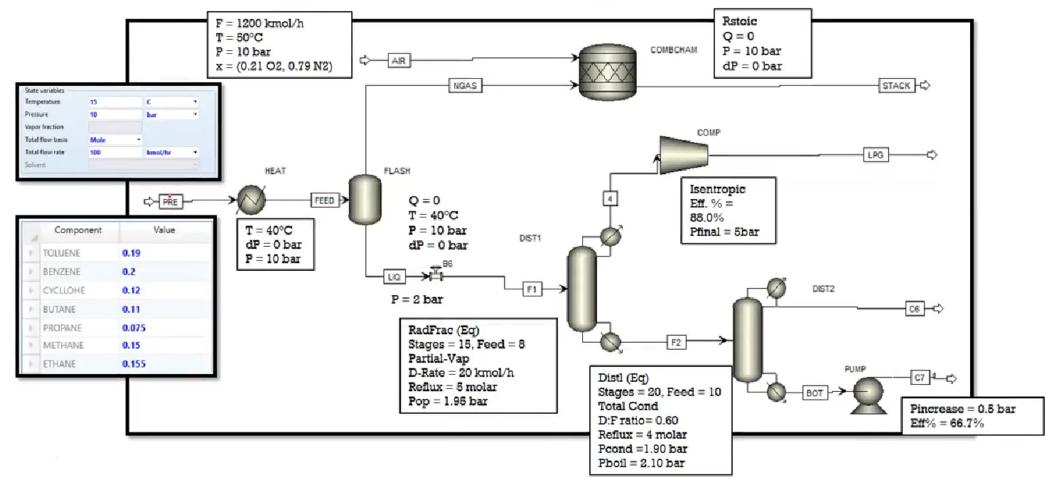








2. Our Chemical Process!



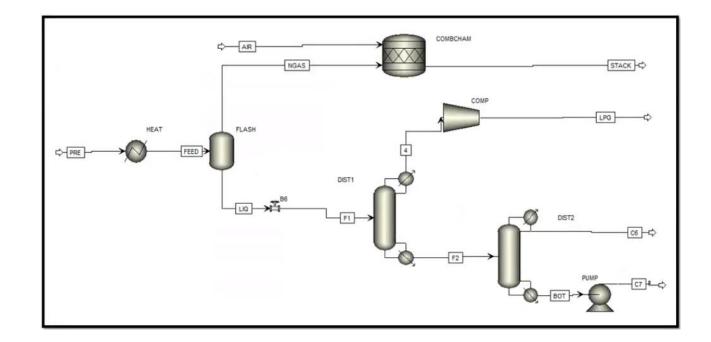




Conditions

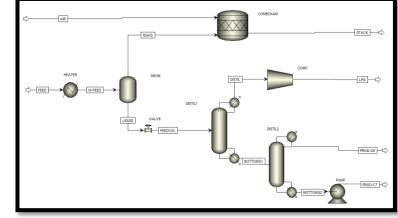
• Unit Operations

- Heat Exchange
 - Heat Exchanger
- Reaction Kinetics
 - Combustion Chamber / Reactor
- Momentum
 - Pump
 - Compressor
- Separation Process
 - Flash Drum
 - Distillation Columns



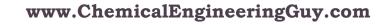






- A hydrocarbon feed rich in aromatics is to be separated via a series of separation processes.
- It is sent from a previous plant at ambient temperature (15°C) and pressurized to 10 bar.
- A total of 100 kmol/h must be treated
- Most of the hydrocarbons msut be recovered and the leftovers will be burnt in a combustion chamber.
- The combustion chamber will burn all hydrocarbons to form carbon dioxide. Assume 100% combustion. The air for combustion was previously adjusted to 50°C, 10bar. There is no pression loss in the combustion chamber.
- The liquified section must be de-pressurized in order to continue treatment. It drops to 2 bar via a valve.

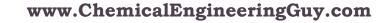


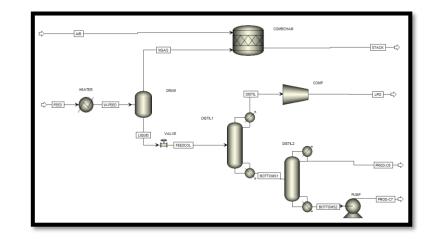




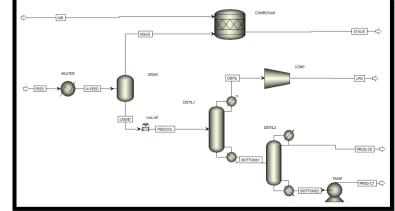
- This stream is then fed to a Distillation Column.
 - It currently has a total of 15 trays.
 - Feed tray must be between 7 and 8.
 - Recommended operation is partial vapor in order to avoid an extra stage. Reflux
 - Ratio is set to 5 (molar) and the approx.
 - Pressure drop is unknown, but can be assumed to be low or negligible.
 - At least 20% of the feed must be recovered for further treatment
- The Distillate is to be treated in a following process. It must be compressed to 5 bar. We use a compressor with approx. 88% efficiency. It can be modeled as an isentropic compression.







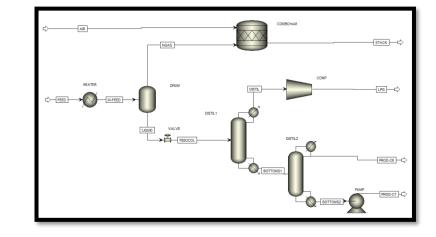




- The bottoms of this column are not pure enough. Further distillation is required.
- The following column requires a total of:
 - 20 trays feeding in 50% approx.
 - It uses a total condenser since the distillate is required as a liquid
 - Recommended Distillate recovery is 60%
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 - Condenser working ate 1.90 bar
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- The bottom must be further pressurized +0.5 bar in order to allow for pressure drop due to frictions. Efficiency of pump is 66.7%







- Requirements:
 - Model the plant using Aspen Plus in Steady State
 - Verify Material/Energy Balances of the unit operations & processes
 - Verify purity and composition of streams
 - Verify conditions such as T, P and Flow rates.
 - For specific unit operations, verify their relevant results
 - Heater \rightarrow Heat duty
 - Combustion Chamber \rightarrow T-max, Heat released by reaction
 - Compressor/Pump \rightarrow Required Work
 - For the Columns \rightarrow Reboiler & Condenser Duties



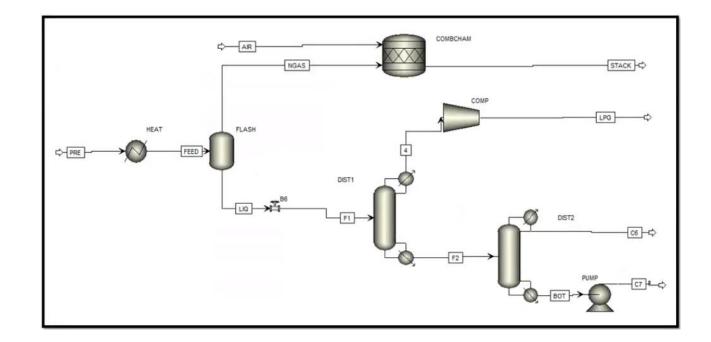




Conditions

• Unit Operations

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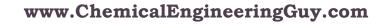




