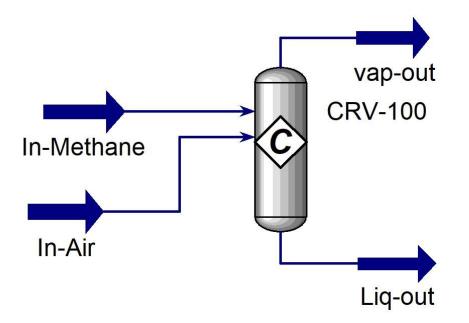
Conversion Reaction Using HYSYS V9

The reaction of methane with air producing hydrogen and carbon oxides is called the partial oxidation. Such kind of processes can be modeled using the conversion reaction in Aspen HYSYS V9. It is possible to perform more than one reaction in one group according to the given rank in order to operate them either sequentially or simultaneously. In this subject, it is intended to learn how to add and work with the reactors including setting up the reactions as well as giving the stoichiometry and the conversion of the basis reactant.



The figure above shows a simple model of the conversion reactor with its inlet, outlet streams using Aspen HYSYS V.9.

Example:

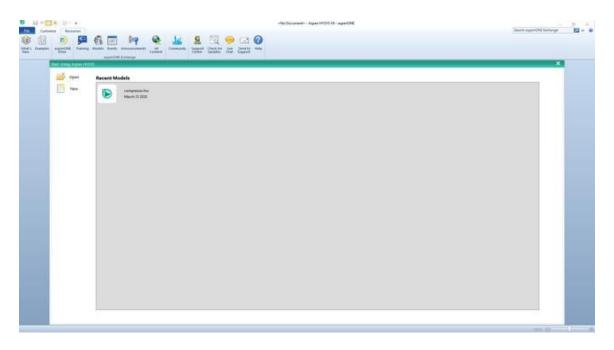
Hydrogyn production from hydrocarbon is an enabling technology. The fuel is converted to hydrogyn by the partial oxidation. The reaction of Methane with air producing the carbon oxides and the hydrogyn is an example of the partial oxidation.

> $CH_4 + \frac{1}{2}O_2 \rightarrow CO + 2H_2$ $CH_4 + O_2 \rightarrow CO_2 + 2H_2$

Model the partial oxidation of methane to produce hydrogyn [1].

Solution:

- Starting HYSYS:
 - 1. Start menu.
 - 2. Type in the search field: Aspen HYSYS V9.
 - 3. Select open.



The above window will pop up once you start HYSYS. It is possible by the Aspen HYSYS start window to open previous cases or create a new case.

- Create a new case:
- 1. File menu
- 2. New $\$ case
- There are two main necessary information have to be given in the properties tab before starting the simulation:
 - 1. Property package : Peng-Robinson
 - 2. Components: CH₄, O₂, N₂, CO, CO₂, H₂
- 1. Properties
- 2. Component lists \setminus Add
- 3. Select: Pure components
- 4. Type in the serach field Ch_4
- 5. Select $Ch_4 \setminus add$
- 6. Repeat the steps (4,5) for N_2 , CO, CO₂, O₂ and H₂

w- 🧐 🙆	Ca Reactions	Map Components Update Properties	Fetroleum Assays Refining 12	Hypotheticals Manager Convert Remove Duplicates Hypotheticals	Cil Manager	Convert to Refining Asse	Definit		PVT Laboratory Measurements PVT Data					
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Fluid Packages	Component	Type		Group			Search for:	h2		Search by:	Full Name/Synonym	•		
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					Replace			H252O3		H2520	в н	25203		
								H2504		H250	4	H2504		
								2-Heptanol		Heptanol-	2 07	7H160		
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								CetyiC1cryla	Hexadecane_2-N	lethyLPropensic_A.	C20H	H38O2		
								Cety/C1cryla	Hexadecy[_2-8	dethyl-2-Propenoat	e C20H	H38O2		
								Caprolactam	Hea	ahydro-2-Azepinon	e C6H	111NO		
								14-CC6DiC1ol	Hexahydro-2-Oxo	-1,4_Cyclohexaned.	CBP	H16O2		
								Caprolactam	Hexahyo	Iro-2H-Azepin-2-on	e C6H	311NO		
								Di2C2C6Adipa		(_bis(2-Ethylhexyl)e.		H4204		
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- Add fluid package:
 - 1. Select Fluid package
 - 2. Click Add
 - 3. Select (Peng-Robinson)
- Adding reactions
 - 1. Properties \ Reactions \ add
 - 2. Add Reaction $\$ conversion $\$ Add reaction

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- 3. Double click on the added (Rxn-1)
- 4. Enter the related information according to what are given in the example.

iometry Info			Basis	
Component	Mole Weight	Stoich Coeff	Base Component	Methane
Methane	16.043	-1.000	Rxn Phase	Overall
Oxygen	32.000	-0.500	Co	<empty></empty>
CO	28.011	1.000	C1	<empty></empty>
Hydrogen	2.016	2.000	C2	<empty></empty>
			Conversion (%) = Co + C1*T + C2*T^2 (T in Kelvin)	
	Balance Error	0.00000		
Balance		-3.6e+04 kJ/kgmole		
Balance	Reaction Heat (25 C)	site of heying inde		

5. Basis

6.	Enter the	information	as shown	below:
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chiometry Info			Basis	
Component	Mole Weight	Stoich Coeff	Base Component	Methane
Methane	16.043	-1.000	Rxn Phase	Overall
Oxygen	32.000	-0.500	Co	40.00
CO	28.011	1.000	C1	<empty></empty>
Hydrogen	2.016	2.000	C2	<empty></empty>
			(T in Kelvin)	
Balance	Balance Error	0.00000		
balarice	Reaction Heat (25 C)	-3.6e+04 kJ/kgmole		

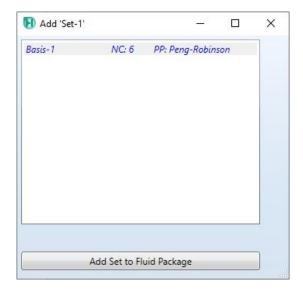
7. Enter the below information regarding the second reaction:

Component Mole Weight Stoich Coeff Base Component Methane 16.043 -1.000 Rxm Phase Oxygen 32.000 -1.000 Co CO2 44.010 1.000 Co	Methane Overall 60.00
Oxygen 32,000 -1,000 Co CO2 44,010 1,000 C1	
CO2 44,010 1.000 C1	60.00
44.010	
	<empty></empty>
Hydrogen 2.016 2.000 C2	<empty></empty>
Add Comp Conversion (%) = Co + C1*T + C2*T^2	
Balance Error 0.00000	
Balance Reaction Heat (25 C) -3.2e+05 kJ/kgmole	

8. Click on Ranking and make the sequential as shown below:

Reaction	Rank	User Spec	
Rxn-1	0		
Rxn-2	1	1	

- Attach the reaction set to a fluid package:
 - 1. Click (Add to FP)
 - 2. Select the desired fluid package
 - 3. Click (Add Set to fluid package)



Now we are ready to enter the simulation environment.

A Cut 🔂 👗	tomze Resources in Methods Assistant Chapter Components in Resources in Methods Assistant Chapter Components in Resources in Methods Assistant Chapter Components in Methods Assistant Chapter	• AL R Accedute Rold Parkses	HISTS 19 - appendix Pri absenter Pri Data	— 0 aspenONE Exhange 🛛 🕼	× •
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69 Energy Analysis	Optional Info : 1 @Main - Unknown Compositions Optional Info : 1 @Main - Unknown Temperature Optional Info : 1 @Main - Unknown Pressure Optional Info : 1 @Main Unknown Flow Rate	Saving case completed.	C:\UsersUMSINC-3\AppData\Local\Temp\AutoRecovery save of Noname (0xb059e).ahc		
				1009 @	

- Create new material stream:
 - 1. Select simulation.
 - 2. Object palette.
 - 3. Select the material stream icon.

Alternatively, you can add new material stream by pressing F11.

- 4. Double click on the added material stream
- 5. Give the below information:

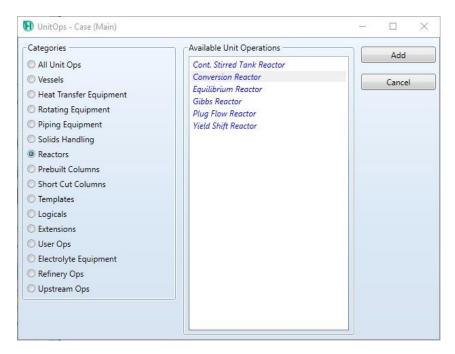
Name	In-Methane
Cond	itions
Temperature	20 ^o C
Pressure	3 bar
Molar flow	100 kgmole/h
Comp	osition
C1	1

1. Add second material stream:

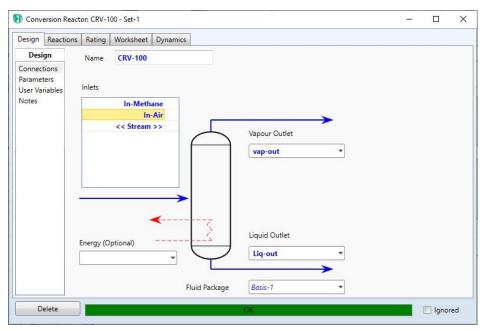
Name	In-Air
Cond	itions
Temperature	20 ^o C
Pressure	3 bar
Molar flow	250 kgmole/h
Comp	osition
N ₂	0.79
O ₂	0.21

The above information should be given according to the application or example.

- Adding Conversion reactor:
 - 1. Press F12
 - 2. Select reactors
 - 3. Select conversion reactor
 - 4. Click (Add)



- 5. Place the selected unit in the desired position.
- 6. Double click on the added conversion reaction.
- 7. $Design \setminus Connection$
- 8. In the Inlets field select (In-Methane, In-Air)
- 9. In the field of Vapour outlet type (Vap-out) [a new material stream will be created and connected to the reactor]
- 10.In the field of Liquid outlet type (Liq-out) [a new material stream will be created and connected to the reactor]



11.Reactions \ Reaction set 12.Select (Set-1)

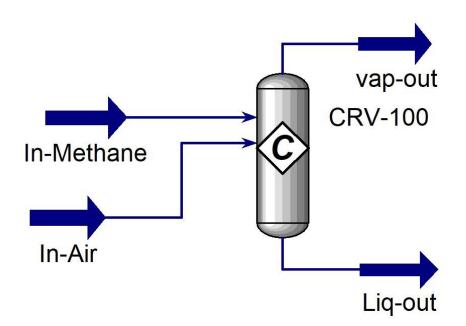
Design Re	actions Rating	Worksheet	Dynamics	SI					
Reactions	Conversion Re	action Details							
Details Results	Reaction Set	Set-1	Set-1		Reaction	ion Rxn-1		-	
	Stoichiome	etry 🔘 B	asis	Conve	rsion %	V	iew Reaction)	
	Stoichiome	try Info			- m			n l	
	Con	nponent		Mole Wg	t	Stoich Coeff			
		М	ethane		16.043		-1.000		
		(Dxygen		32.000		-0.500		
			CO		28.011		1.000		
			drogen		2.016		2.000		
	-	**Add C	omp						
			Balance Error				0.00000		
			Reactio	n Heat (25 C)	k.	-3.6e+04	kJ/kgmole		

13.Select Worksheet.

14.Read the desired results and compositions.

- **15.Select Reactions**
- 16. Select the reaction (Rxn-2).
- 17.Repeat the steps (13,14).

Design React	ions Rating	Worksheet	Dynamics				
Worksheet	Name			In-Methane	In-Air	Liq-out	vap-out
Conditions	Vapour			1.0000	1.0000	0.0000	1.0000
Properties	Temperature [C]			20.00	20.00	817.1	817.1
Composition Pressure [kPa]		300.0	300.0	300.0	300.0		
PF Specs	Molar Flow [kgmole/h]			100.0	250.0	0.0000	442.5
	Mass Flow [kg/h]			1604	7213	0.0000	8817
	Std Ideal Liq Vol Flow [m3/h]			5.358	8.338	0.0000	15.65
	Molar Enthalpy [kJ/kgmole]			-7.513e+004	-170.6	-1.708e+004	-1.708e+004
	Molar Entropy [kJ/kgmole-C]			173.8	142.1	189.1	189.1
	Heat Flow [kJ/h]			-7.513e+006	-4.266e+004	-0.0000	-7.556e+006



- Save the case:
- 1. File menu
- 2. Select save as
- 3. Give the name (Conversion Reaction)

References:

1. Hamid, M. K. A. "Hysys: An introduction to chemical engineering simulation." *Apostila de Hamid* (2007).

Equation Of State in HYSYS V9

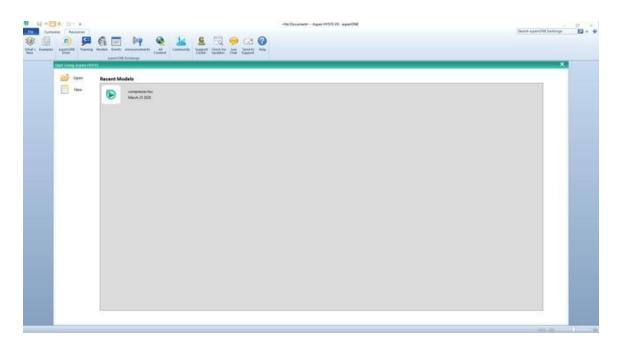
It is possible to find the molar volume of a mixture of material using an equation of state. Aspen HYSYS V9 give an access to several packages like Peng-Robinson (PR) equation of state which can fit with various operation processes. In this subject, it is intended to learn how to determine the specific volume of a mixture of materials at the given conditions and analyze a certain property with a range of independent values using Case Study utility in HYSYS V9.

Example:

A material stream of i-pentane with flow rate of 100kgmole\h. What is the molar volume at 300 K and 25 atm (use equation of state of Peng – Robinson) [1].

Solution:

- Starting HYSYS:
 - 1. Start menu.
 - 2. Type in the search field: Aspen HYSYS V9.
 - 3. Select open.



The above window will pop up once you start HYSYS. It is possible by the Aspen HYSYS start window to open previous cases or create a new case.

- Create a new case:
- 1. File menu
- 2. New \setminus case
- There are two main necessary information have to be given in the properties tab before starting the simulation:
 - 1. Property package : Peng-Robinson
 - 2. Components: i-pentane
- 1. Properties
- 2. Component lists \setminus Add
- 3. Select: Pure components
- 4. Type in the serach field i-pentane

Component Lists Petkages Novigat	ar Methods Assistant Chab Components Beckcion Component List - 1	etes Oll Com Manager Refinin	g Assay 🔄 Options Meas	aborstory urements T Data			
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l Packages oleum Assays	Component Type Group		Search for:	Search by:	Full Name/Synonym)	
tions ponent Maps	i-Pentane Pure Component			and the second se		<u>.</u>	
Properties			Simulation Name	Full Name / Synonym	Formula		
		< Add	Methane		1 CH4		
			Ethane		2 C2H6 3 C3H8		
		Replace	Propane				
			i-Butane	i-C			
			n-Butane	n-6			
		Remove	n-Pentane	m-0	5 C5H12 6 C6H14		
			n-Hexane n-Heptane		7 C7H16		
			n-Neptane n-Octane		28 C8H18		
					8 C8H18 9 C9H20		
			n-Nonane	c.			
			n-Decane n-C11	0			
			n-C12 n-C13	c			
			n-C14	c			
			n-C15	c			
			n-C16	c			
			n-C17	c			
			n-C18	C			
			n-C19	c			
			n-C20	c			
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- Add fluid package:
 - 1. Select Fluid package
 - 2. Click Add
 - 3. Select (Peng-Robinson)

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	ASME Steam Sman K10	EOS Solution Methods	Cubic EOS Analytical Method		
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	Chao Seader Chion Mult	Surface Tension Method	HYSYS Method		
	Clean Fuels Pila	Thermal Conductivity	API 12A3.2-1 Method		
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	Esso Tabular Extended NRTL				
	GCEDS				
	General NRTL # Glycol Package				
	Groyson Steend				
	Kobadi-Donner Lee-Kesier-Piacker				
	MOINR				
	NBS Steam NRTL				
	Deng-Robinson				
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- Create new material stream:
 - 1. Select simulation.
 - 2. Object palette.
 - 3. Select the material stream icon.

