دوره آموزشي hysys

Hysys training courses

برگرفته از دوره TRAINING-Svecek

تهيه كننده : محمد بهزادي Mohammad Behzadi

دوره پیشرفته طراحی با نرم افزار HYSYS

تهیه کننده: محمد بهزادی

Utility

Boiling Point Curves

The Boiling Point Curves utility, which generally is used in conjunction with characterized oils from the Oil Manager, allows you to obtain the results of a laboratory style analysis for your simulation streams. Simulated distillation data including TBP, ASTM D86, D86 (Corr.), D1160(Vac), D1160(Atm), and D2887 as well as critical property data for each cut point and cold property data are calculated. The data can be viewed in a tabular format or graphically.

The object for the analysis can be a stream, a phase on any stage of a tray section, or one of the phases in a separator, in a condenser or in a reboiler. You select the basis for the calculations, and you can specify the boiling ranges for the simulated distillation data.

- TBP
- ASTM D86
- D86 Corr.
- ASTM D1160 (Vac.),
- ASTM D1160 (Atm.)
- ASTM D2887

The ASTM D86 boiling point curve corresponds to the true boiling points of the oil, which assumes no cracking has occurred.

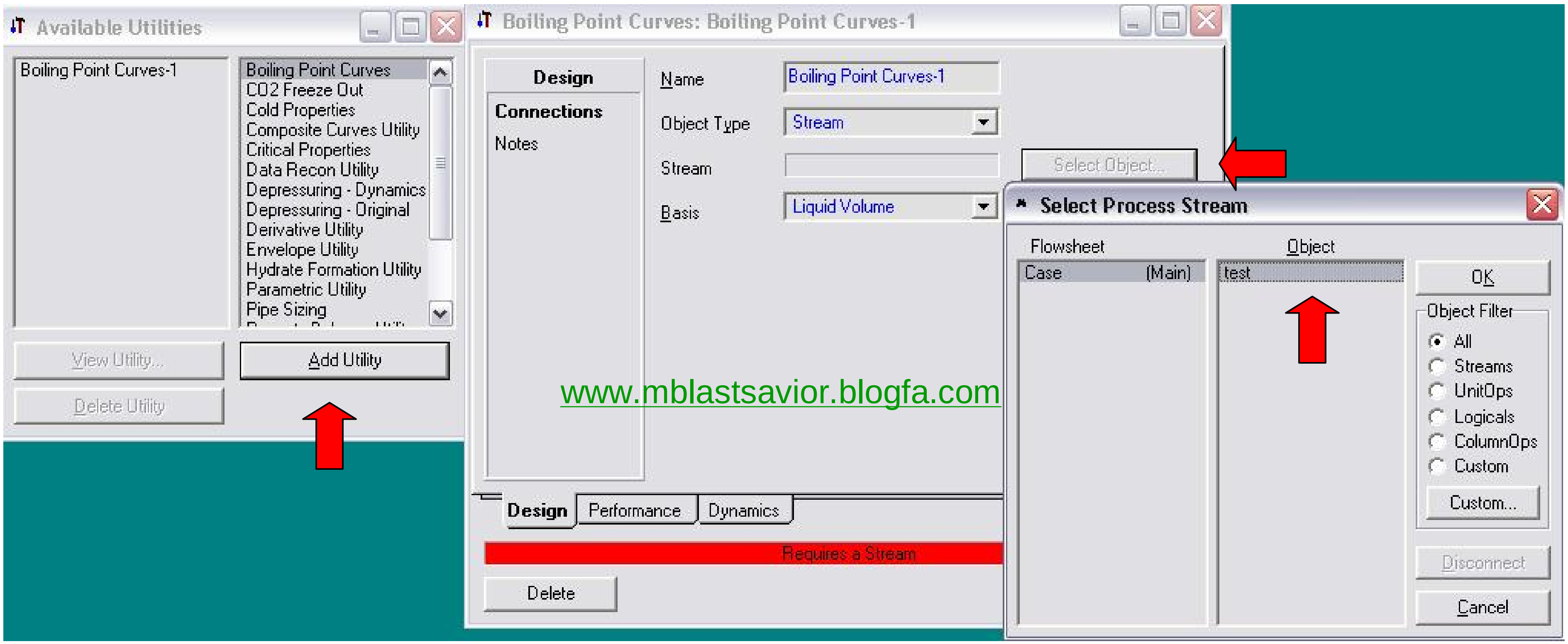
Example

FP:PR

n-Pentane
n-Hexane
n-Heptane
n-Octane
n-Nonane
H2O
n-C11
n-C12
n-C13
n-C14
n-C15
n-C16

Stream Name	test
Vapour / Phase Fraction	0.00000
Temperature [C]	50.000
Pressure [atm]	0.98692
Molar Flow [kgmole/h]	11.560
Mass Flow [kg/h]	1000.0

	Mole Fractions
n-Pentane	0.166667
n-Hexane	0.166667
n-Heptane	0.166667
n-Octane	0.166667
n-Nonane	0.166667
H2O	0.166667
n-C11	0.000000
n-C12	0.000000
n-C13	0.000000
n-C14	0.000000
n-C15	0.000000
n-C16	0.000000



Available Utilities
Boiling Point Curves-1
Boiling Point Curves
CO2 Freeze Out
Cold Properties
Composite Curves Utility
Critical Properties
Data Recon Utility
Depressuring - Dynamics
Depressuring - Original
Derivative Utility
Envelope Utility
Hydrate Formation Utility
Parametric Utility
Pipe Sizing
View Utility...
Add Utility
Delete Utility
Boiling Point Curves: Boiling Point Curves-1
Design
Connections
Notes
Name
Boiling Point Curves-1
Object Type
Stream
Stream
Basis
Liquid Volume
Select Object...
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Design
Performance
Dynamics
Requires a Stream
Delete
Select Process Stream
Flowsheet
Object
Case
(Main)
test
OK
Object Filter
All
Streams
UnitOps
Logicals
ColumnOps
Custom
Custom...
Disconnect
Cancel

Performance

Results

Critical Props

Cold Props

Plots

Results

Cut Point [%]	TBP [C]	ASTM D86 [C]	D86 Crack Reduced [C]	ASTM D1160 (Vac) [C]	ASTM D1160 (Atm) [C]	ASTM D2887 [C]
0.00	18.71	57.75	57.75	-46.87	40.96	23.55
1.00	20.99	58.71	58.71	-46.13	41.94	25.87
2.00	23.26	59.69	59.69	-45.74	42.45	28.20
3.50	26.61	61.20	61.20	-44.72	43.79	31.73
5.00	29.92	62.76	62.76	-43.58	45.30	35.26
7.50	35.33	65.46	65.46	-41.39	48.16	41.07
10.00	40.61	68.25	68.25	-38.92	51.41	46.75
12.50	45.75	71.13	71.13	-36.21	54.97	52.21
15.00	50.76	74.06	74.06	-33.29	58.79	57.44
17.50	55.63	77.03	77.03	-30.23	62.79	62.41
20.00	60.38	80.02	80.02	-27.07	66.93	67.12
25.00	69.46	85.94	85.94	-20.69	75.23	75.76
30.00	77.92	91.37	91.37	-15.19	82.39	83.69
35.00	85.89	96.62	96.62	-9.864	89.29	91.70
40.00	93.43	101.7	101.7	-4.712	95.95	99.70
45.00	100.6	106.5	106.5	0.1946	102.3	107.2
50.00	107.5	111.1	111.1	5.101	108.6	114.2
55.00	114.0	115.6	115.6	9.790	114.6	120.2
60.00	120.2	119.9	119.9	14.36	120.5	125.5
65.00	126.2	124.1	124.1	18.81	126.2	130.5
70.00	131.8	128.1	128.1	23.13	131.7	135.4
75.00	137.3	132.0	132.0	27.38	137.1	140.3
80.00	142.6	136.0	136.0	31.60	142.5	145.2
85.00	147.9	140.0	140.0	35.79	147.8	150.4
90.00	153.1	144.1	144.1	40.00	153.2	155.8
92.50	155.8	146.2	146.2	42.12	155.8	158.6
95.00	158.5	148.4	148.4	44.26	158.5	161.6
96.50	160.1	149.7	149.7	45.54	160.2	163.4
98.00	161.8	151.0	151.0	46.84	161.8	165.3
99.00	162.9	151.9	151.9	47.70	162.9	166.6
100.00	164.0	152.9	152.9	48.57	164.0	168.0

Design | **Performance** | Dynamics

Performance

Results

Critical Props

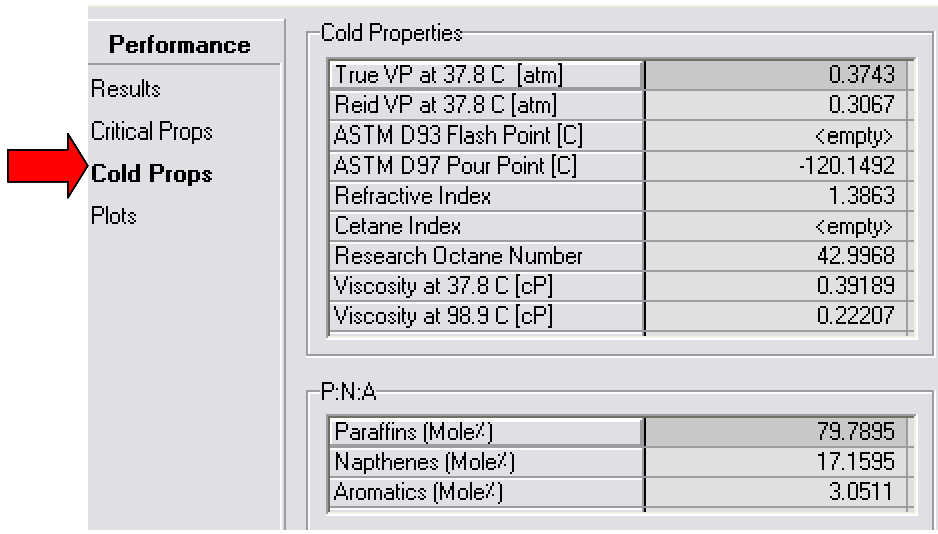
Cold Props

Plots

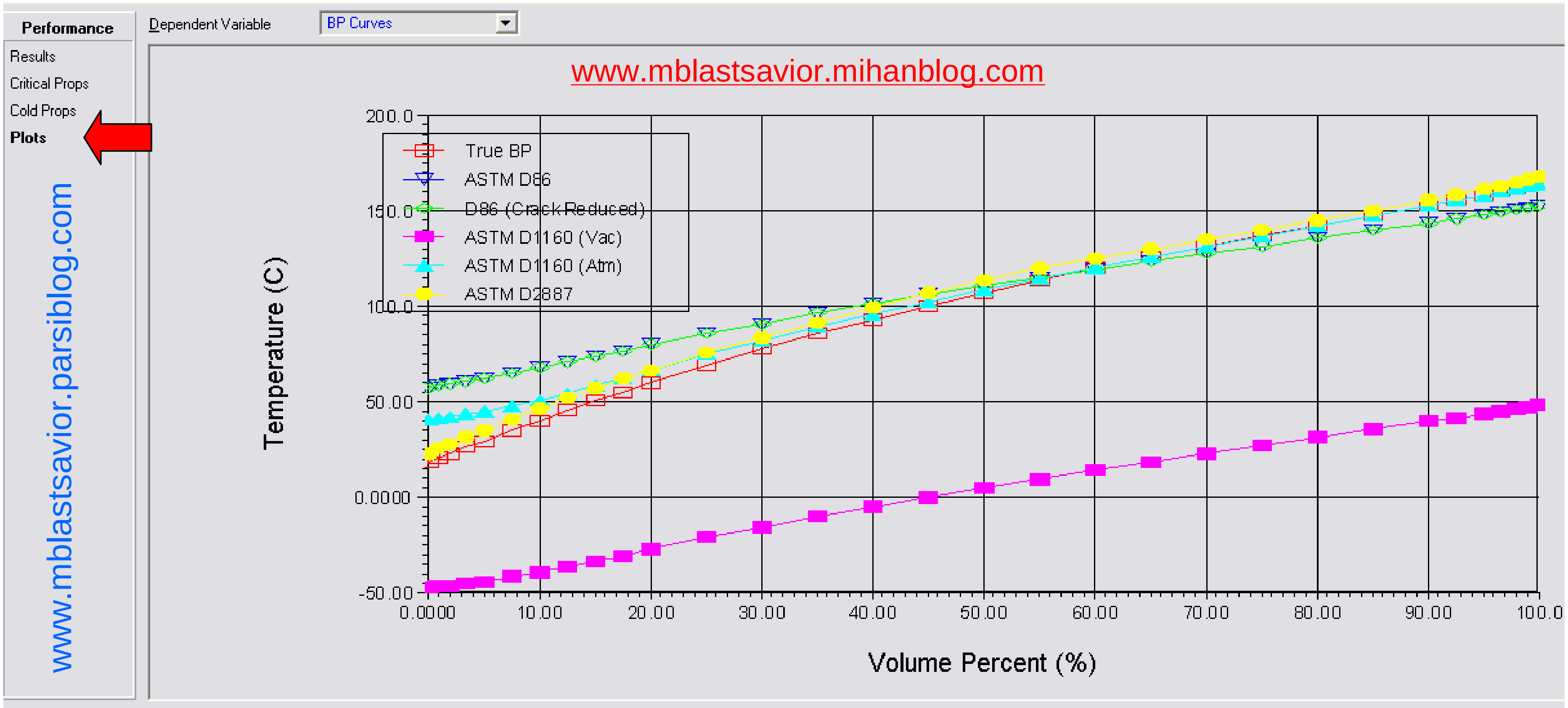
Critical Properties

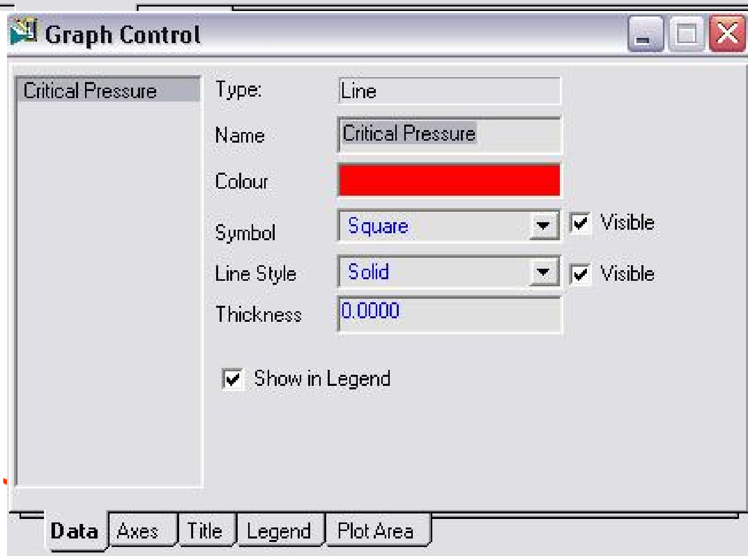
Cut Point [%]	Critical Temp [C]	Critical Press [atm]	Acentric Factor	Mole Wt.	Liquid Density [kg/m3]
0.00	175.4	35.26	0.2309	65.067	610.6
1.00	180.8	34.93	0.2348	66.419	616.3
2.00	183.1	34.68	0.2376	67.257	618.2
3.50	186.5	34.32	0.2418	68.513	621.2
5.00	189.9	33.96	0.2459	69.770	624.1
7.50	195.7	33.39	0.2529	71.865	629.1
10.00	202.0	32.82	0.2601	74.057	634.8
12.50	208.2	32.28	0.2673	76.227	640.3
15.00	214.2	31.75	0.2744	78.357	645.5
17.50	219.9	31.25	0.2813	80.449	650.3
20.00	225.3	30.76	0.2882	82.503	654.9
25.00	235.6	29.85	0.3018	86.505	663.3
30.00	245.0	29.00	0.3151	90.374	670.7
35.00	253.7	28.21	0.3282	94.118	677.3
40.00	261.7	27.48	0.3410	97.748	683.1
45.00	269.3	26.81	0.3538	101.276	688.4
50.00	276.5	26.20	0.3666	104.715	693.3
55.00	283.4	25.62	0.3791	108.066	697.8
60.00	289.8	25.09	0.3913	111.333	701.9
65.00	296.0	24.60	0.4028	114.522	705.7
70.00	301.9	24.13	0.4138	117.640	709.2
75.00	307.6	23.70	0.4239	120.693	712.5
80.00	313.1	23.29	0.4331	123.687	715.6
85.00	318.5	22.91	0.4414	126.627	718.6
90.00	323.9	22.53	0.4496	129.578	721.6
92.50	326.7	22.35	0.4543	131.085	723.2
95.00	329.5	22.16	0.4590	132.592	724.8
96.50	331.2	22.05	0.4618	133.496	725.8
98.00	332.8	21.94	0.4646	134.400	726.8
99.00	333.9	21.87	0.4665	135.003	727.4
100.00	335.1	21.80	0.4684	135.605	728.0

Design | **Performance** | Dynamics



PNA:ratio of paraffins to naphthas to aromatics.

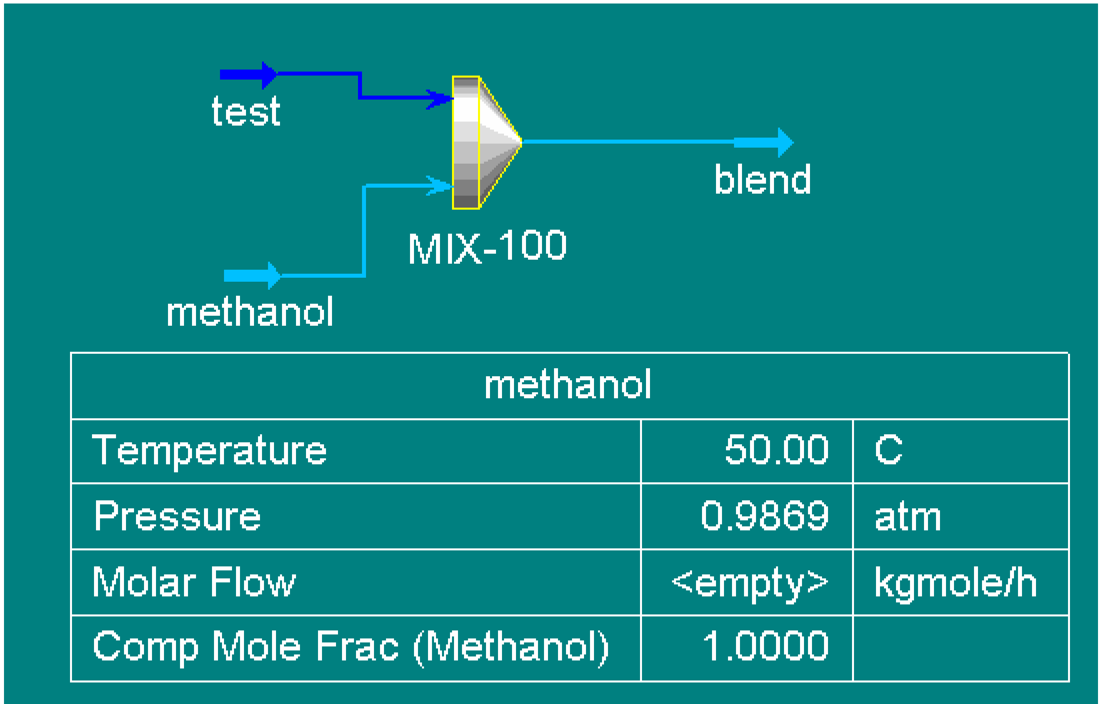


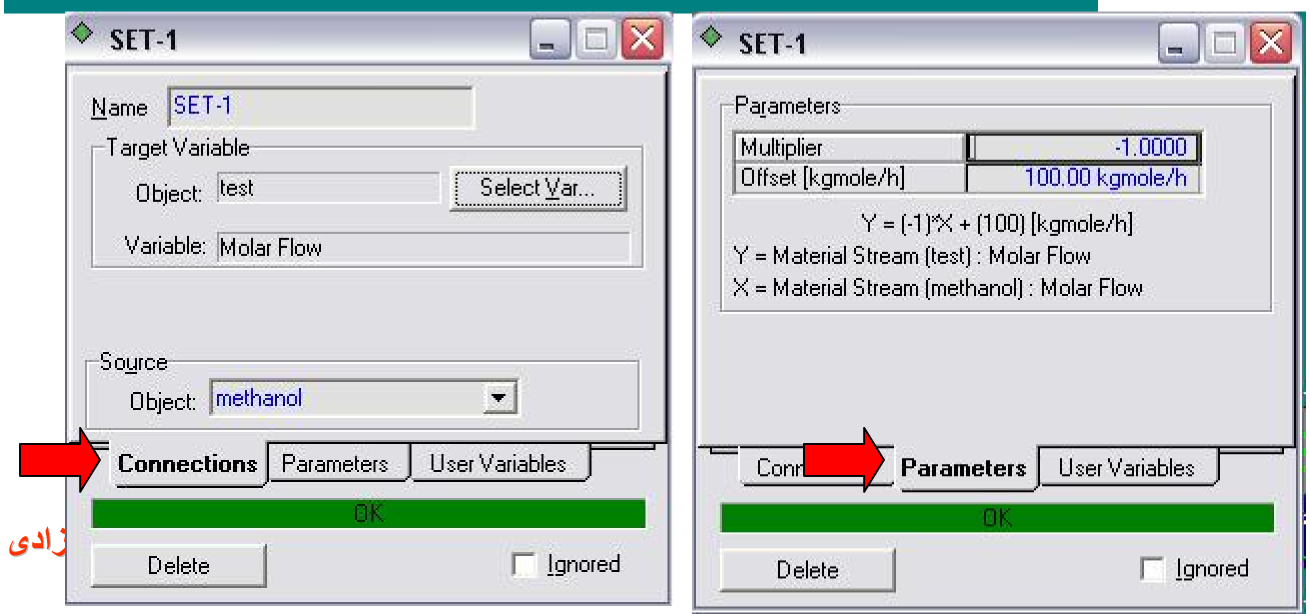


- Boiling Point Curves
- Critical Temperature
- Critical Pressure
- Acentric Factor
- Molecular Weight
- Liquid Density

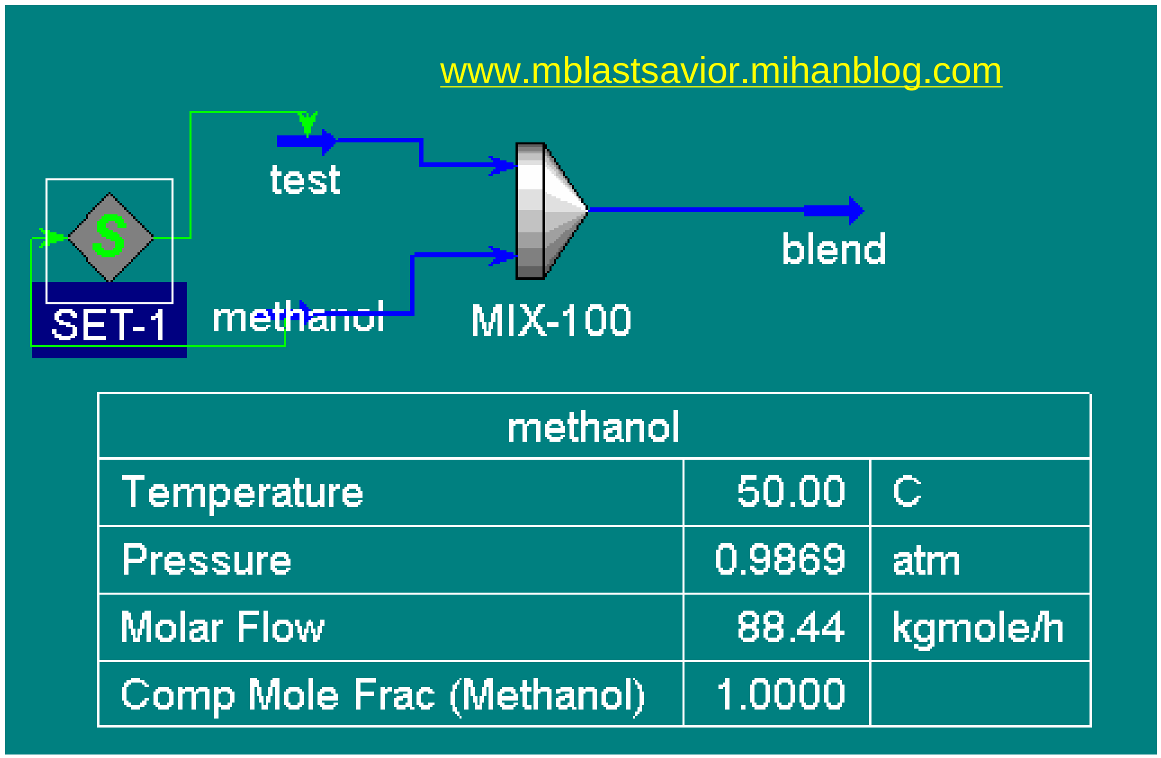
به مثال قبل متانول اضافه کرده و تاثير اضافه کردن متانول به سوخت را بررسي نماييد

Example





نکته:دبي مولي متانول داده نشده بود اما چون ست بود و مقصد مشخص شده بود ورودي هم به طور خودکار مشخص شد!!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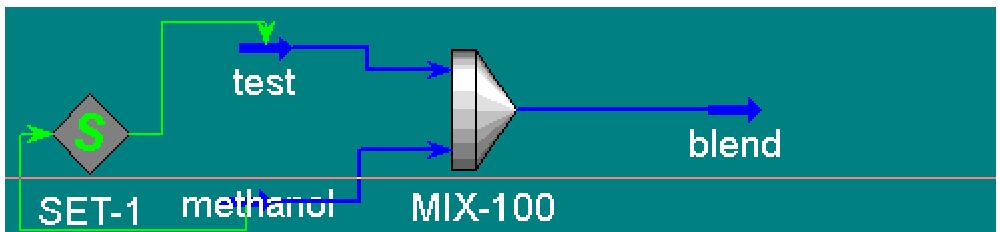
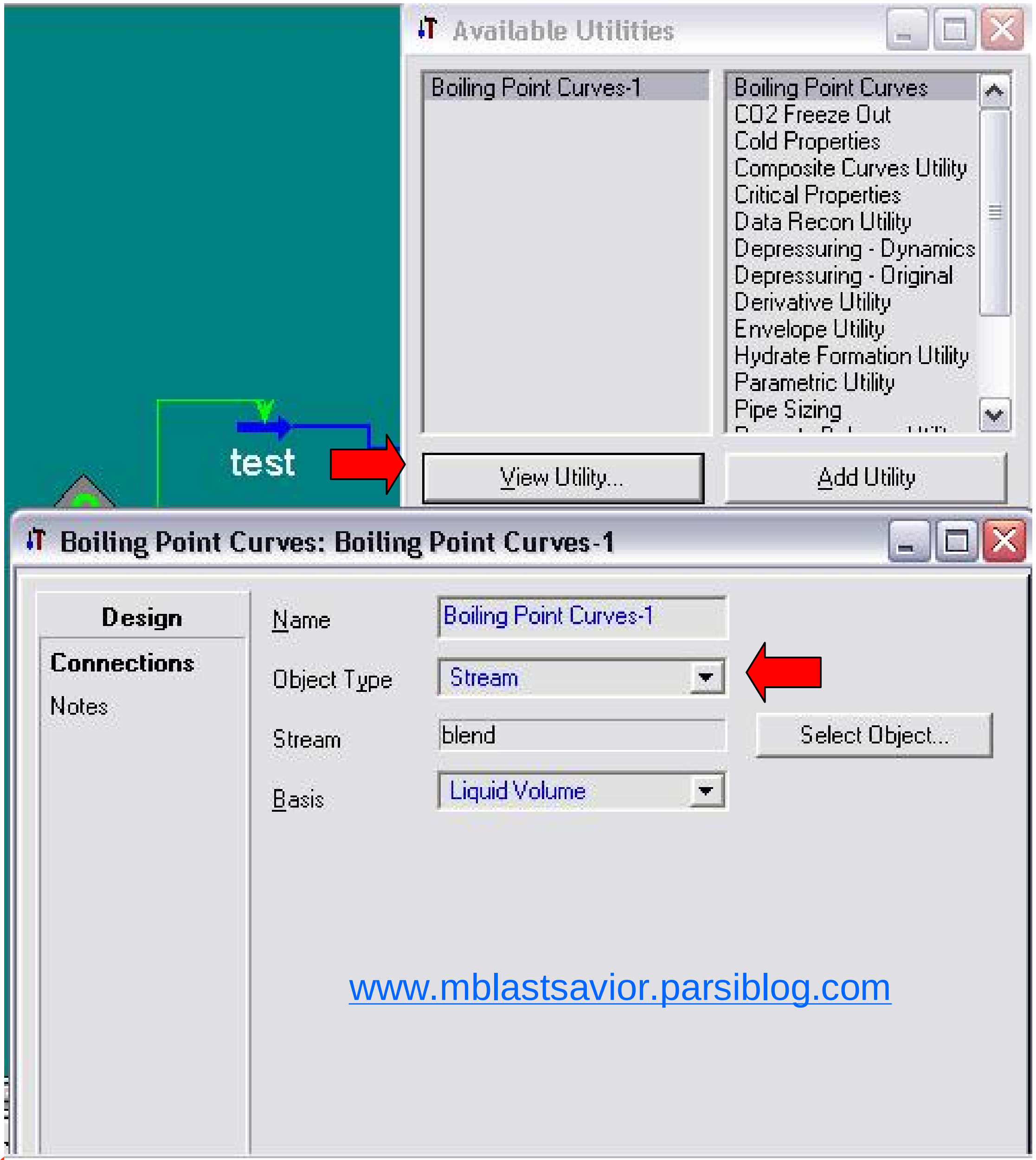
test
SET-1
methanol
MIX-100
blend
methanol
Temperature 50.00 C
Pressure 0.9869 atm
Molar Flow 88.44 kgmole/h
Comp Mole Frac (Methanol) 1.0000