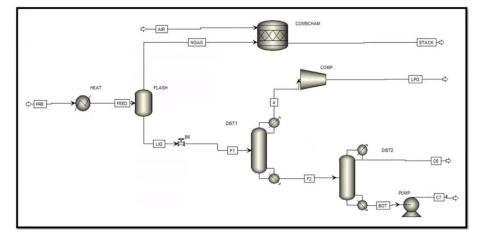
Pipes





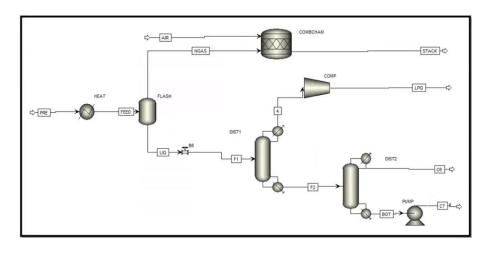








Flash Tank:





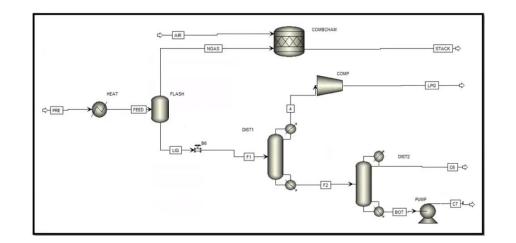








Combustion Chamber / Reactor





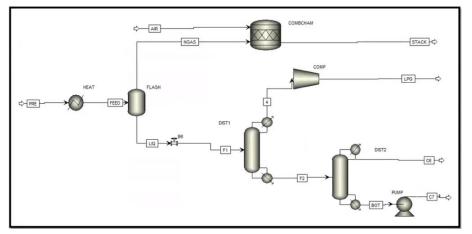




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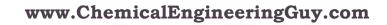
Distillation Columns







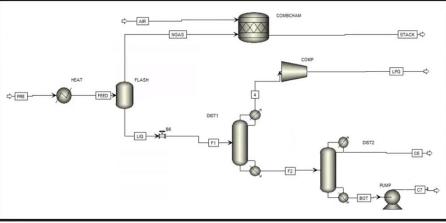




Compressor & Pump











Resources

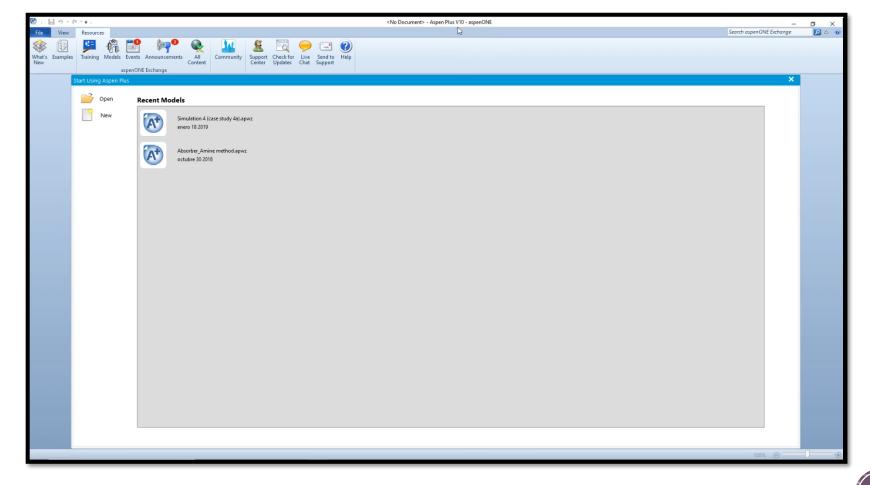
- PDF of Process diagram
- Spreadsheet with Unit Operations & Process conditions
- Spreadsheet with Component list & database





3. Physical Property Environment

Landing Page





3. Physical Property Environment

• Min. Requirements:

- Adding Components to the Component List
- Selecting a Physical Property Method (Thermodynamic pack)

- If you want to further explore this environment \rightarrow

Aspen Plus - Physical Properties

- Different Types of Components
- Methods (EOS, Activity, Mixed)
- Modeling new/inexistent components
- Physical & Chemical Property Analysis
- Thermodynamic & Transport Properties







Adding Components

- Add the following compounds to the "Component List"
 - Methane
 - Ethane
 - Propane
 - N-Butane
 - Cyclohexane
 - Benzene
 - Toluene
 - Oxygen
 - Nitrogen

ele	ct components			
	Component ID	Туре	Component name	Alias
Þ	METHANE	Conventional	METHANE	CH4
Þ	C2	Conventional	ETHANE	C2H6
Þ	PROPA-01	Conventional	PROPANE	СЗН8
Þ	N-BUTANE	Conventional	N-BUTANE	C4H10-1
Þ	CYCLOHEX	Conventional	CYCLOHEXANE	C6H12-1
Þ	BENZENE	Conventional	BENZENE	C6H6
ŀ	TOLUENE	Conventional	TOLUENE	C7H8
Þ	02	Conventional	OXYGEN	02
Þ	N2	Conventional	NITROGEN	N2
Þ				

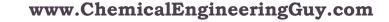




Choosing the Property Method

- Select Peng Robinson, as it is mostly non-polar system
 - Most models will be "set-up"
 - Pure substances Properties will be loaded
 - Binary Interactions are calculated
- Tip: Use the Method Assistant







Choosing the Property Method

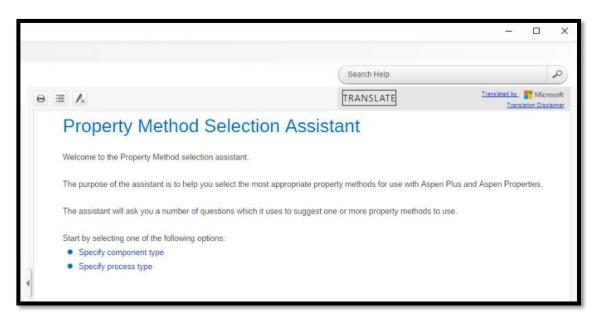
🚡 Copy 🖶 Unit Sets 👩	Setup Na ⁺ Chemistry Components & Customize Methods @ Prop Sets Navigate		meters	DECHEMA	Analysis Estimation Regression Run Mode	Next Run Reset	Control Panel
Properties	Is Navigate Tools Data Source Run Mode Run Methods - Specifications + Global Flowsheet Sections Referenced Comments Property methods & options Method filter ALL Base method Henry components Petroleum calculation options Free-water method STEAM-TA Water solubility 3 Electrolyte calculation options Electrolyte calculation options						
All Items		Referenced	Comment	ts			
 Components Methods Specifications Selected Methods Parameters Routes NC Props Tabpoly Chemistry Property Sets Data Estimation Analysis Customize Results 	Method filter ALL Base method Henry components Petroleum calculation option Free-water method STEAM Water solubility 3	• • • • •	UNIF-H UNIF-L UNIF-L UNIF-L UNIF-L UNIQ-2 UNIQ-7 UNIQ-1	HOC BY L C C 2 HOC NTH RK AC 2 HOC NT HOC	/an Laar/Nothnag Henry's law.	1 (A) -	th





Method Assistant...