Alternatively, you can add new material stream by pressing F11.

- 4. Double click on the added material stream
- 5. Give the below information:

Name	i-pentane					
Cond	itions					
Temperature	300 k					
Pressure	25 atm					
Molar flow	100 kgmole/h					
Compo	Composition					
i-pentane	1					

The above information should be given according to the application or example.

Conditions Vapour / Phase Fraction 0.0000 1.0000 Properties Temperature [C] 26.85 26.85 Composition Pressure [kPa] 2533 2533 Oil & Gas Feed Molar Flow [kgmole/h] 100.0 100.0 Petroleum Assay K Value Mass Flow [kg/h] 7215 7215 User Variables Molar Enthalpy [k//kgmole] -1.792e+005 -1.792e+005 Notes Molar Enthalpy [k//kgmole-C] 37.47 37.47 Normalized Yields Heat Flow [k/h] -1.792e+007 -1.792e+007	
Composition Oil & Gas Feed Petroleum Assay K Value User Variables Pressure [kPa] 2533 2533 Oil & Gas Feed Petroleum Assay K Value Molar Flow [kgmole/h] 100.0 100.0 User Variables Std Ideal Liq Vol Flow [m3/h] 7215 7215 Notes Molar Enthalpy [kl/kgmole] -1.792e+005 -1.792e+005 Cost Parameters Molar Entropy [kl/kgmole-C] 37.47 37.47	
Oil & Gas Feed Petroleum Assay K Value User Variables Molar Flow [kgmole/h] 100.0 100.0 Molar Flow [kg/h] 100.0 100.0 100.0 100.0 100.0 User Variables Molar Flow [kg/h] 7215 7215 7215 Notes Molar Enthalpy [kl/kgmole] -1.792e+005 -1.792e+005 Cost Parameters Molar Entropy [kl/kgmole-C] 37.47 37.47	
Molar How [kgmole/h] 100.0 100.0 Petroleum Assay K Value Mass Flow [kg/h] 7215 7215 User Variables Std Ideal Liq Vol Flow [m3/h] 11.57 11.57 Notes Molar Enthalpy [kl/kgmole] -1.792e+005 -1.792e+005 Cost Parameters Molar Entropy [kl/kgmole-C] 37.47 37.47	
K Value Mass Flow [kg/h] 7/215 7/215 User Variables Std Ideal Liq Vol Flow [m3/h] 11.57 11.57 Notes Molar Enthalpy [kl/kgmole] -1.792e+005 -1.792e+005 Cost Parameters Molar Entropy [kl/kgmole-C] 37.47 37.47	
User Variables Std Ideal Liq Vol Flow [m3/h] 11.57 11.57 Notes Molar Enthalpy [kl/kgmole] -1.792e+005 -1.792e+005 Cost Parameters Molar Entropy [kl/kgmole-C] 37.47 37.47	
Cost Parameters Molar Entropy [kJ/kgmole-C] 37.47 37.47	
New Perd Weld	
Normalized Yields Heat Flow [kJ/h] -1.792e+007 -1.792e+007	
Liq Vol Flow @Std Cond [m3/h] 11.51 11.51	
Fluid Package Basis-1	
Utility Type	

- Working with Workbook:
 - 1. From the Home toolbar, click on workbook

Alternatively, press Ctrl+w

Cut SI ~ Copy* do Unit Sets poste* pboard Units	Process Utility Manager Trackive	Workbook Model Summary Flowsheet Summary Input Summaries	Search aspend	ressure Relief	
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ltems	Capital Cost Utility Cost	Available Energy Sa	vings	Unknown OK	
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🔯 UnitOps	USD USD/Year Off	MW % o	f Actual Off		
Co Streams	Flowsheet Case (Main) - Solver Active × Workbook	× +			
📷 Stream Analysis 📷 Equipment Design	Material Streams Compositions Energy Streams U	nit Ops			
📷 Model Analysis 📷 Data Tables	Name	i-pentane	** New **		
Strip Charts	Vapour Fraction	0.0000			
Case Studies	Temperature [C]	26.85			
📷 Data Fits	Pressure [kPa]	2533			
	Molar Flow (kgmole/h)	100.0			
	Mass Flow [kg/h]	7215			
	Liquid Volume Flow [m3/h]	11.57			
	Heat Flow [kJ/h]	-1.792e+007			
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	FeederBlock_i-pentane		Inclu	de Sub-Flowsheets v Name Only of Hidden Objects: 0	

There is no molar volume in the workbook.

2. From the workbook toolbar, click on Setup

Norkbook Tabs	Add	- Tab Conte - Object -	nts		1
Compositions Energy Streams	Delete	Name:	Material Streams		Order
Unit Ops	Delete	Туре:	Material Str	ream	New Type
		Variable	i		
			Variable	Format	Use Set
			Vapour Fraction	1.4 fixed	
			Temperature	4 sig fig	Add
			Pressure	4 sig fig	
			Molar Flow	4 sig fig	Delete
			Mass Flow	4 sig fig	
			Liquid Volume Flow	4 sig fig	Format
			Heat Flow	4 sig fig	
					Order
					Blank Line

- 3. Highlight Material streams
- 4. Variables \setminus Add

5. Select Molar volume $\setminus Add \setminus Done$

		Q	Selected		
☑ Input ☑ Output Physical Type All	Mass Lower Heating Value Master Comp Mass Flow Master Comp Mass Frac Master Comp Molar Flow Master Comp Molar Flow Master Comp Volume Flo Master Comp Volume Frac Molar Density Molar Entropy Molar Entropy Molar Entropy Molar Flow Molar Volume	e w c	Molar Volume		
	Molecular Weight Normalized Yields (Fractic Normalized Yields (Mixed) _			

- 6. Close the setup window.
- 7. Read the Molar volume

File Home Economics	Dynamics View Customize Resources	Workbook	Search aspen	ONE Exchange		1
Show Subflowsheet Objects	Workbook Pages Pages Excel					
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Strip Charts	Vapour Fraction	0.0000				
Case Studies	Temperature [C]	26.85				
Lo Data His	Pressure [kPa]	2533				
	Molar Flow [kgmole/h]	100.0				
	Mass Flow [kg/h]	7215				
	Liquid Volume Flow [m3/h]	11.57				
	Heat Flow [kl/h]	-1.792e+007				
	Molar Volume [m3/kgmole]	0.1168				
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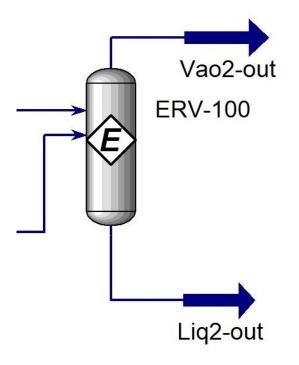
- Save the case:
- 1. File menu
- 2. Select save as
- 3. Give the name (equation of State)

References:

1. Hamid, M. K. A. "Hysys: An introduction to chemical engineering simulation." *Apostila de Hamid* (2007).

Equilibrium Reaction Using HYSYS V9

The Water gas shift reaction increases the H2 and decrease the CO concentrations. Such kind of processes can be modeled using equilibrium reactors in HYSYS V9. It is possible to perform more than one equilibrium reaction in one group according to the given rank to operate them either sequentially or simultaneously. In this subject, it is intended to learn how to add and work with the equilibrium.



The figure above shows a simple model of the Eqiulibirium reactor with its inlet and outlet streams using Aspen HYSYS V.9.

Example:

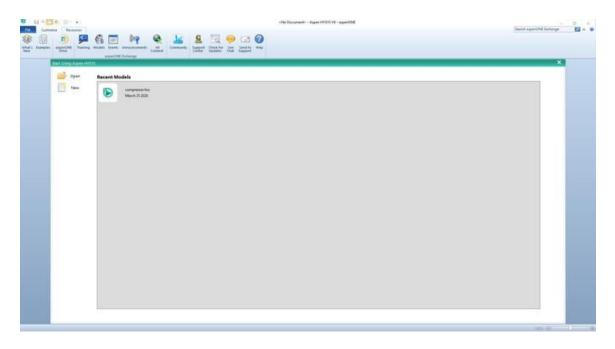
It is possible to improve the efficiency of Hydrogen production by reducing the CO levels. Water Gas Shift (WGS) reaction is an optimum purification process for increasing H2 yield and decreasing CO concentration. The following reaction:

$$CO + H_2 \leftrightarrow CO_2 + H_2$$

is an example of WGS. Model the equilibrium reaction in WGS [1].

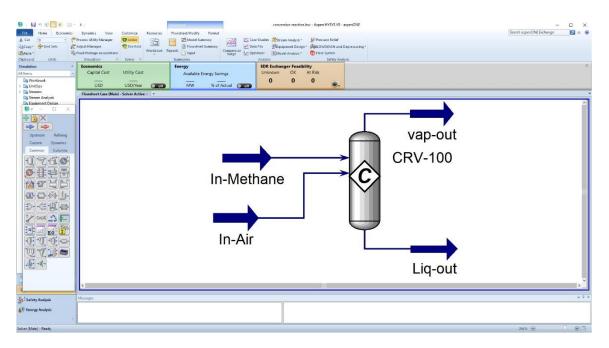
Solution:

- Starting HYSYS:
 - 1. Start menu.
 - 2. Type in the search field: Aspen HYSYS V9.
 - 3. Select open.



The above window will pop up once you start HYSYS. It is possible by the Aspen HYSYS start window to open previous cases or create a new case.

- Open the previous case of conversion reaction:
- 1. File menu
- 2. Open $\$ conversion reaction



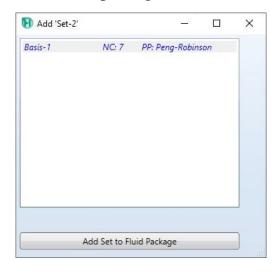
- Modify the component list:
 - 1. Propoerties
 - 2. Double click on (Component list)
 - 3. Component List-1
 - 4. Add H₂O to (Component List-1)
- Adding reaction set
 - 1. Properties $\ \$ Reactions $\ \$ add
 - 2. Add Reaction $\$ Equilibrium $\$ Add reaction

≧Copy*	B Reactions	Map Components Update Properties Components	Retroleum	 Hypotheticals Manager Convert Remove Duplicates Hypotheticals 		PVT Data	
roperties	Reaction Set: Set-2	× +					
II Items Component Lists Filid Packages Petroleum Assays Reactions Filid Set-1 Set-2	Set Info	Unknown		Not Ready		Add to FP etach from FP Advanced	
Go Component Maps Course Properties	Active Reaction	Reaction Reactant	Source /s enProperties m m neous Catalytic	Configured	Opera	tions Attached	
Properties	Add Reaction	T Delete	Reaction	Copy Reaction			
	Messages						* [‡]
- Sarety Analysis	Required Info : Set-2 Warning : Set-2 Read Warning : All reaction	ction set is not comple	ete	Completed.			

- 3. Double click on the added reaction
- 4. Enter the related information according to what is given in the example.

chiometry Keq Approach	Library			
toichiometry			Basis	A
Component	Mole Weight	Stoich Coeff	Phase	Activity VapourPhase
CO	28.011	-1.000	Min Temperature	-273.1 C
H2O	18.015	-1.000	Max Temperature	-275.1 C 3000 C
CO2	44.010	1.000	Max temperature	5000 C
Hydrogen	2.016	1.000		
	Stored Store			*
Add Comp			Basis Units	
	Balance Error	0.00000	Basis Units	
Add Comp Balance	Balance Error Reaction Heat (25 C)	0.00000 -4.1e+04 kJ/kgmole	Basis Units	
			Basis Units	
			Basis Units	

- Attach the reaction set to a fluid package:
 - 1. Click (Add to FP)
 - 2. Select the desired fluid package
 - 3. Click (Add Set to fluid package)



Now we are ready to enter the simulation environment.

🕒 i 🖶 🔊 📃 🔍 🐨	₹ equilibrium reaction.hsc -	Aspen HYSYS V9 - aspenONE	- 🗆 ×
	vigate Components Refining 🗟	Ø Hypotheticals Manager 8 2 % Convert % 6 % Remove Duplicates 1 Hypotheticals Oil	Search aspenONE Exchange 💿 🛆 😨
Properties	< Reaction Set: Set-2 × +		
All Items	Set Info Set Type Equilibrium	Ready Independent	Add to FP Detach from FP Advanced
Component Maps	Autin Decations Tree	Configurad	aliana Amarikan
ag osci riopenies	Active Reactions Type Rxn-3 E	Configured Oper quilibrium 🗸	ations Attached
Properties			
Properties	Add Reaction	Copy Reaction	
	Lease and the second se		↓ ♯)
Safety Analysis	Messages		
69 Energy Analysis		Completed.	
			100% ⊖

- Create new material stream:
 - 1. Select simulation.
 - 2. Object palette.
 - 3. Select the material stream icon.

Alternatively, you can add new material stream by pressing F11.

- 4. Double click on the added material stream
- 5. Give the below information:

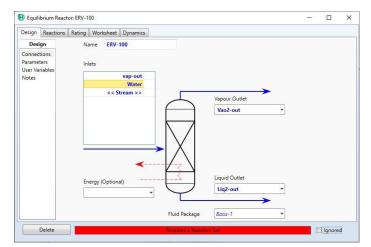
Name	Water
Cond	itions
Temperature	110 ^o C
Pressure	3 bar
Molar flow	100 kgmole/h
Compo	osition
H ₂ O	1

Nole Fractions		
lass Fractions	<empty></empty>	Methane
inger indetronte	<empty></empty>	Nitrogen
in Valuera Frantinan	<empty></empty>	со
iq Volume Fractions	<empty></empty>	CO2
Iole Flows	<empty></empty>	Hydrogen
lass Flows	<empty> 1.0000</empty>	Oxygen H2O
iq Volume Flows		
position Controls		
Erase		
Equalize Composition		
Cancel		
	Total 10000	

- Adding Equilibrium reactor:
 - 1. Press F12
 - 2. Select reactors
 - 3. Select Equilibrium reactor
 - 4. Click (Add)

🕑 UnitOps - Case (Main)			×
Categories	Available Unit Operations	Add	_
 All Unit Ops Vessels Heat Transfer Equipment Rotating Equipment Piping Equipment Solids Handling Reactors Prebuilt Columns Short Cut Columns Templates Logicals Extensions User Ops Electrolyte Equipment Refinery Ops Upstream Ops 	Cont. Stirred Tank Reactor Conversion Reactor Equilibrium Reactor Gibbs Reactor Plug Flow Reactor Yield Shift Reactor	Cancel	

- 5. Place the selected unit in the desired position.
- 6. Double click on the added conversion reaction.
- 7. $Design \setminus Connection$
- 8. In the Inlets field select (Vap-out, water)
- 9. In the field of Vapour outlet type (Vap2-out) [a new material stream will be created and connected to the reactor]
- 10.In the field of Liquid outlet type (Liq2-out) [a new material stream will be created and connected to the reactor]



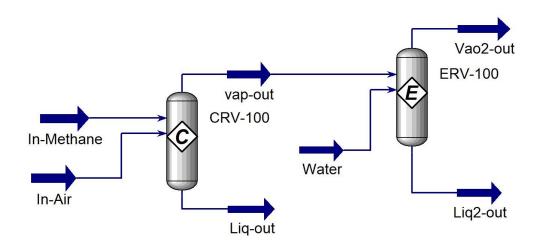
11.Reactions \ Reaction set 12.Select (Set-2)

Design	Reactions	Rating	Worksheet	Dynamics						
Reaction	Equill	ibrium Rea	action Details						7	
Details Results	Rea	ction Set:	Set-2		•	Reaction:	Rxn-4]	
	0	Stoichiom	etry 🔘 B	asis	🔘 Keq	O Appro	ach (View Rxn]	
	St	toichiome	try Info						1	
		Cor	mponent		Mole	Wt.	Stoich C	oeff		
				СО	28.011			-1.000		
				H2O CO2		18.015 44.010		-1.000		
		Hydrogen			2.016 1.000			(All and a second se		
				Comp**		LIGTO		1.000		
				1000	ce Error on Heat (25	0	-4.1e+0	0.00000 4 kJ/kgmole		
				Nedcu	on near (23		4.1270	- N/ Kgillole		

13.Select Worksheet.