- حالا دبي مولي Test حذف و دبي متانول صفر در نظر گرفته شود



methanol		
Temperature	50.00	C
Pressure	0.9869	atm
Molar Flow	0.0000	kgmole/h
Comp Mole Frac (Methanol)	1.0000	



test
Available Utilities
Boiling Point Curves-1
Boiling Point Curves
CO2 Freeze Out
Cold Properties
Composite Curves Utility
Critical Properties
Data Recon Utility
Depressuring - Dynamics
Depressuring - Original
Derivative Utility
Envelope Utility
Hydrate Formation Utility
Parametric Utility
Pipe Sizing
View Utility...
Add Utility
Boiling Point Curves: Boiling Point Curves-1
Design
Connections
Notes
Name
Boiling Point Curves-1
Object Type
Stream
Stream
blend
Select Object...
Basis
Liquid Volume
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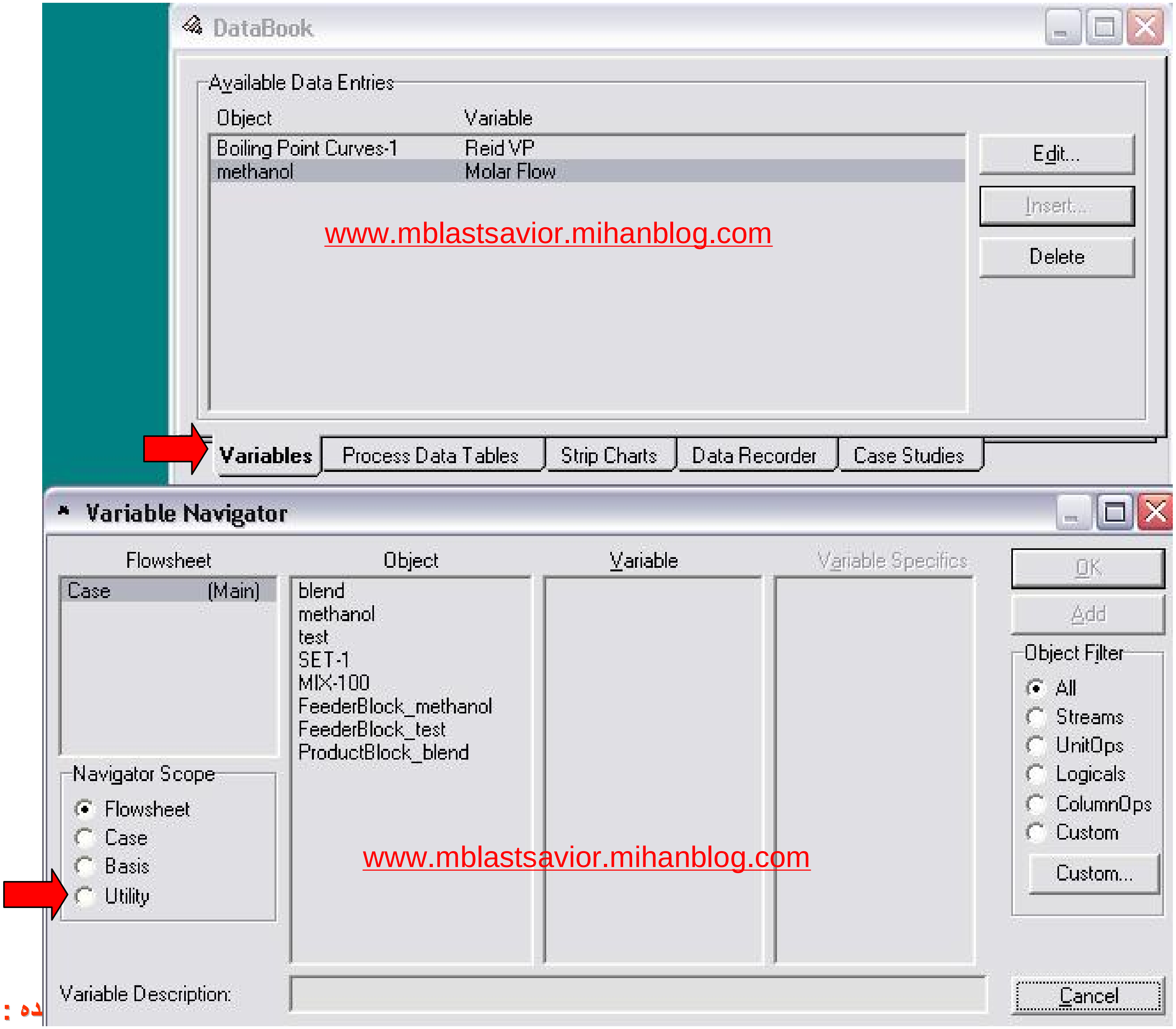
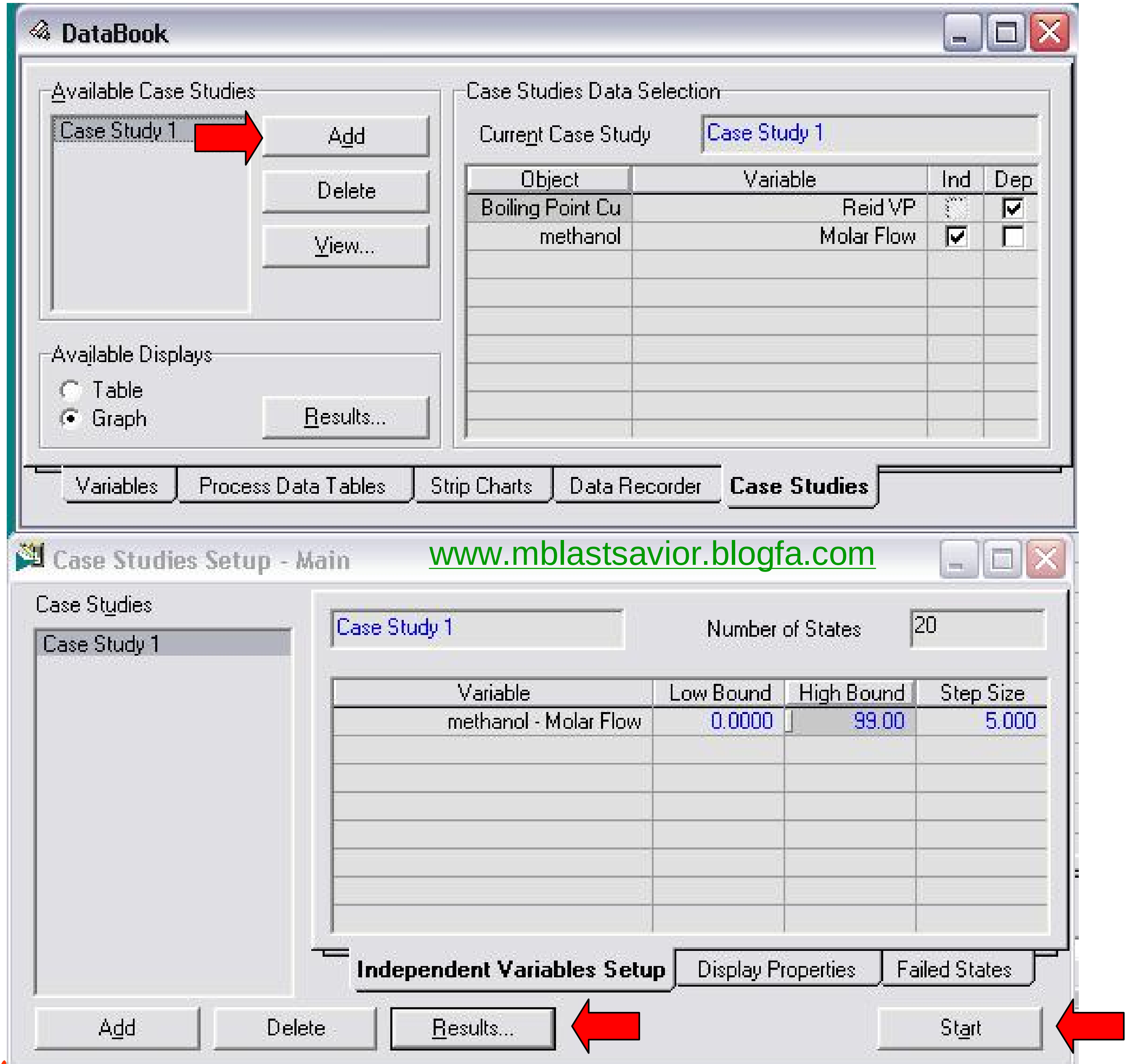

DataBook
Available Data Entries
Object
Variable
Boiling Point Curves-1
Reid VP
methanol
Molar Flow
Edit...
Insert...
Delete
www.mblastsavior.mihanblog.com
Variables
Process Data Tables
Strip Charts
Data Recorder
Case Studies
Variable Navigator
Flowsheet
Object
Variable
Variable Specifics
Case
(Main)
blend
methanol
test
SET-1
MIX-100
FeederBlock_methanol
FeederBlock_test
ProductBlock_blend
OK
Add
Object Filter
All
Streams
UnitOps
Logicals
ColumnOps
Custom
Custom...
Navigator Scope
Flowsheet
Case
Basis
Utility
www.mblastsavior.mihanblog.com
Variable Description:
Cancel


DataBook
Available Case Studies
Case Study 1
Add
Delete
View...
Case Studies Data Selection
Current Case Study
Case Study 1
Object
Variable
Ind
Dep
Boiling Point Cu
Reid VP
methanol
Molar Flow
Available Displays
Table
Graph
Results...
Variables
Process Data Tables
Strip Charts
Data Recorder
Case Studies
Case Studies Setup - Main
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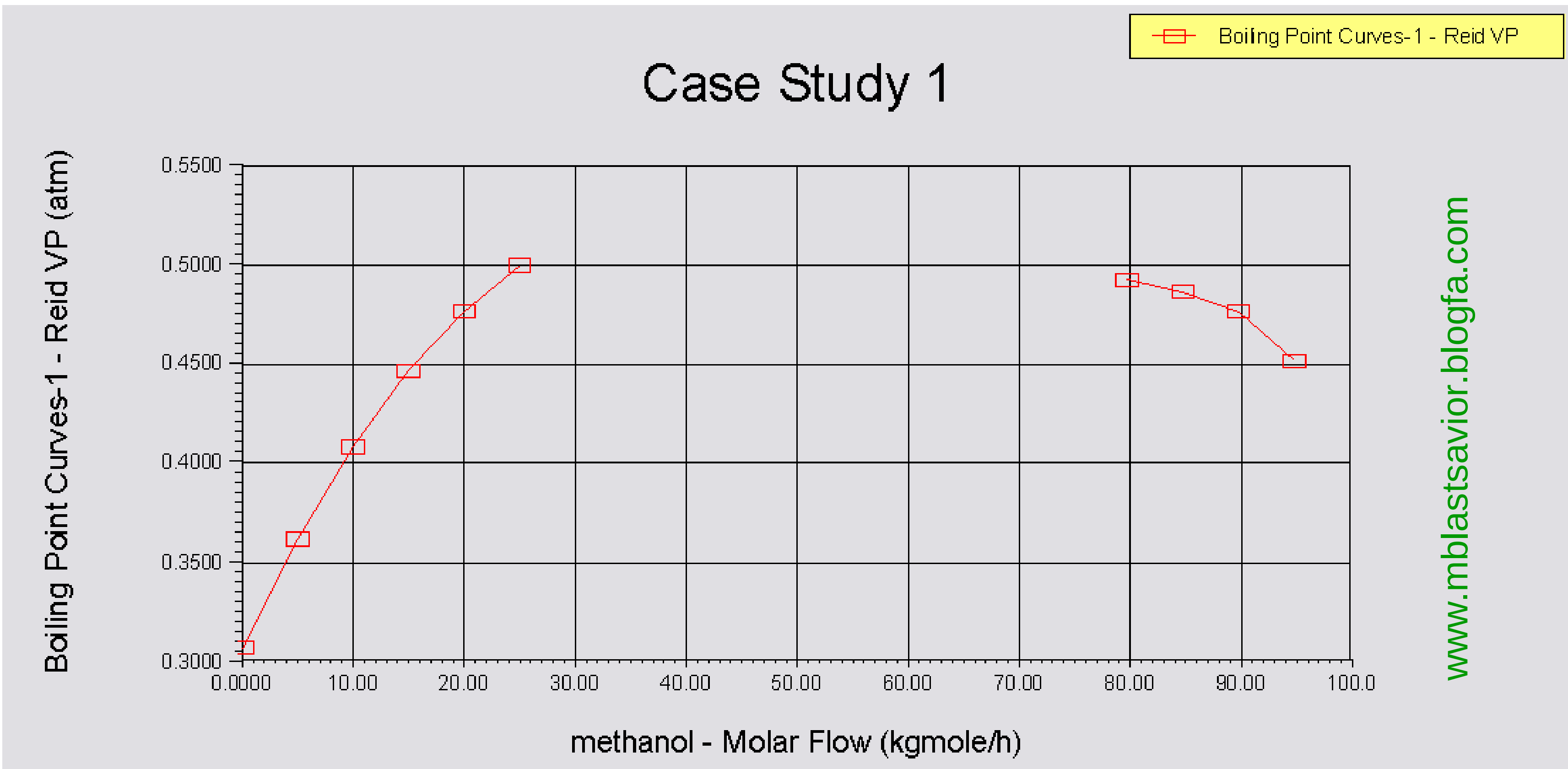
Case Studies
Case Study 1
Case Study 1
Number of States
20
Variable
Low Bound
High Bound
Step Size
methanol - Molar Flow
0.0000
99.00
5.000
Independent Variables Setup
Display Properties
Failed States
Add
Delete
Results...
Start



Boiling Point Curves-1 - Reid VP
Case Study 1
Boiling Point Curves-1 - Reid VP (atm)
0.5500
0.5000
0.4500
0.4000
0.3500
0.3000
0.0000
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.0
methanol - Molar Flow (kgmole/h)
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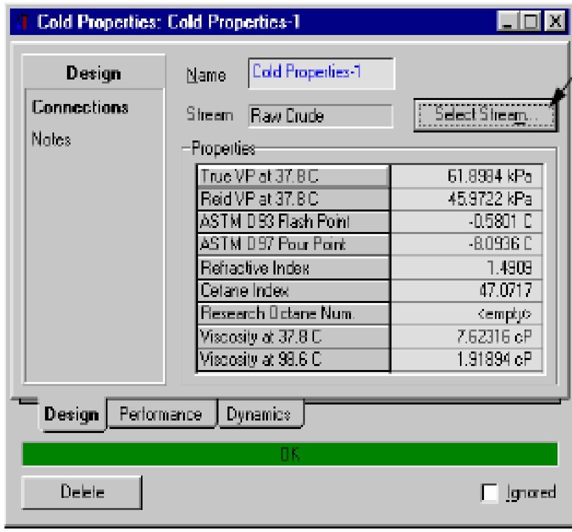
Cold Properties

Cold Property	Calculations	Range of Validity
True Vapour Pressure @ 100°F (37.8°C)	Vapour Pressure method of selected property package	P>1.5 kPa
Reid Vapour Pressure @ 100°F (37.8°C)	Vapour pressure of system when vapour:liquid ratio by volume is 4:1	P>1.5 kPa
Flash Point	As per API 2B7.1	150°F<ASTM D86 10% (or NBP)<1150°F, -15°F<Flash Point<325°F
Pour Point	As per API 2B8.1	140<MW<800, 1<API gravity<50, -110°F<Flash Point<140°F
Refractive Index	As per API 2B5.1-1	70<MW<600, 97°F<NBP<1000°F, 0.63<sg<1.1, 1.35<Refractive Index at 20°C<1.65
Cetane Index (Diesel Index)	Proprietary method	300°F<D86 10%<700°F
Research Octane Number (R.O.N.)	Proprietary method	D86 50% ~420°F
Viscosity at 100°F (37.8°C)		
Viscosity at 210°F (98.6°C)		
ASTM D86 Distillation Curve	API Figure 3A1.1 (1963)	51°F<TBP 10%<561°F
P/N/A (mol%)	As per API 2B4.1	MW>70

Figure 14.12



Click the Select Stream button to open the Select Stream Process view.

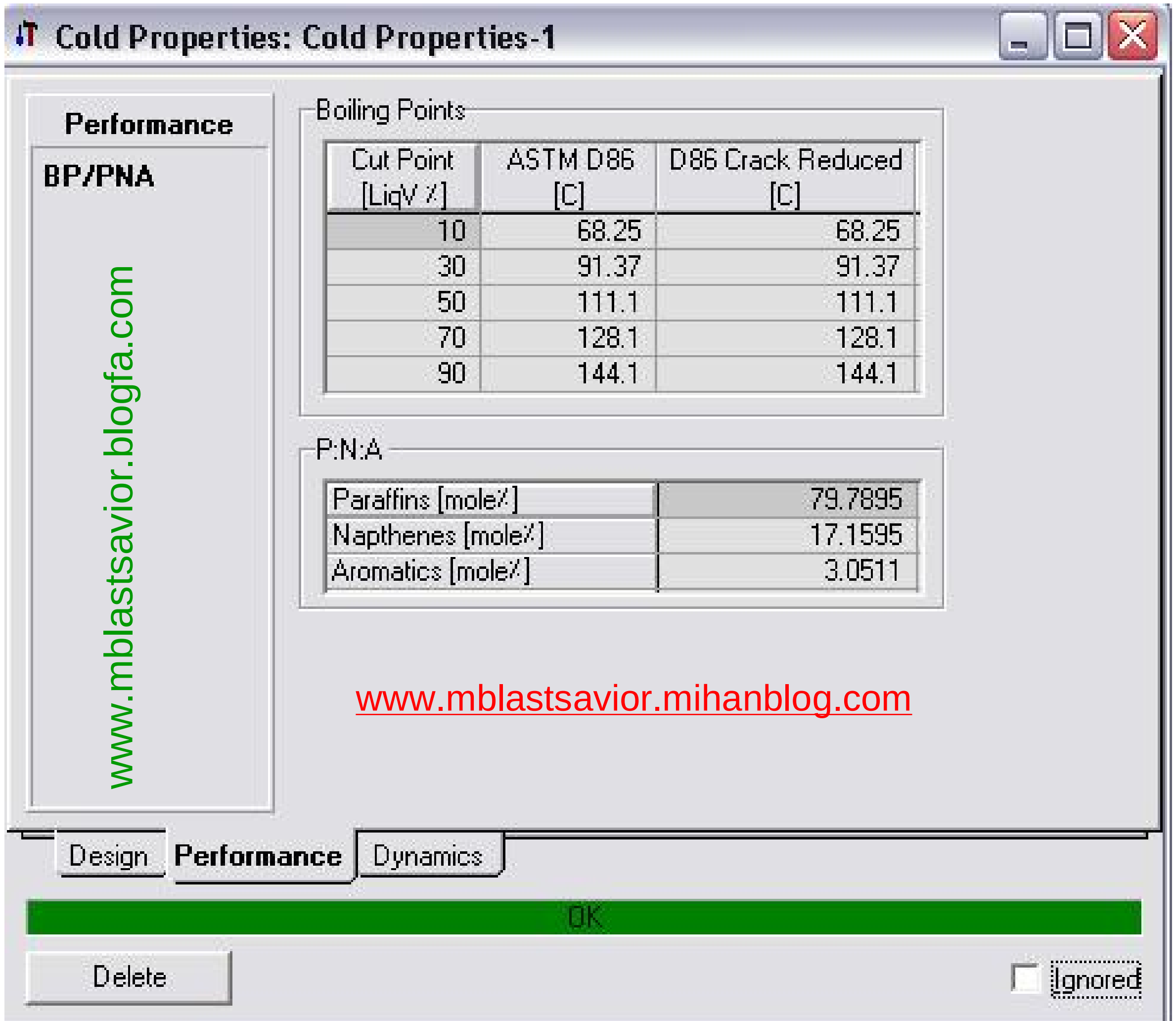
In the Select Stream Process view, you can select the stream you want.

Connections Page

You can attach a stream to the utility, and view the streams properties on the Connections page.

The Properties group displays the following properties:

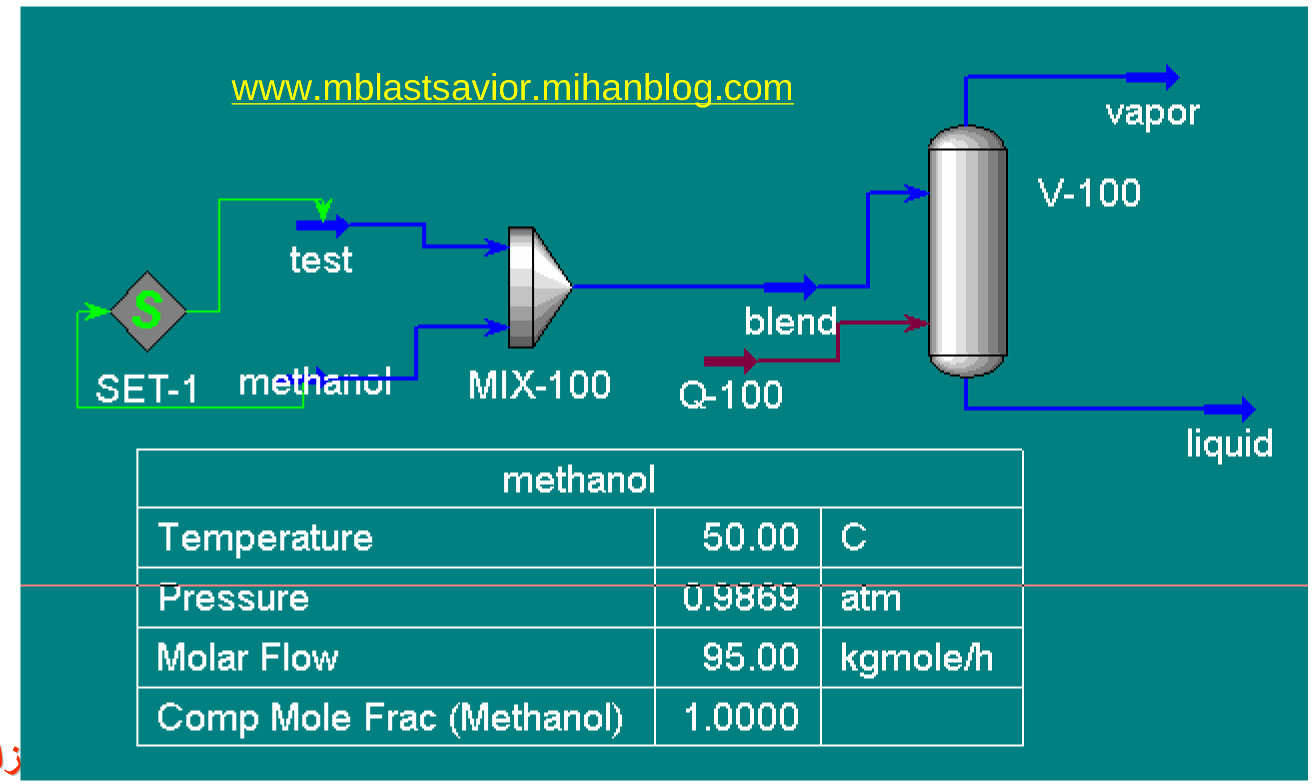
- True Vapour Pressure
- Reid Vapour Pressure
- Flash Point
- Pour Point
- Refractive Index
- Cetane Index
- Research Octane Number
- Viscosity at 100°F (37.8°C) and 210°F (98.6°C)


Cold Properties: Cold Properties-1
Performance
BP/PNA
Boiling Points
Cut Point [LiqV %]
ASTM D86 [C]
D86 Crack Reduced [C]
10 68.25 68.25
30 91.37 91.37
50 111.1 111.1
70 128.1 128.1
90 144.1 144.1
P:N:A
Paraffins [mole%] 79.7895
Napthenes [mole%] 17.1595
Aromatics [mole%] 3.0511
Design
Performance
Dynamics
OK
Delete
Ignored

Vessel Sizing

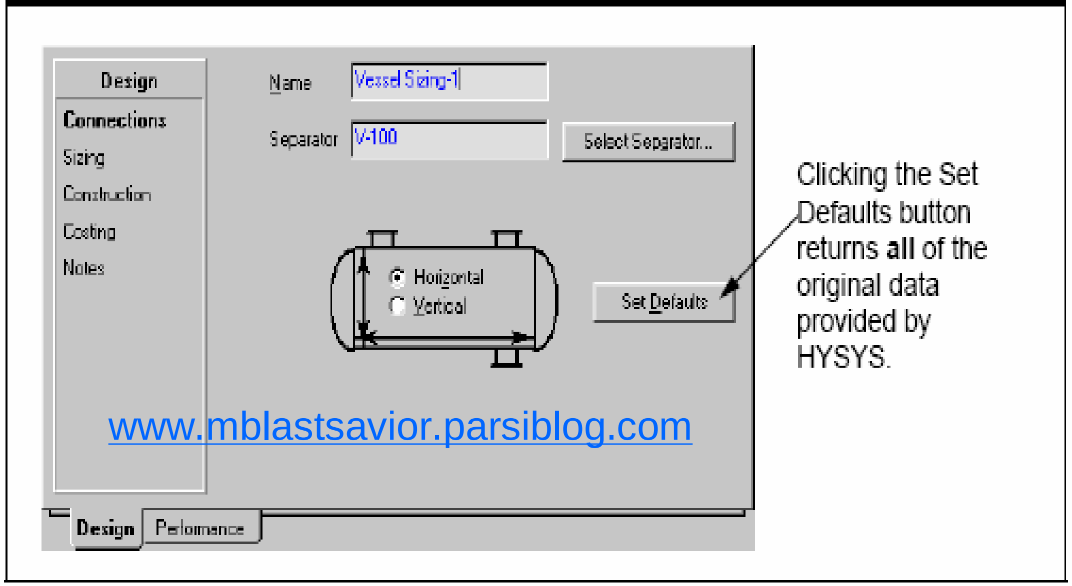
Example

- از مثال قبل
- افت فشار ۰,۰۵ بار و دماي خروجي بخار ۶۵ درجه سانتيگراد



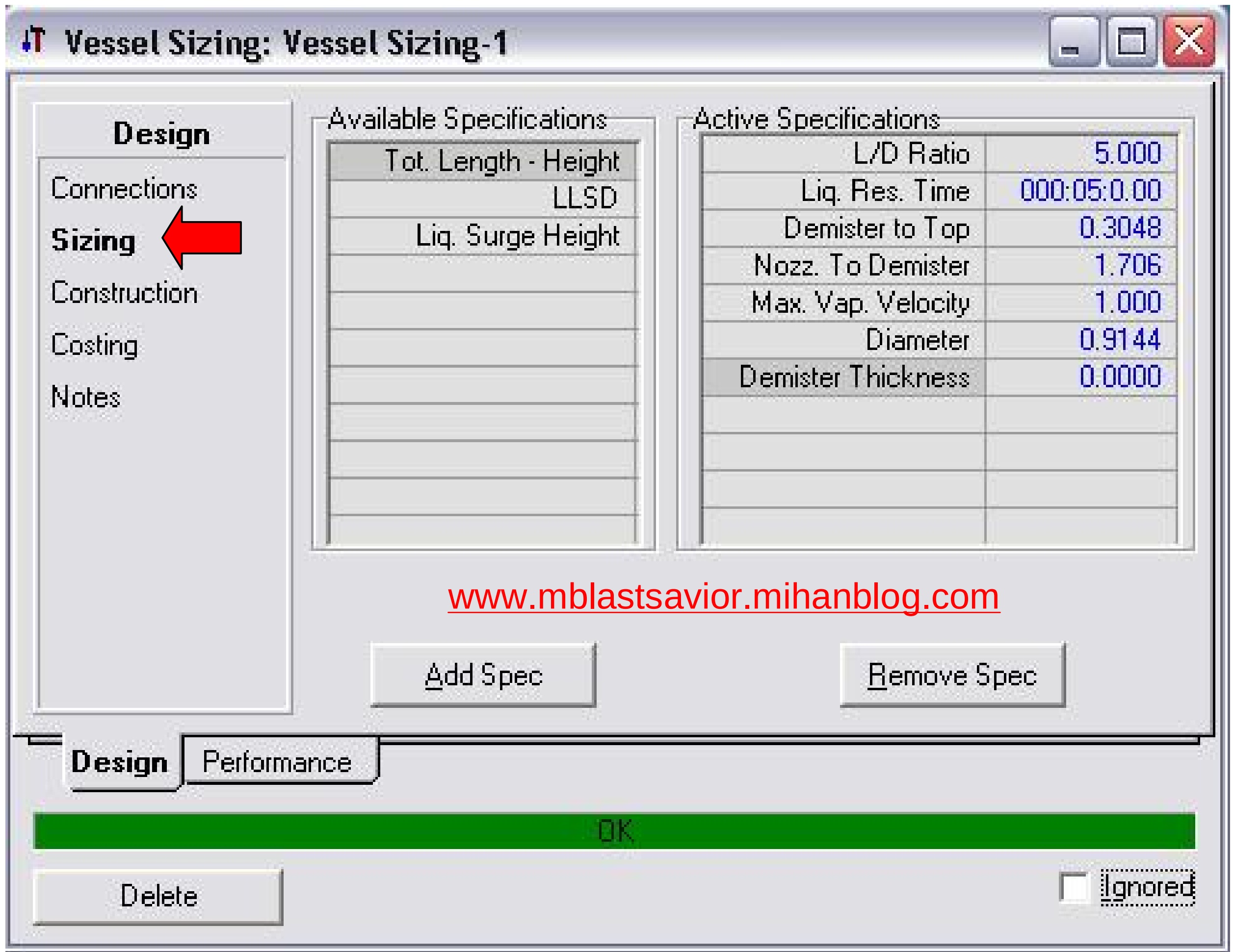
For a comprehensive costing and sizing software package for your entire case, Economix is available.

Figure 14.116



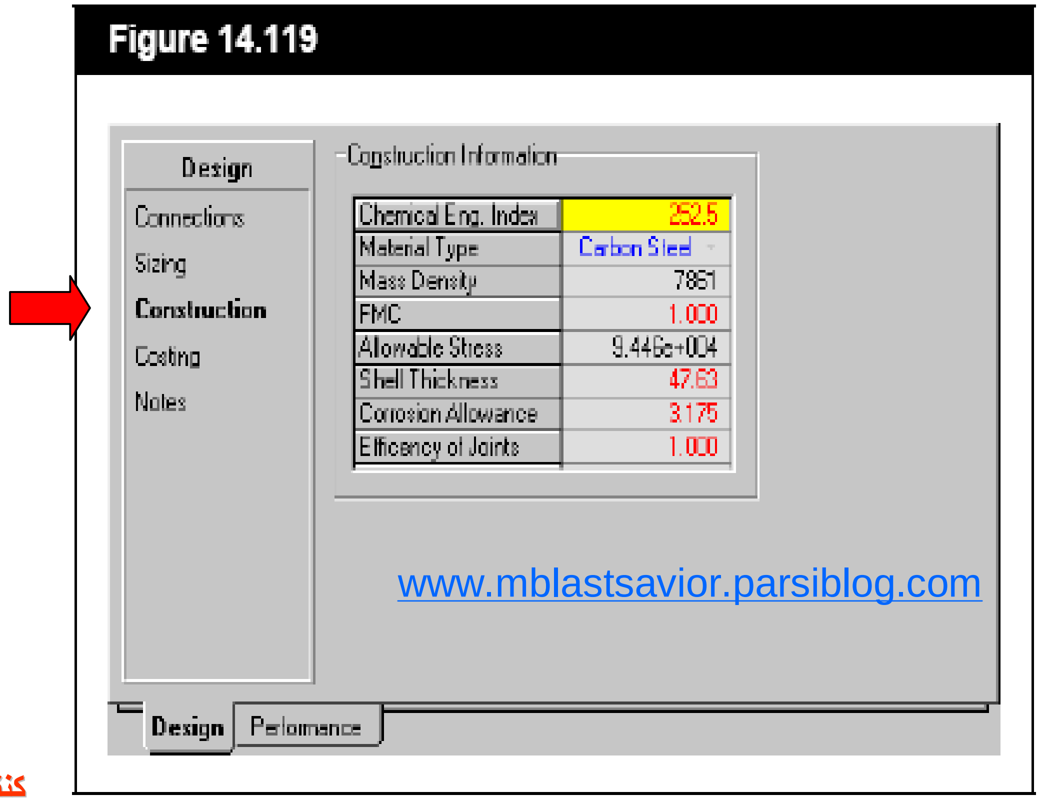
The following is the list of available specifications that are specific to the orientation of the separator:

- Max. Vapour Velocity
- Diameter
- L/D Ratio
- Vapour Space Height
- Demister Thickness
- Liquid Residence Time
- Liquid Surge Height
- Total Length - Height
- Nozzle to Demister
- Demister to Top
- LLSD (Low Level Shut Down)
- Total Separator Height

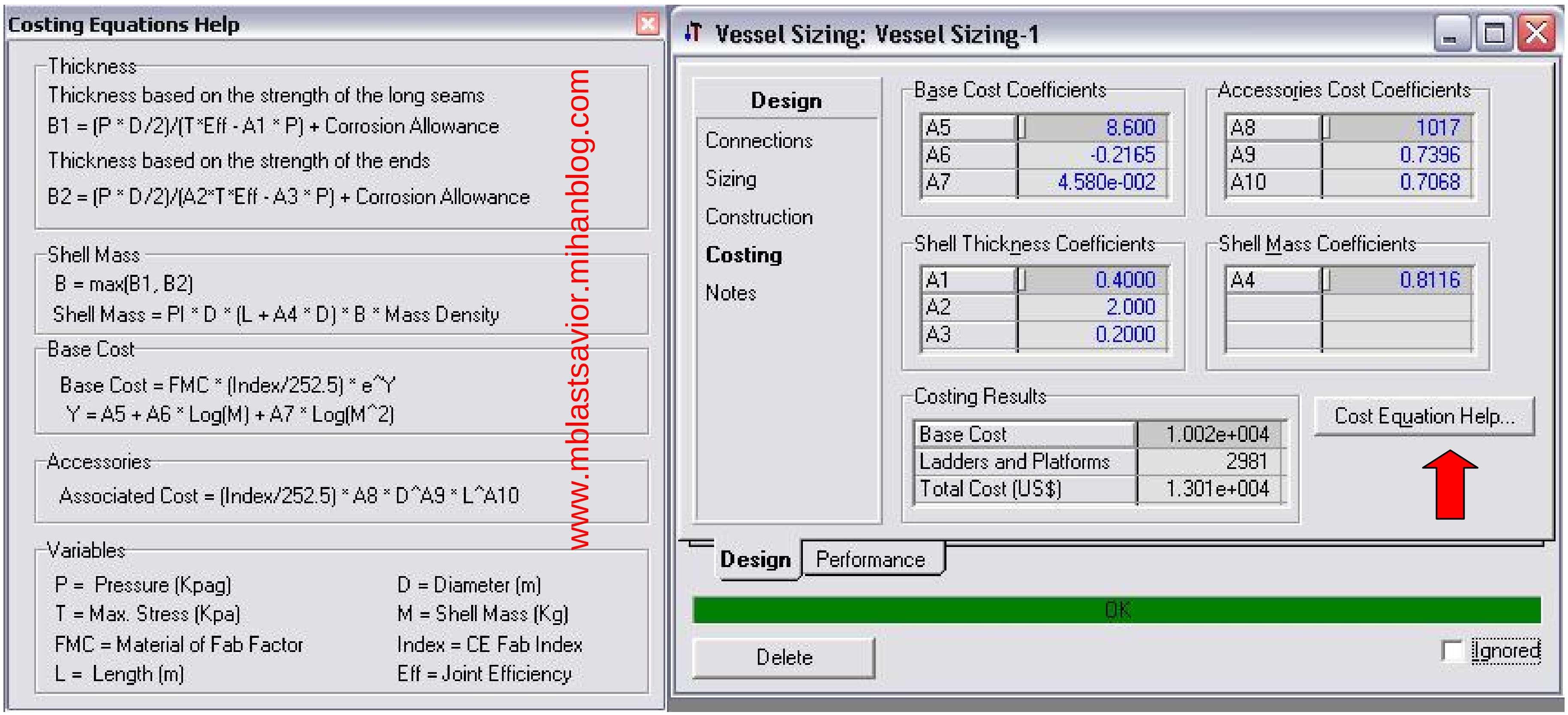


تهیه کننده : محمد بهزادی

- Chemical Engineering Index
- Material Type: Carbon Steel, SS 304, SS 316, Aluminium
- Mass Density
- FMC (material of fabrication factor)
- Allowable Stress
- Shell Thickness
- Corrosion Allowance



Blue text is entered by the user, and red text is entered by HYSYS. You can change the blue and red text.