A Paste Clipboard Units	Customize Resources etup Na ⁺ Chemistry omponents 2 Customize lethods @ Prop Sets Navigate /Methods - Specificati	Draw Structure Structure Tools	arameters 🛞 DECHEMA	Regression Next Run Reset	Control Panel
Properties All Items		et Sections Referenced options ALL ion options STEAM-TA 3 ion options	Method name UNIF-HOC UNIF-LBY UNIF-LL UNIFAC UNIQ-2 UNIQ-HOC UNIQ-NTH UNIQ-RK UNIQUAC VANL-2 VANL-POC VANL-NT VANL-RK	Methods Assistant	









Simulation Environment I: The Flowsheet

- Get to know what is a flowsheet and how to manipulate it.
- Menus, Tool, Areas, etc...
- Important:
 - General Setup
 - Blocks: Unit Operations, Others
 - Streams (Material, Heat, Work)
 - Analysis tools

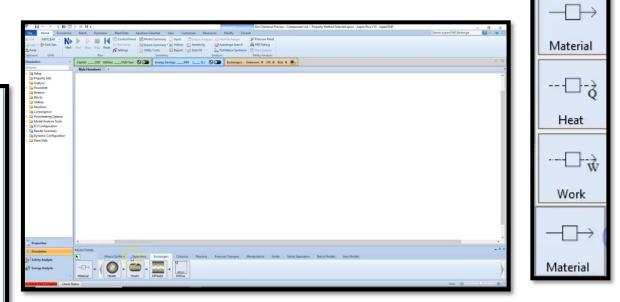




Simulation Environment I: The Flowsheet

- Manipulation of the Flowsheet:
 - Adding Unit Operations
 - Adding Material and Energy streams
 - Moving
 - Labeling
 - Rotating
 - Deleting
 - Copy and Pasting

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Outline Col	or		
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Preview -			
	S1]	
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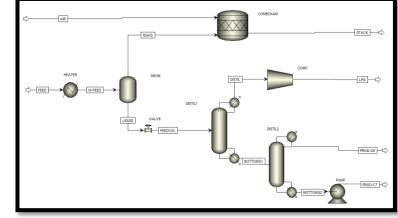
5. Simulation Environment II: Unit Operations

- Typical Unit Operations
- Adding UO
- Setting up
- Connecting streams
- Inlet/outlet



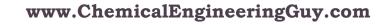






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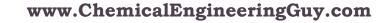


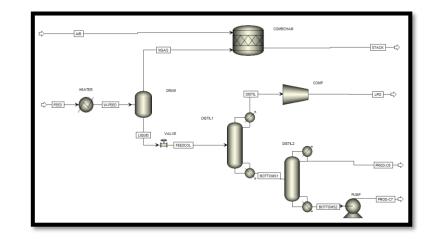




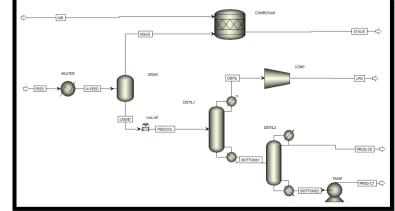
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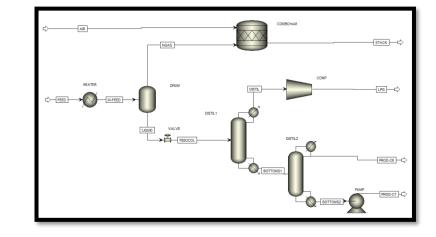




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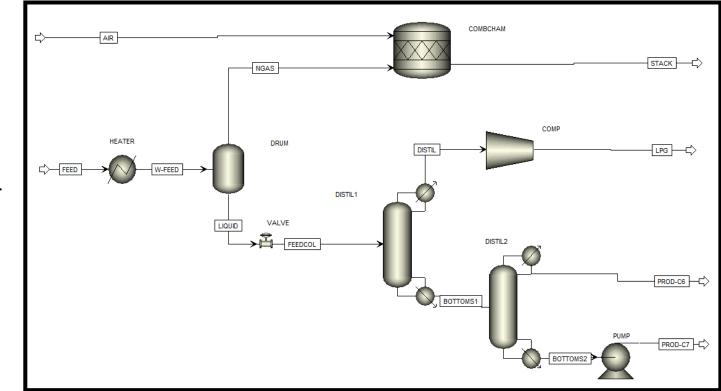




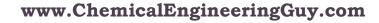
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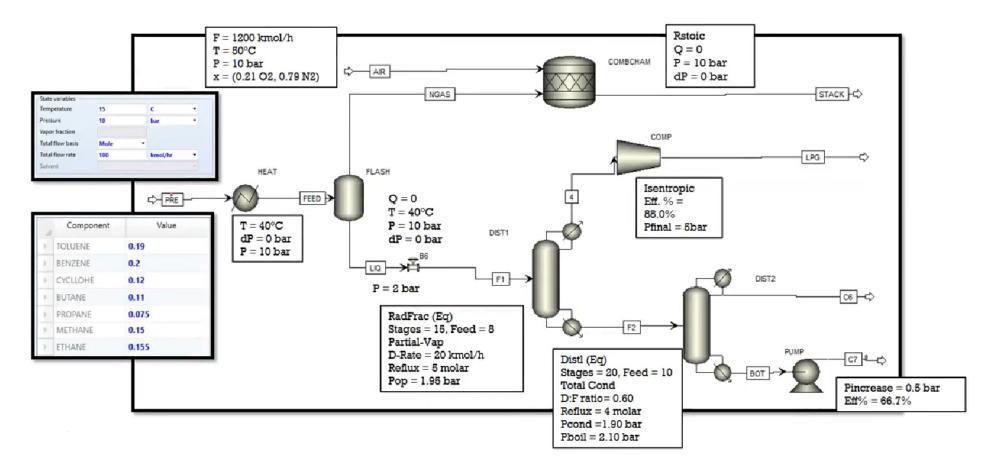








Lets try to build this:







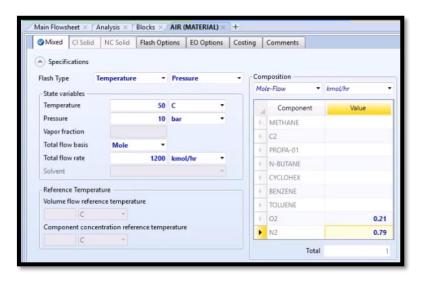
Streams

• Feed

- F = 100 kmol/h
- $T = 15^{\circ}C$
- P = 10 bar
- Comp:
 - Toluene 0.190
 - Benzene 0.200
 - Cyclohex 0.120
 - Butane 0.110
 - Propane 0.075
 - Methane 0.150
 - Ethane 0.155

- Air

- F = 1200 kmol/h
 T = 50°C
 P = 10 bar
 Comp:
 - 0.79 N2 • 0.21 O2



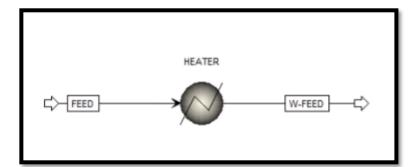




Blocks - Heat Exchanger



- $T = 40^{\circ}C$
- dP = 0 bar
- P = 10 bar



Specifications Flash Options	Utility	Comments				
sh specifications						
ash Type	Temp	Temperature				
	Press	ure		•		
mperature		40	с			
mperature change			С	7		
egrees of superheating			С			
egrees of subcooling			С			
ressure		10	bar	•		
ty			cal/sec			
or fraction						
essure drop correlation parame	ter					
Always calculate pressure dro	p correlatio	n parameter				
lid phases						
/apor-Liquid						