- 14.Composition
- 15.Read the compositions of the outlet streams.

Vapour Temperature [C] Pressure [kPa]	1.0000 817.1	0.0000	0.0000	1.0000
Pressure [kPa]	and the second s	110.0		
Second		110.0	511.1	511.1
	300.0	300.0	300.0	300.0
Molar Flow [kgmole/h]	442.5	100.0	0.0000	542.5
Mass Flow [kg/h]	8817	1802	0.0000	1.062e+004
Std Ideal Liq Vol Flow [m3/h]	15.65	1.805	0.0000	18.01
Molar Enthalpy [kJ/kgmole]	-1.708e+004	-2.796e+005	-6.546e+004	-6.546e+004
Molar Entropy [kJ/kgmole-C]	189.1	73.34	184.1	184.1
Heat Flow [kJ/h]	-7.556e+006	-2.796e+007	-0.0000	-3.551e+007
	Std Ideal Liq Vol Flow [m3/h] Molar Enthalpy [kl/kgmole] Molar Entropy [kl/kgmole-C]	Std Ideal Liq Vol Flow [m3/h] 15.65 Molar Enthalpy [kJ/kgmole] -1.708e+004 Molar Entropy [kJ/kgmole-C] 189.1	Std Ideal Liq Vol Flow [m3/h] 15.65 1.805 Molar Enthalpy [kJ/kgmole] -1.708e+004 -2.796e+005 Molar Entropy [kJ/kgmole-C] 189.1 73.34	Std Ideal Liq Vol Flow [m3/h] 15.65 1.805 0.0000 Molar Enthalpy [kJ/kgmole] -1.708e+004 -2.796e+005 -6.546e+004 Molar Entropy [kJ/kgmole-C] 189.1 73.34 184.1



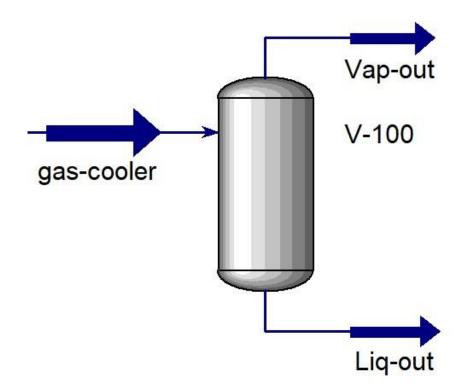
- Save the case:
- 1. File menu
- 2. Select save as
- 3. Give the name (equilibrium Reaction)

References:

1. Hamid, M. K. A. "Hysys: An introduction to chemical engineering simulation." *Apostila de Hamid* (2007).

Modeling of Flash Separator using HYSYS V9

The Flash separator is used to divide the inlet mixture into vapor and liquid phases. HYSYS V9 can model such process and determine the desired properties like the flowrates of the outlet streams at certain conditions. In this subject, it is intended to learn how to work with the flash separator unit and how to connect the right streams in their optimum directions as well as setting up the other related parameters.



The figure above shows a simple model containing the flash seperator with the inlet and outlet streams using Aspen HYSYS V.9.

Example:

Given that a mixture of 30% i-butan, 40% Ethane and 30% Propane at 40° F and atmospheric pressure, and a flowrate of 100 lbmole/hr. The pressure of the mixture is to be raised to 60 psia and then, the temeprature is to be reduced to 35° F. The resulting vapour and liquid are to be separated using a flash seprator. Determine the flow rates and compositions of these two streams. (use Peng-Robinson as a fluid package) [1].

Solution:

- Starting HYSYS:
 - 1. Start menu.
 - 2. Type in the search field: Aspen HYSYS V9.
 - 3. Select open.
- Create a new case:
- 1. File menu
- 2. New \setminus case
- There are two main necessary information have to be given in the properties tab before starting the simulation:
 - 1. Property package : Peng-Robinson
 - 2. Components: C2, C3 and i-C4
- Create list of components
- 1. Properties
- 2. Component lists \setminus Add
- 3. Select: Pure components
- 4. Type in the serach field C2
- 5. Select $C2 \setminus add$
- 6. Repeat steps (4,5) to add C3 and i-C4.

- Add fluid package:
 - 1. Select Fluid package.
 - 2. Click Add.
 - 3. Select (Peng-Robinson).
- Create new material stream:
 - 1. Select simulation.
 - 2. Object palette.
 - 3. Select the material stream icon.

Alternatively, you can add new material stream by pressing F11.

- 4. Double click on the added material stream.
- 5. Give the below information:

Name	Gas-Mixture
Cond	itions
Temperature	40 ^o F
Pressure	1 atm
Molar flow	100 lbmole/hr
Compo	osition
i-C4, C2, C3	0.3, 0.4, 0.3

- Adding compressor:
 - 1. Object palette.
 - 2. Select compressor
 - 3. Place the selected unit in the desired position.

You can add a new unit by pressing F12 and select the desired unit.

- 4. Double click on the compressor
- 5. Select $Design \setminus connections$
- 6. In the Inlet field, select gas-mixture

- 7. In the outlet field, type (gas-comp). [a new material stream will be created and connected to the heat exchanger]
- 8. In the Energy field, type (work). [a new energy stream will be created and connected to the heat exchanger]

		2000 2010 20	1007 100				
Design	Rating	Worksheet	Performance	Dynamics			
Desi	gn		Name	K-100			
Connec Parame Links Jser Va Notes	ters	Inlet gas-mix Energy work	ture		Fluid Package Basis-1 Outlet gas-comp		
						1.0	

- 9. Worksheet\ gas-comp
- 10. Change the pressure to 60 psia

Name gas-mixture gas-comp work	
Vapour 1.0000 1.0000 <empty></empty>	
Temperature [C] 4.444 68.55 <empty></empty>	
Pressure [kPa] 101.3 413.7 <empty></empty>	
Molar Flow [kgmole/h] 45.36 <sempty></sempty>	
Mass Flow [kg/h] 1937 <empty></empty>	
LiqVol Flow [m3/h] 4.126 4.126 <empty></empty>	
Molar Enthalpy [kJ/kgmole] -1.070e+005 -1.024e+005 <empty></empty>	
Molar Entropy [kJ/kgmole-C] 178.7 182.2 <empty></empty>	
Heat Flow [k]/h] -4.854e+006 -4.647e+006 2.070e+005	

- Adding cooler:
- 1. Object palette.
- 2. Select cooler.
- 3. Place the selected unit in the desired position.
- 4. Double click on the cooler
- 5. Select Design \ connections
- 6. In the Inlet field, select gas-comp.
- 7. In the outlet field, type (gas-cooler). [a new material stream will be created and connected to the cooler]
- 8. In the energy field, type (work2). [a new energy stream will be created and connected to the cooler]

Coole	er: E-100					1000		×
Design	Rating	Worksheet	Performance	Dynamics				
Desi	ign		Name	E-100				
Connec Parame User Va Notes	ters	_	comp		Energy work2 Outlet gas-cooler			
[Delete				Unknown Duty		🔲 Ignor	ed

- 9. Select parameters
- 10.Change the Delta P to (0).

Coole	er: E-100					100		\times
Design	Rating	Worksheet	Performance	Dynamics				
Desi	gn	Delta	P					
Connect Paramet		0.000	00 kPa					
Jser Vai		Delta	т		Duty			
Votes					-			
				\sim				
			>	(
			6	$\langle \rangle$				
				~ ~				
_								
L	Delete				Unknown Duty		🔲 Ignor	ed

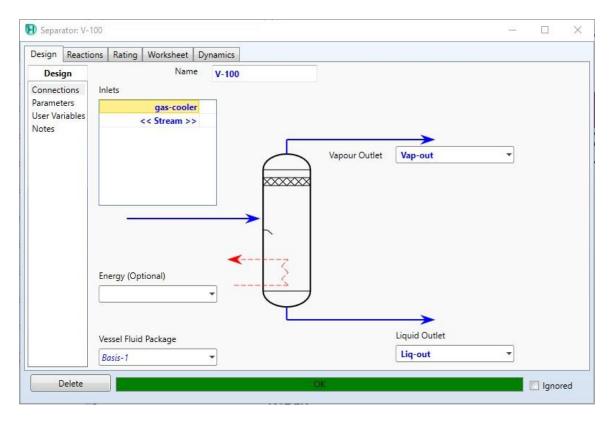
11. Select worksheet

12. Change the temperature	in gas-cooler to 35° F
----------------------------	------------------------

Design Ratin	g Worksheet	Performance	Dynamics				
Worksheet	Name			gas-comp	gas-cooler	work2	
Conditions	Vapour			1.0000	0.9656	<empty></empty>	
Properties	Temperature	Temperature [C]			1.667	<empty></empty>	
Composition	Pressure [kPa]			413.7	413.7	<empty></empty>	
PF Specs	Molar Flow	Molar Flow [kgmole/h]			45.36	<empty></empty>	
	Mass Flow [Mass Flow [kg/h]			1937	<empty></empty>	
	Std Ideal Liq	Std Ideal Liq Vol Flow [m3/h]			4.126	<empty></empty>	
	Molar Entha	lpy [kJ/kgmole]		-1.024e+005	-1.082e+005	<empty></empty>	
	Molar Entro	Molar Entropy [kJ/kgmole-C]			163.1	<empty></empty>	
	Heat Flow [k	J/h]		-4.647e+006	-4.909e+006	2.621e+005	

- Adding Flash Separator
- 1. Object palette.
- 2. Select flash separator.
- 3. Place the selected unit in the desired position.

- 4. Double click on the flash separator
- 5. Select $Design \setminus connections$



- 6. In the Inlet field, select gas-cooler.
- 7. In the Vapour Outlet field, type (Vap-out). [a new material stream will be created and connected to the cooler]
- 8. In the Liquid outlet field, type (Liq-out). [a new material stream will be created and connected to the cooler]
- 9. Select Worksheet.
- 10.Read the flow rate values for the outlet streams.

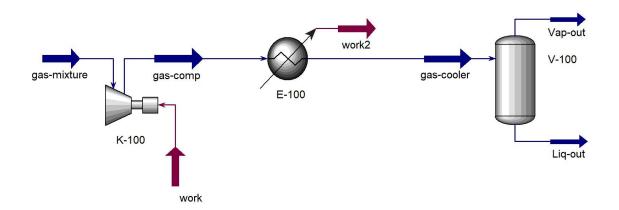
Design React	ions Rating Worksheet Dynamics				
Worksheet	Name	gas-cooler	Liq-out	Vap-out	
Conditions	Vapour	0.9656	0.0000	1.0000	
Properties	Temperature [C]	1.667	1.667	1.667	
Composition	Pressure [kPa]	413.7	413.7	413.7	
PF Specs	Molar Flow [kgmole/h]	45.36	1.561	43.80	
	Mass Flow [kg/h]	1937	81.37	1855	
	Std Ideal Liq Vol Flow [m3/h]	4.126	0.1524	3.973	
	Molar Enthalpy [kJ/kgmole]	-1.082e+005	-1.436e+005	-1.070e+005	
	Molar Entropy [kJ/kgmole-C]	163.1	86.90	165.9	
	Heat Flow [kJ/h]	-4.909e+006	-2.241e+005	-4.685e+006	

11.Select compositions

12.Read the compositions of the outlet streams

Design Rea	action	s Ra	ing	Works	neet	Dynami	cs							
Worksheet								gas-coole	r	Liq-out	Vap-out		 	-
Conditions Properties Composition PF Specs		Ethane				0	.4000	0.0865	0.4	112				
		Propane				0	.3000	0.2548	0.3	016				
		i-Butane				0	.3000	0.6587	0.2	872				

- Save the case:
- 1. File menu
- 2. Select save as
- 3. Give the name (flash separator)

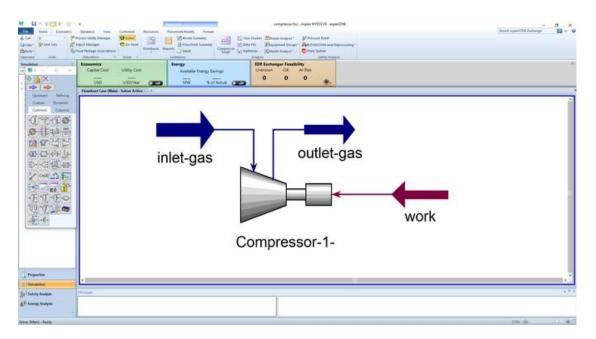


References:

1. Hamid, M. K. A. "Hysys: An introduction to chemical engineering simulation." *Apostila de Hamid* (2007).

Modeling of Compressing Process using HYSYS V9

It is possible to model the process of compressing the gas mixtures using HYSYS. Compressors units in HYSYS are used to increase the pressure of the inlet streams giving the possibility to calculate the related properties such as the temperature and compression efficiency. In this subject, it is intended to learn how to work with the compressor unit to model the compressing process as well as set up the unit connections and other design parameters. In the end, it would be possible to operate the compressor according to the given information.



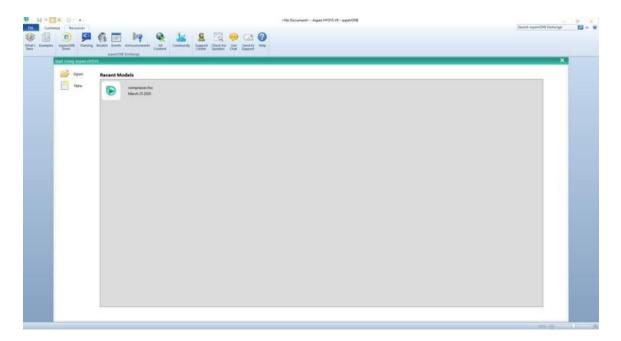
The figure above shows a simple model containing the compressor with inlet, outlet and energy streams using Aspen HYSYS V.9.

Example:

A mixture of (Methane, Ethane, Propane, and C-Hypo) at 1200 C and 2 bar is fed into a compressor with 30% efficiency. the pressure of the outlet stream is 7 bar while the flow rate of the mixture is 100 kgmole/h. determine the outlet temperature using the Peng-Robinson equation of state.

Solution:

- Starting HYSYS:
 - 1. Start menu.
 - 2. Type in the search field: Aspen HYSYS V9.
 - 3. Select open.



The above window will pop up once you start HYSYS. It is possible by the Aspen HYSYS start window to open previous cases or create a new window.