Costing Equations Help
Thickness
Thickness based on the strength of the long seams
B1 = (P * D/2)/(T*Eff - A1 * P) + Corrosion Allowance
Thickness based on the strength of the ends
B2 = (P * D/2)/(A2*T*Eff - A3 * P) + Corrosion Allowance
Shell Mass
B = max(B1, B2)
Shell Mass = PI * D * (L + A4 * D) * B * Mass Density
Base Cost
Base Cost = FMC * (Index/252.5) * e^Y
Y = A5 + A6 * Log(M) + A7 * Log(M^2)
Accessories
Associated Cost = (Index/252.5) * A8 * D^A9 * L^A10
Variables
P = Pressure (Kpag)
D = Diameter (m)
T = Max. Stress (Kpa)
M = Shell Mass (Kg)
FMC = Material of Fab Factor
Index = CE Fab Index
L = Length (m)
Eff = Joint Efficiency
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Vessel Sizing: Vessel Sizing-1
Design
Connections
Sizing
Construction
Costing
Notes
Base Cost Coefficients
A5 8.600
A6 -0.2165
A7 4.580e-002
Accessories Cost Coefficients
A8 1017
A9 0.7396
A10 0.7068
Shell Thickness Coefficients
A1 0.4000
A2 2.000
A3 0.2000
Shell Mass Coefficients
A4 0.8116
Costing Results
Base Cost 1.002e+004
Ladders and Platforms 2981
Total Cost (US$) 1.301e+004
Cost Equation Help...
Design
Performance
OK
Delete
Ignored

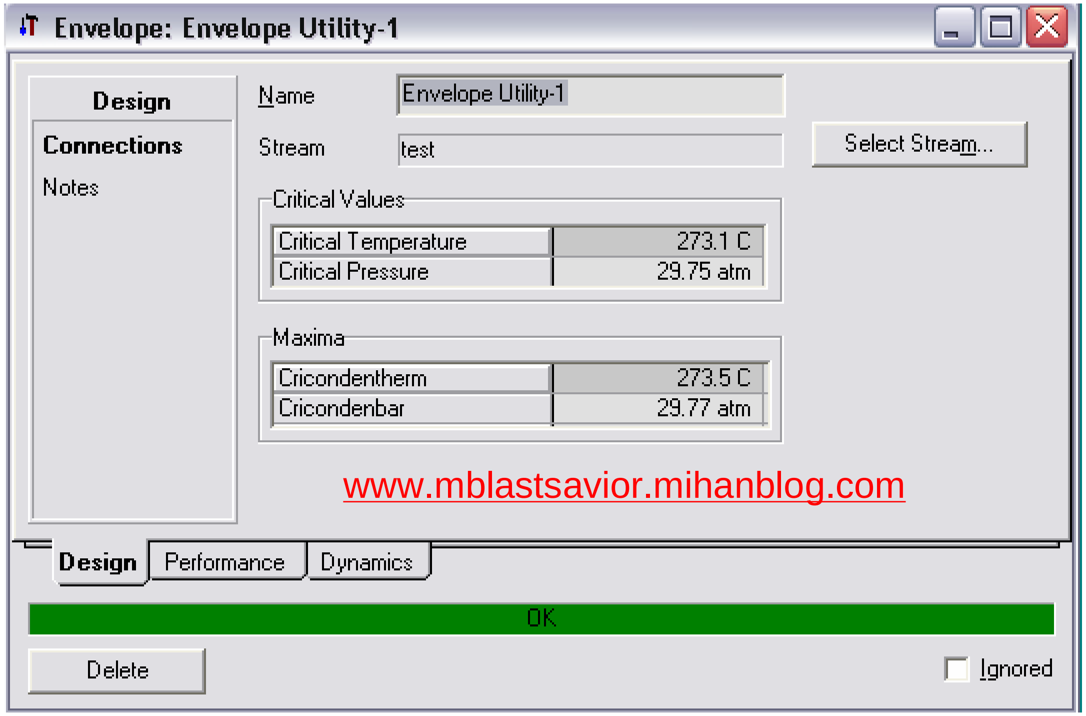
Envelope Utility

The Envelope utility allows you to examine relationships between selected parameters, for any stream of known composition, including streams with only one component. Vapour-Liquid Envelopes can be plotted for the following variables:

- Pressure-Temperature
- Pressure-Volume
- Pressure-Enthalpy
- Pressure-Entropy
- Temperature-Volume
- Temperature-Enthalpy
- Temperature-Entropy

For the Pressure-Temperature envelope, quality lines, and a hydrate curve can also be added to the plot. The remaining curves allow the inclusion of Isocurves (Isotherms or Isobars).

Since the Envelope is calculated on a dry basis, you must be careful when applying the utility to multi-component mixtures that contain H_2O or any other component which can form a second liquid phase.


Envelope: Envelope Utility-1
Design
Connections
Notes
Name
Envelope Utility-1
Stream
test
Select Stream...
Critical Values
Critical Temperature
273.1 C
Critical Pressure
29.75 atm
Maxima
Cricondentherm
273.5 C
Cricondenbar
29.77 atm
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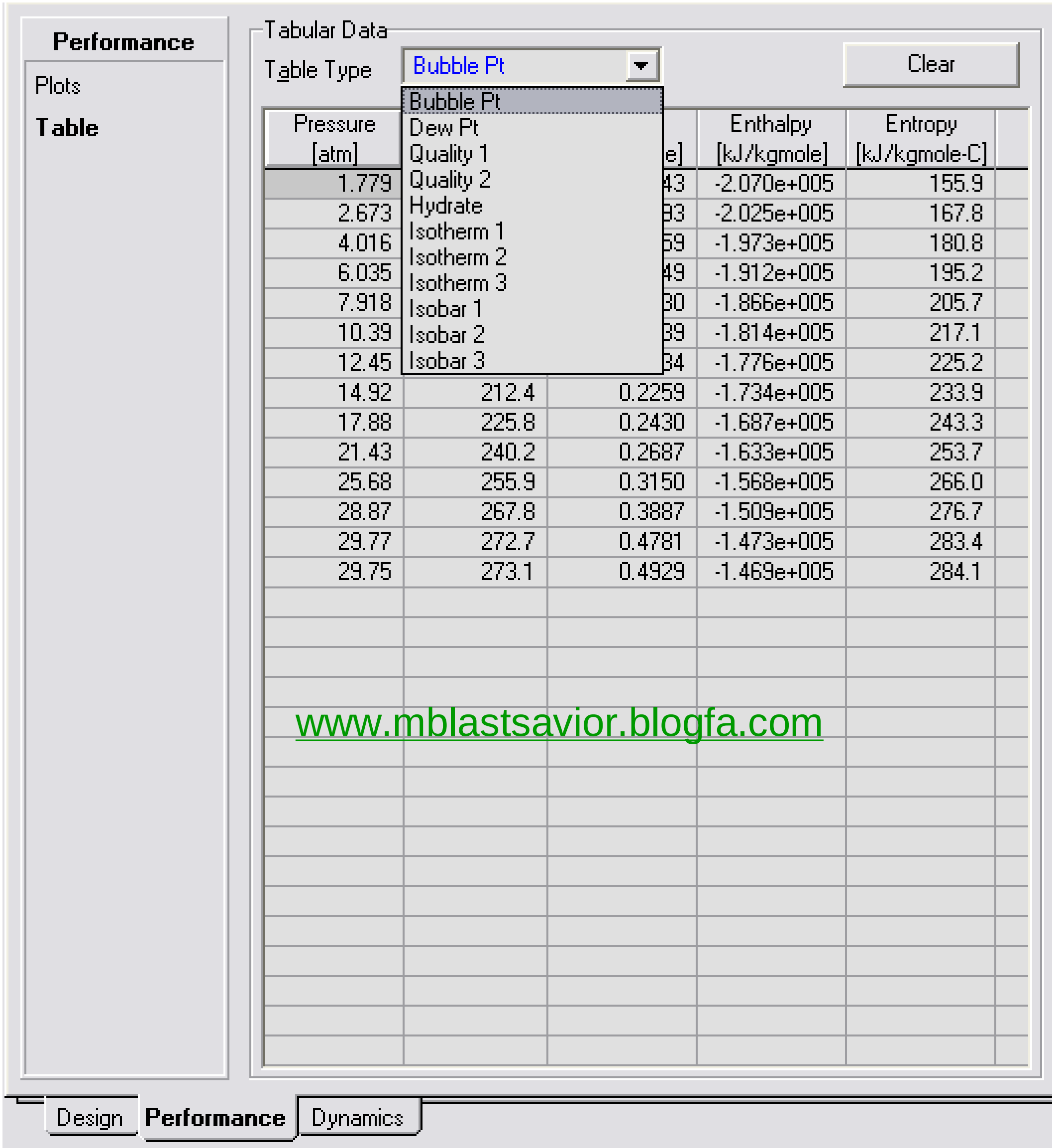
Design
Performance
Dynamics
OK
Delete
Ignored


Performance
Plots
Table
Tabular Data
Table Type
Bubble Pt
Clear
Bubble Pt
Dew Pt
Quality 1
Quality 2
Hydrate
Isotherm 1
Isotherm 2
Isotherm 3
Isobar 1
Isobar 2
Isobar 3
Pressure [atm]
Enthalpy [kJ/kgmole]
Entropy [kJ/kgmole-C]
1.779 43 -2.070e+005 155.9
2.673 93 -2.025e+005 167.8
4.016 59 -1.973e+005 180.8
6.035 49 -1.912e+005 195.2
7.918 30 -1.866e+005 205.7
10.39 39 -1.814e+005 217.1
12.45 34 -1.776e+005 225.2
14.92 212.4 0.2259 -1.734e+005 233.9
17.88 225.8 0.2430 -1.687e+005 243.3
21.43 240.2 0.2687 -1.633e+005 253.7
25.68 255.9 0.3150 -1.568e+005 266.0
28.87 267.8 0.3887 -1.509e+005 276.7
29.77 272.7 0.4781 -1.473e+005 283.4
29.75 273.1 0.4929 -1.469e+005 284.1
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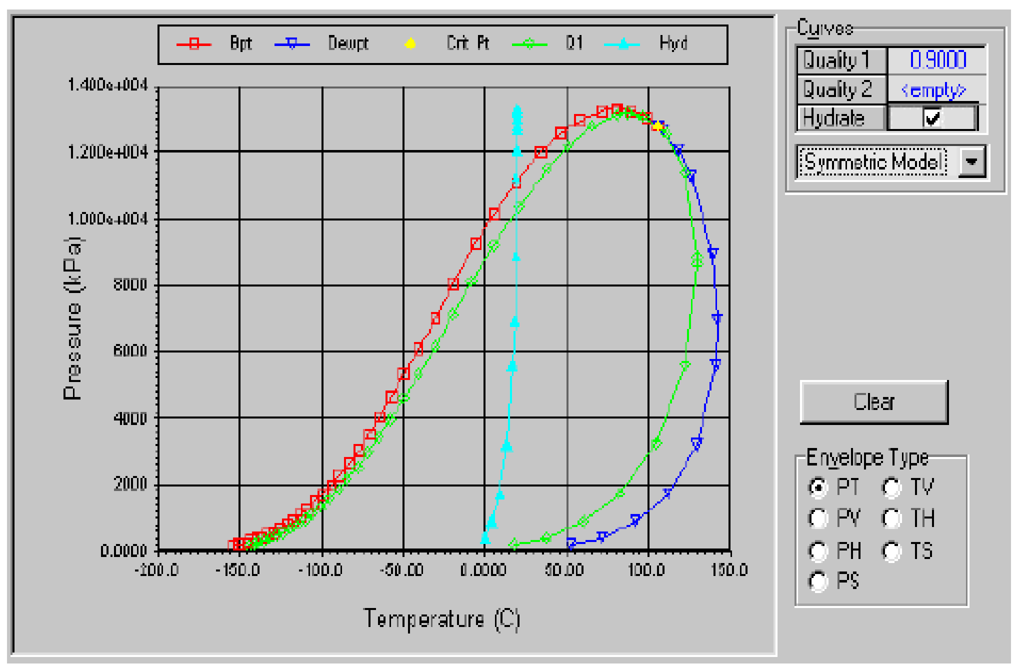
Design
Performance
Dynamics

Pressure-Temperature Envelope

The plot on the right, shows an envelope for a quality of 0.9. A quality of 0.9 is represented by two curves; one with a vapour fraction of 0.9 and the other having a liquid fraction of 0.9.

When you select the PT radio button in the Envelope Type group, the Vapour-Liquid Envelope for a quality of 1.0 automatically appears. This is actually represented by two curves; one with a vapour fraction of 1.0 and the other having a liquid fraction of 1.0. These curves meet at the stream critical point. You can plot additional envelopes for different qualities simply by typing the desired quality (between 0 and 1) in the Quality 1 and Quality 2 fields.

Figure 14.50



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- Activate the Hydrate checkbox to have HYSYS calculate and display the hydrate temperature curve for pressures up to the cricondenbar. When you activate the Hydrate checkbox, you can select from the drop-down list the model (Assume Free Water, Asymmetric, Symmetric or Vapour Phase Only) to perform the Hydrate Formation calculations

Figure 14.51 www.mblastsavior.mihanblog.com

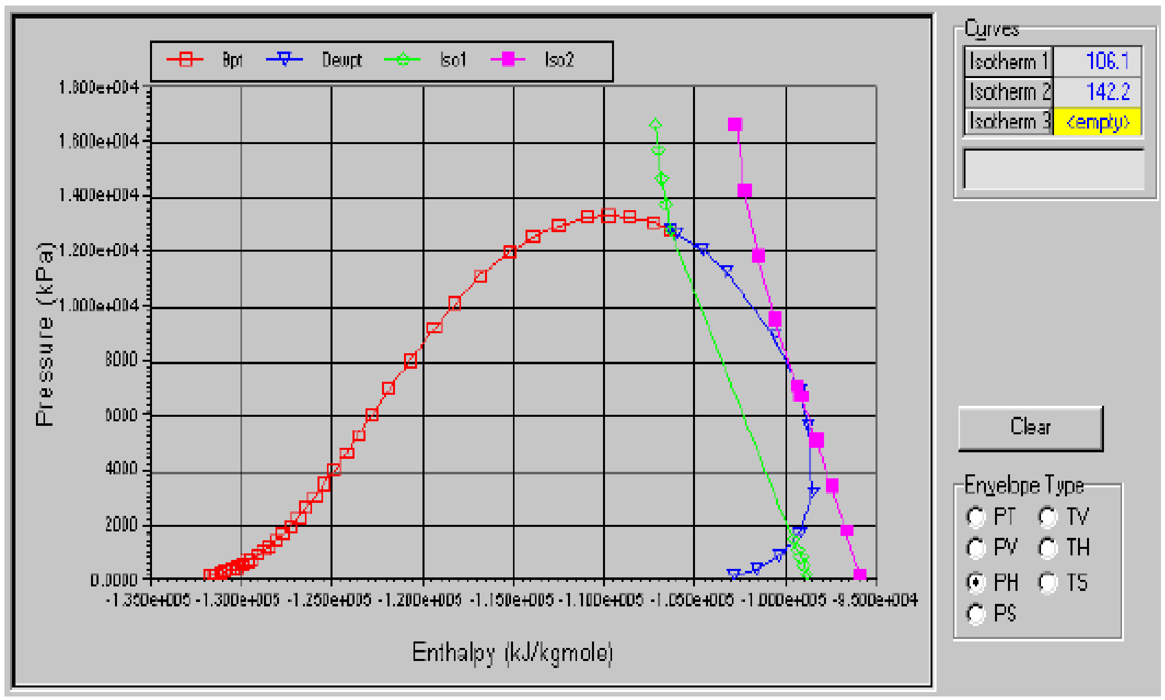
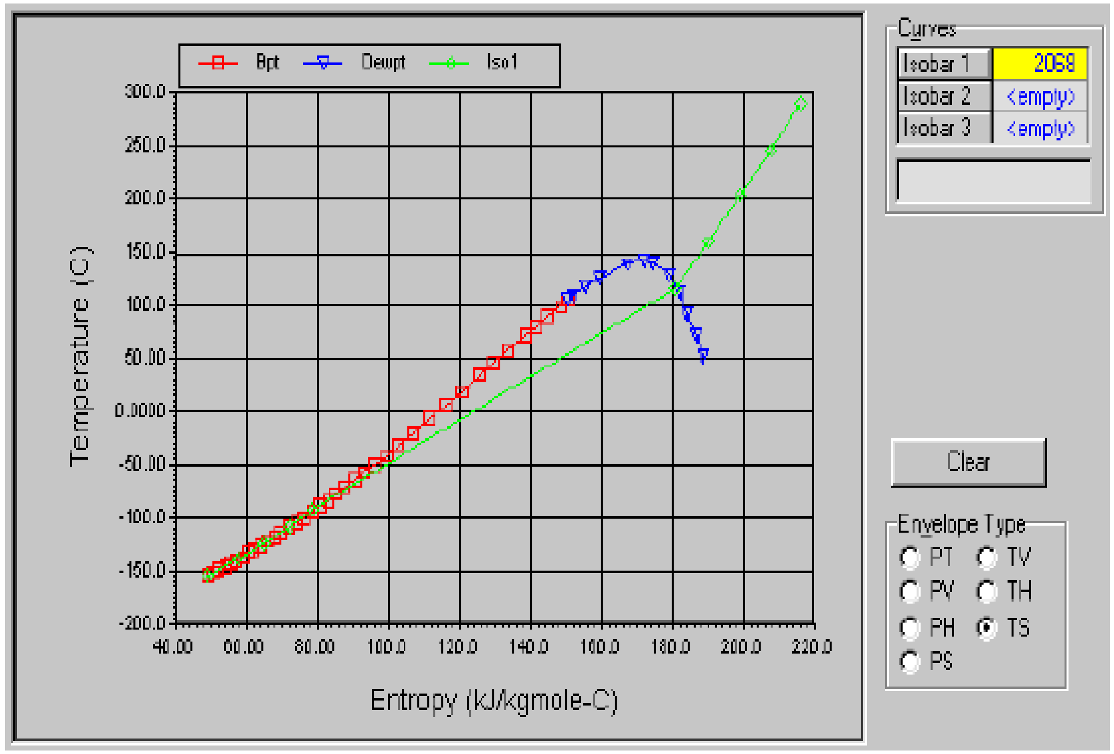


Figure 14.52



You can clear all curves (except the default) at any time by clicking the Clear button.

Critical Properties

The Critical Properties utility calculates both the true and pseudo critical temperature, pressure, volume, and compressibility factor for a fully defined stream.

True & Pseudo Critical Properties

The Critical Properties utility displays two sets of critical properties, true and pseudo critical properties. **True Critical Properties** are those properties calculated using the mixing rules associated with the property package chosen. **Pseudo Critical Properties** use simple linear models to estimate the critical properties of a mixture. They are often very different from the true critical points and **have no real physical significance,** but sometimes are used in empirical correlations.

Mathematically, the pseudo critical temperature, pressure, and compressibility (T_{pc}, P_{pc}, *and* Z_{pc}) are defined as:

$$T_{pc} = \sum_{i=1}^{n} y_i T_{ci}$$

$$P_{pc} = \sum_{i=1}^{n} y_i P_{ci}$$

$$Z_{pc} = \sum_{i=1}^{n} y_i Z_{ci}$$

where: y_i = *mole fraction of component i*

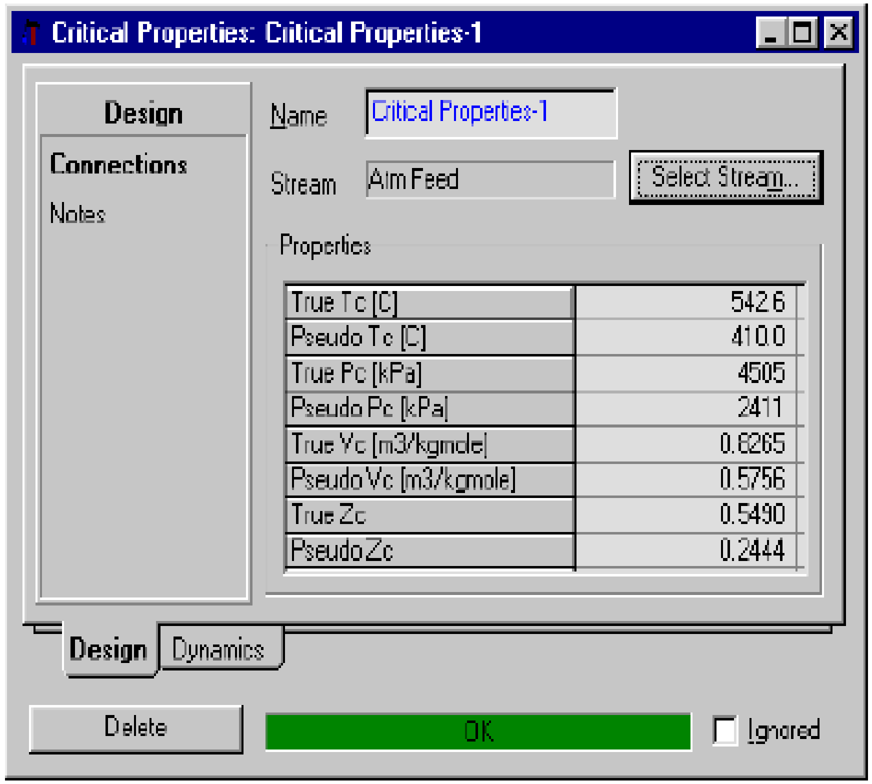
n = *total number of components in mixture*

T_{ci} = *critical temperature of component i*

P_{ci} = *critical pressure of component i*

Z_{ci} = *critical compressibility of component i*

$$v_{pc} = \frac{Z_{pc} T_{pc} R}{P_{pc}}$$

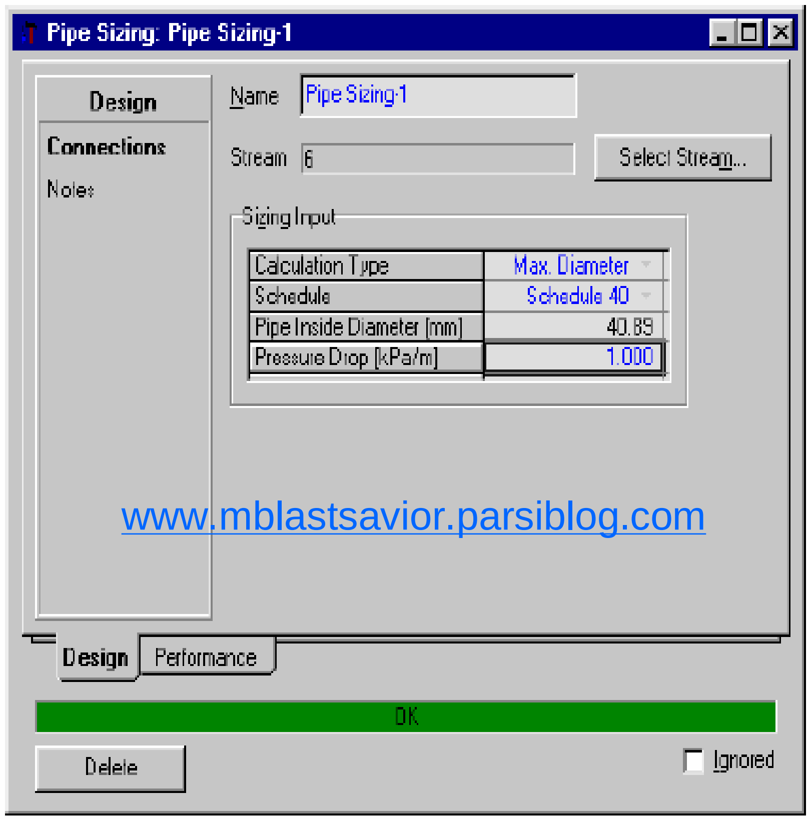


You must set up a fluid package using the Peng Robinson property method to use this utility.

Pipe Sizing

With the Pipe Sizing utility you can perform design calculations on any of the case streams. Results include pipe schedule, pipe diameter, Reynolds number, friction factor, etc.

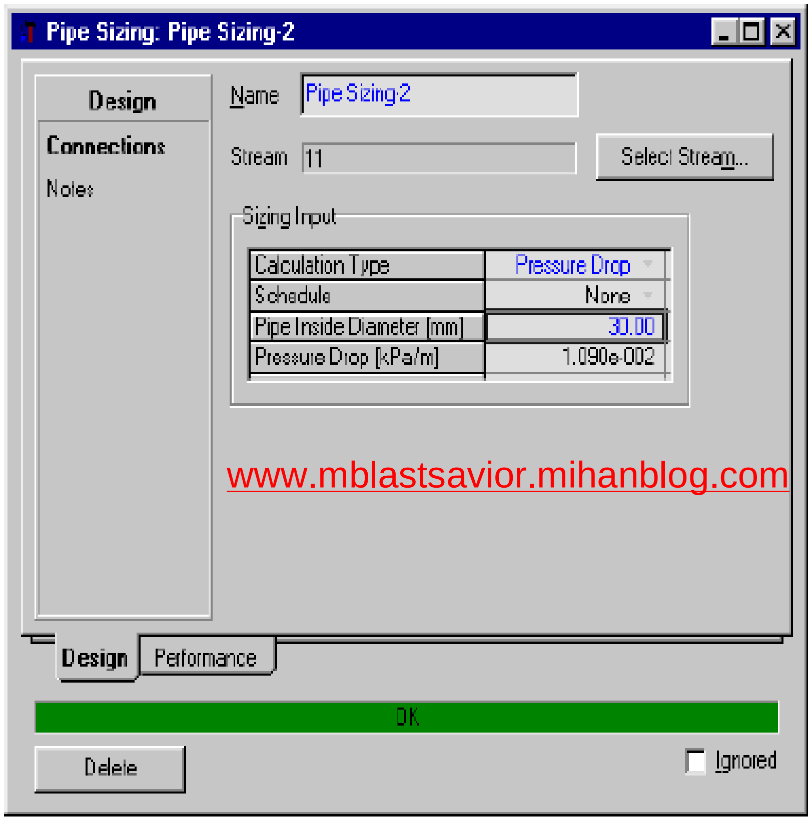
Figure 14.63



- **Max. Diameter**. The input required includes the pipe schedule, and the pressure drop in the pipe.

- **Pressure Drop**. The input required includes the pipe schedule, and the pipe diameter.

Figure 14.65



The following fields are available for each stream chosen.

Object	Description
Calculation Type	Allows you to choose between two calculation types: • Max. Diameter • Pressure Drop
Schedule	Allows you to select a pipe schedule. You have four choices: • None • Schedule 40 • Schedule 80 • Schedule 160 If you selected Pressure Drop as your calculation type, the pipe schedule is automatically set as None.
Diameter	If you selected Pressure Drop as your calculation type, then you have to enter a value for the pipe's actual inner diameter. HYSYS then calculates the pressure drop.
Pressure Drop	If you selected Max. Diameter as your calculation type, then you have to enter a value for the pressure drop. HYSYS then calculates the pipe's actual inner diameter.

Pipe Sizing: Pipe Sizing-1

Performance

Results

Vapour-Liquid Flow Regime : Stratified Flow

Stream Properties

Phase	Vapour	Liquid
Viscosity	1.408e-002 cP	1.354 cP
Flowrate	1124 kg/h	8.824 kg/h
Velocity	2.626 m/s	1.819e-003 m/s
Density	90.53 kg/m3	1026 kg/m3

Parameters

Phase	Vapour	Liquid
Reynolds Number	6.902e+005	56.38
Friction Factor	2.068e-002	1.135
Press. Drop	0.1579 kPa/m	4.709e-005 kPa/m

Schedule	Pipe Inside Diameter	Tot. Press. Drop
Schedule 40	40.89 mm	0.2664 kPa/m

Design | **Performance**

OK

Delete

Ignored

Depressuring

HYSYS contains a Depressuring utility that lets the user examine pressure and temperature profiles in process vessels during simulated gas blowdowns and pressure letdowns. This utility can also be used to safely size Pressure Safety Valves (PSV's) under normal shutdowns and emergency conditions.

In this module, two types of depressuring will be examined. *Adiabatic* depressurization which is used to simulate the normal gas blowdown of pressure vessels and/or piping, and the *Wetted Fire* model which is used to simulate emergency conditions in a plant.

Learning Objectives

After completing this module, you will be able to:

- Use the Depressuring utility of HYSYS
- Predict pressures and temperatures inside process vessels during pressure letdowns and emergency conditions
- Size Pressure Safety Valves to safely meet the conditions in your plant

Information on Depressuring

The Depressuring utility in HYSYS has been created to perform rigorous time dependant pressure and material reduction calculations. The model is comprised of three distinct areas: physical description of the vessel, thermodynamic constraints of the process, and the flow regime through the valve.

Although depressurization is a dynamic process, the small steps that HYSYS takes in achieving a solution allow this process to be modelled in a steady state environment.

Thermodynamic Models

There are four models that HYSYS can use to simulate the depressurization process, and each has its own particular application. Using the right model is very important if accurate results are to be obtained:

- **Fire Mode** - used to simulate conditions that could occur during a plant fire. The application of an external heat source is considered during the calculations for pressure, temperature, and flow profiles. The heat flux into the fluid is user defined.
- **Wetted Fire Mode** - used as above, except that the heat flux into the fluid is calculated according to API equations for heat transfer from a fire to a liquid containing vessel. A wetted area must be supplied.
- **Adiabatic Mode** - used to model the normal gas blowdown of pressure vessels and/or piping. No external heat is supplied. Heat flux between the fluid and the vessel is modelled as the fluid temperature drops. Typically used to model the depressurization of compressor loops on emergency shutdown. The adiabatic model requires an isentropic efficiency term. An efficiency of zero means that the system will behave isenthalpically, i.e. there will be no loss of enthalpy during depressurization. An efficiency of 100%, on the other hand, means that the system will behave isentropically, i.e. there will be no loss of entropy during depressurization.
- **Isothermal Mode** - the temperature of the fluid remains constant during the depressurization process. The necessary heat flux is determined by HYSYS.