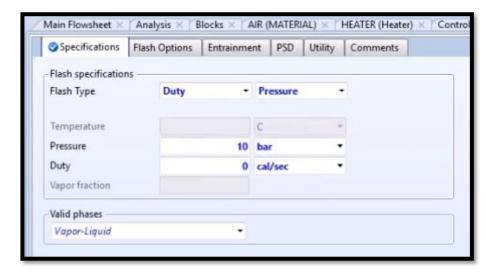




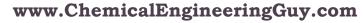


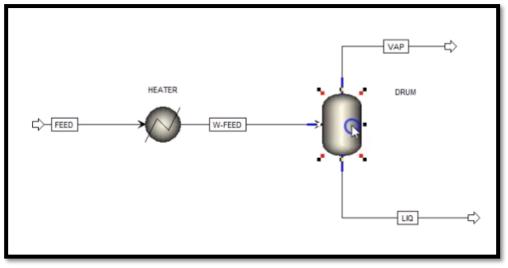
Blocks - Flash Drum

- Flash2
 - Q = 0
 - $T = 40^{\circ}C$
 - P = 10 bar
 - dP = 0 bar





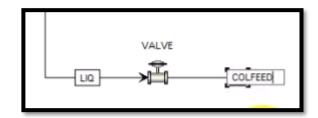






Blocks - Valve

ValveP = 2 bar

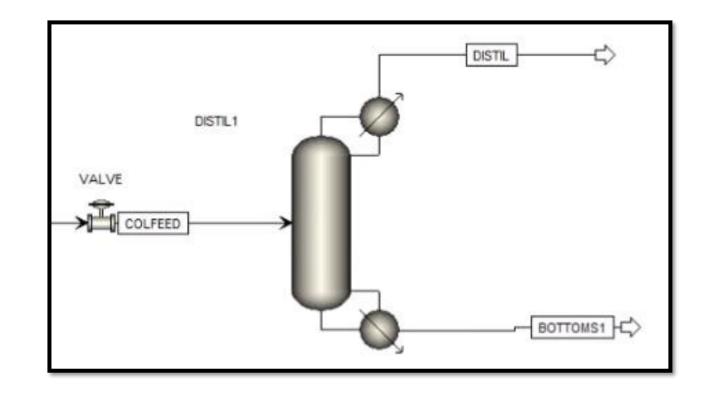


Operation	Valve Parameters	Calculation Optio	ns Pipe Fittings	Comments				
Calculation typ	e							
Adiabatic fla	sh for specified ou	tlet pressure (pressu	re changer)					
🔵 Calculate va	lve flow coefficient	for specified outlet	pressure (design)					
Calculate ou	tlet pressure for sp	ecified valve (rating)	1					
Pressure specifi	cation		Valve ope	Valve operating specification				
Outlet press	ure	2 bar	• © % Ope	Ø % Opening				
Pressure dro	Р	bar	O Flow c	oef				
Flash options -								
Valid phases	apor-Liquid		 Maximum 	iterations	30 🗘			





- RadFrac
 - Stages = 15
 - Feed = 8
 - Cond = Partial
 - D-Rate = 20 kmol/h
 - Reflux = 5 molar
 - P-reboiler = 1.95 bar







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Configuration	Streams	Pressure	Condenser	Reboiler	3-Phi	se Com	ments
etup options ——							
Calculation type			Equilibrium				
umber of stages			15 💮 Stage Wiza				
ondenser		i i	Partial-Vapor -				
eboiler		1	Kettle •				
alid phases		1	Vapor-Liquid •				
onvergence	gence Standard					-	
perating specificati	ions						
Distillate rate	20.005s	- 1	Mole	•	20	kmol/hr	•
Reflux ratio			Mole	•	5		
Free water reflux ratio			0				Feed Basis





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00	onfiguration	Streams	Pressure	Condenser	⊘Re	boiler 3-	Phase Com	ments			
eed	l streams —										
	Name	Stage		Convention							
•	COLFEED		8 Above-S	tage	-						
			Above-S	Stage N			ed between st	ages, above			
rod	luct streams		On-Stag Vapor Liquid	ge bi		lesignated s	tage.				
	Name	Stage	Phas	e	Basis	Flo	w l	Jnits Flo	w Ratio	Feed Specs	
	DISTIL	1	Vapor	Mole			kmol,	/hr		Feed basis	
-	BOTTOMS1	15	Liquid	Mole			kmol	/hr		Feed basis	
seu	ido streams —										
	Name	Pseudo Strea	im Stage	Internal Phas	e Reboi	iler Phase	Reboiler Conditions	Pumparound	Pumparound Conditions	Flow	Units



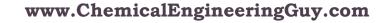




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Config	juration	Streams	@ Pressure	Condenser	Reboiler
View	Top /	Bottom		8.7	
Top stage	e / Conde	nser pressure -			
Stage 1 /	Condens	er pressure	1.95	i bar	•
Stage 2 p	ressure (o	ptional)			
Stage	2 pressure			bar	
Conde	enser pres	sure drop			
Pressure	drop for r	est of column	(optional)		
Stage	pressure	drop		bar	-
Colun	nn pressu	re drop		bar	



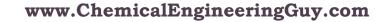




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Configuration	reams 🛛 🥝 Pressu	re 🕜 Co	ndenser	@Reboile	3-Phase	Comments
Condenser specification				43		
O Temperature			C		*	
Distillate vapor fractio	n	Mole			1	
Subcooling specification Subcooled temperature		•	C	;	•	
Both reflux and liquid Only reflux is subcoole		oled				
Utility specification —						
Utility					•	







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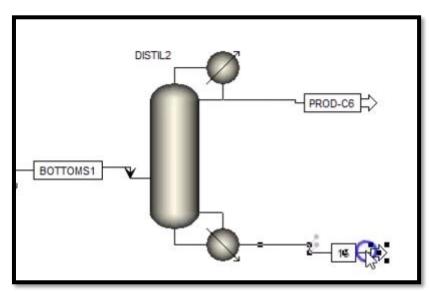
Configuration Streams	OPressure OC	ondenser ØReboiler	3-Phase Comments
Thermosiphon reboiler options —			
Specify reboiler flow rate			
Specify reboiler outlet condition	n		Reboiler Wizard
O Specify both flow and outlet co	ndition	-	
Flow rate		Outlet condition	
Mole *	kmol/hr *	Temperature	-
			C ~
Ontional			
Optional Reboiler pressure		bar	5 5
Reboiler return feed convention	Above-Sta		
Utility	MDOVE-Stai	<u>}</u> =	
Reboiler configurations			
NT-1	NT-1	1	NT-2
★ 1			
	TK I		
	6 6		
() Junin	() m		
NT	NT	1 T	NT
	U.		NT-I
		Le	
Circulation without baffle	O Circulation with the second seco	ith baffle 🛛 🔿 C	irculation with auxiliary baff



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- Distil
 - Stages = 20
 - Feed = 10
 - Cond = Total
 - D:F Ratio = 0.60
 - Reflux = 4 molar
 - P-cond = 1.90 bar
 - P-reboiler = 2.10 bar