- Create a new case:
- 1. File menu
- 2. New \ case
- There are two main necessary information have to be given in the properties tab before starting the simulation:
 - 1. Property package : Peng Robinson
 - 2. Components: C1, C2, C3, C-hypo
- 1. Properties
- 2. Component lists \ Add
- 3. Select: Pure components
- 4. Type in the serach field C1
- 5. Select C1 \ add
- 6. Repeat the steps (4,5) for C2 and C3

The component C-Hypo does not exist in the list of Pure components but, it is possible to create a new hypothetical component.

rfies +	Component List - 1 > +	arrenti belena	Nettron.				rt Cera					
Component Lists	Severa Datamana (1937)				Select	Part Components	• ia		All Families			
nd Packages troleum Acceys	Computered	7,94	One		Search fan	L.,	34	echilip	Full Name/Typenym	•		
ections reported these	Methane	Rue Composers			-							
er Properties	Itere	Fure Component			50.00	ton Name	Pull States / Spin		Formula	- 6		
	Popere	Pure Component		+ AM		- officiarie		104		15		
						o-Butane		+6		10		
						-Partane		10		42		
				- Aging		o-Pertane		60		ett.		
						enterene		0		14		
						e-inaptane		.0		416		
						+ Octave		0		+18		
						n-Nonarw		0		425		
						+ Delane		\$76				
						+-C11		611				
						+0.0		610				
						*-C18		610				
						+-04		- 674				
						+C18		\$15				
						8-CH		616				
						+617		617				
						+-C18		416				
						+09		C16				
						+68		628				
						6.021		620				
-						+-G28		(1)	(2)	- 54		
						+C2 +C2 +C2		C20 C20 C20	2 633	-		
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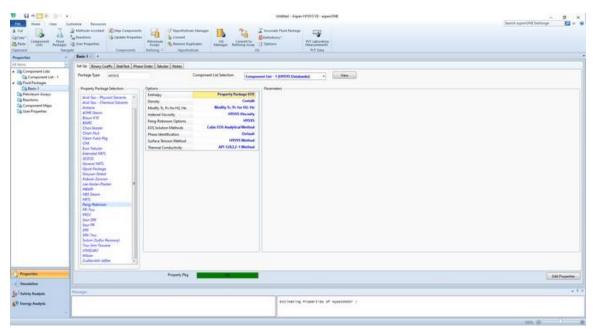
- Create new hypothetical component:
- 1. Select Hypothetical
- 2. In the mehtod field, select (create and edit hypos)
- 3. Click New Hypo
- 4. Double- Click on the added new component

Procetto Composet la ta la * Composet la ta la * * Parteno alla ta la * *	A Cut LaCopy* Patter Component Uits Packapes	Luser Properties	pdate Properties Petrole Assay	s we new over Disponsition			te Fluid Package	HYSYS V9 - aspenC PVT Laboratory Measurements PVT Data	, me			Search aspenONE	ichange 🚺	1-
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Betaching Specification Type Specification Hype Graps Type Matching Betaching Composent Hype Graps Hype Hype Hype Hype Hype Hype Hype Hype	Component List - 1	Source Databank: HYSYS				Select	Hypothetical	•	Method:	Create and Edit Hy	pos *			
Bit Streppent Mags Bit Streppent Mags B		Component	Туря	Group		Hype Group:	HypoGroup1	•	Type	Base Properties				
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Integration Edition Edition Edit Vice Course C Smaletion Edition Edit Vice Course ************************************						10								
C Shankton C Shan	-		1		-	Estimate Un	sknown	Delete Hypo						
(a) Safety Analysis Urrayin Regulard Min - Rude Analysis - Select property package	The second se	Status	Estimate Unknown	Props Edit Properties	Edit Visc Curve									
p Safety Asapas Required this : Flaid Packager - Sefet property package	>{ Simulation													
Tengy Audjoin Proving Mudjoin	Safety Analysis						1							+ 2
	Energy Analysis	Required Info : Fluid Packer	pes — Select property pack	+ge										

- 5. Change thre component name to : C-Hypo
- 6. Select critical
- Change the Normal Boiling point to : (150° C). [the value of the normal Boinling point is given according to the application or example]
- 8. Click (estimate unknown props)
- 9. Change the name of the hypo group to : Hypo-compressor-group
- 10.Select the created component (C-hypo) to your component list
- 11.Click add

Base Properties	
Molecular Weight	127.5
Normal Boiling Pt [C]	150.0
Ideal Liq Density [kg/m3]	768.1
Critical Properties	
Temperature [C]	336.7
Pressure [kPa]	2591
Volume [m3/kgmole]	0.5020
Acentricity	0.3659

- Add fluid package:
 - 1. Select Fluid package
 - 2. Click Add
 - 3. Select (Peng Robinson)



- Create new material stream:
 - 1. Select simulation.
 - 2. Object palette.
 - 3. Select the material stream icon.

Alternatively, you can add new material stream by pressing F11.

- 4. Double click on the added material stream
- 5. Give the below information:

Name	Inlet-gas
Cond	itions
Temperature	120 [°] c
PRESSURE	2 bar
Molar flow	100 kgmole/h
Compo	osition
C1	0.1
C2	0.3
C3	0.4
C-hypo	0.2

The above information should be given according to the application or example.

Worksheet	Attachme	nts Dynamics		
Worksh	eet	Stream Name	inlet-gas	V
Condition	ns	Vapour / Phase Fraction	1.0000	
Properties		Temperature [C]	120.0	
Composit		Pressure [kPa]	200.0	
Oil & Gas Petroleun		Molar Flow [kgmole/h]	100.0	
K Value	n Assay	Mass Flow [kg/h]	5377	5377 9.874 -1.118e+005 -1 236.1 -1.118e+007 -1 9.272 Basis-compressor
User Varia	ables	Std Ideal Liq Vol Flow [m3/h]	9.874	
Notes		Molar Enthalpy [kJ/kgmole]	-1.118e+005	9.874 le+005 -1 236.1 le+007 -1 9.272
Cost Para		Molar Entropy [kJ/kgmole-C]	236.1	
Normalized Yield	ed Yields	Heat Flow [kJ/h]	-1.118e+007	
		Liq Vol Flow @Std Cond [m3/h]	9.272	
		Fluid Package	Basis-compressor	
		Utility Type		

- Adding Compressor:
 - 1. Object palette.
 - 2. Select compressor
 - 3. Place the selected unit in the desired position.

You can add a new unit by pressing F12 and select the desired unit.

- 4. Double click on the compressor
- 5. Select Design \ connections
- 6. In the inlet field, select inlet-gas
- 7. In the outlet field, type (outlet-gas). [a new material stream will be created and connected to the compressor]
- 8. In the Energy field, type work. [a new energy stream will be created and connected to the compressor].

Com	pressor: K	-100				19 <u>44</u>	×
Design	Rating	Worksheet	Performance	Dynamics			
Desi	gn		Name	K-100			
Connec Parame		Inlet			Fluid Package		
.inks Jser Va	riabler	inlet-ga	5	•	Basis-1		
Votes							
				-			
		Energy					
		work		-	·		
					Outlet		
					outlet-gas 💌		
	Delete						

- 9. Select parameters \ Adiabatic Efficiency
- 10. Change the efficiency to 40 %.
- 11. Select worksheet

Design Rating	Worksheet Performance Dynamics	
Design Design Connections Parameters Links User Variables Notes	Efficiency	Curve Input Option
	Screw Compressor Pressure Specs Delta P: Pre	Quasi-Dimensionless ssure Ratio:
	Surge Analysis	
	To study compressor surge under different scenarios, click the "Surge Analysis" botton	Surpe Analysis

- 1. Change the outlet-gas pressure to 7 bar.
- 2. Read the temperature of the outlet-gas.

The temperature of the outlet stream is 209.4o C.

	pressor: K	- 100					×
Design	Rating	Worksheet Performance Dynamics					
Works	heet	Name	inlet-gas	outlet-gas	work		
Conditie	ons	Vapour	1.0000	1.0000	<empty></empty>		
Propert	ies	Temperature [C]	120.0	209.4	<empty></empty>		
Compo	sition	Pressure [kPa]	200.0	700.0	<empty></empty>		
PF Spec	15	Molar Flow [kgmole/h]	100.0	100.0	<empty></empty>		
	Mass Flow [kg/h]	5377	5377	<empty></empty>			
		LiqVol Flow (m3/h)	9.874	9.874	<empty></empty>		
		Molar Enthalpy [kJ/kgmole]	-1.118e+005	-1.014e+005	<empty></empty>		
		Molar Entropy [ki/kgmole-C]	236.1	249.7	<empty></empty>		
		Heat Flow [kl/h]	-1.118e+007	-1.014e+007	1.037e+006		

- Save the case:
- 1. File menu
- 2. Select save as
- 3. Give the name (compressor)

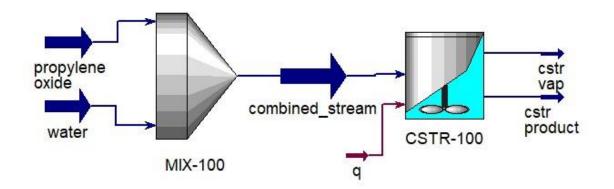
	Speaked year <u>Speaked</u> Researce Standardsold, Speak	See age of the factory and the
	Jand Mangel (1997) 1998 1998 1998 1998 1998 1998 1998 199	
	Dispersion Capital Carting Total Tangge Manufactor (burg) (barring Manufactor (barring (barring) UDD v UDD very UDD very (barring) Diff Lobusger Taubility UDD very (barring) Diff Lobusger Taubility UDD very (barring) UDD very (barring) UDD very (barring) UDD very (barring) UDD very (barring) UDD very (barring) UDD very (barring) UDD very (barring) UDD very (barring) UDD very (barring) UDD very (barring) UDD very (barring) UDD very (barring)	
ipter Alicy	VID UDAVer C VIN ScilActual C C	
09:10		
·学供非 @		
の方も変	inlet-gas outlet-gas	
DICHE	li liet-gas	
E as		
1.1.4.		
- <u>6</u> -6-	work	
	Compressor-1-	
- Properties	and	
In Survey Assessed	Norge	
6 ¹ Energy Analysis		
Selves (Mari) - Rocky		IN 8

References:

1. Hamid, M. K. A. "Hysys: An introduction to chemical engineering simulation." *Apostila de Hamid* (2007).

Modeling of CSTR Using HYSYS V9

The figure above shows a simple model containing the CSTR with inlet, and outlet streams using Aspen HYSYS V.9.



Example:

The propylene glycol is produced in CSTR by combining the propylene oxide with water. The propylene oxide and water streams are combined using a mixer while the the outlet stream is fed to the reactor operating at atmospheric pressure. Simulate the production of Propylene Glycol using CSTR:

$$H_2O + C_3H_6O \rightarrow C_3H_8O_2$$

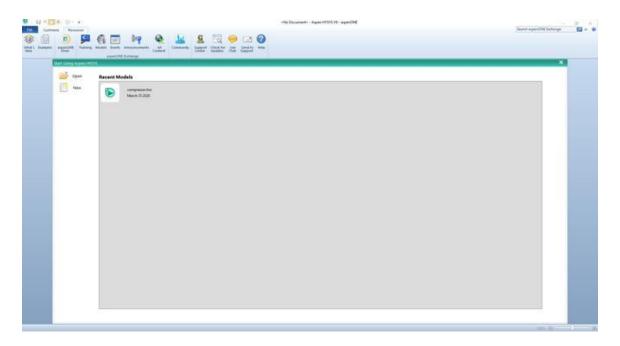
The forward reaction arrhenius parameters:

Frequency factor: 1.7×10^{13} , Activation Energy: 3.24×10^{4}

(fluid Package: UNIQUAC) [1]

Solution:

- Starting HYSYS:
 - 1. Start menu.
 - 2. Type in the search field: Aspen HYSYS V9.
 - 3. Select open.



The above window will pop up once you start HYSYS. It is possible by the Aspen HYSYS start window to open previous cases or create a new window.

- Create a new case:
- 1. File menu
- 2. New \ case

- There are two main necessary information have to be given in the properties tab before starting the simulation:
 - 1. Property package : UNIQUAC
 - 2. Components: Propylene_Glycol, H₂O, PropyleneOxide
- Preference Set:
- 1. File
- 2. Options
- 3. Click (unit of measure)

Set defaults options for units	of measurement		
Display Units			
	lleit	View	
January Can R			
		Add	
122 (1230) (0) (0) (0) (0) (0)		Delete	
Kinematic Visc.	cSt		
	kcal/h	2.↓	
Lead Level in Gasoline	kgPb/m3	D	
Length	m		
Liq. Vol. Flow	m3/h		
Liquid Specific Productivity Inc	dex sm3/s/Pa		
Mass	kg		
Mass Concentration	wt % 🖕		
Available Units Sets			
Unit Set Name EuroSI		Сору	
Field		Delete	
SI			
EuroSI		View Users	
	Display Units Jones Gas B Jones Liq A Jones Liquid B Kinematic Visc. Large Heat Flow Lead Level in Gasoline Length Liq. Vol. Flow Liquid Specific Productivity In Mass Mass Concentration Available Units Sets Unit Set Name EuroSI Field SI	Unit Jones Gas B Jones Liq A Pa-s2/sm6 Jones Liquid B Remark Visc. CSt Large Heat Flow Lead Level in Gasoline Length Liquid Specific Productivity Index Mass Mass Valiable Units Sets Unit Set Name Field S1	Display Units Jones Gas B Pa2/sm3-s Jones Liq A Pa-s2/sm6 Jones Liquid B Pa-s2/sm6 Jones Liquid B Pa/sm3-s Kinematic Visc. cSt Large Heat Flow kcal/h Lead Level in Gasoline kgPb/m3 Length m Liquid Specific Productivity Index sm3/s/Pa Mass kg Mass kg Mass Concentration wt % Vnit Set Name EuroSI Field S/

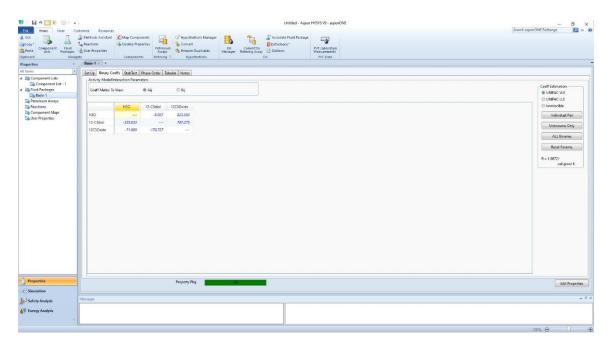
- 4. Avaialable unit set \ click (copy) : new unit set is given.
- 5. Chane the name of the added unit set to (field 2)
- 6. Display Units \ change the units as desired.
- 7. Change the unit of Liq. Vol. flow to (USGPM).
- 8. Change the unit of Mass to (lb).