Experience has shown that a value of 100% works well for most pure vapour systems, while a value between 40% and 70% works well for most two phase systems.

Valve Equations

There are also four types of valves that can be used to model the PSV. Having these options allows you to customize the simulation. The choice of type depends of the information that the user has available and the physical conditions of the simulation.

Constant rate depressurization can be modelled with this valve equation by setting the C1 term to be equal to the flow, and the C2 term to 0.

- **Subsonic Valve** - can be used only if the flow across the valve is expected to be completely subsonic. This is usually the case if the upstream pressure is less than twice the backpressure of the valve. This valve is modelled by the following equation; therefore, two constants must be given, C1 and C2.

$$FLOW = C1 \times \left(\frac{(P_{up} + P_{back})(P_{up} - P_{back})\rho_{up}}{P_{up}} \right)^{C2}$$

- **Supersonic Valve** - used in cases where little or no information is known about the valve. This valve is modelled according to the following equation; therefore, again two variables are needed, C1 and C2. Generally, C2 will never vary from 0.5.

$$FLOW = C1 \times (P_{up} \times \rho_{up})^{C2}$$

- **Masonellan Valve** - used for general depressuring valves to flare stacks. The equation for this model follows. C1 and C2 are automatically set by HYSYS; these values should not be changed without good reason. The C1 term can be changed to maintain dimensional consistency within the equation. The C_V of the value is usually available from the valve manufacturer.

$$FLOW = C1 \times C_V \times C_F \times Y_F \times (P_{up} \times \rho_{up})^{C2}$$

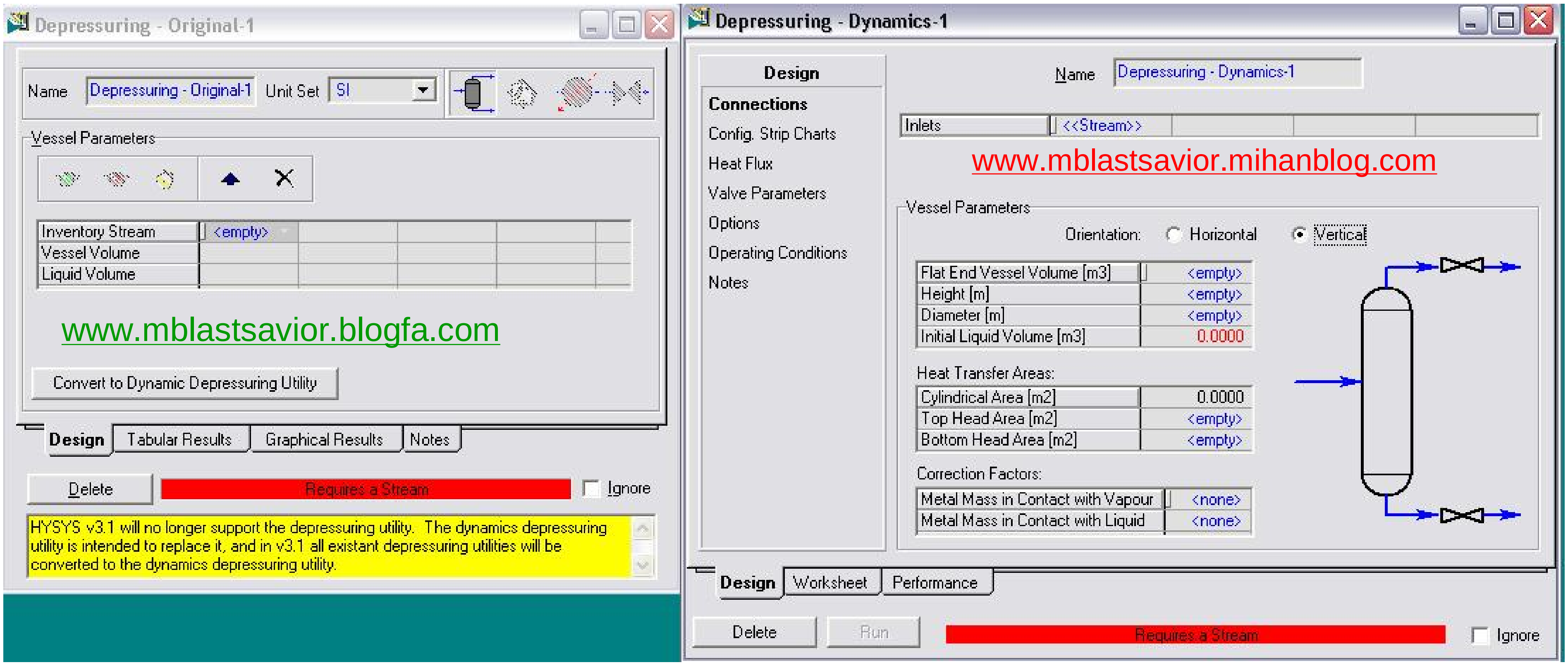
- **General Valve** - use this model if the effective throat area of the valve is known. The model makes limiting assumptions concerning the characteristics of the orifice. The equation used by this model follows. G_c will be 1 if SI units are used, and 32.17 if field units are used. C1 will vary with the geometry of the valve, when modelling orifices, C1 is equal to the Coefficient of Discharge of the orifice. C2 will be equal to 0.5, as usual.

$$FLOW = C1 \times 43200 \times A_V \times K_{term} \times (G_c \times P_{up} \times \rho_{up} \times k)^{C2}$$

Setting up the Simulation

1. Start a new case in HYSYS and select the Peng Robinson EOS package.
2. Add C1 to n-C5 to the component list and enter the Simulation Environment.
3. Install two new streams in the Flowsheet, with the following data:

In This Cell...	Enter...	Enter...
Name	Tank1	Tank2
Temperature, ^oC (^oF)	25 (75)	35 (95)
Pressure, kPa (psia)	4000 (600)	2000 (290)
Molar Flow, kgmole/hr (lbmole/hr)	1.0 (2.2)	1.0 (2.2)
Comp. Mole Fraction - C1	0.56	0.178
Comp. Mole Fraction - C2	0.2	0.198
Comp. Mole Fraction - C3	0.1	0.193
Comp. Mole Fraction - i-C4	0.05	0.135
Comp. Mole Fraction - n-C4	0.05	0.149
Comp. Mole Fraction - i-C5	0.02	0.072
Comp. Mole Fraction - n-C5	0.02	0.075


Depressuring - Original-1
Name
Depressuring - Original-1
Unit Set
SI
Vessel Parameters
Inventory Stream
<empty>
Vessel Volume
Liquid Volume
www.mblastsavior.blogfa.com
Convert to Dynamic Depressuring Utility
Design
Tabular Results
Graphical Results
Notes
Delete
Requires a Stream
Ignore
HYSYS v3.1 will no longer support the depressuring utility. The dynamics depressuring utility is intended to replace it, and in v3.1 all existant depressuring utilities will be converted to the dynamics depressuring utility.
Depressuring - Dynamics-1
Design
Connections
Config. Strip Charts
Heat Flux
Valve Parameters
Options
Operating Conditions
Notes
Name
Depressuring - Dynamics-1
Inlets
<<Stream>>
www.mblastsavior.mihanblog.com
Vessel Parameters
Orientation:
Horizontal
Vertical
Flat End Vessel Volume [m3]
<empty>
Height [m]
<empty>
Diameter [m]
<empty>
Initial Liquid Volume [m3]
0.0000
Heat Transfer Areas:
Cylindrical Area [m2]
0.0000
Top Head Area [m2]
<empty>
Bottom Head Area [m2]
<empty>
Correction Factors:
Metal Mass in Contact with Vapour
<none>
Metal Mass in Contact with Liquid
<none>
Design
Worksheet
Performance
Delete
Run
Requires a Stream
Ignore

Column Sizing

The Shortcut tool will estimate most of the physical parameters of a distillation column with only a very basic understanding of the process. It is a very valuable tool to use in the preliminary design of a distillation column.

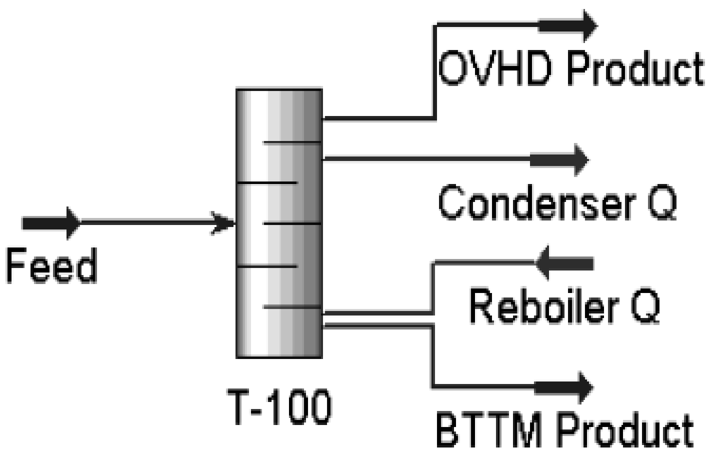
HYSYS also allows users to estimate flow rates inside the column and it will calculate the appropriate tray dimensions.

Learning Objectives

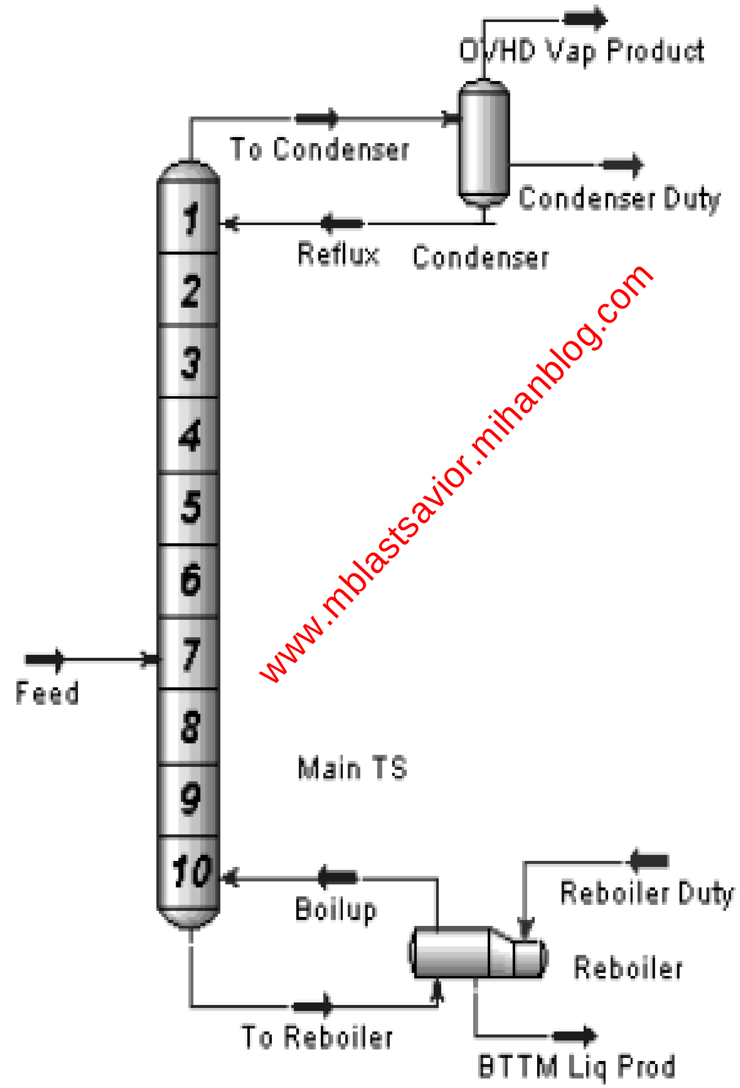
After completion of this module, you will be able to:

- Use the Shortcut Distillation tool in the design of a column.
- Build a distillation column in HYSYS and add different specifications.
- Perform Tray Sizing and Rating calculations.

Shortcut Column Overview



Distillation Column Overview



Information on Shortcut Distillation

The Shortcut distillation tool allows users to estimate several column parameters without knowing a great deal of information about the specifics of the column. The Shortcut column requires much less information in order to solve than a regular column. There are five pieces of required information: 2 component specifications, 2 pressure specifications, and the Reflux ratio. A fully defined feed stream is also required in order to solve the column.

The two component specifications are **Light Key in Bottoms** and **Heavy Key in Distillate.** The Light Key is defined as the most volatile compound to appear at the bottom of the column. The Heavy Key is defined as the least volatile compound to appear at the top of the column. Typically, the Light and Heavy Keys define the operation of the column.

For example, the column that will be simulated in this module is a depropanizer. That is to say, it separates C1, C2 and C3 from heavier molecules like the C4's and C5's. The split occurs between propane and i-butane. Therefore, propane is the Light Key and i-butane is the Heavy Key.

The concentrations of the Light and Heavy Keys must also be specified. Setting these values too low will result in a large (tall) column with a high Reflux, while choosing high values may result in poor product quality and a weak separation.

- the Reboiler pressure should be greater than the Condenser pressure.

Defining the Fluid Package

Once again, the first step in any simulation is defining the fluid package. Start a New Case and choose the Peng Robinson EOS package. The components C1 to n-C9 must be added to the simulation.

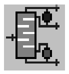
تهیه کننده : محمد بهزادی

Installing the Feed Stream

Install a new stream in the PFD and enter the following information:

In This Cell...	Enter...
Name	Feed
Temperature, °C (°F)	10 (50)
Pressure, kPa (psia)	500 (75)
Molar Flow, kgmole/hr (lbmole/hr)	50 (110)
Molar Composition - C1	0.32
Molar Composition - C2	0.16
Molar Composition - C3	0.11
Molar Composition - n-C4	0.11
Molar Composition - i-C4	0.11
Molar Composition - n-C5	0.05
Molar Composition - i-C5	0.05
Molar Composition - n-C6	0.03
Molar Composition - n-C7	0.03
Molar Composition - n-C8	0.02
Molar Composition - n-C9	0.01

Adding the Shortcut Distillation

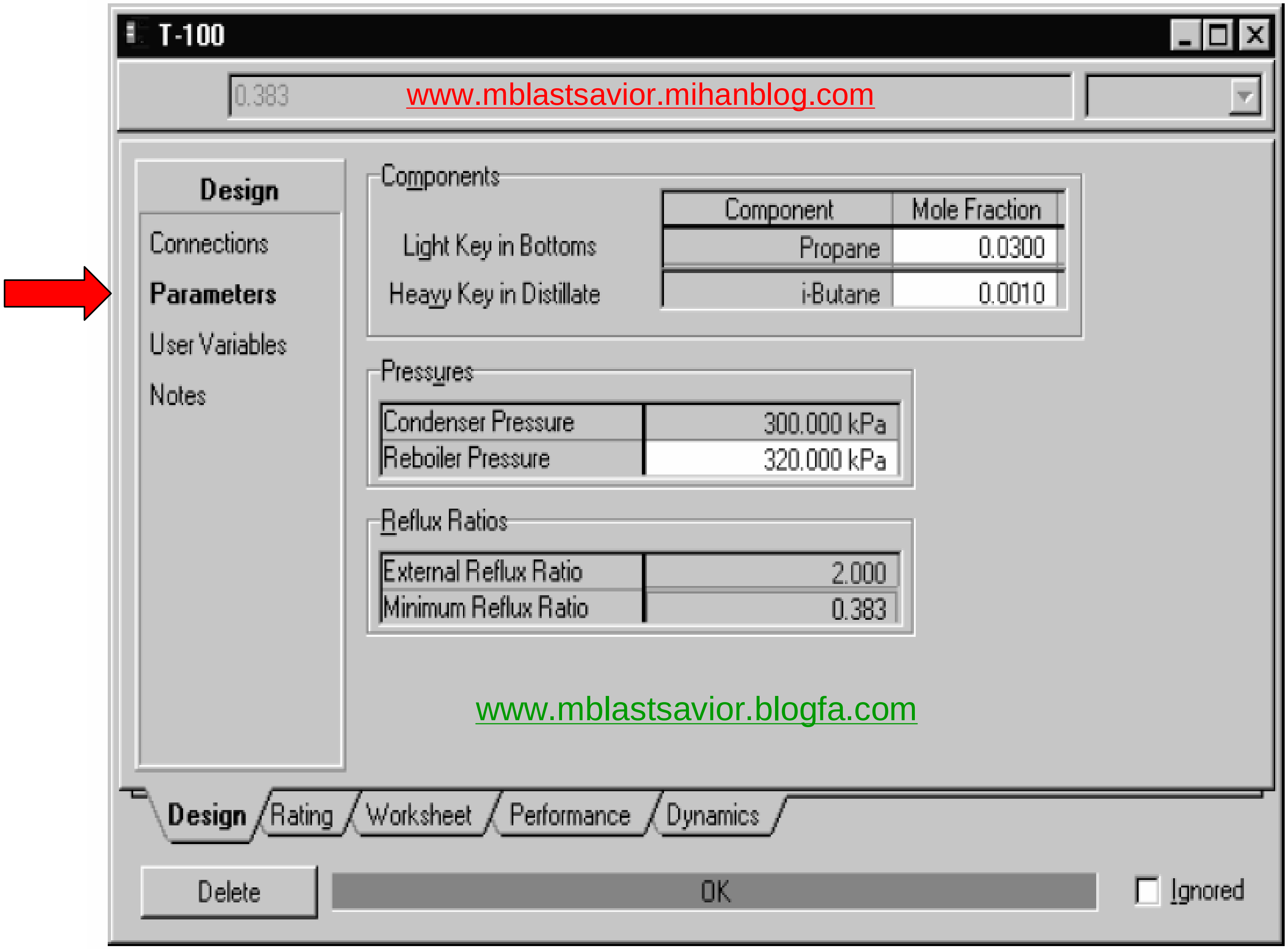


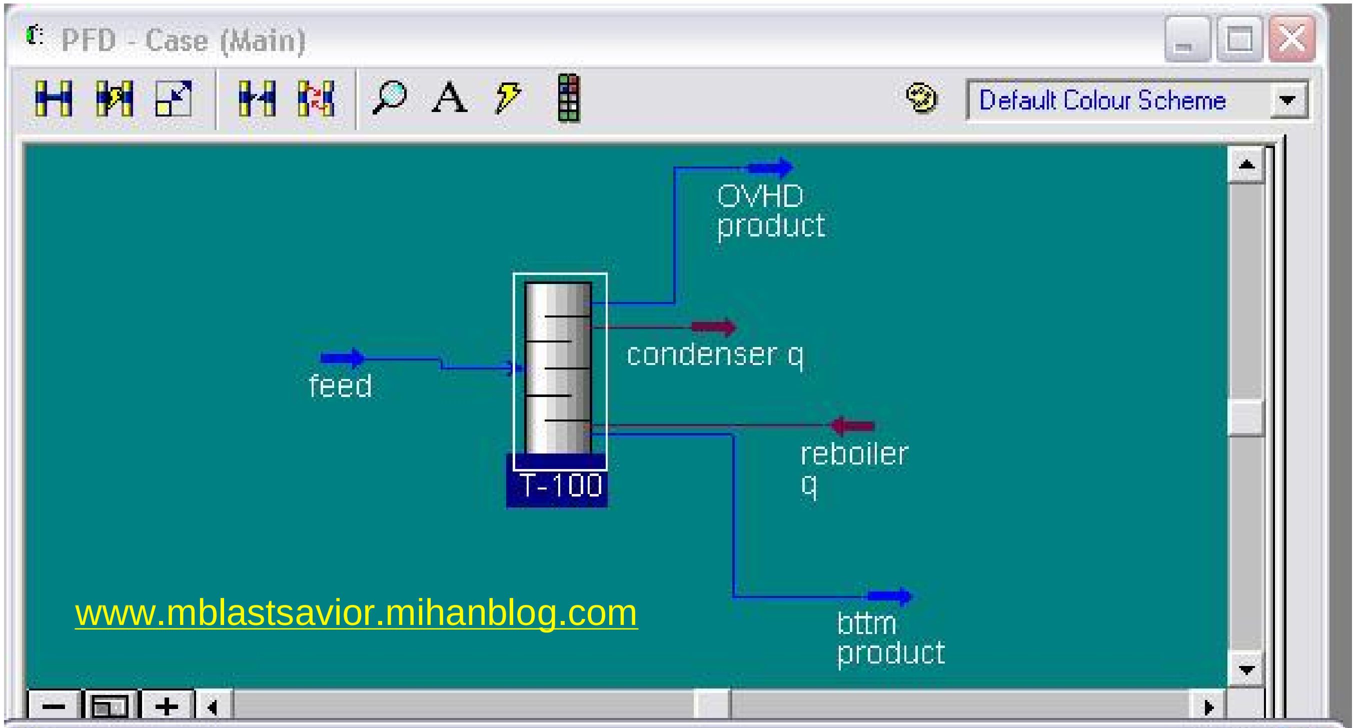
Shortcut Distillation button

Now we can add the Shortcut Distillation operation.

1. Double click on the *Shortcut Distillation* button to enter it into the PFD.
2. Enter the following information into the appropriate boxes.

In This Cell...	Enter...
Feed	Feed
Top Product Phase	Vapour
Overhead Vapour	OVHD Product
Condenser Duty	Condenser Q
Bottoms	Bttm Product
Reboiler Duty	Reboiler Q


T-100
0.383
Design
Connections
Parameters
User Variables
Notes
Components
Light Key in Bottoms
Heavy Key in Distillate
Component
Mole Fraction
Propane
0.0300
i-Butane
0.0010
Pressures
Condenser Pressure
300.000 kPa
Reboiler Pressure
320.000 kPa
Reflux Ratios
External Reflux Ratio
2.000
Minimum Reflux Ratio
0.383
Design
Rating
Worksheet
Performance
Dynamics
Delete
OK
Ignored



T-100

Performance

Trays

Minimum Number of Trays	6.845
Actual Number of Trays	9.140
Optimal Feed Stage	7.238

Temperatures

Condenser [C]	-53.66
Reboiler [C]	42.28

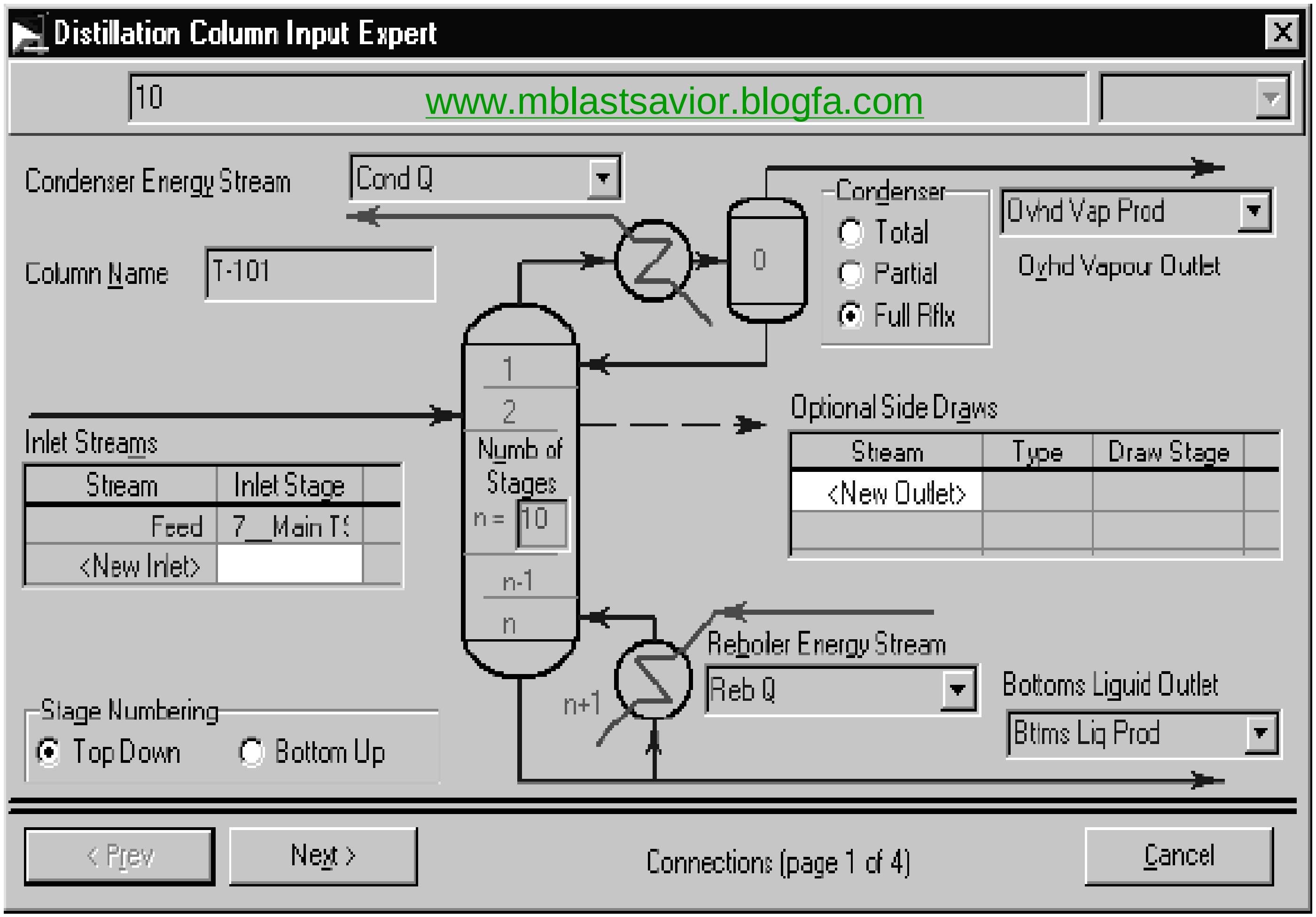
Flows

Rectify Vapour [kgmole/h]	86.693
Rectify Liquid [kgmole/h]	57.795
Stripping Vapour [kgmole/h]	54.400
Stripping Liquid [kgmole/h]	75.503
Condenser Duty [kJ/h]	-1148825.695
Reboiler Duty [kJ/h]	1087901.439

Design | Rating | Wor | **Performance** | Dynamics

These values are estimates only. We will use an actual distillation column to refine the simulation.

Building the Distillation Column



Remember that these are the same values that were used in the Shortcut column.

In This Cell...	Enter...
Condenser Pressure, kPa (psia)	300 (43.5)
Condenser Pressure Drop, kPa (psia)	0
Reboiler Pressure, kPa (psia)	320 (46.5)

5. Enter the temperatures that the Shortcut Distillation operation estimated on the next screen.
6. Enter a Reflux Ratio of **2.0** on the final screen on the **Input Expert**.

The HYSYS Spreadsheet

- The HYSYS Spreadsheet is a powerful tool that allows the user to apply the functionality of Shreadsheet programs to flowsheet modelling. The Spreadsheet has complete access to all process variables; this allows the
- Spreadsheet to be virtually unlimited in its applicability and function. In this module, the Spreadsheet will be used to calculate the required
- orifice area of a Pressure Safety Valve. Unlike the Depressurizing utility, where the area is an input, the flow will be inputted here and the Spreadsheet will calculate the required area.

Learning Objectives

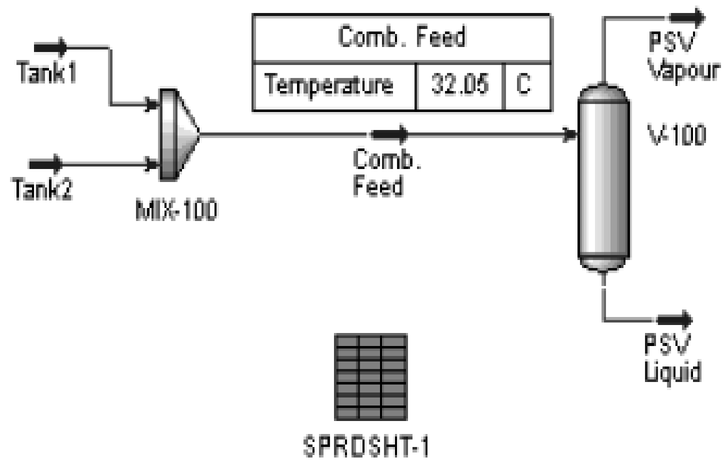
After completion of this module, you will be able to:

- Import and export variables to and from the Spreadsheet
- Add complex formulas to the Spreadsheet
- Use the HYSYS Spreadsheet in a wide variety of applications
- Open and run Macro Language Editor programs

Process Overview

Tank1		
Temperature	25.00	C
Pressure	4000.	kPa
Molar Flow	460.0	kgmole/h
Comp Mole Frac (Methane)	0.5600	
Comp Mole Frac (Ethane)	0.2000	
Comp Mole Frac (Propane)	0.1000	
Comp Mole Frac (i-Butane)	0.0500	
Comp Mole Frac (n-Butane)	0.0500	
Comp Mole Frac (i-Pentane)	0.0200	
Comp Mole Frac (n-Pentane)	0.0200	

Tank2		
Pressure	3000.	kPa
Molar Flow	460.0	kgmole/h
Comp Mole Frac (Methane)	0.1780	
Comp Mole Frac (Ethane)	0.1980	
Comp Mole Frac (Propane)	0.1930	
Comp Mole Frac (i-Butane)	0.1350	
Comp Mole Frac (n-Butane)	0.1490	
Comp Mole Frac (i-Pentane)	0.0720	
Comp Mole Frac (n-Pentane)	0.0750	



SPRDSHT-1		
Number of Columns	4	
Number of Rows	15	

Building the Simulation

In this module, the required orifice area for a Pressure Relief Valve will be calculated in a manner quite different from the method used in the Depressurization module. However, the same streams will be used.

Therefore, continue with, or open, the Depressurization case. In this module the two streams will be combined with a mixer, a flow rate will be specified and the Spreadsheet will be used to calculate the required orifice area.

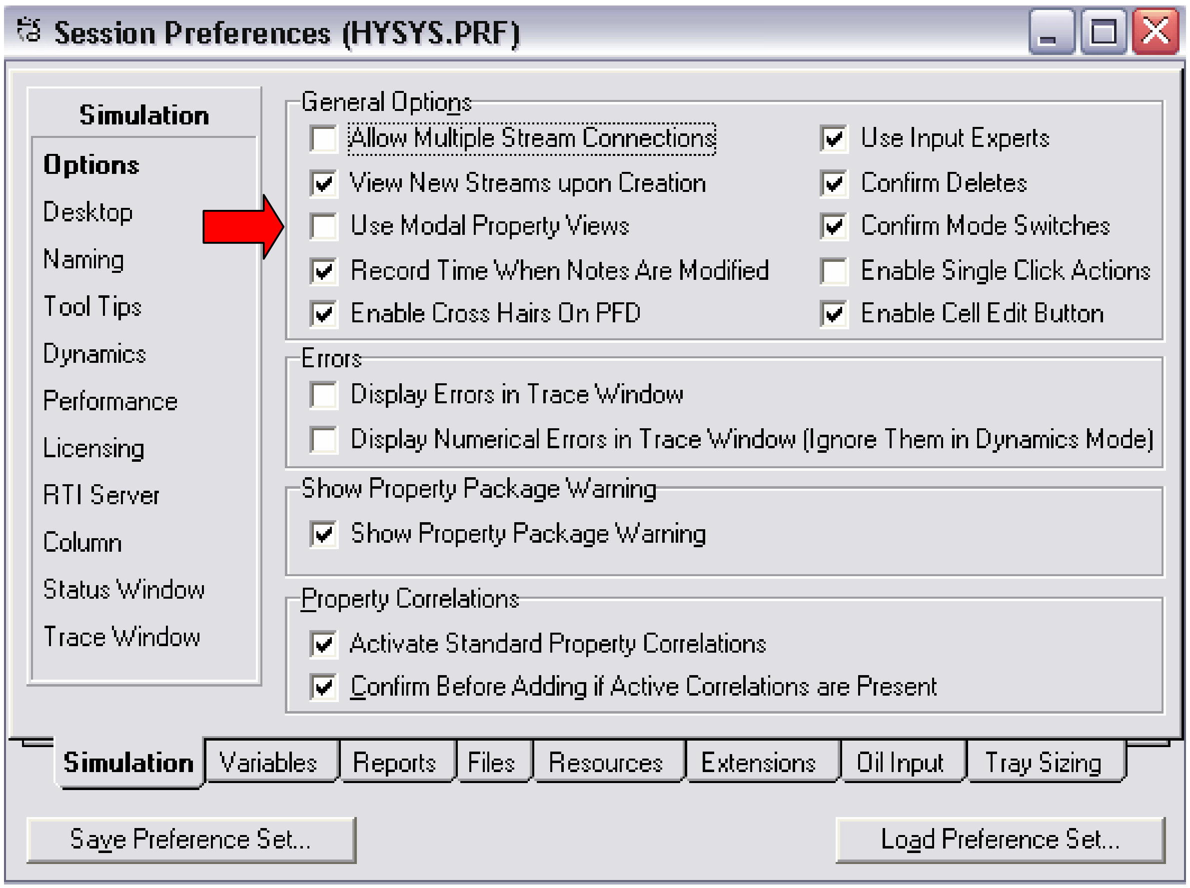
The addition of a V/L Separator allows the user to calculate orifice areas for both vapour and liquid streams separately.