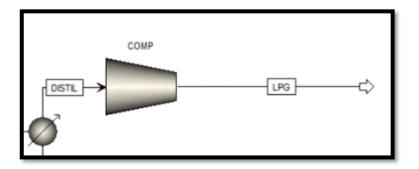


Specifications Converge	nce Commer	its		
Column specifications ——				
Number of stages		20 🤤		
Feed stage		10 🗘		
Reflux ratio		4		
Distillate to feed mole ratio		0.6		
Condenser type	Total	•		
Pressure specifications				
Condenser pressure	1.9	bar	•	
Reboiler pressure	21	bar		



Blocks - Compressor

- Compr
 - Type = Isentropic
 - Eff = 88%
 - P-final = 5 bar



Specifications	Calculation Options	Power Loss	Convergence	Integration Parameters	1
Model and type —		T			
Model © Con Type Isentr	npressor 🔘	Turbine		-	
in the second					
Outlet specification		Tanan			
O Discharge press		bar	~		
Pressure increase	e	bar	*		
Pressure ratio					
Power required		kW	*		
O Use performance	e curves to determin	e discharge con	ditions		
Efficiencies	e curves to determin	e uscharge con	JURITS		
Isentropic	.88 Polytropic	Me	chanical		

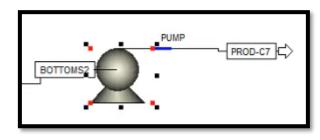




Blocks - Pump

Pump

- Type = Isentropic
- Eff = 66.7%
- P-increse = 0.5 bar



Specifications	Calculation Options	Flash Opti	ons Utility	Comments
1odel				
Pump	e	Turbine		
ump outlet speci	fication			
) Discharge press	sure	bar		*
Pressure increa	se	0.5 bar		•
Pressure ratio				
Power required		kW		-
Use performan	ce curve to determine	discharge co	nditions	
				<u></u>
fficiencies				
ump	0.667	Driver		

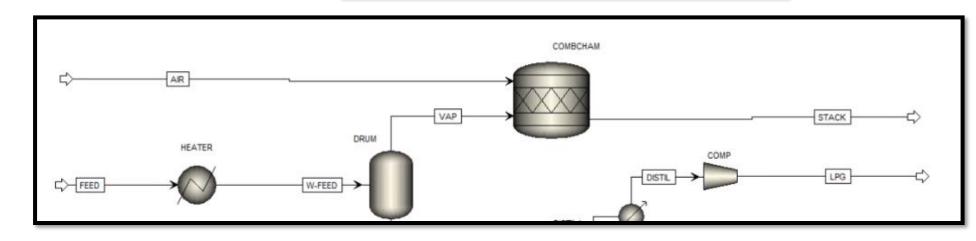




Blocks - Combustion Chamber

- RSTOIC
 - Type = Stoichiometry
 - Q = 0
 - P = 10 bar
 - dP = 0 bar

Specifications	Reactions	Combustio	n Heat of I	Reaction	Selectivity	PSD	
Operating condition							
Flash Type	Pressure	e •	Duty	•			
Temperature			С				
Pressure		0	bar	-			
Duty		0	cal/sec	•			
Vapor fraction							
Valid phases							
Vapor-Liquid							







Blocks - Combustion Chamber

RXN

- CH4 + 2O2 = CO2 + 2H2O
- C2H6 + 7O2 = 4CO2 + 6H2O
- C3H8 + 5O2 = 3CO2 + 4H2O
- 2C4H10 + 13O2 = 8CO2 + 10H2O
- C6H12 + 6O2 = 3CO2 + 6H2O
- 2C6H6 + 15O2 = 12CO2 + 6H2O
- C7H8 + 9O2 = 7CO2 + 4H2O

	ecification	s 🛛 🕜 Reactions	Combustion	Heat of Reaction	Selectivity	1.00	Component Attr.	Utility Comments	
	tions —				T. Same	- Transier			
	Rxn No.	Specification	type	Molar extent	Units	Fract	ional conversion	Fractional Conversion of Component	Stoichiometry
• 1	1	Frac. conversion			kmol/hr		1	METHANE	METHANE + 2 O2> CO2(MIXED) + 2 H2O(MIXED)
2	2	Frac. conversion			kmol/hr		1	C2	2 C2 + 7 O2> 4 CO2(MIXED) + 6 H2O(MIXED)
3	3	Frac. conversion			kmol/hr		1	PROPA-01	PROPA-01 + 5 O2> 3 CO2(MIXED) + 4 H2O(MIXED)
4	4	Frac. conversion			kmol/hr		1	N-BUTANE	2 N-BUTANE + 13 O2> 8 CO2(MIXED) + 10 H2O(MIXED)
5	5	Frac. conversion			kmol/hr		1	CYCLOHEX	CYCLOHEX + 9 O2> 6 CO2(MIXED) + 6 H2O(MIXED)
e	5	Frac. conversion			kmol/hr		1	BENZENE	2 BENZENE + 15 02> 12 CO2(MIXED) + 6 H2O(MIXED)
7	7	Frac. conversion			kmol/hr		1	TOLUENE	TOLUENE + 9 O2> 7 CO2(MIXED) + 4 H2O(MIXED)
			New	dit Delete	Co	py	Paste		





Save File!



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Running, Results & Analysis

- Running the simulation
 - Errors & Debugging
- Getting Results
 - Stream Results
 - Block Results
- Analysis
 - What if Scenarios







Running the Simulation

Error Messages

Results Summary - Run Status × PUMP (Pump) - Setup × VAP (MATERIAL) - Results (Default) × Main Flowsheet × Analysis × Blocks × AIR (MATERIAL) × HEATER (Heater) × Control Panel × DRUM (Flash2) × VALVE (Valve) × DISTIL1 (RadFrac) × DISTIL2 (Distl) × +
Summary Status
Convergence status
Property status
Aspen Plus messages:
The following messages were issued during Input Translation:
* WARNING IN THE 'STREAM' PARAGRAPH WHICH BEGINS ON LINE 156 STREAM NAME: AIR
COMPONENT MOLE FLOWS OF SUBSTREAM: 'MIXED' ARE NORMALIZED TO THE TOTAL MOLE FLOW VALUE.
* WARNING IN THE 'STREAM' PARAGRAPH WHICH BEGINS ON LINE 160
STREAM NAME: FEED COMPONENT MOLE FLOWS OF SUBSTREAM: 'MIXED'
ARE NORMALIZED TO THE TOTAL MOLE FLOW VALUE.