- Click (save prefernce set) in order to save the set as a separate file. It is possible to use this prefernce set in another simulation case by clicking (load prefernce set).
- 10. Click ok

Simulation	Set defaults options for units of meas	urement		
Reports Equipment	Display Units			
Units Of Measure		Unit	View	
Aspen Properties Options	lones Gas B	Pa2/sm3-s		
Resources Options	Jones Lig A	Pa-s2/sm6	Add	
Resources options	Jones Liquid B	Pa/sm3-s	Delete	
	Kinematic Visc.	cSt		
	Large Heat Flow	kcal/h	Â↓	
	Lead Level in Gasoline	kgPb/m3	<u></u>	
	Length	m		
	Liq. Vol. Flow	USGPM		
	Liquid Specific Productivity Index	sm3/s/Pa		
	Mass	lb		
	Mass Concentration	wt %		
	Available Units Sets			
	Unit Set Name field 2		Сору	
	Field		Delete	
	SI			
	EuroSI		View Users	
	field 2			

- Adding Component list:
- 1. Properties
- 2. Component lists \ Add
- 3. Select: Pure components
- 4. Type in the serach field Propylene_Glycol
- 5. Select Propylene_Glycol \ add
- 6. Repeat the steps (4,5) for PropyleneOxide and water

- Add fluid package:
 - 1. Properties
 - 2. Select Fluid package
 - 3. Click Add
 - 4. Select (UNIQUAC)
 - 5. Binary Coeffs
 - 6. Click (Unknown only)



- Adding reaction set:
 - 1. Properties
 - 2. Reactions
 - 3. Click (Add Reaction)
 - 4. Select kinetic
 - 5. Click (Add reaction)

Reactions	10 <u>-</u> 11	×
Reactant Source	e ———	
Hysys		
AspenProp	erties	
Conversion		7
Equilibrium		
Heterogeneous C	Catalytic	
Kinetic		
Simple Rate		
		ŝ
Add I	Reaction	

- 6. Double click on (Rxn1)
- 7. Enter the related information of stoichiometry according to what are given in the equation.
- 8. Change (Fwd Order) of H_2O to 0.
- 9. Basis
- 10. Change the (basis component) to (Propylene Oxide)
- 11. Change the (Rxn phase) to (Combined_liquid)
- 12. Forward reaction
- 13.Set (A) to the value of the Frequency factor: 1.7 x 10¹³ as given above. [1.7e+13]
- 14. Set (E) to the value of the Activation Energy: 3.24 x 10⁴ as given above. [3.24e+4]

oichiometry and Ra	ate Info				Basis -				
Component	Mole Wt.	Stoich Coeff	Fwd Order	Rev Order	Ba	sis		Molar Concn	
H2O	18.015	-1.000	0.00	0.00	Ba	se Component		12C3Oxide	
12C3Oxide	58.080	-1.000	1.00	0.00	Association of the second	n Phase	C	ombinedLiquid	
12-C3diol	76.096	1.000	0.00	1.00		n. Temperature		-273.1 C	
Add Comp					Ma	ax Temperature		3000 C	
						Basis Units	kgmole/m3	•	
						Rate Units	kgmole/m3-	s 🔹	
					Forwar	d Reaction	Rever	se Reaction	
					A	1.7000e+013	A'	<empty< td=""><td>></td></empty<>	>
					E	32400	E'	<empty< td=""><td>></td></empty<>	>
					b	<empty></empty>	b'	<empty< td=""><td>></td></empty<>	>
					r = k =	on Help k*f(Basis) - k'*f'(Basis) A * exp { -E / RT } * T ^ A' * exp { -E' / RT } * T/			
		Balance Error		0.00000	Tink	Gelvin			
				0.00000 e+04 kcal/kgmole					
Balance		Reaction Hea							

- Attach the reaction set to a fluid package:
 - 1. Click (Add to FP)
 - 2. Select the desired fluid package
 - 3. Click (Add Set to fluid package)
- Create new material streams:
 - 1. Select simulation.
 - 2. Object palette.
 - 3. Select the material stream icon.

Alternatively, you can add new material stream by pressing F11.

- 4. Double click on the added material stream
- 5. Give the below information:

Name	Propylene Oxide
Cond	itions
Temperature	75 ⁰ F
PRESSURE	1.1 atm
Molar flow	150 lbmole/h
Comp	osition
Propylene Oxide	1

6. Repeat step 5 to add another stream and give the following information:

Name	Water
Cond	itions
Temperature	75 ⁰ F
PRESSURE	1.1 atm
Molar flow	1.1e+4 lb/hr
Compo	osition
Water	1

- Adding Mixer:
 - 1. Object palette.
 - 2. Select mixer
 - 3. Place the selected unit in the desired position.

You can add a new unit by pressing F12 and select the desired unit.

- 4. Double click on the mixer
- 5. In inlets field, select (propylene oxide) and (water)
- 6. In outlet field, type (combined stream). [a new material stream will be created and connected to the compressor]

Design Rating	Worksheet	Dynamics			
Design		Name	MIX-100		
Connections Parameters Jser Variables Notes				Outlet	
	Inlets	propylene op	ride	combined_stream	
			ater		
		<< Stream	>>	Fluid Package	
		<< stream			
		<< stream		Bosis-1	

- Adding CSTR:
 - 1. Object palette.
 - 2. Select CSTR (Continuously Stirred Tank Reactor)
 - 3. Place the selected unit in the desired position.
 - 4. Double click on the mixer
 - 5. In inlets field, select (combined stream)
 - 6. In Vapour outlet field, type (cstr vap). [a new material stream will be created and connected to the compressor]
 - 7. In Liquid outlet field, type (cstr product). [a new material stream will be created and connected to the compressor]

	rea lank	Reactor:	CSTR-100				>
esign Re	actions	Rating	Worksheet	Dynami	5		
Design			Nam	e CS	R-100		
Connections Parameters Jser Variabl Notes		Inlets					
			combined_st				
			<< Strea	m >>	×		
					Vapour Outlet		
				cstr vap 💌			
				-			
		Energy	(Optional)	-	Liquid Outlet		
				*	cstr product 🔹		
					└ <u></u>		
					Fluid Package Basis-1		

- 8. Reactions
- 9. In Reaction Set field , select Set-1
- 10.Dynamics
- 11. Model details
- 12.Set the vessel Volume to :280 ft3
- 13.Set the Liq Volume Percent [%] to 85%

Design Reaction	ns Rating Worksheet Dynam	nics		
Dynamics	Model Details			
pecs	Initialize From Products	Vessel Volume [m3]	7.929	
loldup	Dry Startup	Vessel Diameter [m]	1.888	
tripChart	O Initialize From User	Height [m]	2.832	
leat Exchanger		Liq Volume Percent [%]	85.00	
	Init HoldUp			
		Level Calculator	Vertical cylinder	
	📃 Lag Rxn Temperature	Fraction Calculator	Use levels and nozzles	
	Dynamic Specifications	Calculations		
	Feed Delta P [bar]	0.00	00	
	Vessel Pressure [bar]	1.1	15 🗖	
Delete		- OK		Ign

- 14.Deign \connection
- 15.In Energy field, type (Q). [a new energy stream will be created and connected to the compressor]

16.Worksheet

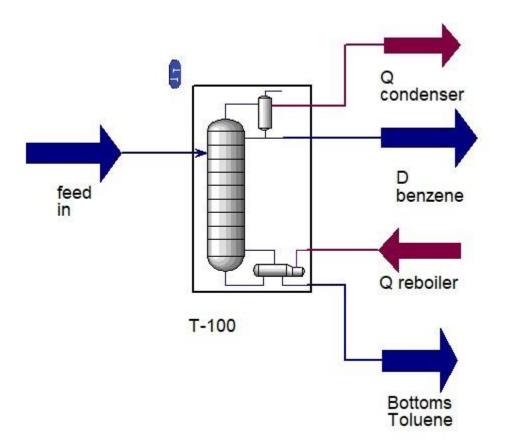
17.Set the temperature in cstr product to 75°F.

- Save the case:
- 1. File menu
- 2. Select save as
- 3. Give the name (compressor)

References:

1. Hamid, M. K. A. "Hysys: An introduction to chemical engineering simulation." *Apostila de Hamid* (2007).

Modeling of Distillation Column Using HYSYS V9 -2-



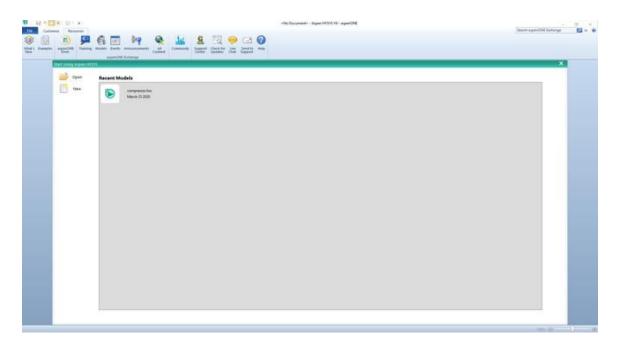
The figure above shows a simple model containing the Distillation Column with inlet, and outlet streams using Aspen HYSYS V.9.

Example:

A material stream consists of 40% Benzyn and 60% Toluene with temperatureof 35°C, pressure of 1.1 atm, and flowrate of 140 kgmole/h is fed into a distillation column so that these components are separated into two material streams. Give the required steps to simulate this separation process using (distillation column sub0flowsheet).

Solution:

- Starting HYSYS:
 - 1. Start menu.
 - 2. Type in the search field: Aspen HYSYS V9.
 - 3. Select open.



The above window will pop up once you start HYSYS. It is possible by the Aspen HYSYS start window to open previous cases or create a new window.

- Open the case (distillation):
- 1. File menu
- 2. open \ dostillation
- checking the external reflux ratio and actual number of trays:
- 1. Simulation \ (short cut distillation)
- 2. double click
- 3. design \ parameters : read the (external reflux ratio)

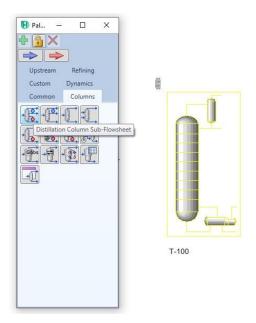
Design	Rating	Worksheet	Performance	Dynamics				
Desig	jn	Compone	nts				-	
Connecti	ions	X			Component	Mole Fraction		
Paramete	ers	Light Key	in Bottoms		Benzene	0.0300		
User Vari Notes	iables	Heavy Ke	y in Distillate		Toluene	0.0200		
		- Pressures	6				_	
	Condens	er Pressure		111.457 kPa				
	Reboiler	Pressure		115.000 kPa				
		Reflux Rat	ios ———					
		External	Reflux Ratio		2.300			
		Minimur	n Reflux Ratio		1.545			

4. Performance \ trays : read (actual number of trays)

erformance			
	Trays		
	Minimum Number of Trays	7.933	
	Actual Number of Trays	14.846	
	Optimal Feed Stage	8.685	
	Temperatures		
	Condenser [C]	82.28	
	Reboiler [C]	113.7	
	Flows		
	Rectify Vapour [kgmole/h]	192.789	
	Rectify Liquid [kgmole/h]	134.368	
	Stripping Vapour [kgmole/h]	192.789	
	Stripping Liquid [kgmole/h]	284.368	
	Condenser Duty [kJ/h]	-5945847.712	
	Reboiler Duty [kJ/h]	7540780.626	

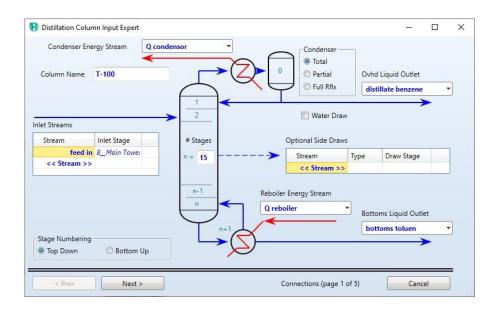
• Delete the (short cut distillation) and streams (Distillate benzene, Q condenser, Q reboiler, Vottoms toluen)

- Adding (distillation column sub-flowsheet)
- 1. Simulation
- 2. Object palette \ columns
- 3. Select (distillation column sub-flowsheet)
- 4. Place the selected unit in the deisred location inside the flowsheet



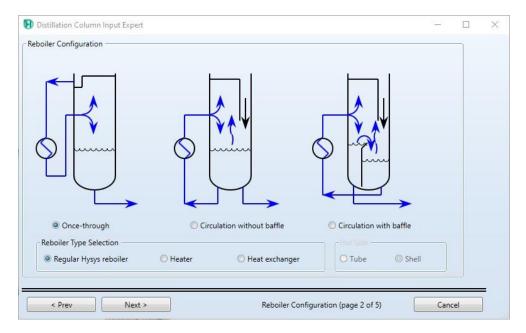
- 5. Double click
- 6. Set (Stages \ n=15)
- 7. In inlet streams, select (feed in)
- 8. In Condenser energy stream field, type (Q condenser). [a new energy stream will be created and connected to the distillation column]
- 9. In Reboiler energy stream field, type (Q Reboiler). [a new energy stream will be created and connected to the ditillation column]
- 10.Select condensor \ total
- 11.In Ovhd Liquid Outlet field, type (Distillate Benzene). [a new material stream will be created and connected to the distillation column]

- 12.In Bottoms Liquid Outlet field, type (Bottoms toluene). [a new material stream will be created and connected to the distillation column]
- 13.Click (Next)



14. In reboiler configuration select (once through)

15.Click (Next)

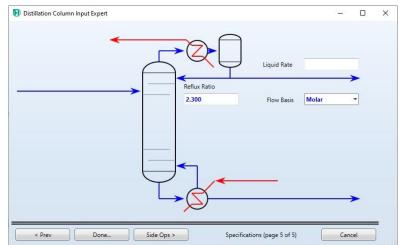


- 16.Set the condenser pressure to 1.1 atm
- 17.Set the reboiler pressure to 115 KPa
- 18.Set the pressure drop in both condenser and reboiler to 0 KPa
- 19.Click (Next)

Distillation Column Input Expert		33_32		×
	Condenser Pressure 111.5 kPa			
	Condenser Pressure Drop 0.0000 kPa		>	
	Reboiler Pressure Drop			
	0.0000 kPa			
	Reboiler Pressure			
\bigcup	1150 kPa			
L,			>	
	\sim			_
< Prev Next >	Pressure Profile (page 3 of 5)	Can	cel	

20.In optional estimates page click (Next)

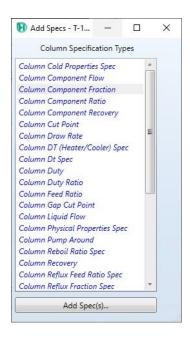
- 21.In specification page \ set the reflux ratio to 2.3
- 22.Click (Done)



- Specifications
- 1. Design
- 2. Monitor \ specifications
- 3. Uncheck the active state of (Distillate rate)

Design innections	Option	al Charles		Worksheet	Performance	e Flowsheet	Reactions	Dynamic	.s						_
		ai checks				Profile									-
lonitor	In	put Summa	ary	View Initial E	stimates		Te	Temperature vs. Tray Position from Top							
						Ten	10.0		Temperature		-	_	-	1	7
ecs ecs Summary	Iter	Step	Equilibriur	n Heat /	/ Spec	O Pre	8.0	» =				+	+	+	-
bcooling			h			© Flor	6.0	-				-	-	-	-
tes						U FIO	4.0	-	+			+	+	+	-
							2.0	» 1	. 1			+-	+ -	-	
(0	2 4	6	8	10	12	14	1
															_
	Specifi	Specifications										-			
				Specified Value		Current Value	Wt	Error	Active	Estimate					
	10000000	x Ratio			2.300	<emp< td=""><td></td><td><empty></empty></td><td>N</td><td></td><td>V</td><td></td><td></td><td></td><td></td></emp<>		<empty></empty>	N		V				
		x Rate			<empty></empty>	<emp< td=""><td></td><td><empty></empty></td><td></td><td>N</td><td></td><td></td><td></td><td></td><td></td></emp<>		<empty></empty>		N					
	1000000000	Prod Rate			<empty></empty>	<emp< td=""><td>oty></td><td><empty></empty></td><td></td><td>N</td><td></td><td></td><td></td><td></td><td></td></emp<>	oty>	<empty></empty>		N					
	Distil	late Rate			<empty></empty>	<emp< td=""><td>oty></td><td><empty></empty></td><td></td><td>V</td><td></td><td></td><td></td><td></td><td></td></emp<>	oty>	<empty></empty>		V					

- 4. Click (Add Spec...)
- 5. Select (Column component fraction)
- 6. Click (Add spec(s)...)