- seamless transfer of data between the Simulation Environment and the Spreadsheet is a simple matter. Any changes in the Simulation Environment are immediately reflected in the Spreadsheet, and viceversa.
- The Spreadsheet has several common applications. For example, the Spreadsheet can be used to:

• Transfer variables between flowsheet objects.

• Relate the pressure drop in a Heat Exchanger to the flow.

• Perform mathematical operations using variables from the simulation.



Session Preferences (HYSYS.PRF)
Simulation
Options
Desktop
Naming
Tool Tips
Dynamics
Performance
Licensing
RTI Server
Column
Status Window
Trace Window
General Options
Allow Multiple Stream Connections
View New Streams upon Creation
Use Modal Property Views
Record Time When Notes Are Modified
Enable Cross Hairs On PFD
Use Input Experts
Confirm Deletes
Confirm Mode Switches
Enable Single Click Actions
Enable Cell Edit Button
Errors
Display Errors in Trace Window
Display Numerical Errors in Trace Window (Ignore Them in Dynamics Mode)
Show Property Package Warning
Show Property Package Warning
Property Correlations
Activate Standard Property Correlations
Confirm Before Adding if Active Correlations are Present
Simulation
Variables
Reports
Files
Resources
Extensions
Oil Input
Tray Sizing
Save Preference Set...
Load Preference Set...

Importing and Exporting Variables

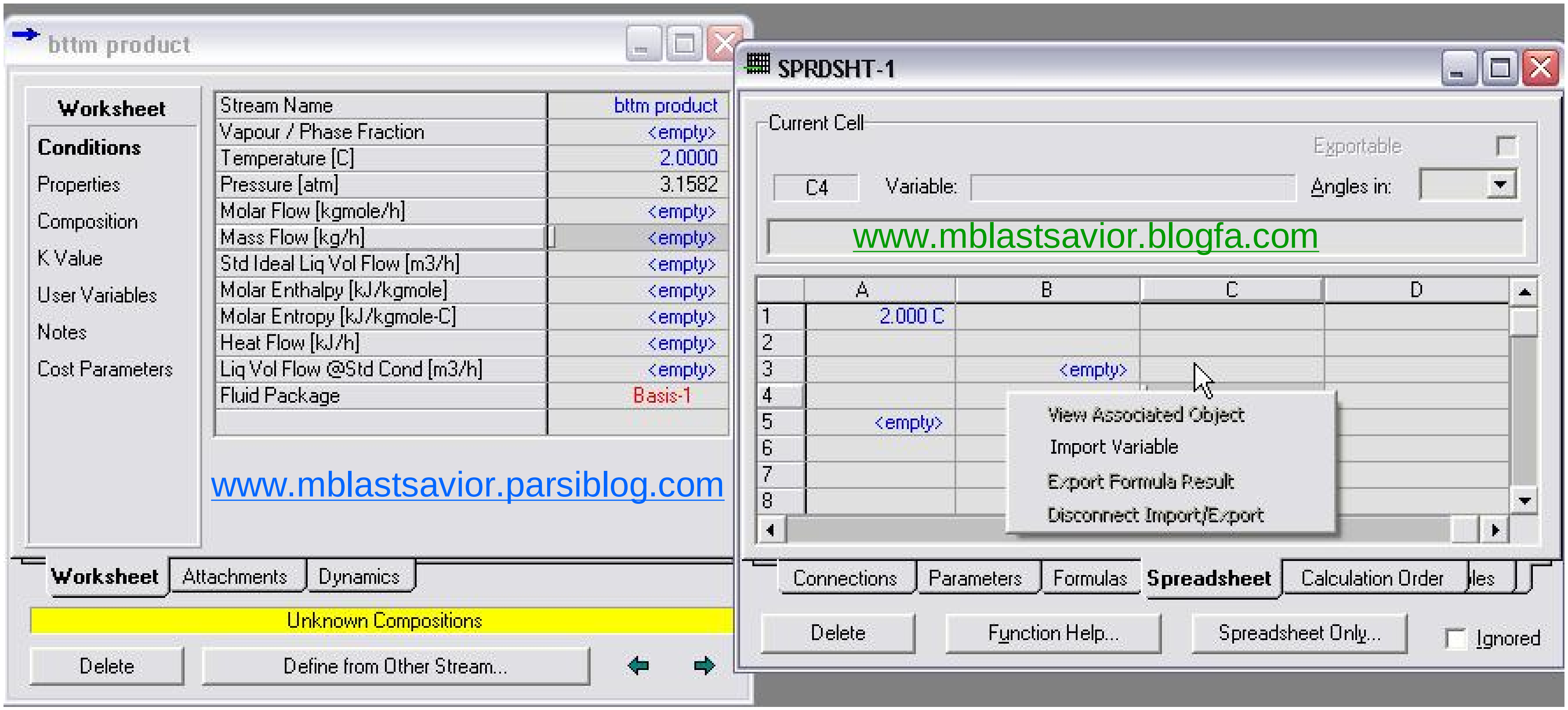
The contents of any cell in the Simulation Environment can be added to the Spreadsheet. The contents of any Spreadsheet cell can be exported to any specifiable (blue) cell in the Simulation Environment. Note that the contents of any Spreadsheet cell cannot be simulationsly imported and exported.

In order for a variable to be dragged out of a particular view, that view must be "un-pinned" or non-modal. Click on the pin to convert the view.

There are three ways of importing values into the Spreadsheet.

- **Drag and Drop** - Position the cursor over the desired item; then press and hold the *right* mouse button. Move the cursor over to the Spreadsheet. Once over the Spreadsheet, the cursor's appearance will change to a "bull's eye" type. Release the *right* mouse button when the "bull's eye" cursor is over the desired cell. The specific information about the imported variable will appear in the **Current Cell** group.
- **Variable Browsing** - A variable may also be imported into the Spreadsheet by placing the cursor on an empty cell in the Spreadsheet and pressing (and releasing) the *right* mouse button. Choose **Import Variable** from the list that appears, and select the variable using the Variable Navigator.
- **Connections Page** - On the **Connections** page, press the ***Add Import*** button and select the desired variable using the Variable Navigator. After selecting the variable, choose the desired cell from the Drop Down list.

دی


bttm product
Worksheet
Conditions
Properties
Composition
K Value
User Variables
Notes
Cost Parameters
Stream Name | bttm product
Vapour / Phase Fraction | <empty>
Temperature [C] | 2.0000
Pressure [atm] | 3.1582
Molar Flow [kgmole/h] | <empty>
Mass Flow [kg/h] | <empty>
Std Ideal Liq Vol Flow [m3/h] | <empty>
Molar Enthalpy [kJ/kgmole] | <empty>
Molar Entropy [kJ/kgmole-C] | <empty>
Heat Flow [kJ/h] | <empty>
Liq Vol Flow @Std Cond [m3/h] | <empty>
Fluid Package | Basis-1
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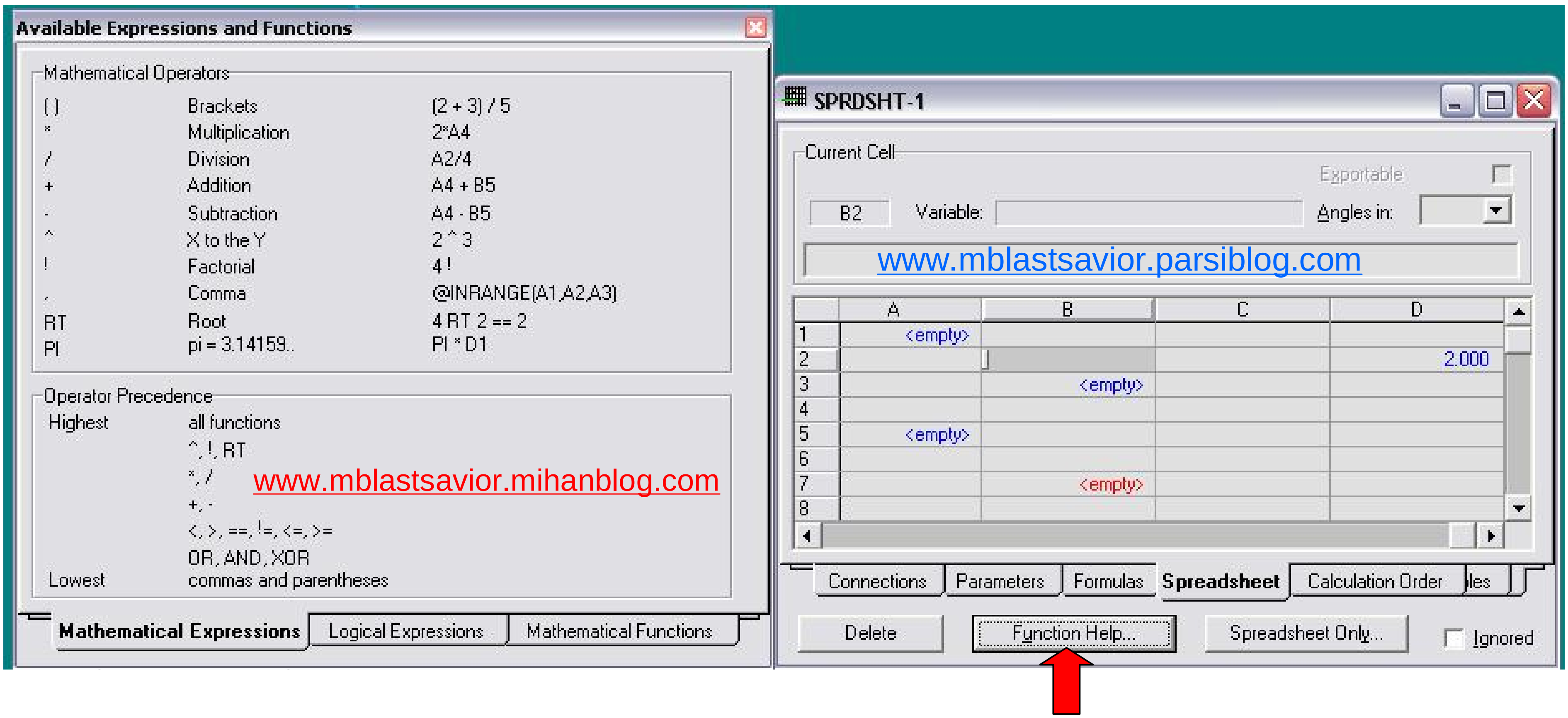
Worksheet
Attachments
Dynamics
Unknown Compositions
Delete
Define from Other Stream...
SPRDSHT-1
Current Cell
Exportable
C4
Variable:
Angles in:
www.mblastsavior.blogfa.com
A
B
C
D
2.000 C
<empty>
<empty>
View Associated Object
Import Variable
Export Formula Result
Disconnect Import/Export
Connections
Parameters
Formulas
Spreadsheet
Calculation Order
Delete
Function Help...
Spreadsheet Only...
Ignored

To view the available HYSYS functions any time, press the ***Function Help*** *button. This view has two pages,* ***Functions and Expressions.***



Adding Spreadsheet Functions

The HYSYS Spreadsheet has extensive mathematical and logical function capabilities. Users familiar with common Spreadsheet programs will immediately recognize the form of the HYSYS functions as similar to the form used by these other programs.

All functions in the HYSYS Spreadsheet must be proceeded by either a "+" or an "@" depending on the type of function. Plus signs (+) are used for straight mathematical functions: addition, subtraction, multiplication, and division. The ampersand (@) is used before special functions such as logarithmic, trigonometric, and logical functions.

A cell's numerical value can be copied to another cell using the simple formula, +A1, for example.

Some examples of the HYSYS functions and their form follow here:

- **Addition** - uses the "+" sign, e.g. +A1+A2
- **Subtraction** - uses the "-" sign, e.g. +A1-A2
- **Multiplication** - uses the "*" sign, e.g +A1*A2
- **Division** - uses the "/" sign (not the "\") e.g. +A1/A2
- **Power** - uses the "^" sign, e.g. +A2^4
- **Factorial** - uses the "!" sign, e.g +A2!
- **Square Root** - uses the "@SQRT" function, e.g @SQRT(A2)
- **Sine, Cosine, and Tangent** - use the @sin, @cos, and @tan functions, e.g @sin(A2). Inverse trigonometric functions are also available, @asin, @acos, and @atan. Hyperbolic functions can also be represented in HYSYS, they use the form @sinh, @cosh, and @tanh.
- **Logarithmic Functions** - are represented in HYSYS with the following forms: @ln, @log, and @exp.
- **Pi** - simply enter "+pi" to represent the number 3.1416....

Parenthesis are mandatory in many of the advanced HYSYS functions.

They can also be used to designate the calculation order.

Logical Operators

The HYSYS Spreadsheet supports Boolean logic, essentially a true/false logic. A true statement has a value of 1, and a false statement has a value of 0. For example, suppose that the cell A1 has a value of 10, and the cell A2 has a value of 5. If the logical statement +A1<A2 were entered into cell A3. The cell would display a value of 0 because the logic statement is false.

The following logical operators can be used in Boolean logic statements:

- **Equal to** - uses "==", e.g +A1==A2
- **Not Equal to** - uses "!=", e.g. +A1!=A2
- **Greater than** - uses ">", e.g. +A1>A2
- **Less than** - uses "<", e.g. +A1<A2
- **Greater than or Equal to** - uses ">=", e.g. +A1>=A2
- **Less than or Equal to** - uses "<=", e.g. +A1<=A2

IF/THEN/ELSE Statements

The "else" is not optional here. An If/Then statement is not valid in HYSYS.

The HYSYS Spreadsheet also supports the basic IF/THEN/ELSE Statement. The form of this statement is:

@if *(condition)* then *(if true)* else *(if false)*

The *condition* is a logical expression, such as "B1<= 10". The *if true* represents what the cell will show if the condition is true; it can be a number or a formula. The *if false* represents what the cell will show if the condition is false; it can also be a number or a formula.

An example of the completed statement follows.

@if (B1<=10) then (B1*2) else (B1/10)

> *Suppose that the value in cell B1 is 8. What will the IF/THEN/ELSE Statement shown above calculate?* ________

تهیه کننده : محمد بهزادی

The formulas that will be used to calculate the orifice area are based on API-520. The formula for orifice area for the vapour stream is:

$$A_V = \frac{M \times \sqrt{T \times Z}}{C \times K_d \times K_b \times K_v \times P \times \sqrt{MW}}$$

And the equation for the orifice area required for the liquid flow is:

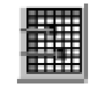
$$A_L = \frac{G \times \sqrt{SG}}{22.8 \times K_d \times K_w \times K_u \times \sqrt{\Delta P}}$$

Note that all of the constants given here are defined in Field units. Using SI units without changing the constants will give wrong results.

Variable Type	Unit
Area	in^2
Temperature	Rankin (R)
Actual Liquid Volume Flow	USGPM

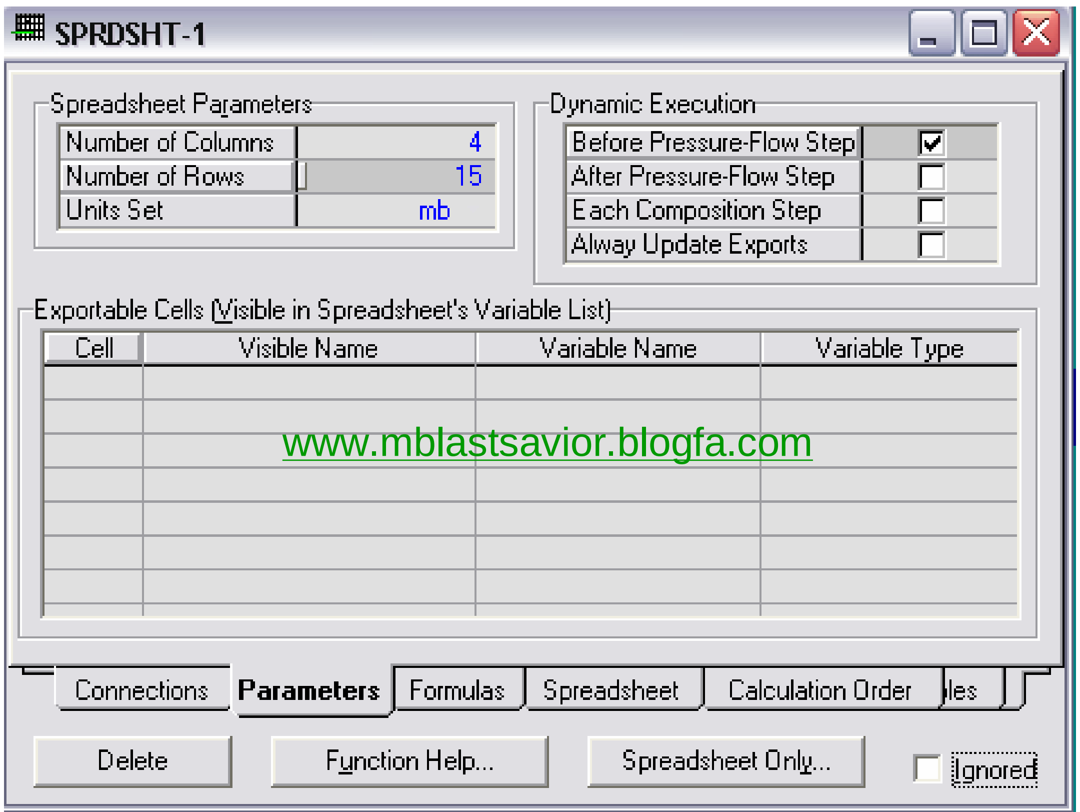
The terms in the above equations are defined here:

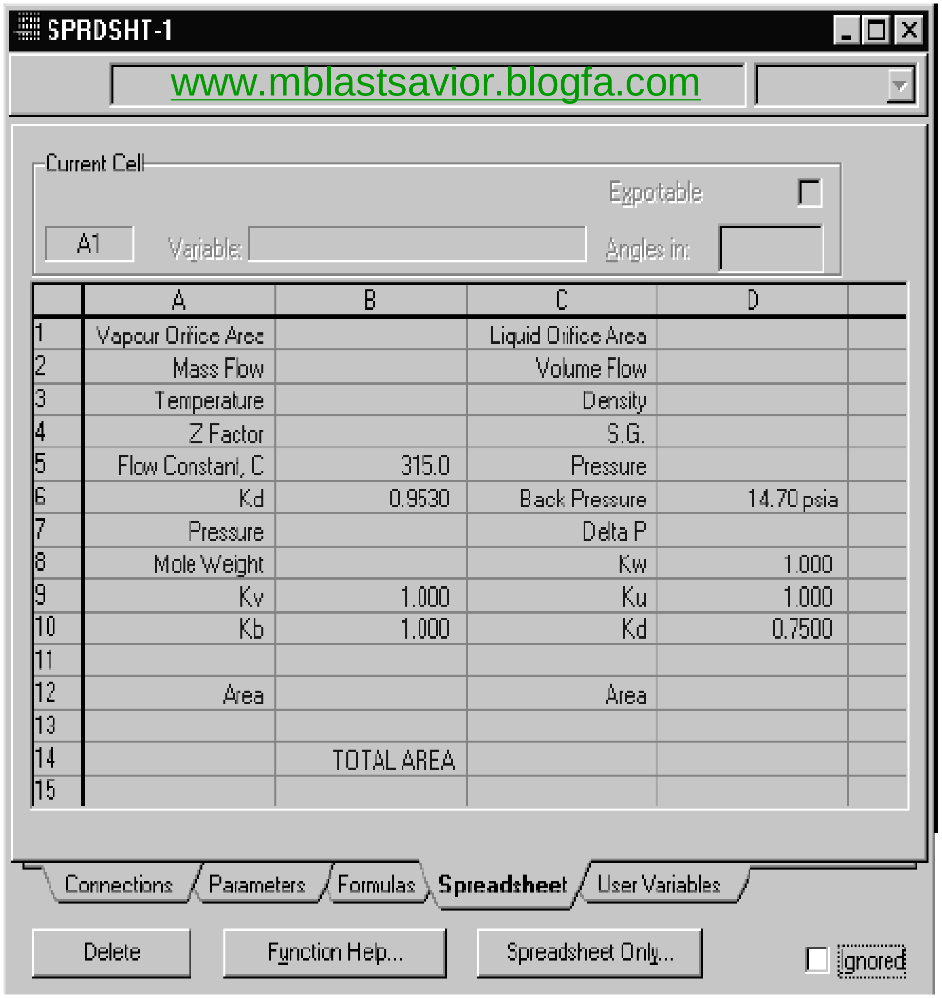
- **A_V** and **A_L** = the orifice area required for vapour and liquid flows, respectively, in square inches.
- **M** = the mass flow of the vapour stream in lb/hr.
- **T** = the stream temperature in Rankin.
- **Z** = the compressibility factor of the vapour stream.
- **C** = the Vapour Flow constant = 315, for this example.
- **K_d** = the Coefficient of Discharge of the orifice = 0.953, for this example.
- **K_b** = the Vapour Flow Correction Factor = 1.0, for this example.
- **K_v** = the Vapour Flow Factor for variable back pressures, used with bellows values only = 1.0, in this example.
- **MW** = the average Molecular Weight of the stream.
- **P** = the pressure of the stream, in psia.
- **G** = the actual Volume Flow, in GPM.
- **SG** = the specific gravity of the liquid stream.
- **Delta P** = Pressure Drop across the valve, in PSI.
- **K_w** = the Liquid Flow Factor of variable back pressures, used with bellows valves only = 1.0, in this example.
- **K_u** = the Liquid Viscosity Correction Factor = 1.0, in this example.



Spreadsheet Button

- Change the size of the Spreadsheet to 4 columns and 15 rows.





	A	B	C	D
1	Vapour Orifice Area		Liquid Orifice Area	
2	Mass Flow		Volume Flow	
3	Temperature		Density	
4	Z Factor		S.G.	
5	Flow Constant, C	315.0	Pressure	
6	Kd	0.9530	Back Pressure	14.70 psia
7	Pressure		Delta P	
8	Mole Weight		Kw	1.000
9	Kv	1.000	Ku	1.000
10	Kb	1.000	Kd	0.7500
11				
12	Area		Area	
13				
14		TOTAL AREA		
15				

Of course, labels are not necessary, but as the Spreadsheet grows, it can become difficult to remember what each number represents.

تهیه کننده : محمد بهزادی

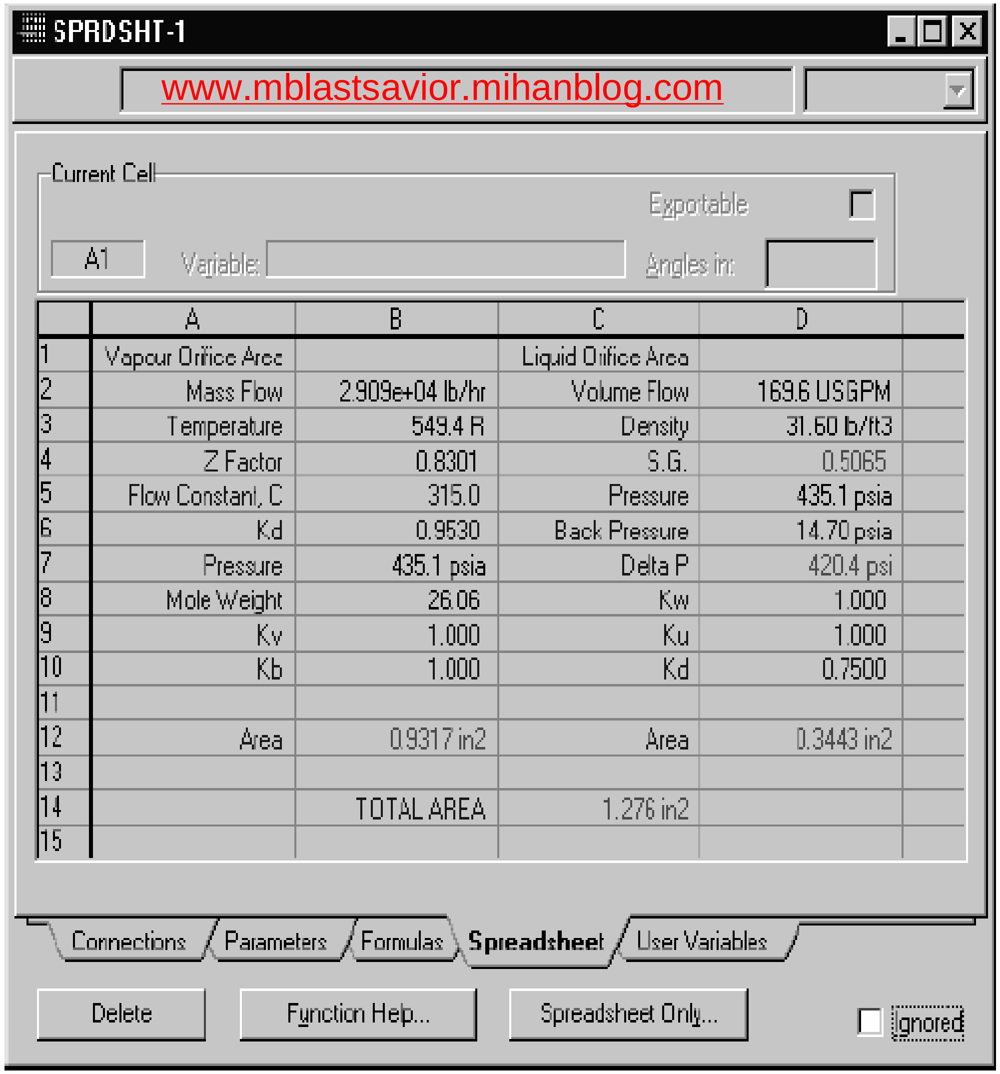
The following variables have to be imported into the Spreadsheet:

In this Cell...	Import...
B2	PSV Vapour - Mass Flow
B3	PSV Vapour - Temperature
B4	PSV Vapour - Phase Z Factor
B7	PSV Vapour - Pressure
B8	PSV Vapour - Molecular Weight
D2	PSV Liquid - Act Liquid Vol. Flow
D3	PSV Liquid - Mass Density
D5	PSV Liquid - Pressure

The following formulas can now be to be added to the Spreadsheet:

In this Cell...	Enter...
B12	+(b2*@sqrt(b3)*@sqrt(b4))/ (b5*b6*b7*b9*b10*@sqrt(b8))
D4	+d3/62.4
D7	+d5-d6
D12	+(d2*@sqrt(d4))/ (22.8*d8*d9*d10*@sqrt(d7))
C14	+b12+d12

The final Spreadsheet should look like this:



	A	B	C	D
1	Vapour Orifice Area		Liquid Orifice Area	
2	Mass Flow	2.909e+04 lb/hr	Volume Flow	169.6 USGPM
3	Temperature	549.4 R	Density	31.60 lb/ft3
4	Z Factor	0.8301	S.G.	0.5065
5	Flow Constant, C	315.0	Pressure	435.1 psia
6	Kd	0.9530	Back Pressure	14.70 psia
7	Pressure	435.1 psia	Delta P	420.4 psi
8	Mole Weight	26.06	Kw	1.000
9	Kv	1.000	Ku	1.000
10	Kb	1.000	Kd	0.7500
11				
12	Area	0.9317 in2	Area	0.3443 in2
13				
14		TOTAL AREA	1.276 in2	
15				

What is the total required area of the orifice? ___________

Optimization

بهينه سازي و انتگراسيون انرژي

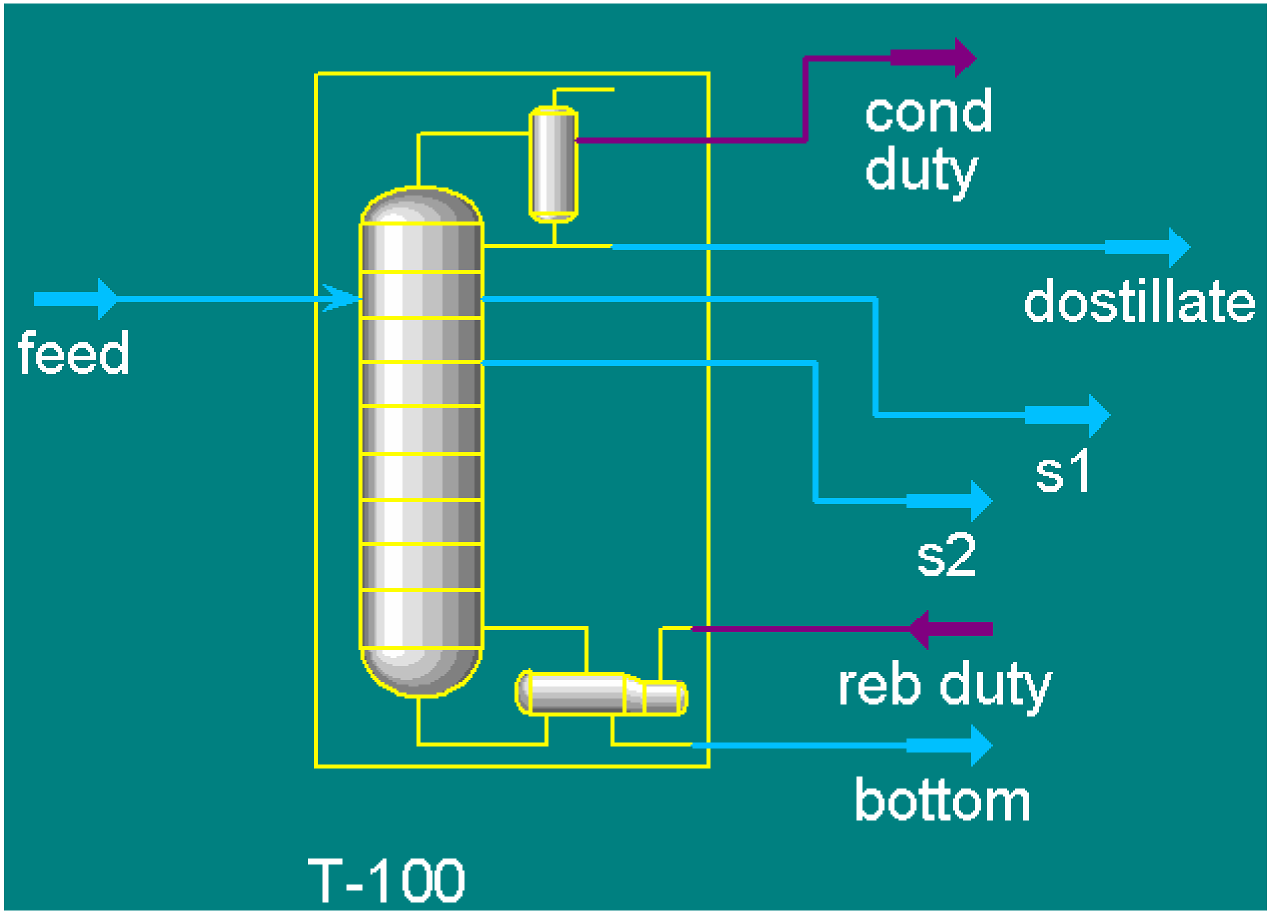
HYSYS contains a multi-variable steady state Optimizer. Once your flowsheet has been built and a converged solution has been obtained, you can use the Optimizer to find the operating conditions which minimize (or maximize) an Objective Function. The object-oriented design of HYSYS makes the Optimizer extremely powerful, since it has access to a wide range of process variables for your optimization study.