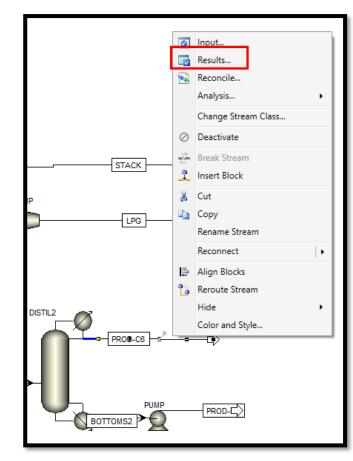


Getting Stream Results

Heat Load Work Vol.% Curves	Wt. % Curves	Petroleum Polymers	Solids										(3
	Units	BOTTOMS1 -	BOTTOMS2 -	COLFEED -	DISTIL -	FEED -	LIQ -	LPG -	PROD-C6 -	PROD-C7 -	STACK -	VAP +	W-FEED -
Molar Density	mol/cc	0.00887379	0.00816443	0.000651575	8.15994e-05	0.0015948	0.0101947	0.000193645	0.00934497	0.00816398	9.22889e-05	0.000408329	0.00122446
Mass Density	gm/cc	0.753306	0.74826	0.0483167	0.00388533	0.0956828	0.755973	0.00922034	0.751204	0.748219	0.00263436	0.0113674	0.0734636
Enthalpy Flow	cal/sec	4918.25	37762.7	-188442	-135027	-378537	-188442	-131514	-30424	37774.7	-113942	-166711	-355152
Average MW		84.8911	91.6487	74.1537	47.6147	59.9968	74.1537	47.6147	80.3859	91.6487	28.5447	27.8388	59.9968
+ Mole Flows	kmol/hr	49.4333	19.7733	69.4333	20	100	69.4333	20	29.66	19.7733	1242.66	30.5667	100
- Mole Fractions													
METHANE		7.64126e-22	0	0.0142686	0.0495358	0.15	0.0142686	0.0495358	0	0	0	0.458318	0.15
C2		6.79459e-16	0	0.0662011	0.229828	0.155	0.0662011	0.229828	0	0	0	0.35671	0.155
PROPA-01		2.01073e-12	0	0.062759	0.217878	0.075	0.062759	0.217278	3.35121e-12	0	0	0.102806	0.075
N-BUTANE		1.24588e-08	0	0.130493	0.453029	0.11	0.130493	045302)	2.07647e-08	0	0	0.063449	0.11
CYCLOHEX		0.233528	0.0234228	0.170325	0.0141078	0.12	0.170325	0.0141078	0.373598	0.0234228	0	0.00568554	0.12
BENZENE		0.383983	0.0217369	0.283637	0.0356162	0.2	0.283637	0.0356162	0.625481	0.0217369	0	0.0100147	0.2
TOLUENE		0.382489	0.95484	0.272316	5.45676e-06	0.19	0.272316	5.45676e-06	0.000921004	0.95484	0	0.00301676	0.19
02		0	0	0	0	0	0	0	0	0	0.122971	0	0
N2		0	0	0	0	0	0	0	0	0	0.762878	0	0
CO2		0	0	0	0	0	0	0	0	0	0.0454879	0	0
H20		0	0	0	0	0	0	0	0	0	0.0686636	0	0
 Mass Flows 	kg/hr	4196.44	1812.2	5148.74	952.294	5999.68	5148.74	952.294	2384.25	1812.2	35471.4	850.941	5999.68
 Mass Fractions 													
Volume Flow	l∕min	92.8451	40.3647	1776.04	4085	1045.06	113.512	1721.36	52.8983	40.367	224415	1247.63	1361.15
Vapor Phase													
Liquid Phase													
d properties>													

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Getting Stream Results



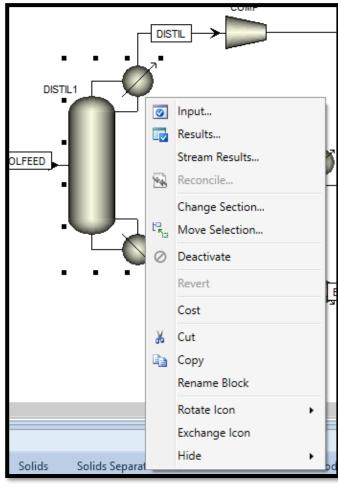
	11-2-	
	Units	PROD-C6 -
 MIXED Substream 		
Phase		Liquid Phase
Temperature	С	102.643
Pressure	bar	1.9
Molar Vapor Fraction		0
Molar Liquid Fraction		1
Molar Solid Fraction		0
Mass Vapor Fraction		0
Mass Liquid Fraction		1
Mass Solid Fraction		0
Molar Enthalpy	cal/mol	-3692.74
Mass Enthalpy	cal/gm	-45.9376
Molar Entropy	cal/mol-K	-82.6706
Mass Entropy	cal/gm-K	-1.02842
Molar Density	mol/cc	0.00934497
Mass Density	gm/cc	0.751204
Enthalpy Flow	cal/sec	-30424
Average MW		80.3859
- Mole Flows	kmol/hr	29.66
METHANE	kmol/hr	0
C2	kmol/hr	0
PROPA-01	kmol/hr	9.93969e-11
N-BUTANE	kmol/hr	6.1588e-07
CYCLOHEX	kmol/hr	11.0809

		Units	PROD-C6 -
– Mole F	lows	kmol/hr	29.66
ME	THANE	kmol/hr	0
C2		kmol/hr	0
PRO	OPA-01	kmol/hr	9.93969e-11
N-E	BUTANE	kmol/hr	6.1588e-07
CYC	CLOHEX	kmol/hr	11.0809
BEN	NZENE	kmol/hr	18.5517
TOI	LUENE	kmol/hr	0.0273169
02		kmol/hr	0
N2		kmol/hr	0
CO	2	kmol/hr	0
H20	0	kmol/hr	0
– Mole F	ractions		
ME	THANE		0
C2			0
PRO	OPA-01		3.35121e-12
N-E	BUTANE		2.07647e-08
CYC	CLOHEX		0.373598
BEN	NZENE		0.625481
TOI	LUENE		0.000921004
02			0
N2			0
CO	2		0
H20	0		0



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Getting Block Results



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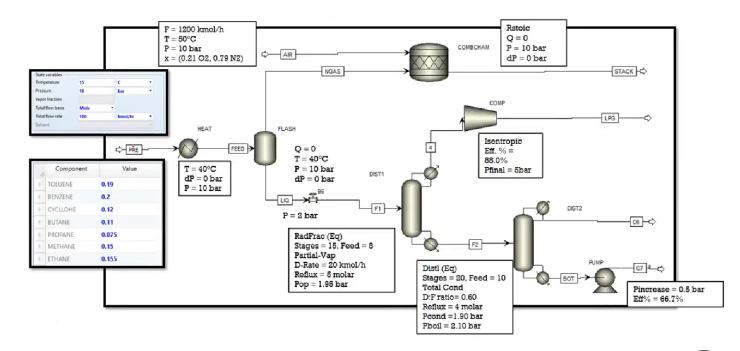
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Sum	imary	Balance	Split Fraction	Reboiler	Utilities	Stage	Utilities	🕜 Status	
Basis	Mol	e	•						
-Cor	ndenser	/ Top stag	e performance –						
			Name		Value		U	nits	
	Temp	erature			2	5.3431	С		
	Subco	oled temp	erature						
	Heat	duty			-2	27468	cal/sec		
	Subco	oled duty							≡
	Distill	ate rate				20	kmol/hr		
	Reflux	rate				100	kmol/hr		
	Reflux	ratio				5			
	Free v	vater distilla	ate rate						
	Free v	vater reflux	ratio						•
Reb	oiler /	Bottom sta	ge performance						
			Name		Value		U	nits	
	Temp	erature			1	13.747	С		
	Heat	duty			2	85802	cal/sec		
	Botto	ms rate			49	9.4333	kmol/hr		
	Boilu	o rate			14	42.104	kmol/hr		
	Boilu	o ratio			2.	87466			
	Botto	ms to feed	ratio						