- 7. Select the added specification
- 8. Double click
- 9. In stage field : select (condenser)
- 10.In flow Basis : select (Mole fraction)
- 11.In Phase : select (Liquid)
- 12.Set the Spec Value to 0.98
- 13.In components select (Benzene)

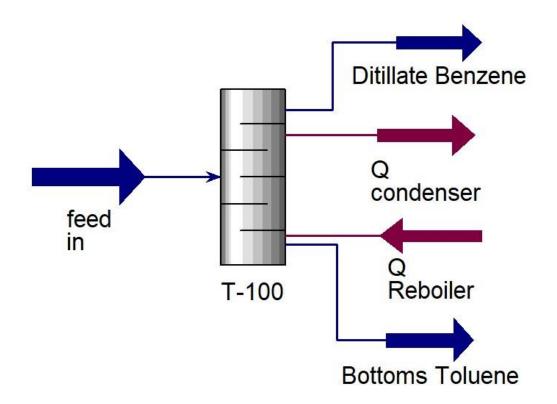
Parameters	Summary	Spec Type					
Name			Comp Fraction				
Stage			Condenser				
Flow Basis			Mole Fraction				
Phase			Liquid				
Spec Value		0.9800					
			mponent >>				

- Run
- 1. Click Run
- 2. Internals
- 3. Click (Auto sections)
- 4. Performance

References:

1. Hamid, M. K. A. "Hysys: An introduction to chemical engineering simulation." *Apostila de Hamid* (2007).

Modeling of Distillation Column Using HYSYS V9



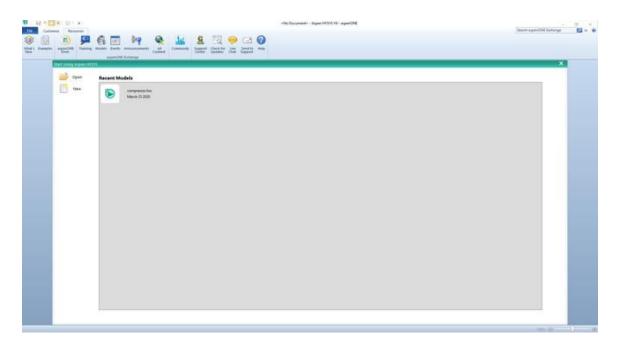
The figure above shows a simple model containing the Distillation Column with inlet, and outlet streams using Aspen HYSYS V.9.

Example:

A material stream consists of 40% Benzyn and 60% Toluene with temperature of 35°C, pressure of 1.1 atm, and flowrate of 140 kgmole/h is fed into a distillation column so that these components are separated into two material streams. Give the required steps to simulate this separation process.

Solution:

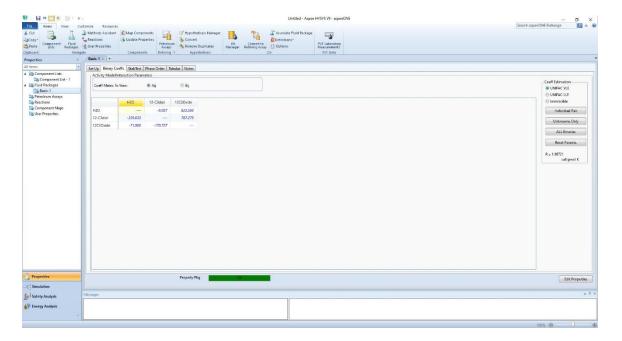
- Starting HYSYS:
 - 1. Start menu.
 - 2. Type in the search field: Aspen HYSYS V9.
 - 3. Select open.



The above window will pop up once you start HYSYS. It is possible by the Aspen HYSYS start window to open previous cases or create a new window.

- Create a new case:
- 1. File menu
- 2. New \ case
- There are two main necessary information have to be given in the properties tab before starting the simulation:
- 1. Property package : NRTL
- 2. Components: Benzyn, Toluene

- Adding Component list:
- 1. Properties
- 2. Component lists \ Add
- 3. Select: Pure components
- 4. Type in the serach field Benzyn
- 5. Select Benzyn \ add
- 6. Repeat the steps (4,5) for Toluen
- Add fluid package:
- 1. Properties
- 2. Select Fluid package
- 3. Click Add
- 4. Select (NRTL)
- 5. Binary Coeffs
- 6. Click (Unknown only)



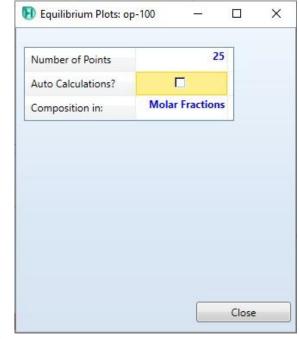
- Test the isotropic point:
- 1. Select simulation.
- 2. Object palette \ custom
- 3. Select Equilibrium Unit Operation.
- 4. Place the selected unit in the desired position.



- 5. Double click on the added unit
- 6. Binary
- 7. Available
- 8. Select Benzene
- 9. Click (Add Comp.)
- 10.Select Toluene
- 11.Click (Add Comp.)
- 12.Set the pressure to 1.1 atm
- 13.Data plot
- 14.Select (XY plot)

Equilib	orium P	lots: op-1	00					5025		×
inary	Ternary	About								
Plot Dat	a —									
XY Plot	0		•							
vailable	e		Selected	0.04 -						
			Benzene	-						
			Toluene	0.02 —						
			L	-						
			<- Del Comp.	0-						
			-> Add Comp.							
Pressur	e Te	emp.		-0.02 -						
[kPa]		[C]	Plot Settings							
111	.46 <	empty>	Plot	-0.04 -						
				-0.04						
					-4.000	-2.000	0.000 2.00	0	4.000	
_					_		Warn Table		0	
			Update plot				View Table		Close	

- 15.Click plot settings
- 16.Set the number of points to 25
- 17.Click close



18. Click plot

lot Data		Piper, Plat
XY Plot		Binary Plot
vailable	Selected	1.00 Reference Line, (slope=1)
	Benzene	0.80
	Toluene	
	L	P 0.60
	<- Del Comp.	
	-> Add Comp.	
Pressure Temp.		
[kPa] [C]	Plot Settings	0.20
111.46 <empty< td=""><td>/> Plot</td><td></td></empty<>	/> Plot	
		0.00 0.20 0.40 0.60 0.80 1.0 x Benzene

- Create new material streams:
- 1. Select simulation.
- 2. Object palette.
- 3. Select the material stream icon.

Alternatively, you can add new material stream by pressing F11.

- 4. Double click on the added material stream
- 5. Give the below information:

Name	Feed in		
Cond	itions		
Temperature	35°C		
PRESSURE	1.1 atm		
Molar flow	140 lbmole/h		
Compo	osition		
Benzene	0.4		
Toluene	0.6		

- Adding distillation column:
- 6. Object palette\ column
- 7. Select (short cut distillation)
- 8. Place the selected unit in the desired position.

You can add a new unit by pressing F12 and select the desired unit.

- 9. Double click on the distillation column
- 10.In inlet field, select (feed in)
- 11.In Condenser Duty field, type (Q condenser). [a new energy stream will be created and connected to the compressor]
- 12.In Dsitillate field, type (Distillate Benzene). [a new material stream will be created and connected to the compressor]
- 13.In Reboiler Duty field, type (Q Reboiler). [a new energy stream will be created and connected to the compressor]
- 14. In Dsitillate field, type (Bottoms Toluene). [a new material stream will be created and connected to the compressor]

esign Rating			Dynamics	Condenser Duty			
Design Connections	Name	T-100		Q condenser	-		
arameters					->		
Jser Variables Notes				$\boldsymbol{\triangleleft}$			
votes				Distillate			
			-	Ditillate Benzene	•		
	Inlet		(\rightarrow		
	feed in		-				
	Fluid Pack	age		Reboiler Duty			
	Basis-1		•	Q Reboiler	•		
			— t				
	Top Pro	duct Phase	`	Bottoms			
	🔘 Liqui	d 💿 Vap	our	Bottoms Toluene	-		
					->		
Delete				y Components		🔲 Ign	ore

- 15.Design \ parameters \ Components
- 16. Set the mole fraction in (Light key in Bottoms) to (0.03) for (Benzene).
- 17.Set the mole fraction in (Heavy key in Distillate) to (0.02) for (Toluene).
- 18. Set the condenser pressure to 1.1 atm
- 19.Set the condenser pressure to 115 KPa

20.Set the External Reflux ratio to 2.3

esign	Rating	Worksheet	Performance	Dynamics				
Desi	ign	Compone	nts					
onnec	tions				Component	Mole Fraction		
Parameters		Light Key in Bottoms			Benzene	0.0300		
User Variables Notes		Heavy Ke	y in Distillate		Toluene	0.0200		
	Pressures			14 July a series				
		Condens	er Pressure		111.457 kPa			
		Reboiler Pressure			115.000 kPa			
		Reflux Ratios						
		External	Reflux Ratio		2.300			
		Minimur	n Reflux Ratio		1.545			

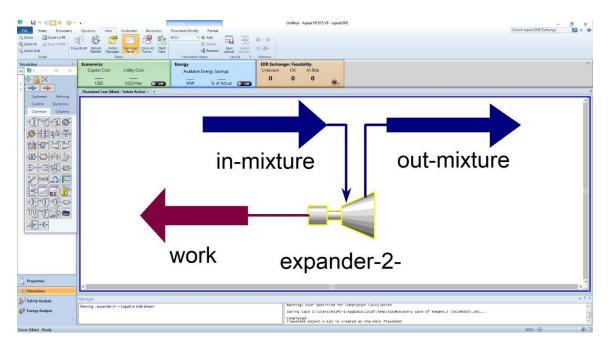
- Save the case:
- 1. File menu
- 2. Select save as
- 3. Give the name (Distillation)

References:

1. Hamid, M. K. A. "Hysys: An introduction to chemical engineering simulation." *Apostila de Hamid* (2007).

Modeling of Expander using HYSYS V9

High pressure gas stream can be processed by the expansion operation to produce an outlet mixture with low pressure and high velocity. The expansion process converts the internal energy of the gas to kinetic energy. Expanders units in HYSYS are used to decrease the pressure of the inlet streams giving the possibility to calculate the related properties such as the temperature and the operation efficiency. In this subject, it is intended to learn how to work with the expander unit to model the expansion process as well as set up the unit connections and other design parameters. In the end, it would be possible to operate the expander according to the given information.



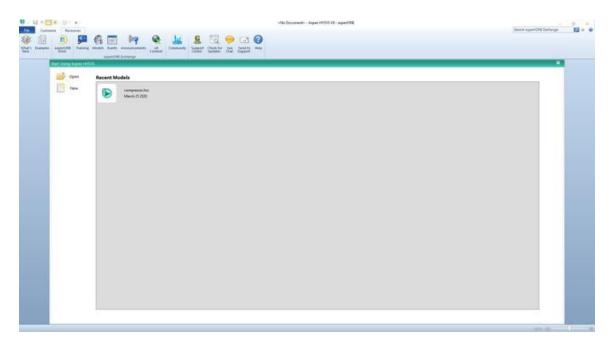
The figure above shows a simple model containing the expander with inlet, outlet and energy streams using Aspen HYSYS V.9.

Example:

A mixture of (Methane, Ethane, Propane, and and i-Butane) at 30° C and 25 bar is fed into an expander with 20% efficiency. the pressure of the outlet stream is 10 bar while the flow rate of the mixture is 100 kgmole/h. determine the outlet temperature using the SRK equation of state.

Solution:

- Starting HYSYS:
 - 1. Start menu.
 - 2. Type in the search field: Aspen HYSYS V9.
 - 3. Select open.



The above window will pop up once you start HYSYS. It is possible by the Aspen HYSYS start window to open previous cases or create a new case.

- Create a new case:
- 1. File menu
- 2. New \setminus case
- There are two main necessary information have to be given in the properties tab before starting the simulation:
 - 1. Property package : SRK
 - 2. Components: C1, C2, C3, i-C4
- 1. Properties
- 2. Component lists \setminus Add
- 3. Select: Pure components
- 4. Type in the serach field C1
- 5. Select $C1 \setminus add$
- 6. Repeat the steps (4,5) for C2, C3 and i-C4

Computerit Kinthana Ilinana	1ge			Salart Pare Components					
Computer4 Nationa									
Nettane				The second second	* Pilan d	All Families	95		
		- Smp		Search lan	Seech By	Auf Name/Systempts			
litere	Rure Camponere								
	Fure Component			Simulation Name	Put Isane / Synorym	Formula	4		
Popere	Pure Component		+ AM	- Subre	404				
-Base	Rue Component			identere	+05				
				a Parsana	n-C3				
					547 (317)				
Aug.	100		2						
					Image Arigues Image	0.	National Coll Other Addisory Cl Cl	Answer C CHINE Address CHINE CHINE	Neme O O Marrier 0 O O Marrier

- Add fluid package:
 - 1. Select Fluid package
 - 2. Click Add
 - 3. Select (SRK)

A Cut LaCopy" A Parte Dipboard		All 3. Convert	Associef Huad Peckage Definitions************************************	Search agenONE Exchange 🛛 🖸 o 🖷
Properties 4	Basis-1 + Set Up Binary Coeffs StabTest Pha			
© Composed Line 1 © Composed Line 1 © Composed Line 1 © Paradum Auge © Paradum Auge © Composed Mage © Composed Mage © Our Progetties	Petagen Type Petage	Composent List Selection Composent List Selection Composed Entitlegy Entitle	et List - 1 phYSP Darabaskaj • Usen	
Properties		Property Pkg		Edt Properties
C Simulation				
Safety Analysis	Messager			
🕅 Energy Analysis				

- Create new material stream:
 - 1. Select simulation.
 - 2. Object palette.
 - 3. Select the material stream icon.

Alternatively, you can add new material stream by pressing F11.

- 4. Double click on the added material stream
- 5. Give the below information:

Name	In-mixture
Cond	itions
Temperature	30 ^o C
Pressure	25 bar
Molar flow	100 kgmole/h
Comp	osition
C1	0.3
C2	0.4
C3	0.2
i-C4	0.1

The above information should be given according to the application or example.

Properties Tempe Composition Pressu	r / Phase Fraction rature [C] re [kPa]	0.9694 30.00 2500	0.9694 30.00 2500	0.0306 30.00
Composition Pressu Oil & Gas Feed Molar	re [kPa]	and the second sec	0.000	
Oil & Gas Feed Molar	• •	2500	3500	
Molar			2500	2500
	Flow [kgmole/h]	100.0	96.94	3.063
K Value Mass F	low [kg/h]	3147	3014	132.8
	al Liq Vol Flow [m3/h]	7.764	7.489	0.2753
Notes Molar	Enthalpy [kJ/kgmole]	-9.236e+004	-9.144e+004	-1.217e+005
	Entropy [kJ/kgmole-C]	161.5	163.0	114.2
Normalized Yields Heat F	low [kJ/h]	-9.236e+006	-8.863e+006	-3.726e+005
Liq Vo	Flow @Std Cond [m3/h]	751.1	1022	0.2694
Fluid F	ackage	Basis-1		
Utility	Туре			

- Adding Expander:
 - 1. Object palette.
 - 2. Select expander
 - 3. Place the selected unit in the desired position.

You can add a new unit by pressing F12 and select the desired unit.

- 4. Double click on the expander
- 5. Select Design \setminus connections
- 6. In the inlet field, select in-mixture
- 7. In the outlet field, type (out-mixture). [a new material stream will be created and connected to the expander]
- 8. In the Energy field, type work. [a new energy stream will be created and connected to the expander].

🕖 Expai	nder: Exp	ander-2-				<u></u> 01		×
Design	Rating	Worksheet	Performance	Dynamics				0
Desi Connect Paramet Links User Var Notes	tions ters	Inlet in-mixt Energy work	275	ame E	Fluid Package Basis-1 Outlet out-mixture			
C	Delete				Unknown Duty		🔲 🔲 Igi	nored
					m			

- 9. Select parameters \ Adiabatic Efficiency
- 10. Change the efficiency to 20 %.
- 11. Select worksheet

関 Expander: Ex	pander-2-				×
Design Rating	Worksheet Performance Dynamics				
Design	Efficiency				
Connections	Adiabatic Efficiency	20.000			
Parameters	Polytropic Efficiency	<empty></empty>			
Links User Variables					
Notes					
	← =	=			
	Duty	\leq			
	Pressure Specs	Curve Input Option			
	Delta P:		Multiple IGV Curves		
	Pressure Ratio:	 Non-Dimensional Atlas Copco/Mafi Trench 	Quasi-Dimensionless		
Delete		Unknown Duty		📃 🔲 Igr	ored

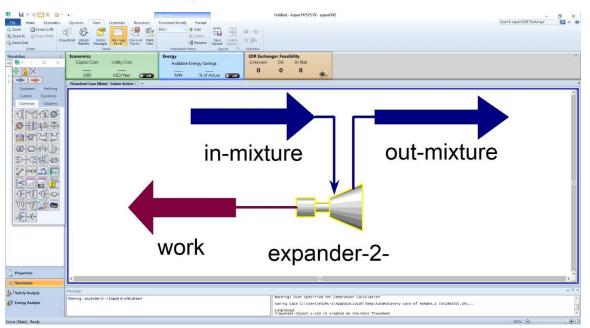
12. Change the outlet-gas pressure to 10 bar.