The Optimizer is available for steady state calculations only; it does not run in Dynamic mode.

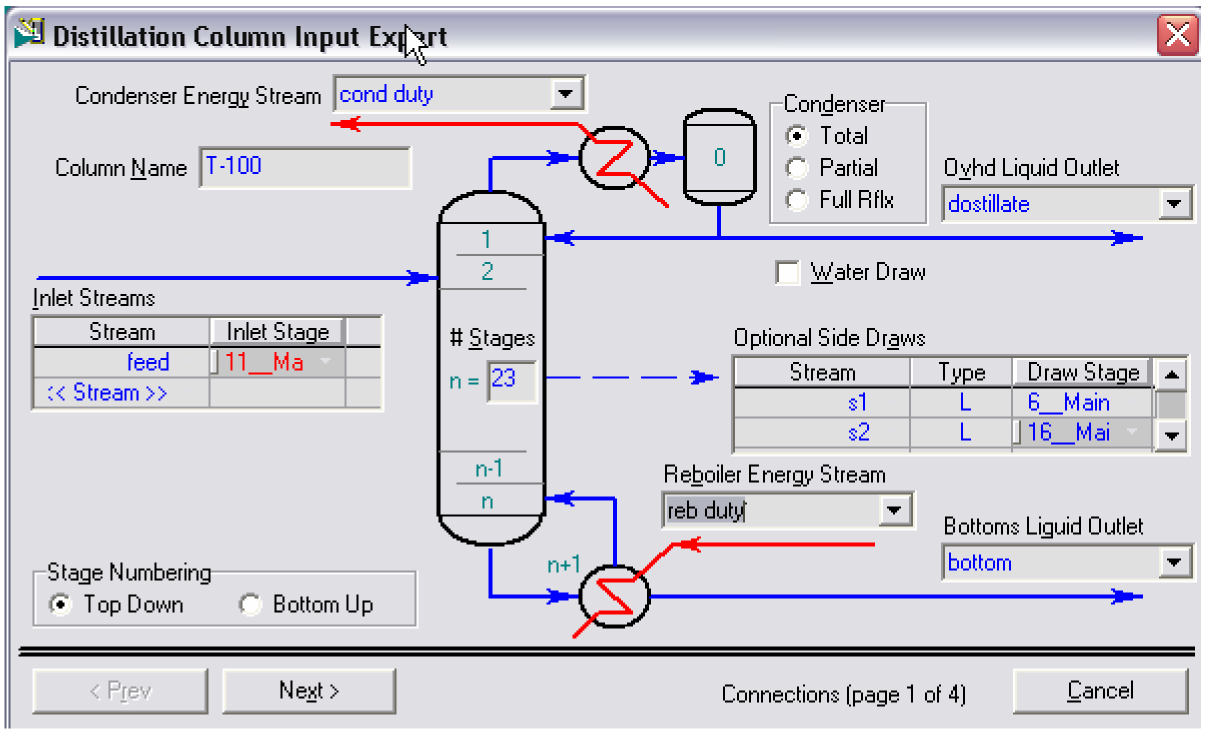
example

- جريان nc5,nc6,nc7,nc8,nc9 در یک برج جداسازي.محصولات از چهار نقطه خارج مي شوند:
- Maximize(distillate $_{nc5}$+ side stream 1 $_{nc6}$+ side stream 2 $_{nc7}$+ side stream 2 $_{nc8}$ + bottom $_{nc9}$)
- Subject to:
- 5<=reflux ratio<=10
- ٠<=distillate/feed <=0.7
- ٠<=side stream 1/feed <= 0.7
- ٠<=side stream 2/feed <= 0.7
- .05<=bottom/feed
- FP:CS unit-set :field

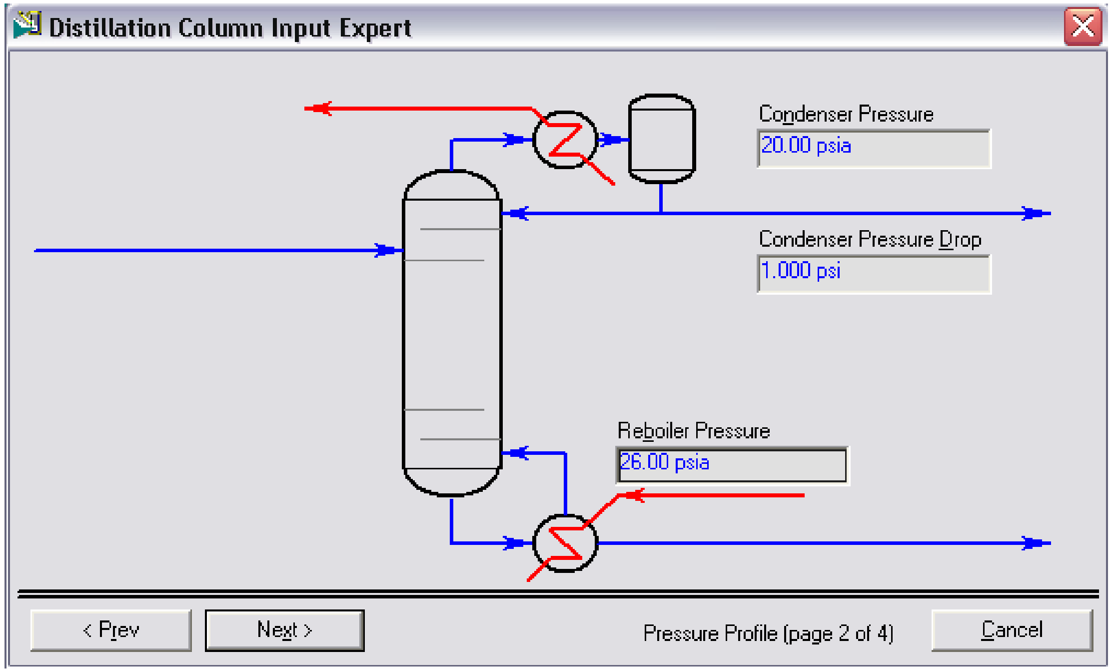
مرحله اول:شبیه سازی برج

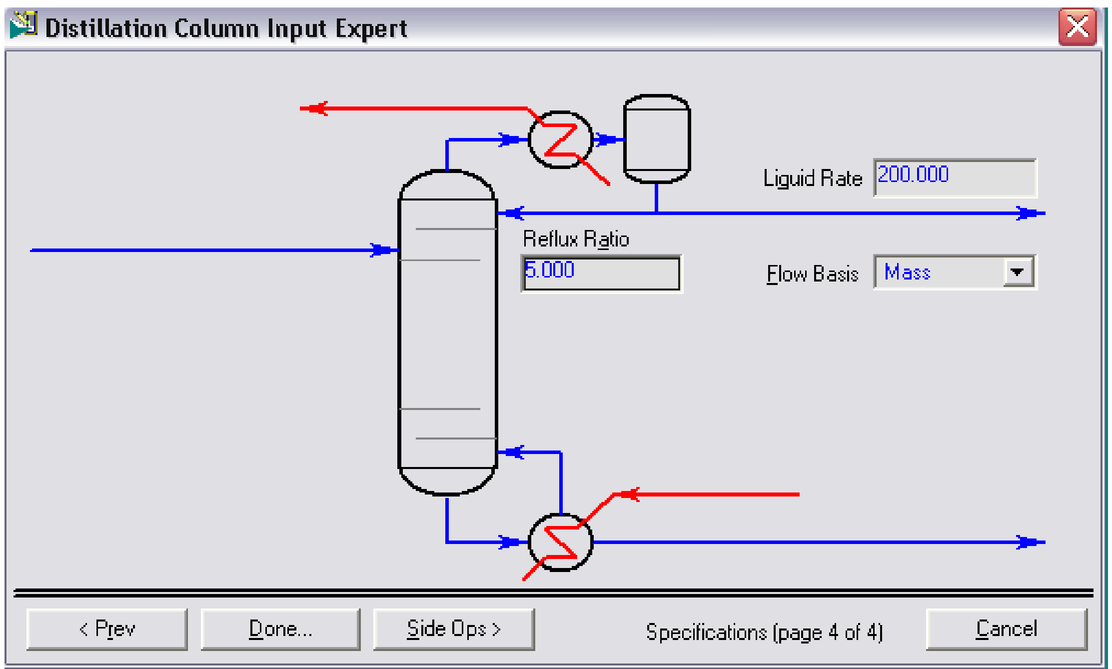


مرحله اول:شبیه سازی برج



مرحله اول:شبیه سازی برج





مرحله اول:شبیه سازی برج

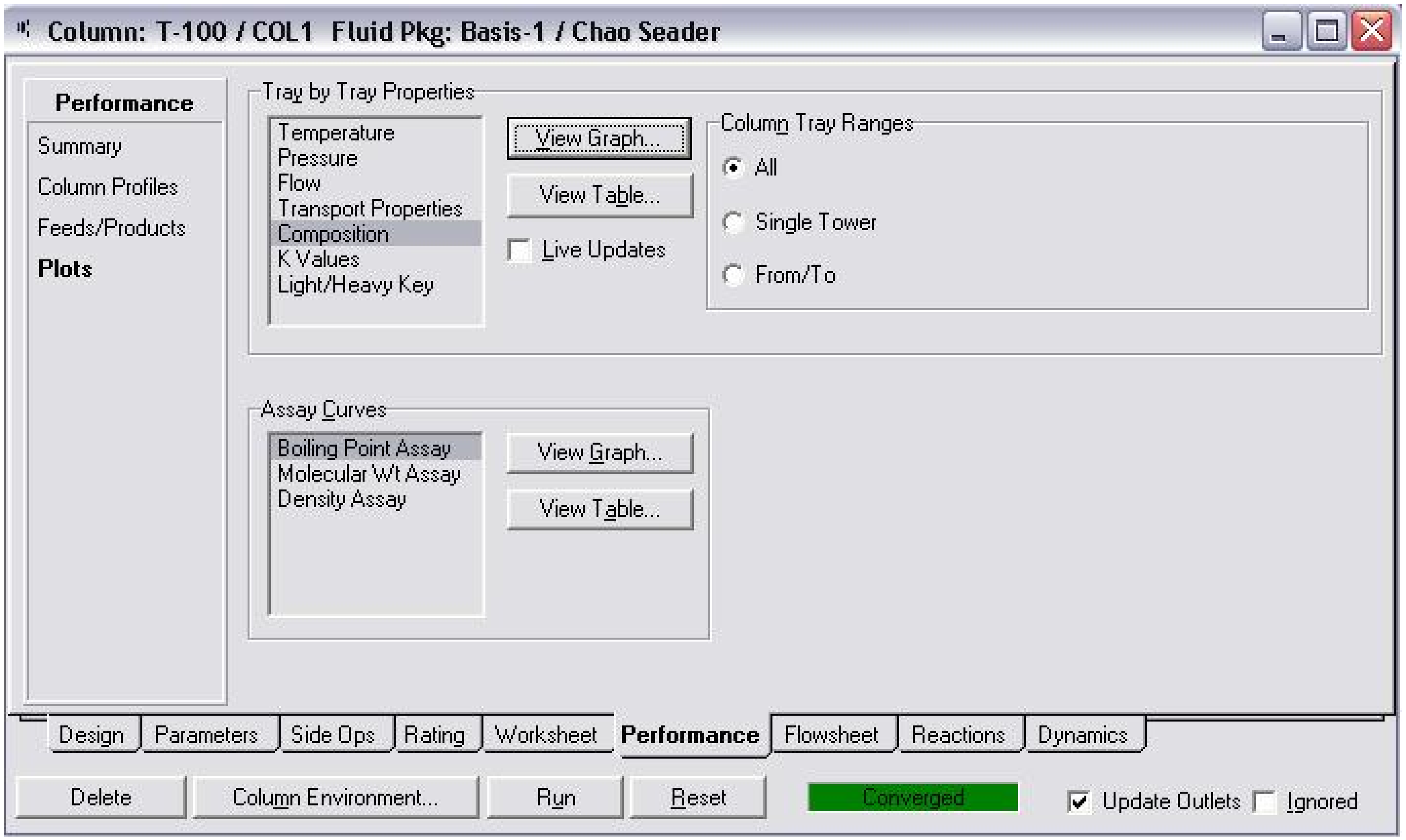
Stream Name	feed
Vapour / Phase Fraction	0.00000
Temperature [F]	10.000
Pressure [psia]	25.000

	Molar Flows
n-Pentane	3.0492
n-Hexane	1.2764
n-Heptane	1.5967
n-Octane	0.43770
n-Nonane	3.1187

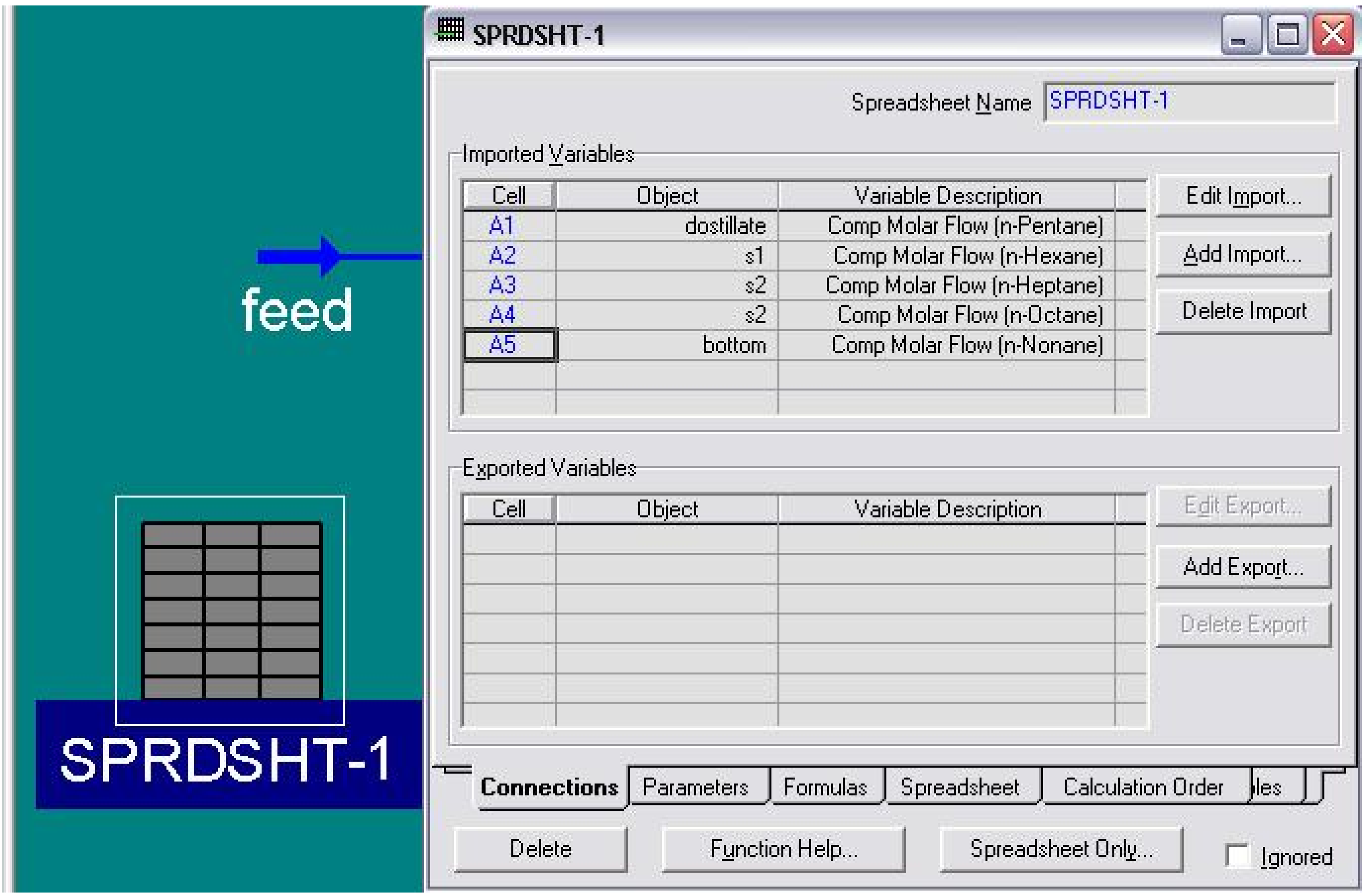
Specs Summary

	Specified Value
Reflux Ratio	5.000
Reflux Rate	<empty>
Btms Prod Rate	<empty>
s1 Rate	2.000
s2 Rate	2.000
Distillate Rate	200.0

مرحله اول:شبیه سازی برج



مرحله دوم: ایده بهینه سازی



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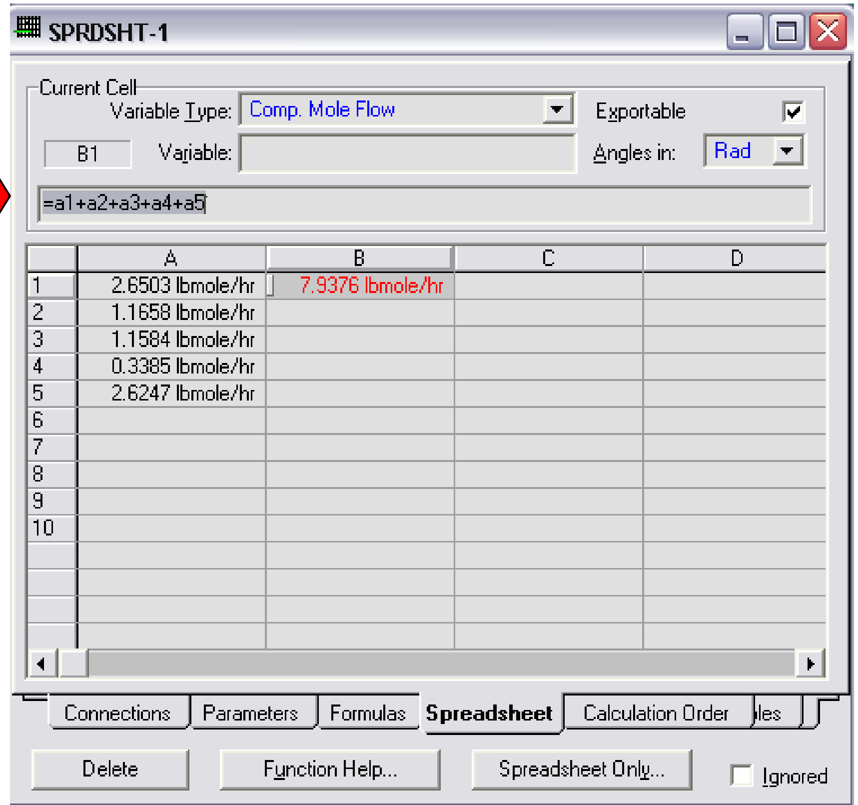

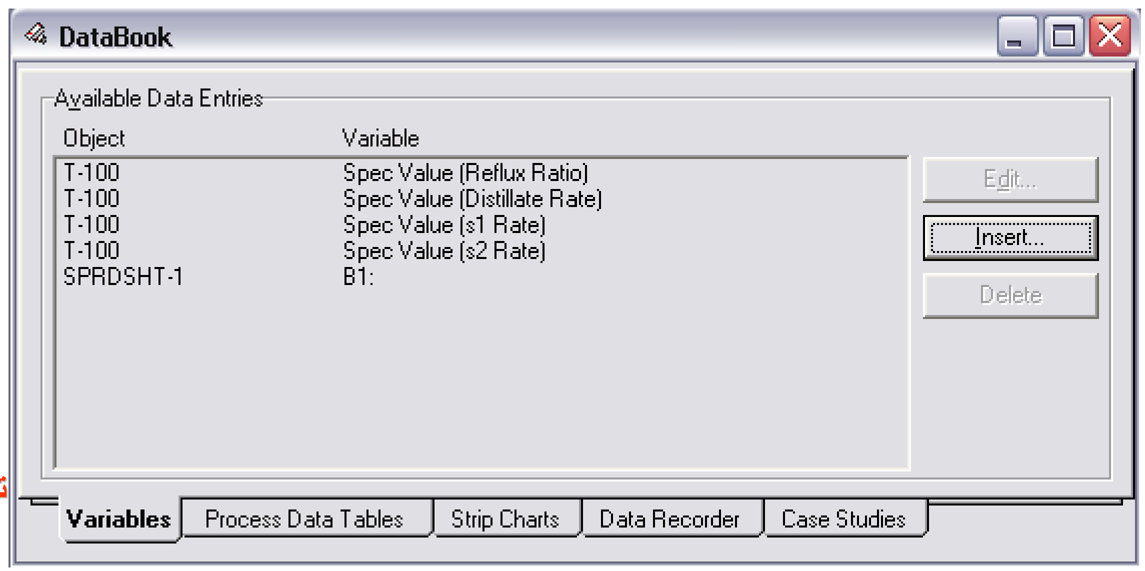

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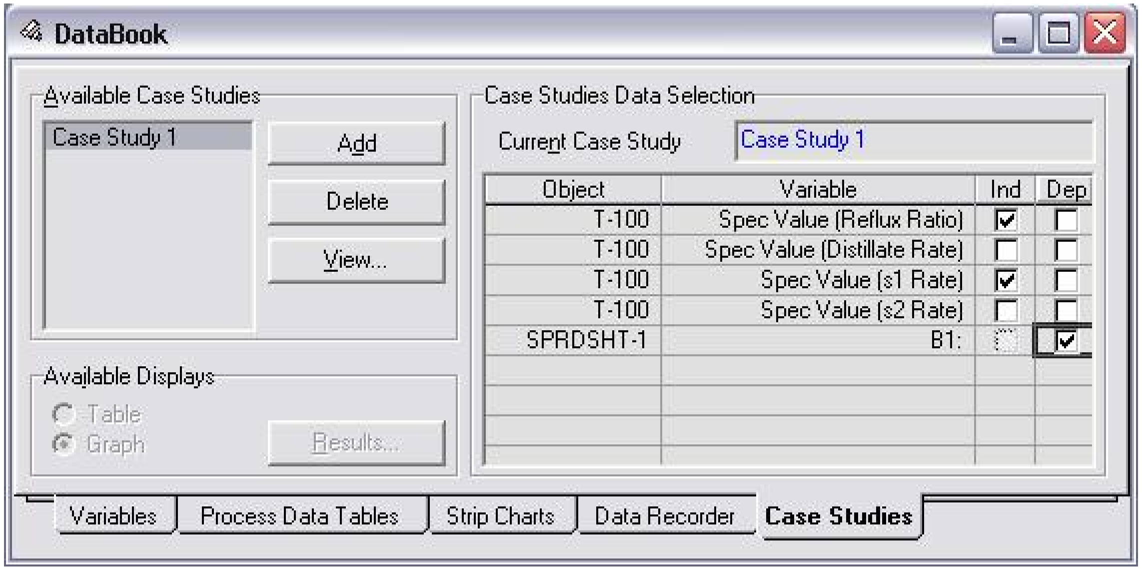
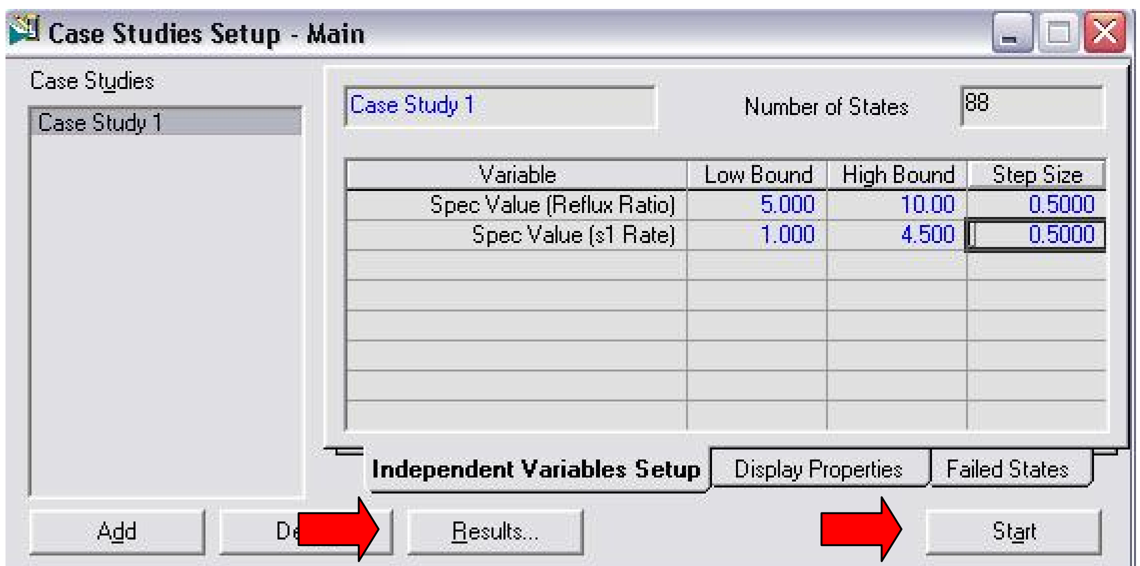
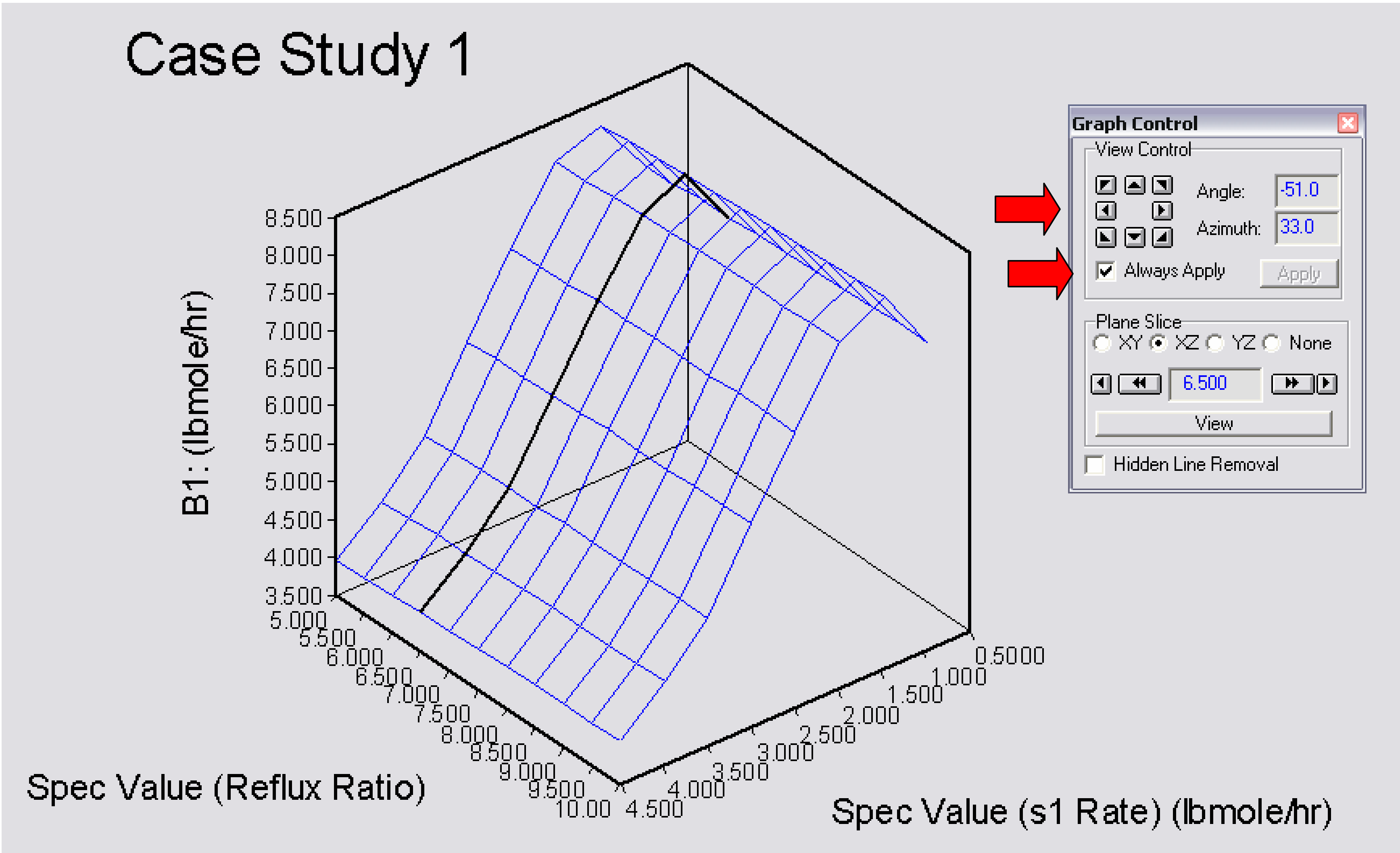
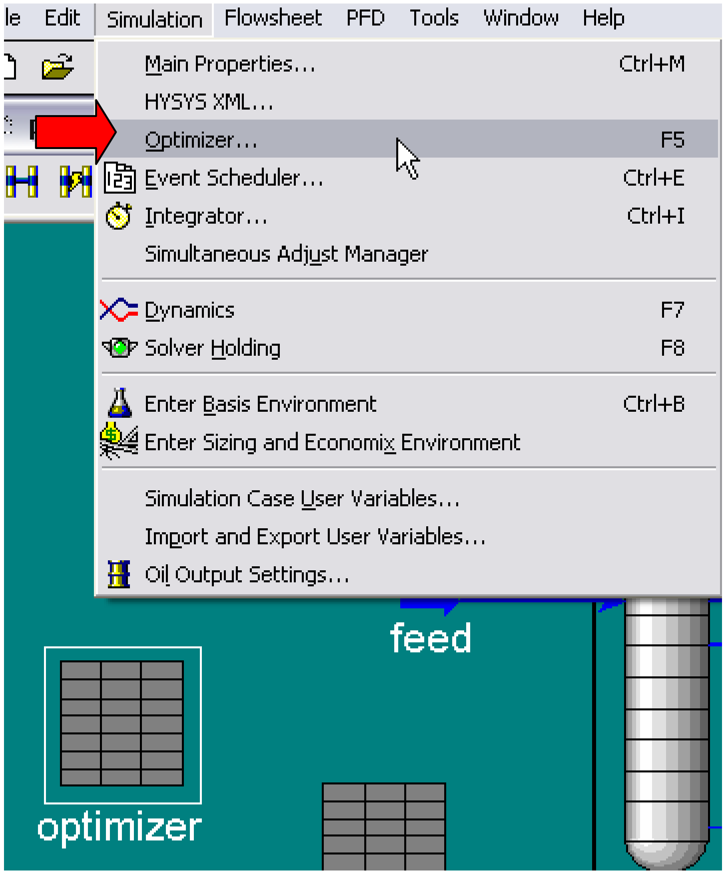




مرحله دوم: ایده بهینه سازی



مرحله سوم: بهینه سازی

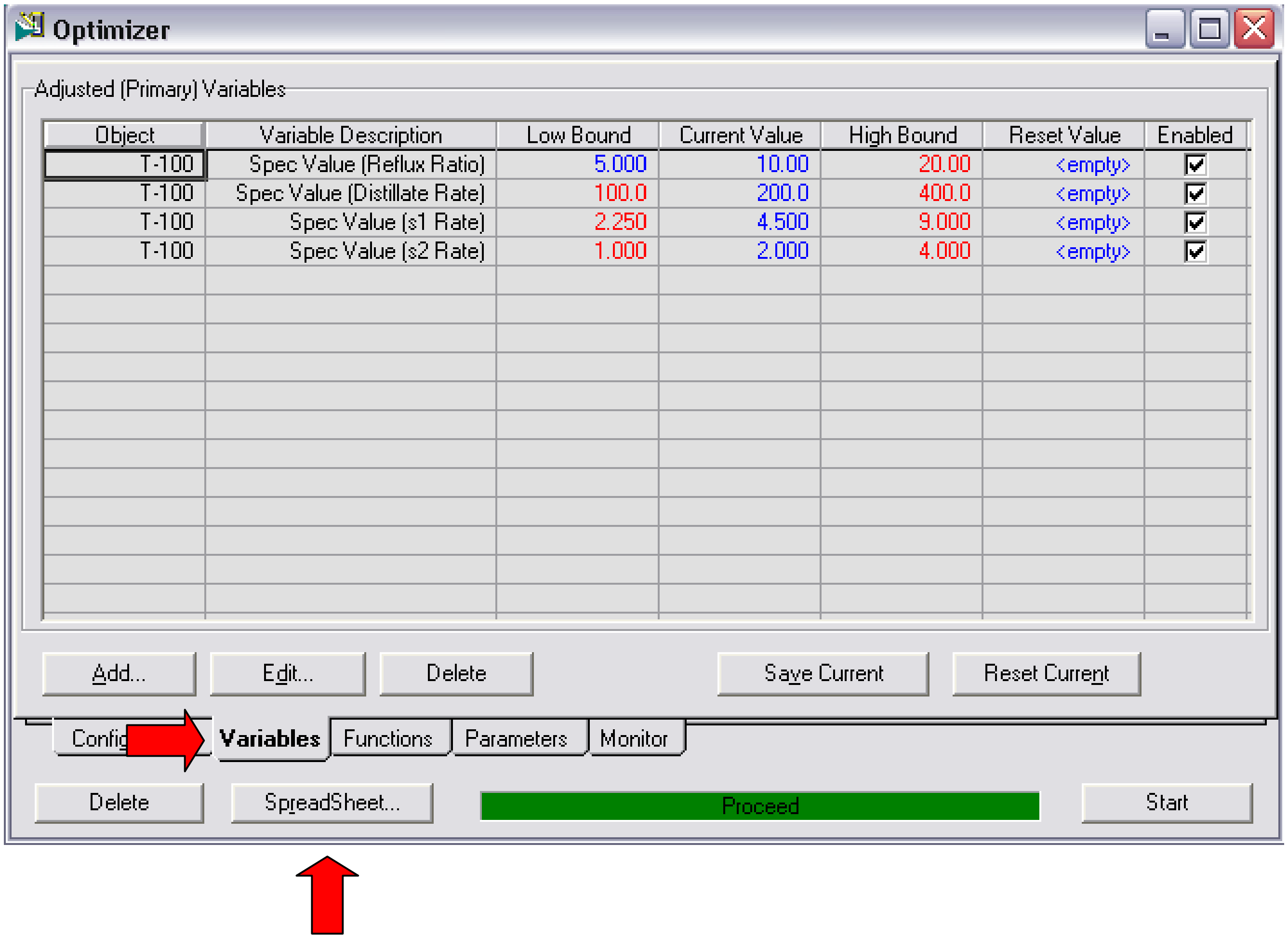


Terms	Definition
Primary Variables	These are the variables imported from the flowsheet whose values are manipulated in order to minimize (or maximize) the objective function. You set the upper and lower bounds for all of the primary variables, which are used to set the search range, as well as for normalization.
Objective Function	The function which is to be minimized or maximized. There is a great deal of flexibility in describing the Objective Function; primary variables can be imported and functions defined within the Optimizer Spreadsheet, which possesses the full capabilities of the main flowsheet spreadsheet.
Constraint Functions	Inequality and Equality Constraint functions can be defined in the Optimizer Spreadsheet. An example of a constraint is the product of two variables satisfying an inequality (e.g., -A*B<K). The BOX, Mixed, and Sequential Quadratic Programming (SQP) methods are available for constrained minimization with inequality constraints. Only the Original and Hyprotech SQP methods can handle equality constraints. The Fletcher-Reeves and Quasi-Newton methods are available for unconstrained optimization problems.