Analysis

- Manual "what if" cases
 - Change several inputs to get new outputs
 - Change of T Heat
 - Change of P valve
 - Change of P Reactor
 - Changer of Reflux Dist1
 - Change of Stages Dist2







My results

Compare your results with mine:

	Units	STACK -	LPG -	PROD-C6 -	PROD-C7
Mole Flows	kmol/hr	1242.66	20	29.66	19.773
METHANE	kmol/hr	0	0.990716	0	
C2	kmol/hr	0	4.59656	0	
PROPA-01	kmol/hr	0	4.35757	9.93969e-11	
N-BUTANE	kmol/hr	0	9.06057	6.1588e-07	
CYCLOHEX	kmol/hr	0	0.282155	11.0809	0.4631
BENZENE	kmol/hr	0	0.712325	18.5517	0.429
TOLUENE	kmol/hr	0	0.000109135	0.0273169	18.88
02	kmol/hr	152.811	0	0	
N2	kmol/hr	948	0	0	
CO2	kmol/hr	56.5261	0	0	
H2O	kmol/hr	85.3257	0	0	
Mole Fractions					
METHANE		0	0.0495358	0	
C2		0	0.229828	0	
PROPA-01		0	0.217878	3.35121e-12	
N-BUTANE		0	0.453029	2.07647e-08	
CYCLOHEX		0	0.0141078	0.373598	0.02342
BENZENE		0	0.0356162	0.625481	0.02173
TOLUENE		0	5.45676e-06	0.000921004	0.954
02		0.122971	0	0	
N2		0.762878	0	0	
CO2		0.0454879	0	0	
H2O		0.0686636	0	0	





CASEA - Change of T Heat

• Change T = 40° C to T = 30° C of Heater

	Units	STACK -	LPG -	PROD-C6 -	PROD-C7
Mole Flows	kmol/hr	1242.66	20	29.66	19.7733
METHANE	kmol/hr	0	0.990716	0	0
C2	kmol/hr	0	4.59656	0	0
PROPA-01	kmol/hr	0	4.35757	9.93969e-11	0
N-BUTANE	kmol/hr	0	9.06057	6.1588e-07	0
CYCLOHEX	kmol/hr	0	0.282155	11.0809	0.463146
BENZENE	kmol/hr	0	0.712325	18.5517	0.42981
TOLUENE	kmol/hr	0	0.000109135	0.0273169	18.8804
O2	kmol/hr	152.811	0	0	0
N2	kmol/hr	948	0	0	0
CO2	kmol/hr	56.5261	0	0	0
H2O	kmol/hr	85.3257	0	0	0
Mole Fractions					
METHANE		0	0.0495358	0	0
C2		0	0.229828	0	C
PROPA-01		0	0.217878	3.35121e-12	C
N-BUTANE		0	0.453029	2.07647e-08	0
CYCLOHEX		0	0.0141078	0.373598	0.0234228
BENZENE		0	0.0356162	0.625481	0.0217369
TOLUENE		0	5.45676e-06	0.000921004	0.95484
02		0.122971	0	0	0
N2		0.762878	0	0	0
C02		0.0454879	0	0	0
H2O		0.0686636	0	0	0

	Units	STACK -	LPG 🝷	PROD-C6 -	PROD-C7 -
Mole Flows	kmol/hr	1238.26	20	31.0797	20.7198
METHANE	kmol/hr	0	1.15624	0	0
C2	kmol/hr	0	5.47187	1.00933e-10	0
PROPA-01	kmol/hr	0	4.92073	3.38701e-06	0
N-BUTANE	kmol/hr	0	8.45116	1.1446	5.72647e-12
CYCLOHEX	kmol/hr	0	3.8388e-10	10.985	0.909186
BENZENE	kmol/hr	0	3.52203e-09	18.9357	0.877564
TOLUENE	kmol/hr	0	5.43581e-14	0.0144238	18.933
02	kmol/hr	164.364	0	0	0
N2	kmol/hr	948	0	0	0
C02	kmol/hr	49.3783	0	0	0
H2O	kmol/hr	76.5157	0	0	0
Mole Fractions					
METHANE		0	0.0578118	0	0
C2		0	0.273593	3.24757e-12	0
PROPA-01		0	0.246037	1.08978e-07	0
N-BUTANE		0	0.422558	0.0368278	2.76377e-13
CYCLOHEX		0	1.9194e-11	0.353447	0.0438801
BENZENE		0	1.76102e-10	0.609262	0.0423539
TOLUENE		0	2.71791e-15	0.000464093	0.913765
02		0.132738	0	0	0
N2		0.765592	0	0	0
C02		0.0398773	0	0	0
H2O		0.061793	0	0	0





CASE B - Change of P valve

Change Pressure of Valve

- P = 1 bar
- P = 5 bar

	Units	STACK -	LPG 👻	PROD-C6 -	PROD-C7
Mole Flows	kmol/hr	1242.66	20	29.66	19.7733
METHANE	kmol/hr	0	0.990716	0	0
C2	kmol/hr	0	4.59656	0	0
PROPA-01	kmol/hr	0	4.35757	9.93969e-11	0
N-BUTANE	kmol/hr	0	9.06057	6.1588e-07	C
CYCLOHEX	kmol/hr	0	0.282155	11.0809	0.463146
BENZENE	kmol/hr	0	0.712325	18.5517	0.42981
TOLUENE	kmol/hr	0	0.000109135	0.0273169	18.8804
02	kmol/hr	152.811	0	0	C
N2	kmol/hr	948	0	0	C
C02	kmol/hr	56.5261	0	0	C
H20	kmol/hr	85.3257	0	0	C
Mole Fractions					
METHANE		0	0.0495358	0	C
C2		0	0.229828	0	(
PROPA-01		0	0.217878	3.35121e-12	C
N-BUTANE		0	0.453029	2.07647e-08	C
CYCLOHEX		0	0.0141078	0.373598	0.0234228
BENZENE		0	0.0356162	0.625481	0.0217369
TOLUENE		0	5.45676e-06	0.000921004	0.95484
02		0.122971	0	0	C
N2		0.762878	0	0	C
CO2		0.0454879	0	0	C
H2O		0.0686636	0	0	C

No Drastic Change



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CASE C - Change of P Reactor

Change Pressure of Reactor

- P = -5bar
- P = 1bar

	Units	STACK -	LPG 🝷	PROD-C6 -	PROD-C7 -
Mole Flows	kmol/hr	1242.66	20	29.66	19.7733
METHANE	kmol/hr	0	0.990716	0	0
C2	kmol/hr	0	4.59656	0	0
PROPA-01	kmol/hr	0	4.35757	9.93969e-11	0
N-BUTANE	kmol/hr	0	9.06057	6.1588e-07	0
CYCLOHEX	kmol/hr	0	0.282155	11.0809	0.463146
BENZENE	kmol/hr	0	0.712325	18.5517	0.42981
TOLUENE	kmol/hr	0	0.000109135	0.0273169	18.8804
02	kmol/hr	152.811	0	0	0
N2	kmol/hr	948	0	0	0
CO2	kmol/hr	56.5261	0	0	0
H2O	kmol/hr	85.3257	0	0	0
Mole Fractions					
METHANE		0	0.0495358	0	0
C2		0	0.229828	0	0
PROPA-01		0	0.217878	3.35121e-12	0
N-BUTANE		0	0.453029	2.07647e-08	0
CYCLOHEX		0	0.0141078	0.373598	0.0234228
BENZENE		0	0.0356162	0.625481	0.0217369
TOLUENE		0	5.45676e-06	0.000921004	0.95484
02		0.122971	0	0	0
N2		0.762878	0	0	0
CO2		0.0454879	0	0	0
H2O		0.0686636	0	0	0