13.Read the temperature of the outlet-gas.

The temperature of the outlet stream is 2.384° C.

Design Rating	Worksheet Performance Dynamics				
Worksheet	Name	in-mixture	out-mixture	work	
Conditions	Vapour	0.9694	0.9907	<empty></empty>	
Properties	Temperature [C]	30.00	2.384	<empty></empty>	
Composition	Pressure [kPa]	2500	1000	<empty></empty>	
PF Specs	Molar Flow [kgmole/h]	100.0	100.0	<empty></empty>	
	Mass Flow [kg/h]	3147	3147	<empty></empty>	
	Std Ideal Liq Vol Flow [m3/h]	7.764	7.764	<empty></empty>	
	Molar Enthalpy [kJ/kgmole]	-9.236e+004	-9.271e+004	<empty></empty>	
	Molar Entropy [kJ/kgmole-C]	161.5	166.6	<empty></empty>	
	Heat Flow [kJ/h]	-9.236e+006	-9.271e+006	3.517e+004	

- Save the case:
- 1. File menu
- 2. Select save as
- 3. Give the name (expander)

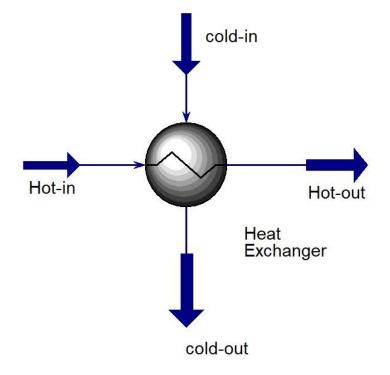


References:

1. Hamid, M. K. A. "Hysys: An introduction to chemical engineering simulation." *Apostila de Hamid* (2007).

Modeling of heat Exchanger using HYSYS V9

HYSYS can be used to model the heat exchanger and determine the flowrate of the material stream passing through the unit at certain conditions. Shell and tube heat exchanger in Aspen HYSYS V9 can give material balance calculations. In this subject, it is intended to learn how to work with this unit to model such process and how to connect the right streams in their optimum directions as well as setting up the other related parameters.



The figure above shows a simple model containing the heat exchanger unit with the two sided inlet, outlet streams using Aspen HYSYS V.9.

Example:

Given that a shell and tube heat changer is used to heat a cold water at 20° C and 110 psig via a hot water stream at 300° C and 1100 psig. The temperatures of the outlet cold and hot streams are 135° C and 220° C. The flow rate of the hot stream is 100 kg/h. using Peng-Robinson as a fluid package, determine the mass low of the cold stream.

Solution:

- Starting HYSYS:
 - 1. Start menu.
 - 2. Type in the search field: Aspen HYSYS V9.
 - 3. Select open.
- Create a new case:
- 1. File menu
- 2. New $\$ case
- There are two main necessary information have to be given in the properties tab before starting the simulation:
 - 1. Property package : Peng-Robinson
 - 2. Components: H₂O
- Create list of components
- 1. Properties
- 2. Component lists \setminus Add
- 3. Select: Pure components
- 4. Type in the serach field H_2O
- 5. Select $H_2O \setminus add$

- Add fluid package:
 - 1. Select Fluid package
 - 2. Click Add
 - 3. Select (Peng-Robinson)
- Create new material stream:
 - 1. Select simulation.
 - 2. Object palette.
 - 3. Select the material stream icon.

Alternatively, you can add new material stream by pressing F11.

- 4. Double click on the added material stream
- 5. Give the below information:
- 6.

Name	Hot-in
Cond	itions
Temperature	300 ^o C
Pressure	1100 psig
Mass flow	100 kg/h
Compo	osition
H ₂ O	1

7. Repeat the steps (2,3,4) for adding a material stream with the following information:

Name	Cold-in				
Cond	itions				
Temperature	20 ^o C				
Pressure	110 psig				
Composition					
H ₂ O	1				

Conditions			Vapour Phase	
	Vapour / Phase Fraction	1.0000	1.0000	
Properties	Temperature [C]	300.0	300.0	
Composition	Pressure [kPa]	790.8	790.8	
Oil & Gas Feed	Molar Flow [kgmole/h]	5.551	5.551	
Petroleum Assay K Value	Mass Flow [kg/h]	100.0	100.0	
User Variables	Std Ideal Liq Vol Flow [m3/h]	0.1002	0.1002	
Notes	Molar Enthalpy [kJ/kgmole]	-2.326e+005	-2.326e+005	
Cost Parameters Normalized Yields	Molar Entropy [kJ/kgmole-C]	178.9	178.9	
	Heat Flow [kJ/h]	-1.291e+006	-1.291e+006	
	Liq Vol Flow @Std Cond [m3/h]	9.854e-002	9.854e-002	
	Fluid Package	Basis-1		
	Utility Type			

Conditions Vapour / Phase Fraction 0.0000 1.0000 Properties Temperature [C] 25.00 25.00 Composition Pressure [kPa] 859.7 859.7 Oil & Gas Feed Petroleum Assay Molar Flow [kgmole/h] 5.551 5.551 Vature User Variables Std Ideal Liq Vol Flow [m3/h] 0.1002 0.1002 Notes Molar Entropy [kJ/kgmole] -2.862e+005 -2.862e+005 Cost Parameters Molar Entropy [kJ/kgmole-C] 53.69 53.69 Normalized Yields Heat Flow [kJ/h] -1.589e+006 -1.589e+006 Liq Vol Flow @Std Cond [m3/h] 9.854e-002 9.854e-002	Worksheet	Stream Name	cold-in	Aqueous Phase	
Properties Composition Oil & Gas Feed Petroleum Assay K Value User Variables Notes Temperature [C] 25.00 25.00 Molar Flow [kgmole/h] 859.7 859.7 Molar Flow [kgmole/h] 5.551 5.551 Value User Variables Notes Std Ideal Liq Vol Flow [m3/h] 100.0 100.0 Molar Enthalpy [kl/kgmole] -2.862e+005 -2.862e+005 Cost Parameters Normalized Yields Molar Entropy [kl/kgmole-C] 53.69 Heat Flow [kJ/h] -1.589e+006 -1.589e+006 Liq Vol Flow @Std Cond [m3/h] 9.854e-002 9.854e-002					
Composition Oil & Gas Feed Petroleum Assay K Value User Variables Notes Pressure [kPa] 859.7 859.7 Molar Flow [kgmole/h] 5.551 5.551 Mass Flow [kg/h] 100.0 100.0 Std Ideal Liq Vol Flow [m3/h] 0.1002 0.1002 Molar Entropy [k//kgmole] -2.862e+005 -2.862e+005 Korse Molar Entropy [k//kgmole-C] 53.69 Heat Flow [kJ/h] -1.589e+006 -1.589e+006 Liq Vol Flow @Std Cond [m3/h] 9.854e-002 9.854e-002			25.00	25.00	
Molar Flow [kgmole/h] 5.551 5.551 Petroleum Assay K Value Mass Flow [kgmole/h] 100.0 100.0 User Variables Mass Flow [kgmole] 0.1002 0.1002 Notes Molar Enthalpy [kl/kgmole] -2.862e+005 -2.862e+005 Cost Parameters Molar Entropy [kl/kgmole-C] 53.69 53.69 Normalized Yields Heat Flow [kl/h] -1.589e+006 -1.589e+006 Liq Vol Flow @Std Cond [m3/h] 9.854e-002 9.854e-002	Composition		859.7		
K Value User Variables Notes Mass Flow [kg/h] 100.0 100.0 Mass Flow [kg/h] 0.1002 0.1002 Molar Enthalpy [k/kgmole] -2.862e+005 -2.862e+005 Cost Parameters Normalized Yields Molar Entropy [k/kgmole-C] 53.69 Heat Flow [kl/h] -1.589e+006 -1.589e+006 Liq Vol Flow @Std Cond [m3/h] 9.854e-002 9.854e-002		Molar Flow [kgmole/h]	5.551	5.551	
User Variables Notes Std Ideal Liq Vol Flow [m3/h] 0.1002 0.1002 Notes Molar Enthalpy [kJ/kgmole] -2.862e+005 -2.862e+005 Cost Parameters Molar Entropy [kJ/kgmole-C] 53.69 53.69 Normalized Yields Heat Flow [kJ/h] -1.589e+006 -1.589e+006 Liq Vol Flow @Std Cond [m3/h] 9.854e-002 9.854e-002		Mass Flow [kg/h]	100.0	100.0	
Cost Parameters Normalized Yields Molar Entropy [kJ/kgmole-C] 53.69 53.69 Liq Vol Flow @Std Cond [m3/h] -1.589e+006 -1.589e+006	A CONTRACTOR AND A CONTRACTOR	Std Ideal Liq Vol Flow [m3/h]	0.1002	0.1002	
Normalized Yields Heat Flow [k//h] -1.589e+006 -1.589e+006 Liq Vol Flow @Std Cond [m3/h] 9.854e-002 9.854e-002	Notes	Molar Enthalpy [kJ/kgmole]	-2.862e+005	-2.862e+005	
Liq Vol Flow @Std Cond [m3/h] 9.854e-002 9.854e-002		Molar Entropy [kJ/kgmole-C]	53.69	53.69	
		Heat Flow [kJ/h]	-1.589e+006	-1.589e+006	
Eluid Deckage		Liq Vol Flow @Std Cond [m3/h]	9.854e-002	9.854e-002	
Fluid Package Busis- /		Fluid Package	Basis-1		
Utility Type		Utility Type			

- Adding heat exchanger:
 - 1. Object palette.
 - 2. Select heat exchanger
 - 3. Place the selected unit in the desired position.

You can add a new unit by pressing F12 and select the desired unit.

- 4. Double click on the heat exchanger
- 5. Select Design \ connections
- 6. In the Tube side Inlet field, select Hot-in
- 7. In the Tube side outlet field, type (Hot-out). [a new material stream will be created and connected to the heat exchanger]
- 8. In the Shell side Inlet field, select cold-in
- 9. In the Tube side outlet field, type (cold-out). [a new material stream will be created and connected to the heat exchanger]

Design Rating	Worksheet Performance D	ynamics Rigorous	Shell&Tube				
Design	Tube Side Inlet	Name	Heat Exchanger	Shell Side Inlet			
Connections Parameters Specs User Variables	Hot-in	•		cold-in	•		
Notes	Tubeside Flow	sheet Case (Main)	Shellside Flowsheet Case	(Main)			
	Tube Side Outlet	.		Shell Side Outlet			
	Hot-out	•	Switch streams	cold-out	•		
	Tube Side Fluid Pkg			Shell Side Fluid Pkg			
	Basis-1	•		Basis-1	•		
		le exchanger model	by a fully rigorous model in your via input or by importing a prepa er Specify Geon	red file.			
Delete			Unknown Delta P	1 1	Update	Ignor	

10.Select parameters \ Specified Pressure Drop

11. Change the drop to (0) in shell side and tube side.

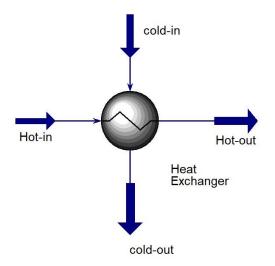
Design Rating	Worksheet Pe		mics Rigorous	Shell&Tube	2180				
Design	-Heat Exchang	er Model		Heat Le	ak/Loss ———				
Connections Parameters	Simple End	Point	•	Non	ne 🔘 Extre	emes 🔘 P	Proportional		
Specs User Variables	End Point Model								
Notes	Overall UA	[kJ/C-h]		<em< td=""><td>ipty></td><td></td><td></td><td></td><td></td></em<>	ipty>				
		101 1010101	1	SHELL			-SIDE		
	Specified Pre	essure Drop [kPa]		0.	.0000	0.	0000		
	Use Ft	Tube Passes	Shell Passes	Shells In Series	First Pass	Shell Type			
	2	2							
	Convert to Rig	gorous Model —	*	1 1			E		
	Convert to Rig You can repl	gorous Model	hanger model by	r a fully rigorous mo input or by import	odel in your simul	ation defining a			
	Convert to Rig You can repl	gorous Model	hanger model by t specification via	r a fully rigorous mo input or by import	odel in your simul ing a prepared fil	ation defining a			
	Convert to Rig You can repl	gorous Model	hanger model by t specification via	r a fully rigorous mo input or by import	odel in your simul ing a prepared fil	ation defining a			

- 12. Select worksheet
- 13. Change the temperature in hot-out to $200^{\circ}\,C$
- 14.Change the temperature in cold-out to $135^{\rm o}\,C$

Design Rating	Worksheet Performance Dynamics	Rigorous Shell&Tube					
Worksheet	Name	Hot-in	Hot-out	cold-in	cold-out		
Conditions	Vapour	1.0000	1.0000	0.0000	0.0000		
Properties	Temperature [C]	300.0	200.0	25.00	135.0		
Composition	Pressure [kPa]	790.8	790.8	859.7	859.7		
PF Specs	Molar Flow [kgmole/h]	5.551	5.551	2.346	2.346		
	Mass Flow [kg/h]	100.0	100.0	42.26	42.26		
	Std Ideal Liq Vol Flow [m3/h]	0.1002	0.1002	4.234e-002	4.234e-002		
	Molar Enthalpy [kJ/kgmole]	-2.326e+005	-2.362e+005	-2.862e+005	-2.775e+005		
	Molar Entropy [kJ/kgmole-C]	178.9	171.8	53.69	78.41		
	Heat Flow [kJ/h]	-1.291e+006	-1.311e+006	-6.713e+005	-6.510e+005		

15.Read the mass flow of the cold stream.

The mass flow of the cold stream is 42.26 Kg/h.



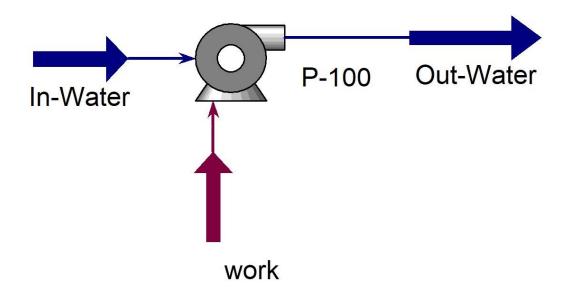
- Save the case:
- 1. File menu
- 2. Select save as
- 3. Give the name (expander)

References:

1. Hamid, M. K. A. "Hysys: An introduction to chemical engineering simulation." *Apostila de Hamid* (2007).

Modeling of Pump using HYSYS V9

It is possible to increase the pressure of the liquid stream using the pump unit. Pumping process for inlet material streams is modeled in Aspen HYSYS V9 including the calculation of the desired properties like temperature and efficiency. In this subject, it is intended to learn how to work with the Pump unit to model the pumping process as well as set up the unit connections and other design parameters. In the end, it would be possible to operate the pump according to the given condition.



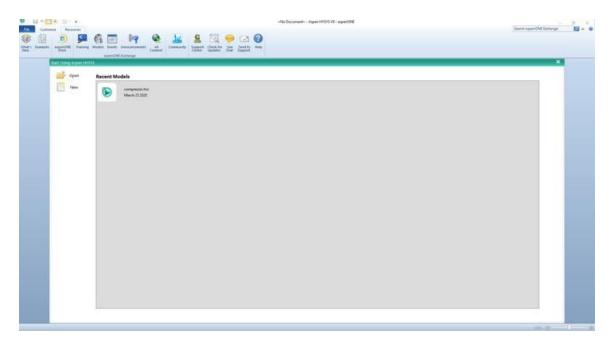
The figure above shows a simple model containing the Pump with inlet, outlet and energy streams using Aspen HYSYS V.9.