Configuration Tab
The Configuration tab allows you to select the Optimizer mode you want, by selecting appropriate radio button in the Data Model group. HYSYS has five modes of Optimizer:

- **Original**. The Default option from HYSYS 2.4..
- **Hyprotech SQP**. The new Optimizer available for HYSYS 3.0.
- **MDC Optim**. The Optimization option from HYSYS 2.4.
- **MDC DataRecon**. The DataRecon option from HYSYS 2.4.
- **Selection Optimization**. The Selection Optimization option available for HYSYS 3.1..

مرحله سوم: بهینه سازی



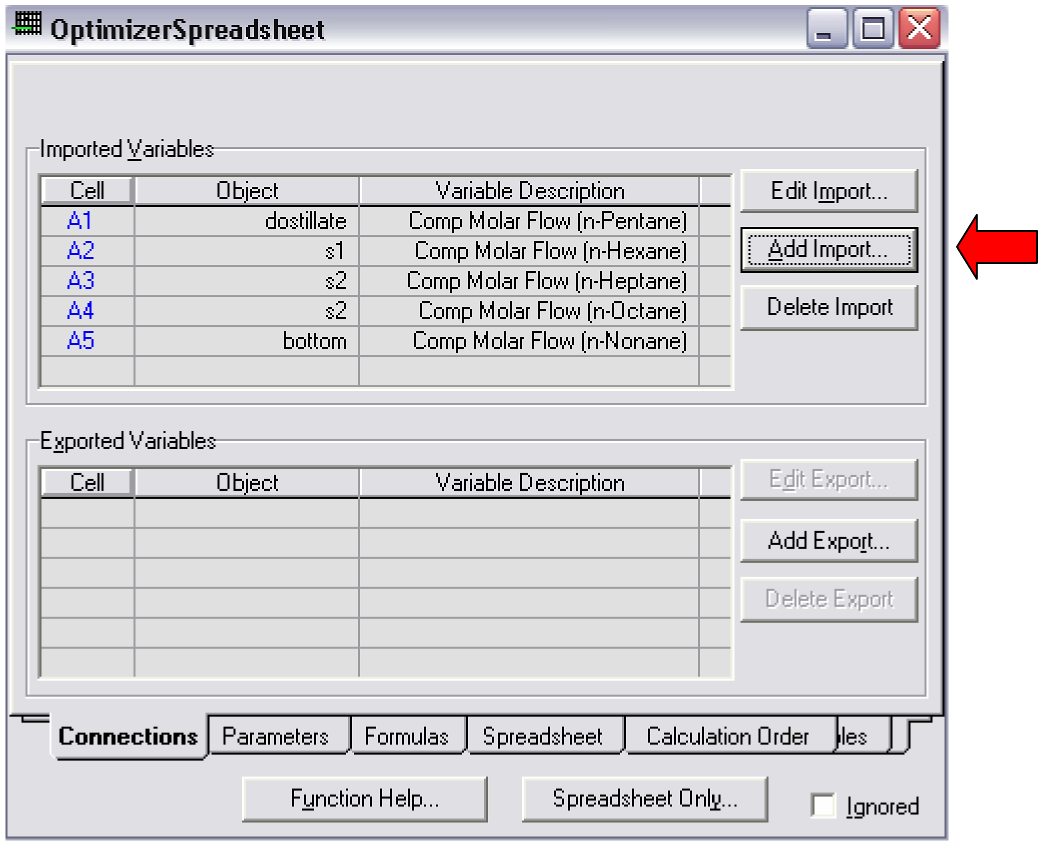
All variables must be given upper and lower bounds, which are used to normalize the Primary Variable:

$$x_{norm} = \frac{x - x_{low}}{x_{high} - x_{low}} \qquad (13.1)$$

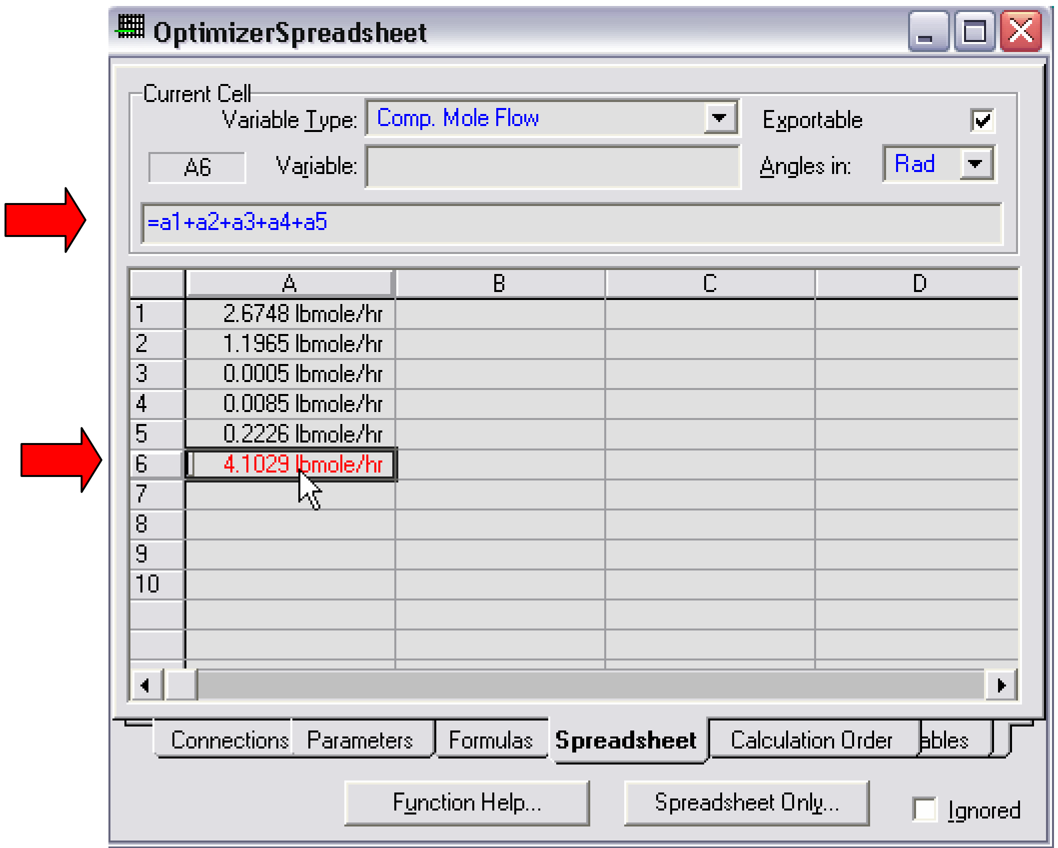
The upper and lower bound for each Primary Variable should be chosen such that a reasonable flowsheet solution is obtained within the entire range. For example, assume that the Primary Variable is the Molar Flow of a stream being fed to the tube side of a heat exchanger. If this Molar Flow is too low, a temperature cross may result in the heat exchanger, which stops the Optimizer calculations. In this case, the lower bound should be chosen such that the temperature cross does not occur.

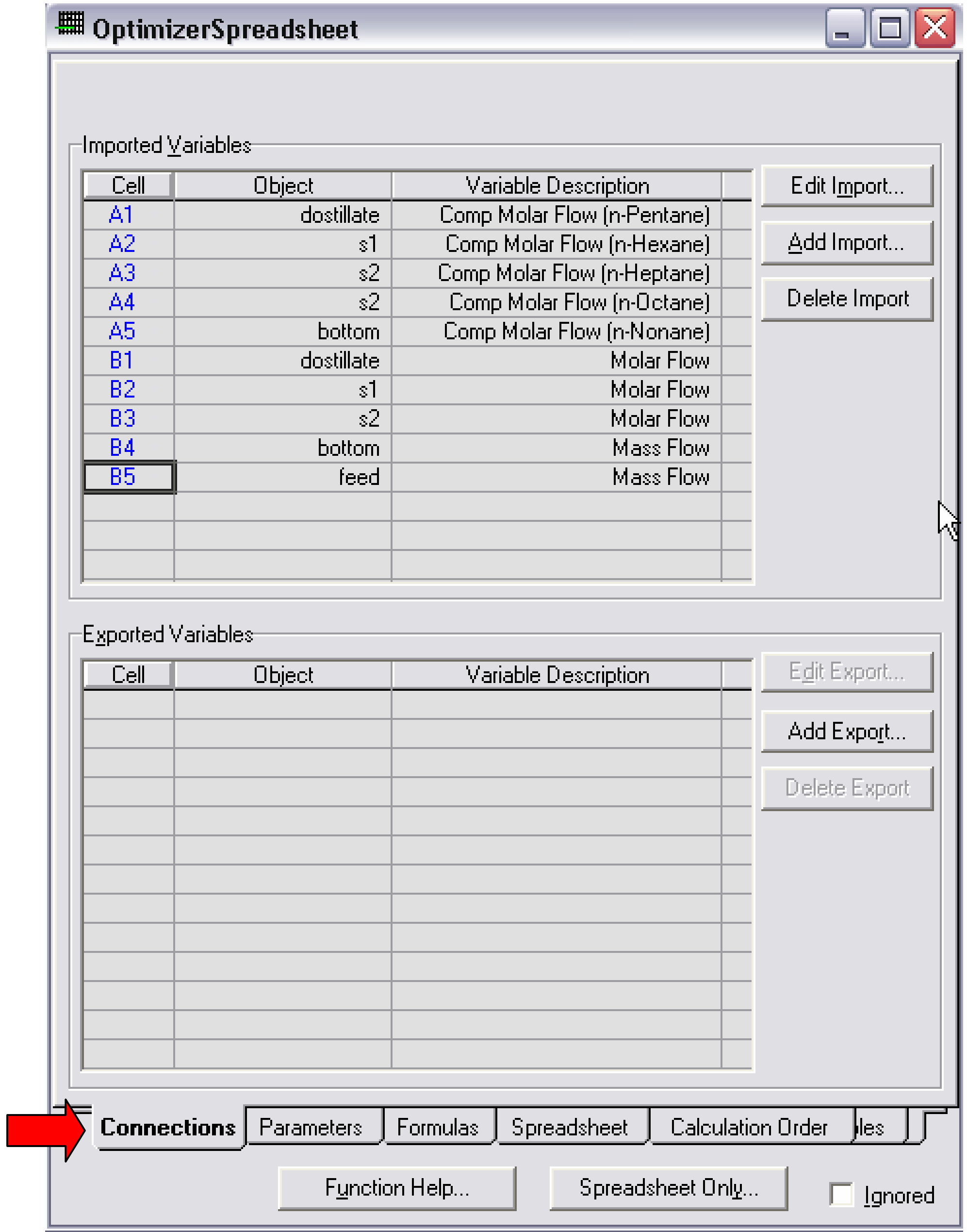
Buttons	Description
Delete	Erases all the current information from the Optimizer and its Spreadsheet.
Spreadsheet	Accesses the Optimizer's dedicated Spreadsheet.
Start/Stop	Starts or stops the Optimizer calculations. An objective function must be defined prior to the start of the calculations.

مرحله سوم: بهینه سازی

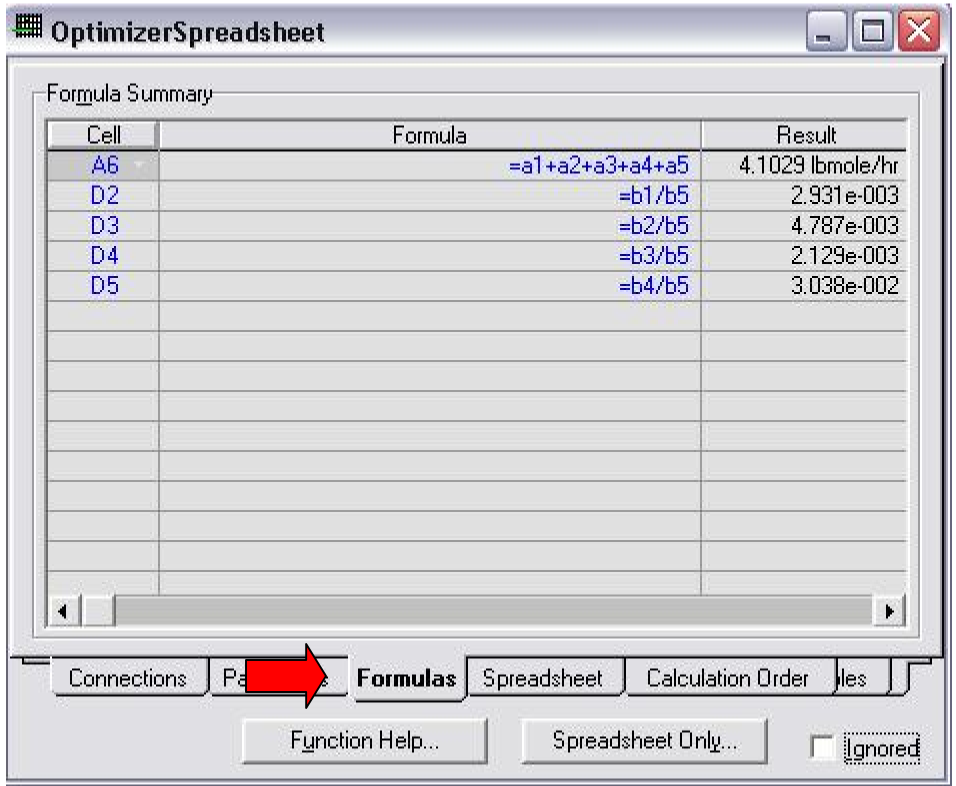


مرحله سوم: بهینه سازی

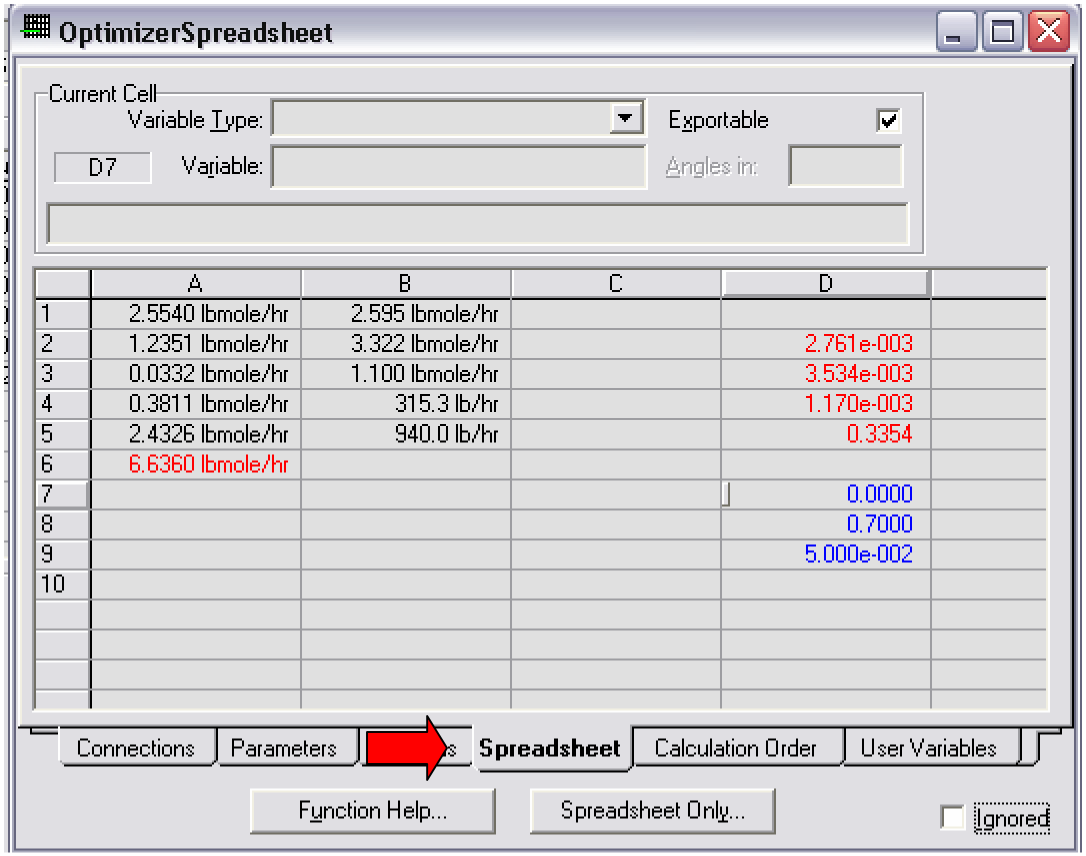



OptimizerSpreadsheet
Imported Variables
Cell | Object | Variable Description
A1 dostillate Comp Molar Flow (n-Pentane)
A2 s1 Comp Molar Flow (n-Hexane)
A3 s2 Comp Molar Flow (n-Heptane)
A4 s2 Comp Molar Flow (n-Octane)
A5 bottom Comp Molar Flow (n-Nonane)
B1 dostillate Molar Flow
B2 s1 Molar Flow
B3 s2 Molar Flow
B4 bottom Mass Flow
B5 feed Mass Flow
Edit Import...
Add Import...
Delete Import
Exported Variables
Cell | Object | Variable Description
Edit Export...
Add Export...
Delete Export
Connections
Parameters
Formulas
Spreadsheet
Calculation Order
Function Help...
Spreadsheet Only...
Ignored

مرحله سوم: بهینه سازی

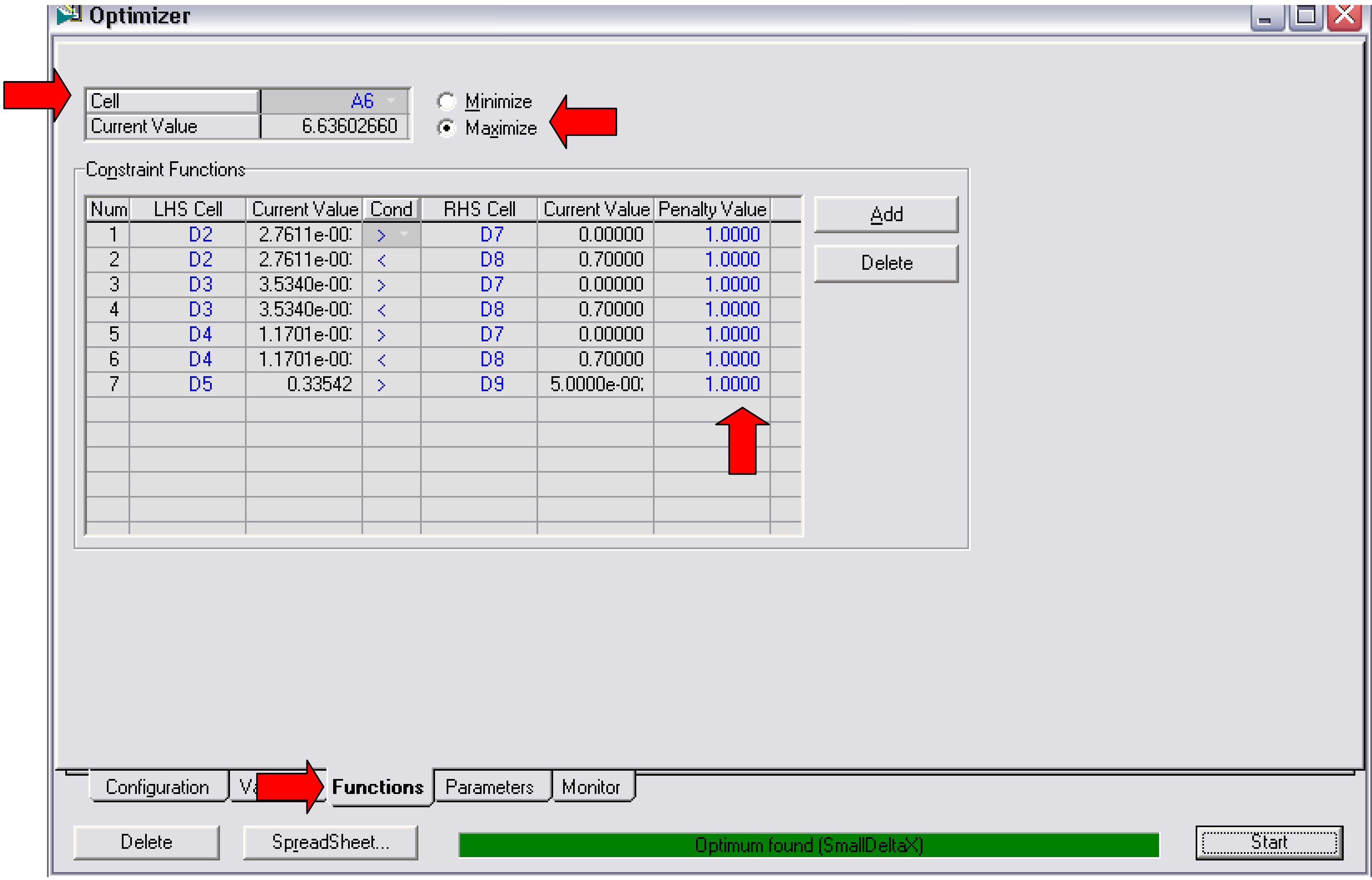


مرحله سوم: بهینه سازی



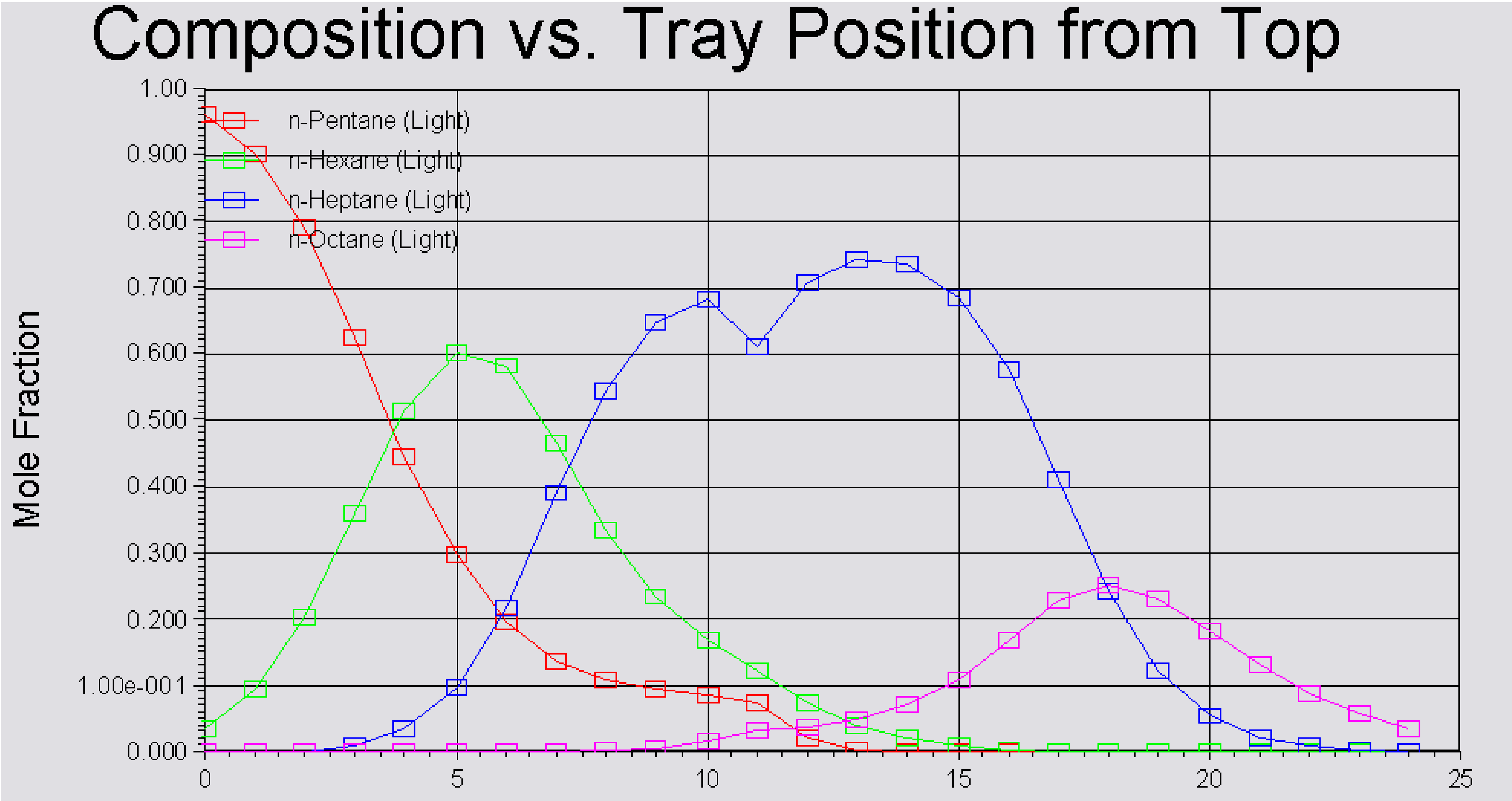
	A	B	C	D
1	2.5540 lbmole/hr	2.595 lbmole/hr		
2	1.2351 lbmole/hr	3.322 lbmole/hr		2.761e-003
3	0.0332 lbmole/hr	1.100 lbmole/hr		3.534e-003
4	0.3811 lbmole/hr	315.3 lb/hr		1.170e-003
5	2.4326 lbmole/hr	940.0 lb/hr		0.3354
6	6.6360 lbmole/hr			
7				0.0000
8				0.7000
9				5.000e-002
10				

مرحله سوم: بهینه سازی



The Functions tab is only available if you select the Original configuration.

مرحله اول:شبیه سازی برج

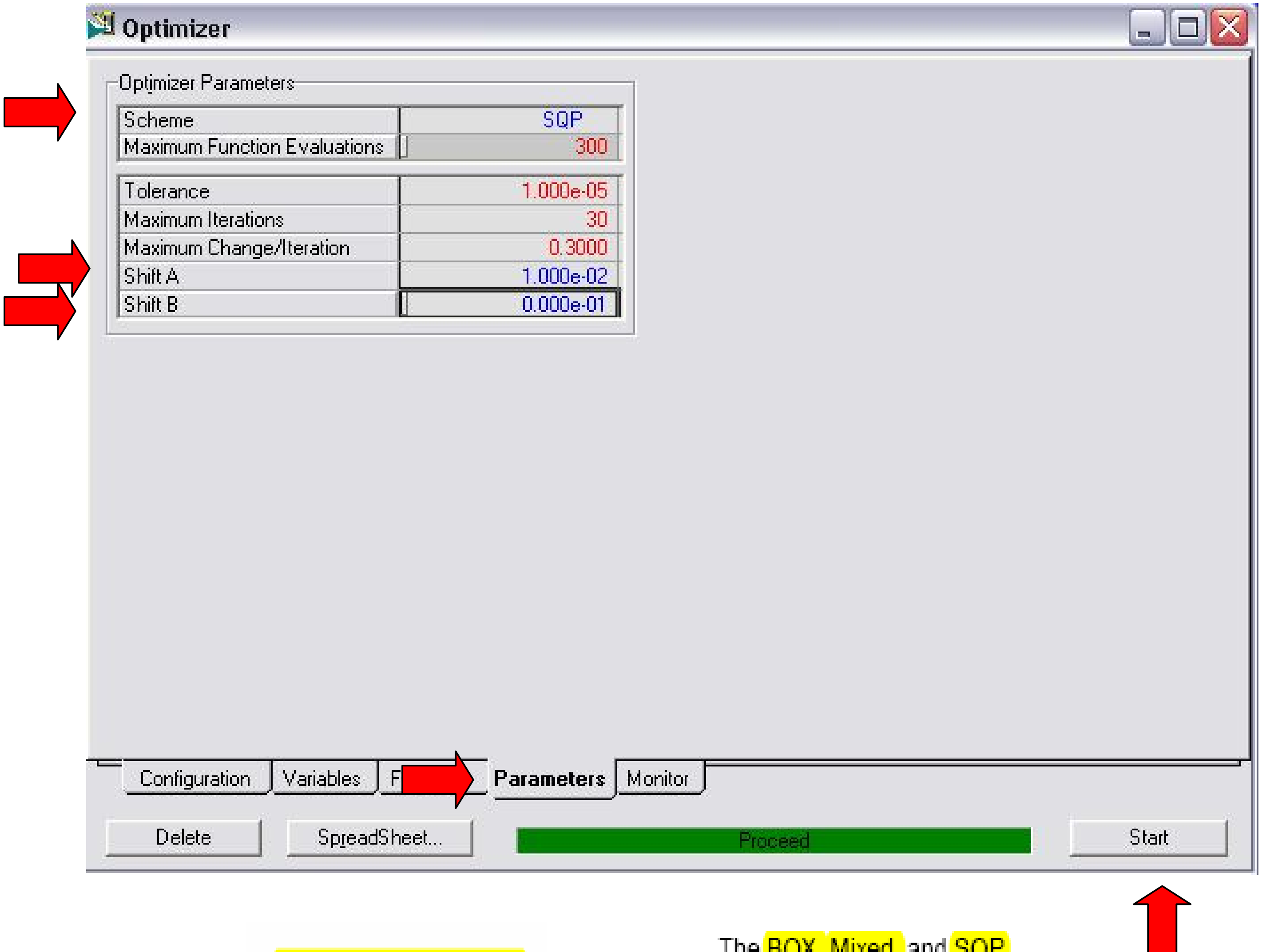


You can specify the Objective Function in the Cell field. The current value of the objective function is provided in the display field below the Cell field. Further, the objective function group is the location where you can specify (via radio buttons) to minimize or maximize the objective function.