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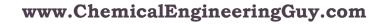


CASE D - Change of Reflux Dist2

Change Reflux Ratio from 4 to 2 and/or 6 and/or 15

	Units	STACK -	LPG -	PROD-C6 -	PROD-C7
- Mole Flows	kmol/hr	1242.66	20	29.66	19.773
METHANE	kmol/hr	0	0.990716	0	(
C2	kmol/hr	0	4.59656	0	(
PROPA-01	kmol/hr	0	4.35757	9.93969e-11	
N-BUTANE	kmol/hr	0	9.06057	6.1588e-07	
CYCLOHEX	kmol/hr	0	0.282155	11.0809	0.46314
BENZENE	kmol/hr	0	0.712325	18.5517	0.4298
TOLUENE	kmol/hr	0	0.000109135	0.0273169	18.880
02	kmol/hr	152.811	0	0	
N2	kmol/hr	948	0	0	
CO2	kmol/hr	56.5261	0	0	
H2O	kmol/hr	85.3257	0	0	
Mole Fractions					
METHANE		0	0.0495358	0	
C2		0	0.229828	0	
PROPA-01		0	0.217878	3.35121e-12	
N-BUTANE		0	0.453029	2.07647e-08	
CYCLOHEX		0	0.0141078	0.373598	0.023422
BENZENE		0	0.0356162	0.625481	0.021736
TOLUENE		0	5.45676e-06	0.000921004	0.9548
02		0.122971	0	0	
N2		0.762878	0	0	
CO2		0.0454879	0	0	
H2O		0.0686636	0	0	(



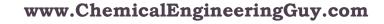




Course Closure

- 1. Introduction
- 2. Our Chemical Process!
- 3. Setting up the Physical Property Environment
- 4. Simulation Environment I The Flowsheet
- 5. Simulation Environment II Unit Operations
- 6. Running, Results & Analysis
- 7. Case Studies
- 8. Conclusion





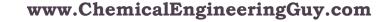


Course Closure

Introductory Knowledge of Processes Modeling

- General Flowsheet Concepts
- Setting the adequate Physical Properties
- Basic Flowsheet "manipulation"
- Minimum Requirements to set up & run a Simulation
- Common Unit Operations
- Create an interest in Process Modeling



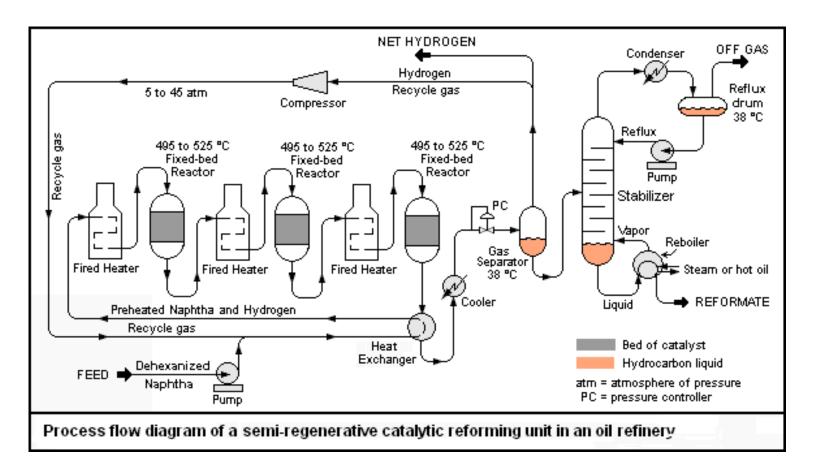




Solve this!

Change:

- All T of Reactors
- Feed Composition
- No. of Plates in Distl. Col
- T of Heat Ex
- Gas Sep. T
- Compressor P
- Utility Costs







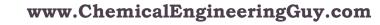


What's Next?

- Typically, you will follow your training with
 - Basic Course
- What do you learn there:
 - More on Aspen Plus
 - More on Physical Property Environment
 - Flowsheet techniques
 - More Unit Operations
 - Analysis Tools
 - Plenty Workshops
 - Process & Industry Case Studies





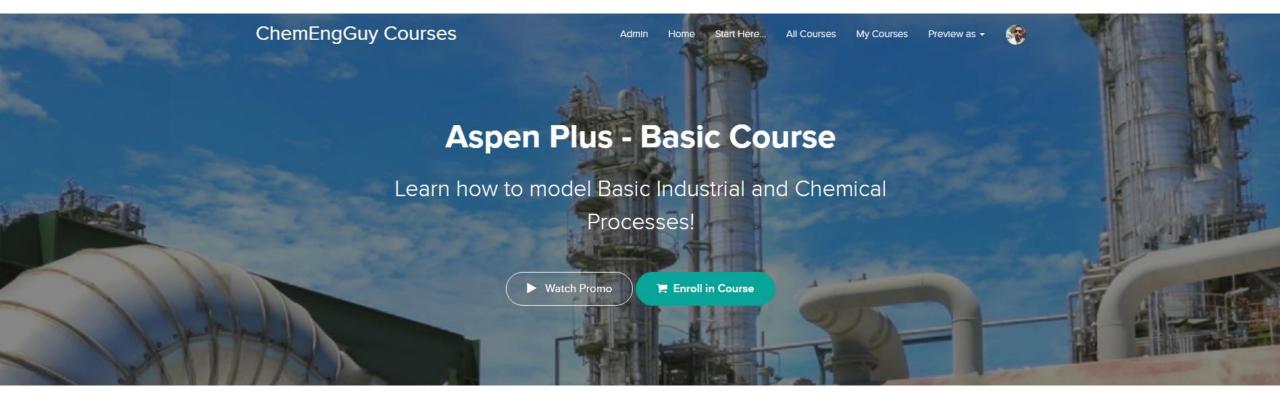




For my students!

• Aspen Plus – Basic Course!

1 Month Free Trial then \$8.00 USD/month





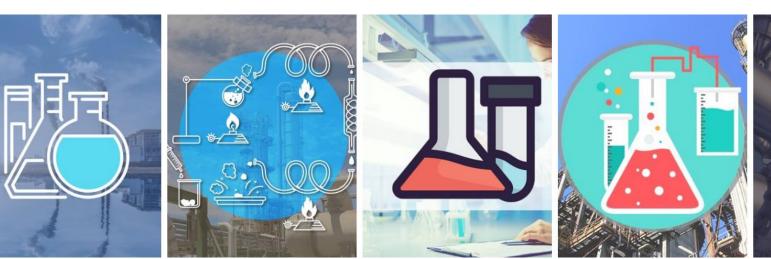
www.ChemicalEngineeringGuy.com



For my students!

• Aspen Plus – Training Bundle includes:

- Aspen Plus Getting Started
- Aspen Plus Basic Course
- Aspen Plus Physical Properties
- Aspen Plus Intermediate Course
- Aspen Plus Boot camp: 12 Case studies
- All other new upcoming Aspen Plus courses







10%