Example:

Material stream of Water at 130°C and 4 bar is fed into a pump with 15% efficiency. The pressure of the outlet stream is 90 bar and the flow rate of the water is 100 kgmole/h. Deteremine the outlet temperature of the water using Peng-Robinson equation [1].

Solution:

- Starting HYSYS:
 - 1. Start menu.
 - 2. Type in the search field: Aspen HYSYS V9.
 - 3. Select open.



The above window will pop up once you start HYSYS. It is possible by the Aspen HYSYS start window to open previous cases or create a new case.

- Create a new case:
- 1. File menu
- 2. New \setminus case
- There are two main necessary information have to be given in the properties tab before starting the simulation:
 - 1. Property package : Peng-Robinson
 - 2. Components: H₂O
- 1. Properties
- 2. Component lists \setminus Add
- 3. Select: Pure components
- 4. Type in the search field H_2O

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Petroleum Asseys	Component	Type	Group		Search for:	H2o		Search by:	Full Name/Synonym		
Reactions	H2O	Pure Component			-				L 2001-02		
User Properties					Simul	ation Name	Full Name /		Formula		
				< Add		H2O2		H2O2			
						H2\$2O3		H2S2O3			
						H25O4		H2SO4			
				Replace		Cety/C1cryla	Hexadecane_2-Meth				
						Cety/C1cryla	Hexadecyl_2-Met				
						Caprolactam		dro-2-Azepinone			
					_	14-CC6DiC1ol	Hexahydro-2-Oxo-1,	4_Cyclonexaned 2H-Azepin-2-one			
						Caprolactam	Hexanyoro-	2H-Azepin-2-one	COHTINU		
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69 Energy Analysis	Required Info : Fluid Package	es Select property packag	÷								
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- Add fluid package:
 - 1. Select Fluid package
 - 2. Click Add
 - 3. Select (Peng-Robinson)

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- Create new material stream:
 - 1. Select simulation.
 - 2. Object palette.
 - 3. Select the material stream icon.

Alternatively, you can add new material stream by pressing F11.

- 4. Double click on the added material stream
- 5. Give the below information:

Name	In-Water
Cond	itions
Temperature	130 ^o C
Pressure	4 bar
Molar flow	100 kgmole/h
Comp	osition
H ₂ O	1

The above information should be given according to the application or example.

Worksheet	Stream Name	In-Water	Aqueous Phase	
Conditions	Vapour / Phase Fraction	0.0000	1.0000	
Properties	Temperature [C]	130.0	130.0	
Composition	Pressure [kPa]	400.0	400.0	
Oil & Gas Feed	Molar Flow [kgmole/h]	100.0	100.0	
Petroleum Assay K Value	Mass Flow [kg/h]	1802	1802	
User Variables	Std Ideal Liq Vol Flow [m3/h]	1.805	1.805	
Notes	Molar Enthalpy [kJ/kgmole]	-2.780e+005	-2.780e+005	
Cost Parameters	Molar Entropy [kJ/kgmole-C]	77.42	77.42	
Normalized Yields	Heat Flow [kJ/h]	-2.780e+007	-2.780e+007	
	Liq Vol Flow @Std Cond [m3/h]	1.775	1.775	
	Fluid Package	Basis-1		
	Utility Type			
		OK		

- Adding Pump:
 - 1. Object palette.
 - 2. Select pump
 - 3. Place the selected unit in the desired position.

You can add a new unit by pressing F12 and select the desired unit.

- 4. Double click on the Pump
- 5. Select Design \setminus connections
- 6. In the inlet field, select In-Water
- 7. In the outlet field, type (Out-water). [a new material stream will be created and connected to the pump]
- 8. In the Energy field, type work. [a new energy stream will be created and connected to the Pump].

Pump	: P-100									>
)esign	Rating	Worksheet	Performance	Dynamic	CS .					
Desi	gn		١	Name	P-100					
Connec	tions									
aramet	ters					0.4				
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			Energy			Fluid Package				
			work		•	Basis-1	•			
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- 9. Select parameters \ Adiabatic Efficiency
- 10. Change the efficiency to 15 %.

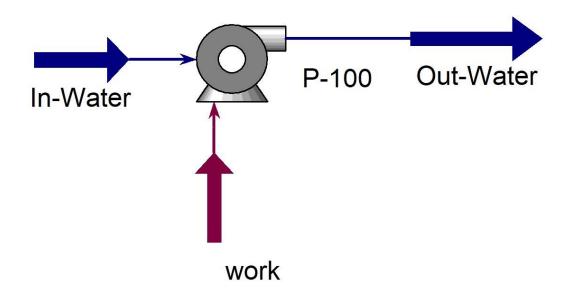
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		Duty]	→Ľ			
E	Delete				Unknown Duty 🖉 On	🔲 Ign	ored

- 11. Select worksheet
- 12. Change the outlet-stream pressure to 90 bar.
- 13.Read the temperature of the outlet-stream.

The temperature of the outlet stream is 142.4° C.

esign Rating	Worksheet	Performance	Dynamics					
Worksheet	Name			In-Water	Out-Water	work	 	_
Conditions	Vapour			0.0000	0.0000	<empty></empty>		
roperties	Temperature [C]			130.0	142.4	<empty></empty>		
Composition	Pressure [kP	'a]		400.0	9000	<empty></empty>		
F Specs	Molar Flow	[kgmole/h]		100.0	100.0	<empty></empty>		
	Mass Flow [kg/h]		1802	1802	<empty></empty>		
	Std Ideal Liq	Vol Flow [m3/h]	1.805	1.805	<empty></empty>		
	Molar Entha	lpy [kJ/kgmole]		-2.780e+005	-2.768e+005	<empty></empty>		
	Molar Entro	py [kJ/kgmole-0]	77.42	79.67	<empty></empty>		
	Heat Flow [k	J/h]		-2.780e+007	-2.768e+007	1.120e+005		

- Save the case:
- 1. File menu
- 2. Select save as
- 3. Give the name (pump)



References:

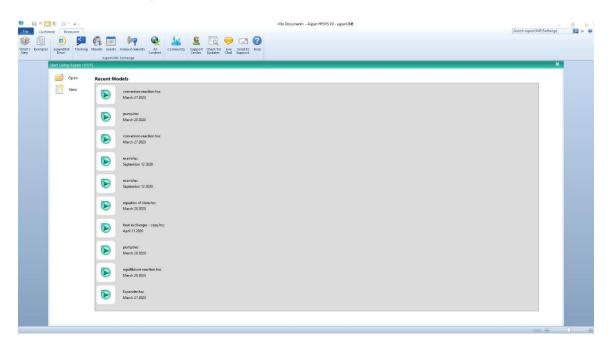
1. Hamid, M. K. A. "Hysys: An introduction to chemical engineering simulation." *Apostila de Hamid* (2007).

Starting HYSYS V9

HYSYS V9 is a professional simulation tool in chemical engineering applications. It presents a comprehensive environment including the design and modeling, facilitated interface, active interactivity and result visualizations. HYSYS is commonly given in universities and laboratories as a simulation and modeling software for chemical engineers with different levels. In this lecture, the main steps for starting HYSYS V9 are detailed thorough the software interface, component selection, Fluid package selection, working with material streams.

How to start HYSYS:

- 1. Start menu.
- 2. Type in the search field: Aspen HYSYS V9.
- 3. Select open.



The above window will pop up once you start HYSYS. Mainly, there are two options to start working:

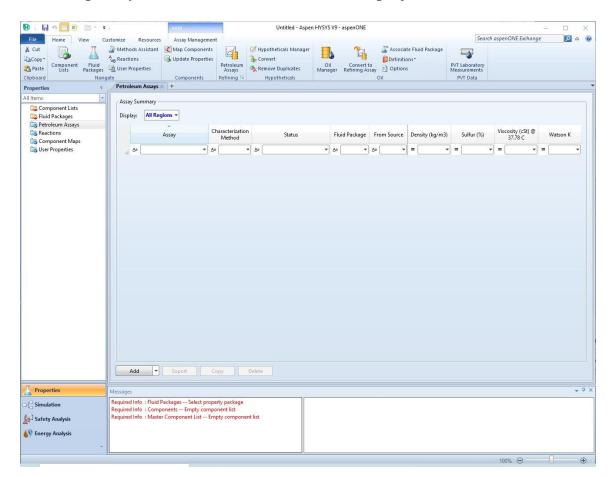
- <u>Open</u>: Enables the user to work with the models and projects which have been created previuosly. If (open) is chosen, it will be possible to browse you computer and select the desired project. However, it can be seen in the above figure that there are shortuts for recently opened files that have been edited by HYSYS V9. Alternatively, it is possible to open the HYSYS files by:
 - **<u>1.</u>** (ctrl+o) buttons on keyboard
 - **<u>2.</u>** file menu \setminus open
- <u>New</u>: Enables the user to create a new simulation project. As (new) is chosen, it will be neessary to define the main propeties of the created project. Alternatively, it is possible to create new HYSYS files by:
 - **<u>3.</u>** (ctrl+n) buttons on keyboard
 - **<u>4.</u>** file menu \setminus new

Properties of the simulation case:

The figure below shows the initial view of HYSYS V9 desktop windowfor a new simulation case. The properties tab is exist on the the left down corner. It is possible to access and edit the realted information regarding the opened project from (properties). This includes the selection of components and choosing the fluid package. The first step before adding the project information is to save the file in a well known location in your computer as:

- 1. file \setminus save
- browse your computer and give the file name in the desired location.
 [create a new folder (name: chemical fourth {your name})] and a file name of (stating hysys).
- 3. save

Moreover, the information of component lists and fluid package can be stored seprately in order to use them with other projects.



Adding component lists:

1. properties \ component lists window is opened.

 Add (Add button is exist in the left down corner of the component lists window). A new window with the component library is opened as shown below.

Petroleum Assays × Co	mponent List - 1 × +								
Source Databank: HYSYS				Select:	Pure Components	•	Filter:	All Families	•
Component	Туре	Group		Search for:			Search by:	Full Name/Synonym	•
				Simul	ation Name	Full Nam	e / Synonym	Formula	-
			< Add		Methane		C	CH4	
					Ethane		c	2 C2H6	
					Propane		¢	C3H8	
			Replace		i-Butane		i-C	C4H10	
					n-Butane		n-C	C4H10	
					i-Pentane		i-C	:5 C5H12	
			Remove		n-Pentane		n-C	5 C5H12	
					n-Hexane		c	6 C6H14	
					n-Heptane		c	.7 C7H16	
					n-Octane		C	C8H18	
					n-Nonane		C	C9H20	
					n-Decane		C1	0 C10H22	
					n-C11		C1	1 C11H24	
					n-C12		C1		
					n-C13		C1		
					n-C14		C1		
					n-C15		C1		
					n-C16		C1		
					n-C17		C1		
					n.C18		C1	C18H38	*

3. Select the desired components. It is possible to search for a certain component in the field (search for) according to one of three entries in (search by) field: Full name/Synonym, Simulation name and formula.

[Choose the (Full name/Synonym) and write (water) in search for field. Select water]

4. Add

A new component list is created (component List - 1) with single component (H₂O). It is possible to add or remove component from the component lists using add, remove and replace buttons. Moreover, the component list can be saved separately as:

1. Component Lists

- 2. Select the desired component list
- 3. Export
- 4. browse your computer and give the file name in the desired location

Component List - 1	HYSYS Databanks	Associated Fluid Packages	Not attached to fluid package
Add Copy	Delete		
mport - Export			

Once the component list is saved in a certain location. It will be allowed to use it in other project as:

- 1. Component Lists
- 2. browse your computer and select the desired file.
- 3. Import

Adding the fluid package:

The fluid package is chosen in order to calculate the desired properties of the chemical mixtures accompanied in the simulation.

References:

1. Hamid, M. K. A. "Hysys: An introduction to chemical engineering simulation." *Apostila de Hamid* (2007).

Case Study in HYSYS V9

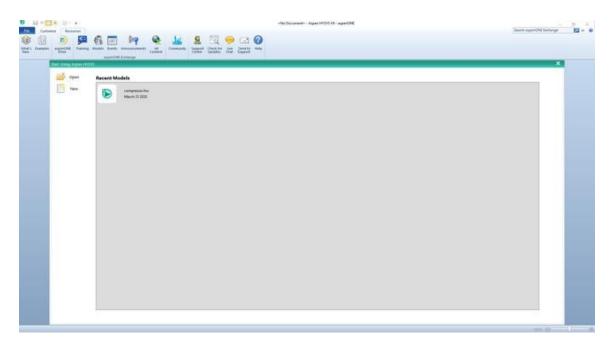
We can analyze the molar volume with a range of temperature values using the case study utility in Aspen HYSYS V9.

Example:

Show how the specific volume of a material stream of i-pentane when the temperature is changing from 250 k to 350 k [1].

Solution:

- Starting HYSYS:
 - 1. Start menu.
 - 2. Type in the search field: Aspen HYSYS V9.
 - 3. Select open.



The above window will pop up once you start HYSYS. It is possible by the Aspen HYSYS start window to open previous cases or create a new case.

- Open the case of the previuos example:
- 1. File menu
- 2. Open $\$ equation of state
- Working with databook:
 - 1. From the Home toolbar, click on case studies
 - 2. Add

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		Completed.	*
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- 3. Variable selection
- 4. In Independent Variable click on Find variables
- 5. Highlight the desired material stream
- 6. Select the desired variable (temperature) \ Add
- 7. Done

ontext Flowsheet	 Objects 	C	Variables	٩	Selected
Case (Main)	Object Type	FeederBlock_i-pentane i-pentane ProductBlock_i-pentane	Input Output Physical Type All	Master Comp Volume Flow Master Comp Volume Flow Master Comp Volume Frac Molar Electrical Conductivity - Aqueous Molar Flow Osmotic Pressure - Aqueous Petroleum Assay Type Phase - Molar Flow Phase - Pressure Phase - Temperature Phase Pressure Phase Respective Phase Pressure Phase Pressure Phase Pressure Pressure Pressure Product Nozzle Elevation Specific Electrical Conductivity - Aqueous Temperature	i-pentane . Temperature

- 8. In Dependent Variable click on Find variables
- 9. Highlight the desired material stream
- 10.Select the desired variable (Molar Volume) \ Add

11.Done

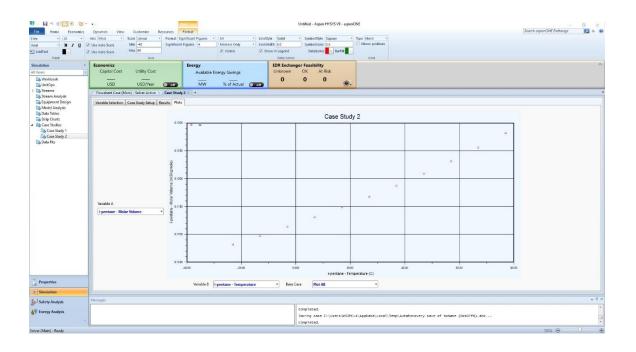
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- 12. Select the Case Study Setup
- 13.Change the start value to 250 K
- 14. Change the end value to 350 K
- 15.Change the step size to 10 K
- 16.Click Run

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	l		Completed.		100% 👄 🕛 🛞
Solver (Main) - Ready					100% (C)

17.Select results and read the volume values with temperature 18.Select plots



- Save the case:
- 1. File menu
- 2. Select save as
- 3. Give the name (case study)

References:

1. Hamid, M. K. A. "Hysys: An introduction to chemical engineering simulation." *Apostila de Hamid* (2007).