The Constraint Functions group is where you can specify the left and right sides of the Constraint function (in the LHS Cell and RHS Cell columns). Specify the relationship between the left hand and right hand cell (LHS > RHS, LHS < RHS, LHS = RHS) in the Cond column. The Constraint Function is multiplied by the Penalty Value in the Optimization calculations. If you find that a constraint is not being met, increase the Penalty Value; the higher the Penalty Value, the more weight that is given to that constraint. The Penalty Value is equal to 1 by default.

The current values of the Objective Function and the left and right sides of the Constraint Function cells appear in their respective fields.

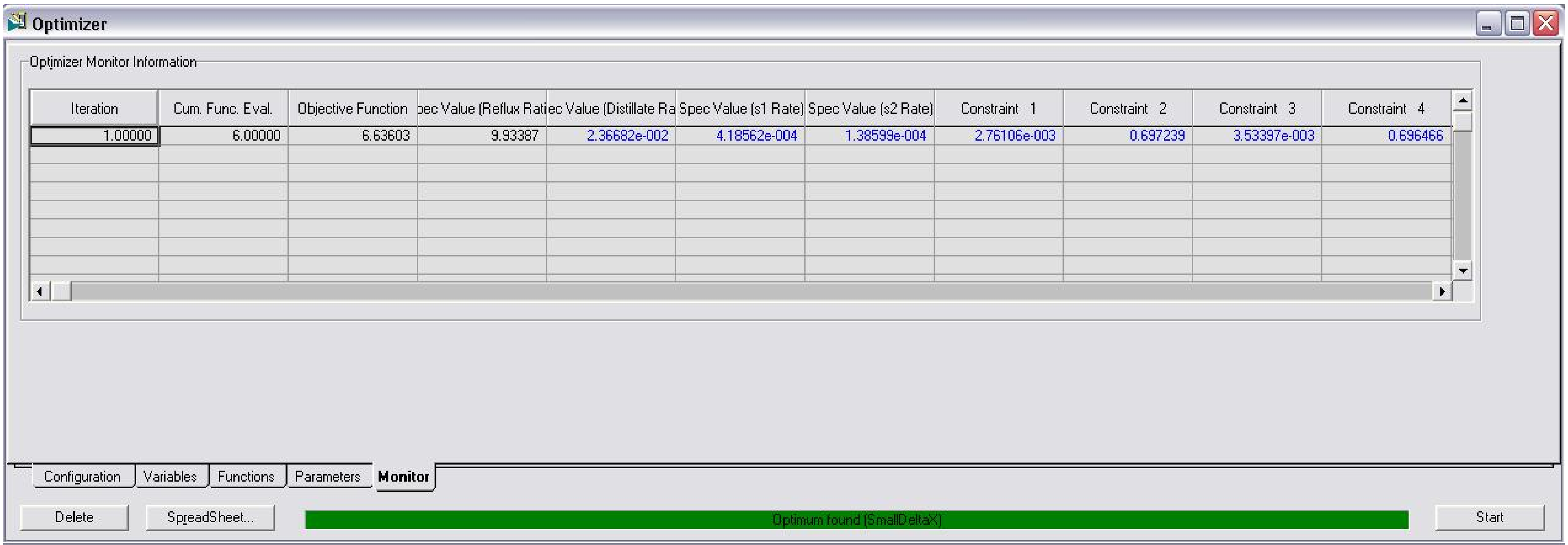
مرحله سوم: بهینه سازی



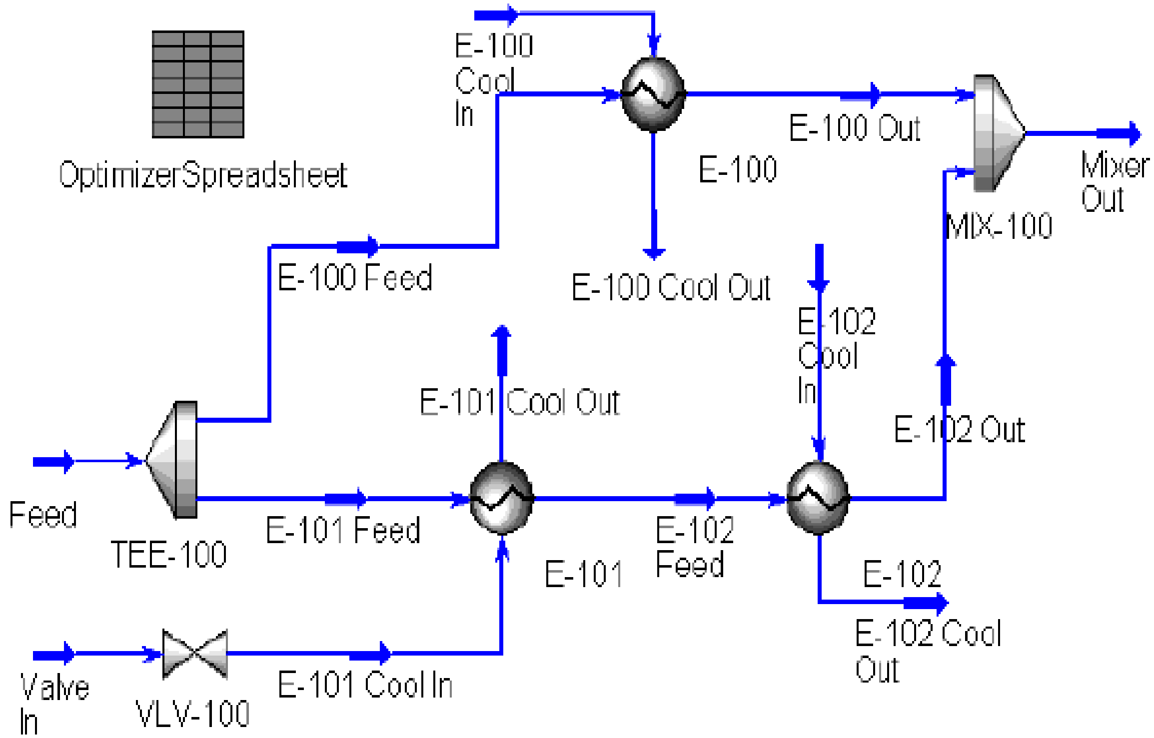
The Parameters tab is only available if you select the Original configuration.

The BOX, Mixed, and SQP Methods allow for Inequality Constraints. Only the SQP Method incorporates Equality Constraints.

Method	Unconstrained Problems	Constrained Problems: Inequality	Constrained Problems: Equality	Calculates Derivatives
BOX	X	X		
Mixed	X	X		X
SQP	X	X	X	X
Fletcher-Reeves	X			X
Quasi-Newton	X			X


Optimizer
Optimizer Monitor Information
Iteration
Cum. Func. Eval.
Objective Function
pec Value (Reflux Rati
ec Value (Distillate Ra
Spec Value (s1 Rate)
Spec Value (s2 Rate)
Constraint 1
Constraint 2
Constraint 3
Constraint 4
1.00000
6.00000
6.63603
9.93387
2.36682e-002
4.18562e-004
1.38599e-004
2.76106e-003
0.697239
3.53397e-003
0.696466
Configuration
Variables
Functions
Parameters
Monitor
Delete
SpreadSheet...
Optimum found (SmallDeltaX)
Start

Example: Original Optimizer



- PP:PR

Material Streams					
Tab [Page]	**In this cell...**	**Feed**	**E-100 Cool In**	**Valve In**	**E-102 Cool In**
Worksheet [Conditions]	Temperature (F)	20	-142	120	<empty>
	Pressure (psia)	1000	250	350	251
	Molar Flow (lbmole/hr)	2745	1542	<empty>	1640
Worksheet [Composition]	Methane Mole Frac	0.7515	0.9073	0.0000	0.2828
	Ethane Mole Frac	0.2004	0.0927	0.0000	0.2930
	Propane Mole Frac	0.0401	0.0000	1.0000	0.1414
	i-Butane Mole Frac	0.0040	0.0000	0.0000	0.1313
	n-Butane Mole Frac	0.0040	0.0000	0.0000	0.1515

Heat Exchanger [E-100]		
Tab [Page]	**In this cell...**	**Enter**
Design [Parameters]	Tubeside Delta P	10 psi
	Shellside Delta P	10 psi
	UA	4.00e+04 Btu/F-hr
	Heat Leak/Loss	None
	Heat Exchange Model	Weighted
	Intervals (E-100 Feed)	10
	Intervals (E-100 Cool In)	10
	Dew/Bubble Pt (E-100 Cool In)	Inactive

Heat Exchanger [E-101]		
Tab [Page]	**In this cell...**	**Enter**
Design [Parameters]	Tubeside Delta P	5 psi
	Shellside Delta P	1 psi
	UA	5.00e+04 Btu/F-hr
	Heat Leak/Loss	None
	Heat Exchange Model	Weighted
	Intervals (E-100 Feed)	10
	Intervals (E-100 Cool In)	10

Heat Exchanger [E-102]		
Tab [Page]	**In this cell...**	**Enter**
Design [Parameters]	Tubeside Delta P	5 psi
	Shellside Delta P	5 psi
	UA	3.50e+04 Btu/F-hr
	Heat Leak/Loss	None
	Heat Exchange Model	Weighted
	Intervals (E-100 Feed)	10
	Intervals (E-100 Cool In)	10
	Dew/Bubble Pt (E-102 Cool In)	Inactive

- Temperature of stream E-102 Out, -40°F
- Vapour Fraction stream E-101 Cool Out, 1.00
- Temperature of stream E-100 Out, -65°F
- Pressure of E-101 Cool Out, 20 psia

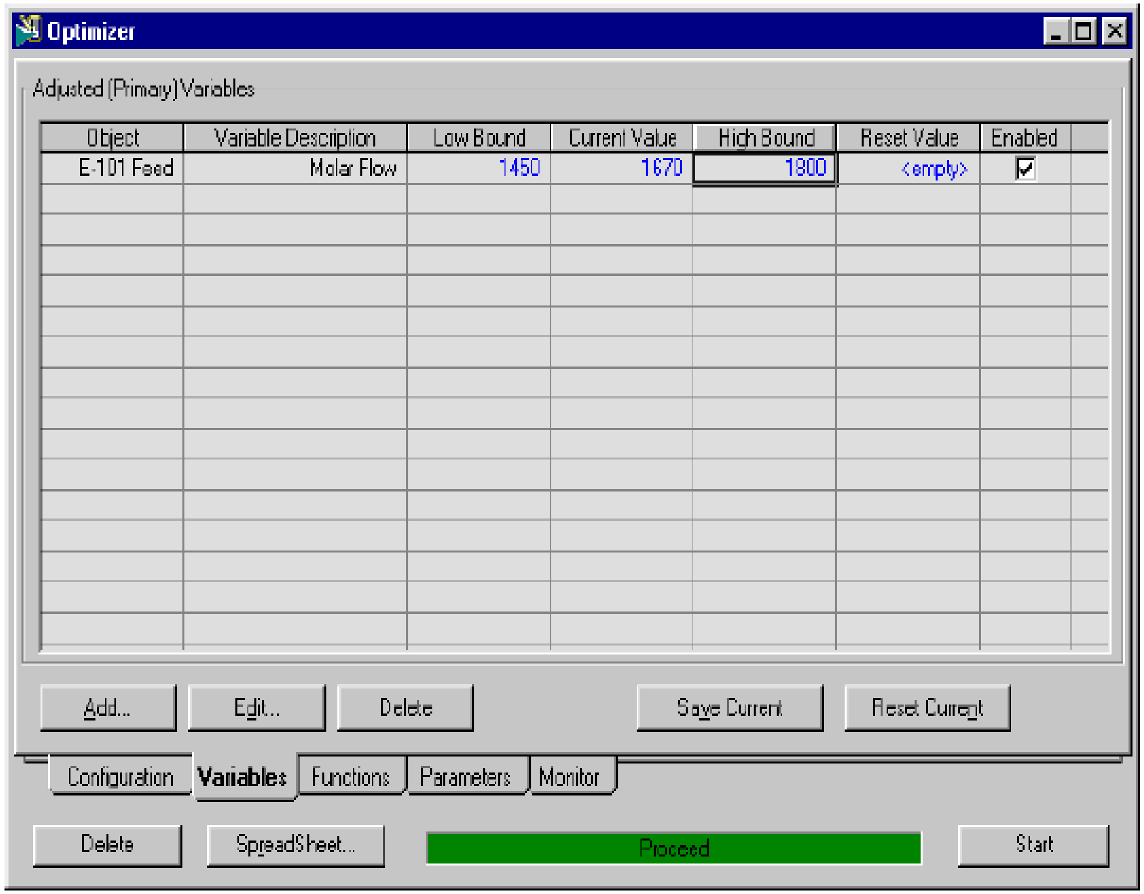
Name	Feed	E-100 Cool In	Valve In	E-102 Cool In	E-100 Feed
Vapour Fraction	1.0000	0.8249	0.0000	0.0363	1.0000
Temperature [F]	20.00	-142.0	120.0	-87.93	20.00
Pressure [psia]	1000	250.0	350.0	251.0	1000
Molar Flow [lbmole/hr]	2745	1542	375.4	1640	1077
Mass Flow [lb/hr]	5.577e+004	2.674e+004	1.655e+004	5.907e+004	2.187e+004
Liquid Volume Flow [barrel/day]	1.156e+004	5961	2237	9086	4535
Heat Flow [Btu/hr]	-9.752e+007	-5.471e+007	-1.887e+007	-8.315e+007	-3.825e+007
Name	E-101 Feed	E-100 Out	E-102 Out	Mixer Out	E-101 Cool In
Vapour Fraction	1.0000	0.0000	0.3714	0.0342	0.5234
Temperature [F]	20.00	-65.00	-40.00	-47.19	-28.68
Pressure [psia]	1000	990.0	990.0	990.0	21.00
Molar Flow [lbmole/hr]	1668	1077	1668	2745	375.4
Mass Flow [lb/hr]	3.389e+004	2.187e+004	3.389e+004	5.577e+004	1.655e+004
Liquid Volume Flow [barrel/day]	7027	4535	7027	1.156e+004	2237
Heat Flow [Btu/hr]	-5.927e+007	-4.105e+007	-6.224e+007	-1.033e+008	-1.887e+007
Name	E-100 Cool Out	E-102 Feed	E-101 Cool Out	E-102 Cool Out	** New **
Vapour Fraction	1.0000	0.8456	1.0000	0.1583	
Temperature [F]	-21.68	-13.30	-30.84	-56.17	
Pressure [psia]	240.0	995.0	20.00	246.0	
Molar Flow [lbmole/hr]	1542	1668	375.4	1640	
Mass Flow [lb/hr]	2.674e+004	3.389e+004	1.655e+004	5.907e+004	
Liquid Volume Flow [barrel/day]	5961	7027	2237	9086	
Heat Flow [Btu/hr]	-5.191e+007	-6.067e+007	-1.747e+007	-8.158e+007	

Optimizing Overall UA

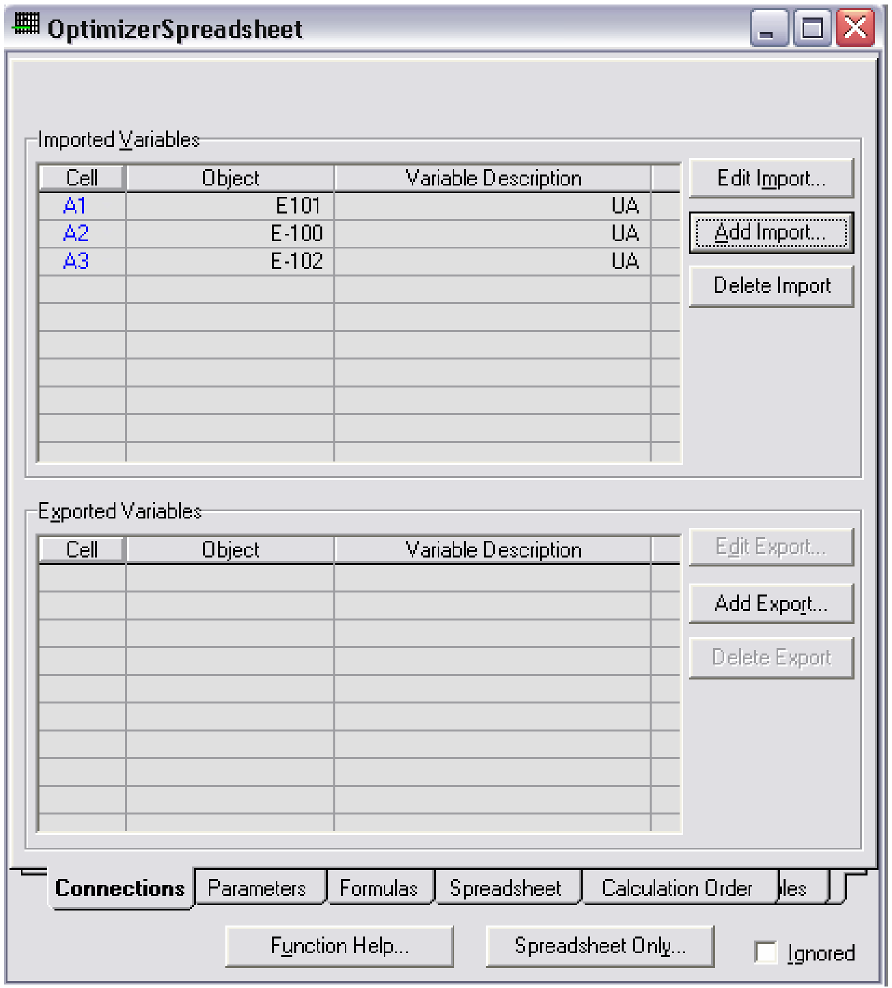
The Optimizer determines the optimum Tee flow ratio such that the Overall UA is minimized. Therefore, delete the individual heat exchanger UA specs and replace them with the following:

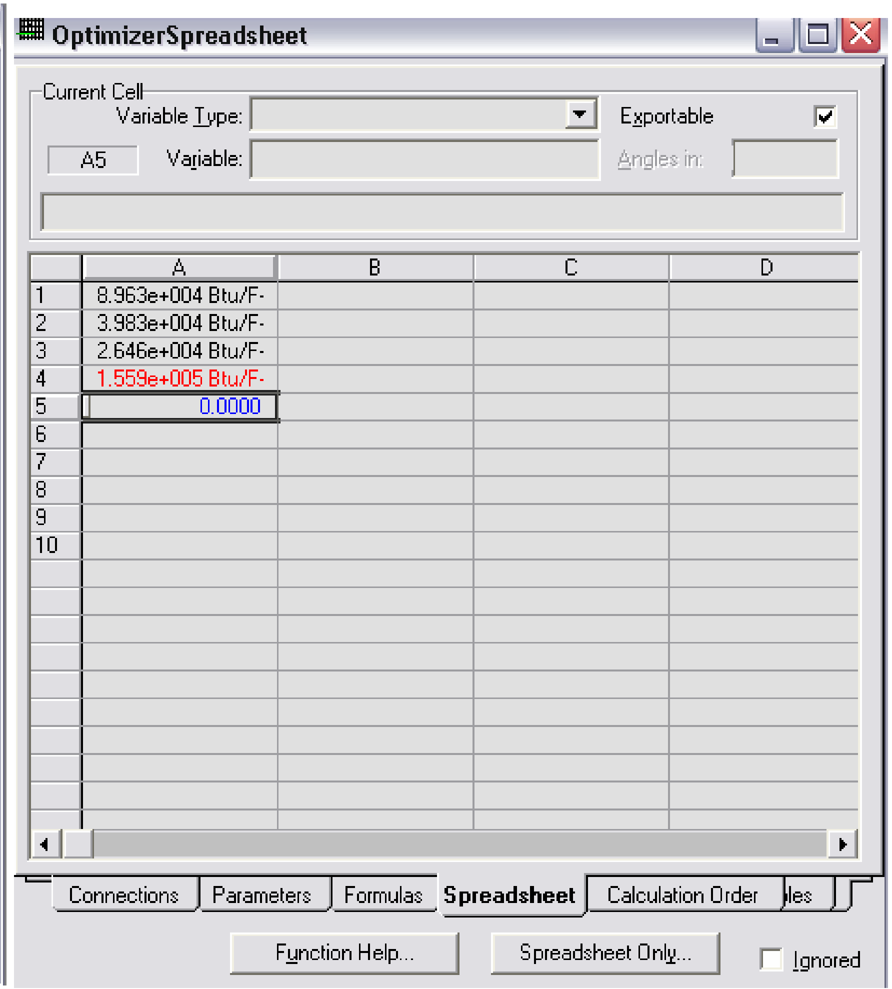
- Temperature of E-102 Cool In – -85°F
- Flowrate of Valve In – 495 lbmole/hr
- Flowrate of E-101 Feed – Optimized variable (Initially set to the previous flow rate of 1,670 lbmole/hr)

After replacing the specs, the flowsheet solves and UAs are calculated.



The search is now within a range of 1450 lbmole/hr - 1800 lbmole/hr to avoid a temperature cross.

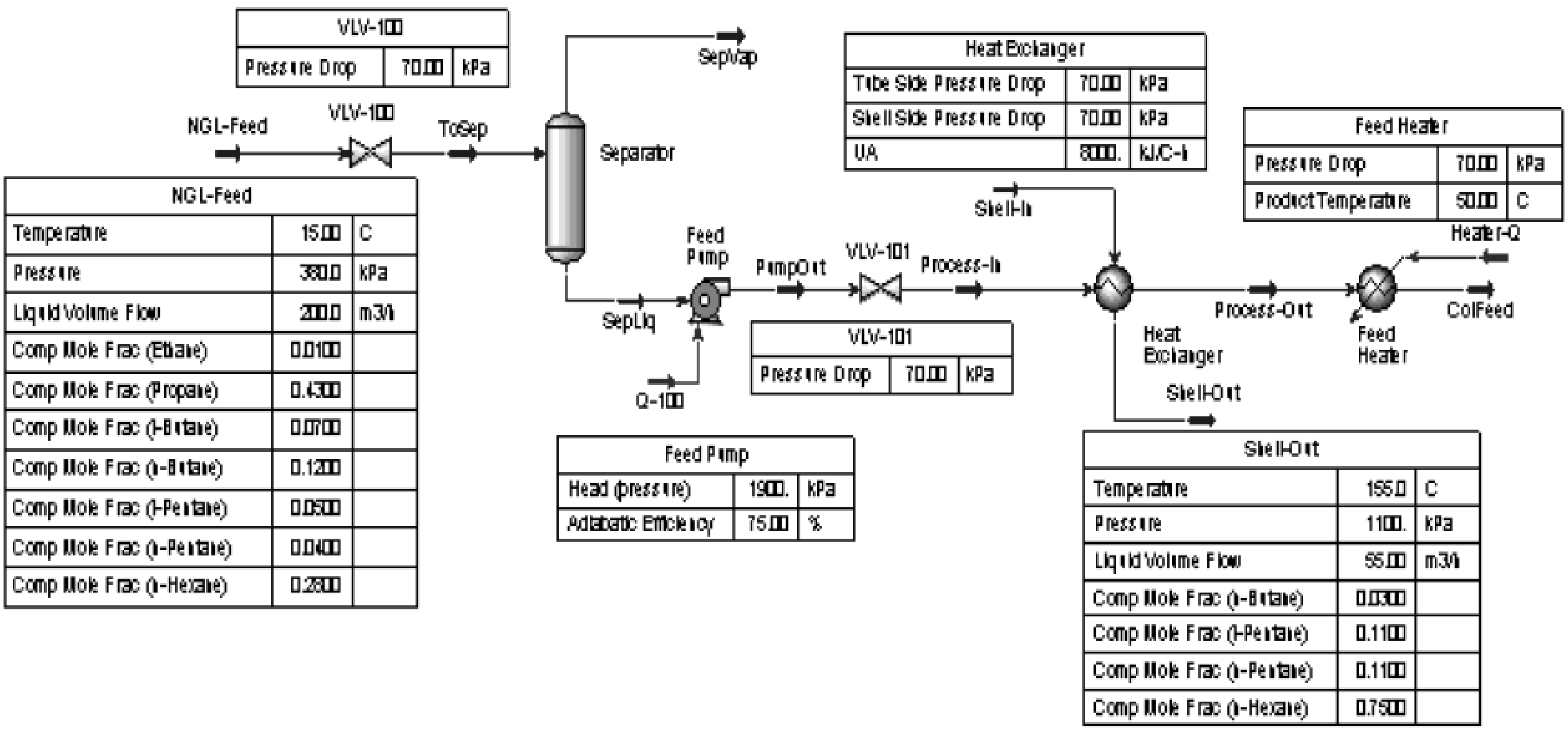




Click the **Spreadsheet** tab. In cell A4, enter the formula, +a1+a2+a3. This sums the UAs. In cell A5, enter 0.0. This is used in the constraints.

Dynamic

Getting Started in Steady State



VLV-100		
Pressure Drop	70.00	kPa

NGL-Feed		
Temperature	15.00	C
Pressure	380.0	kPa
Liquid Volume Flow	200.0	m3/h
Comp Mole Frac (Ethane)	0.0100	
Comp Mole Frac (Propane)	0.4300	
Comp Mole Frac (i-Butane)	0.0700	
Comp Mole Frac (n-Butane)	0.1200	
Comp Mole Frac (i-Pentane)	0.0500	
Comp Mole Frac (n-Pentane)	0.0400	
Comp Mole Frac (n-Hexane)	0.2800	

Heat Exchanger		
Tube Side Pressure Drop	70.00	kPa
Shell Side Pressure Drop	70.00	kPa
UA	8000.	kJ/C-h

Feed Heater		
Pressure Drop	70.00	kPa
Product Temperature	50.00	C

VLV-101		
Pressure Drop	70.00	kPa

Feed Pump		
Head (pressure)	1900.	kPa
Adiabatic Efficiency	75.00	%

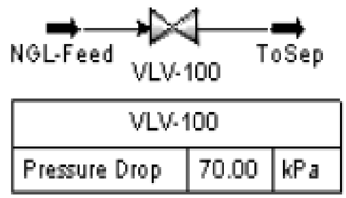
Shell-Out		
Temperature	155.0	C
Pressure	1100.	kPa
Liquid Volume Flow	55.00	m3/h
Comp Mole Frac (n-Butane)	0.0300	
Comp Mole Frac (i-Pentane)	0.1100	
Comp Mole Frac (n-Pentane)	0.1100	
Comp Mole Frac (n-Hexane)	0.7500	

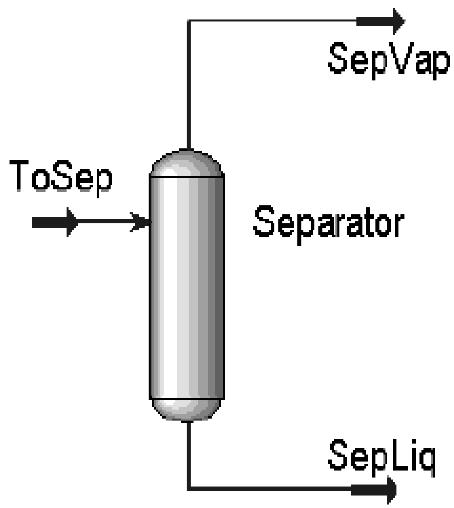
- FP:PR

Ethane
Propane
i-Butane
n-Butane
i-Pentane
n-Pentane
n-Hexane

In this cell...	Enter...
Worksheet / Conditions	
Name	NGL Feed
Temperature	15°C (60 °F)
Pressure	380 kPa (55 psia)
Liquid Volume Flow	200 m^3/hr (30,000 bbl/d)
For this Component...	**Enter this Mole Fraction...**
Ethane	0.01
Propane	0.43
i-Butane	0.07
n-Butane	0.12
i-Pentane	0.05
n-Pentane	0.04
n-Hexane	0.28

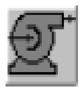
In this cell...	Enter...
Name	Shell-Out
Temperature	155°C (310 °F)
Pressure	1100 kPa (160 psia)
Liquid Volume Flow	55 m^3/h (8300 bbl/d)
For this Component...	**Enter this Mole Fraction...**
Ethane	0
Propane	0
i-Butane	0
n-Butane	0.03
i-Pentane	0.11
n-Pentane	0.11
n-Hexane	0.75



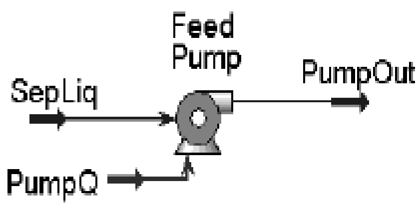


In this cell...	Enter...
Connections	
Name	Separator
Feed	ToSep
Vapour Outlet	SepVap
Liquid Outlet	SepLiq

Note that the Separator unit operation is completely defined in Steady State without having to specify a pressure drop and a volume, but these are important parameters for dynamic simulation analysis.



Pump button



Feed Pump		
Head (pressure)	1900.	kPa
Adiabatic Efficiency	75.00	%

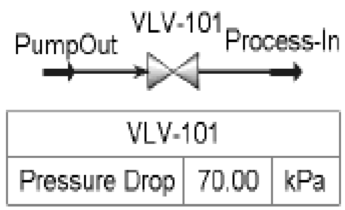
Add a Pump

Add a pump and enter the following information:

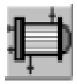
In this cell...	Enter...
Connections	
Name	Feed Pump
Inlet	SepLiq
Outlet	PumpOut
Energy	PumpQ
Parameters	
Pressure Increase	1900 kPa (275 psi)
Adiabatic Efficiency	75%

Add a Valve

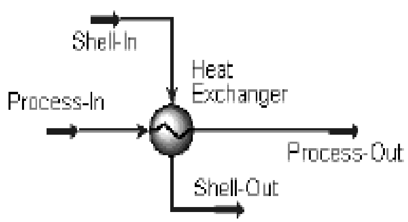
Add another valve and enter the following information:



In this cell...	Enter...
Connections	
Name	VLV-101 (default)
Feed	PumpOut
Product	Process-In
Parameters	
Pressure drop	70 kPa (10 psi)



Heat Exchanger button



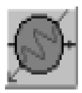
Heat Exchanger		
Tube Side Pressure Drop	70.00	kPa
Shell Side Pressure Drop	70.00	kPa
UA	8000.	kJ/C-h

Add a Heat Exchanger

Add a heat exchanger and enter the following information:

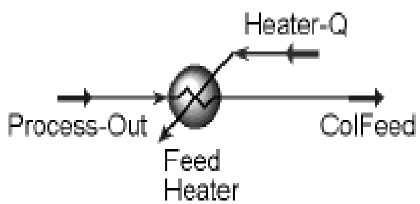
In this cell...	Enter...
Connections	
Name	Heat Exchanger
Tube Side Inlet	Process-In
Shell Side Inlet	Shell-In
Tube Side Outlet	Process-Out
Shell Side Outlet	Shell-Out
Parameters	
Heat Exchanger Model	EndPoint
Tube Side Delta P	70 kPa (10 psi)
Shell Side Delta P	70 kPa (10 psi)
UA	8000 kJ/C-h (4200 BTU/F-hr)
Heat Leak/Loss	None

Add a Heater



Heater button

Add a heater and enter the following information:



Feed Heater		
Pressure Drop	70.00	kPa
Product Temperature	50.00	C

In this cell...	Enter...
Connections	
Name	Heater
Inlet	Process-Out
Outlet	ColFeed
Energy	Heater-Q
Parameters	
DeltaP	70 kPa (10 psi)
Worksheet	
ColFeed Temperature	50 °C (120 °F)

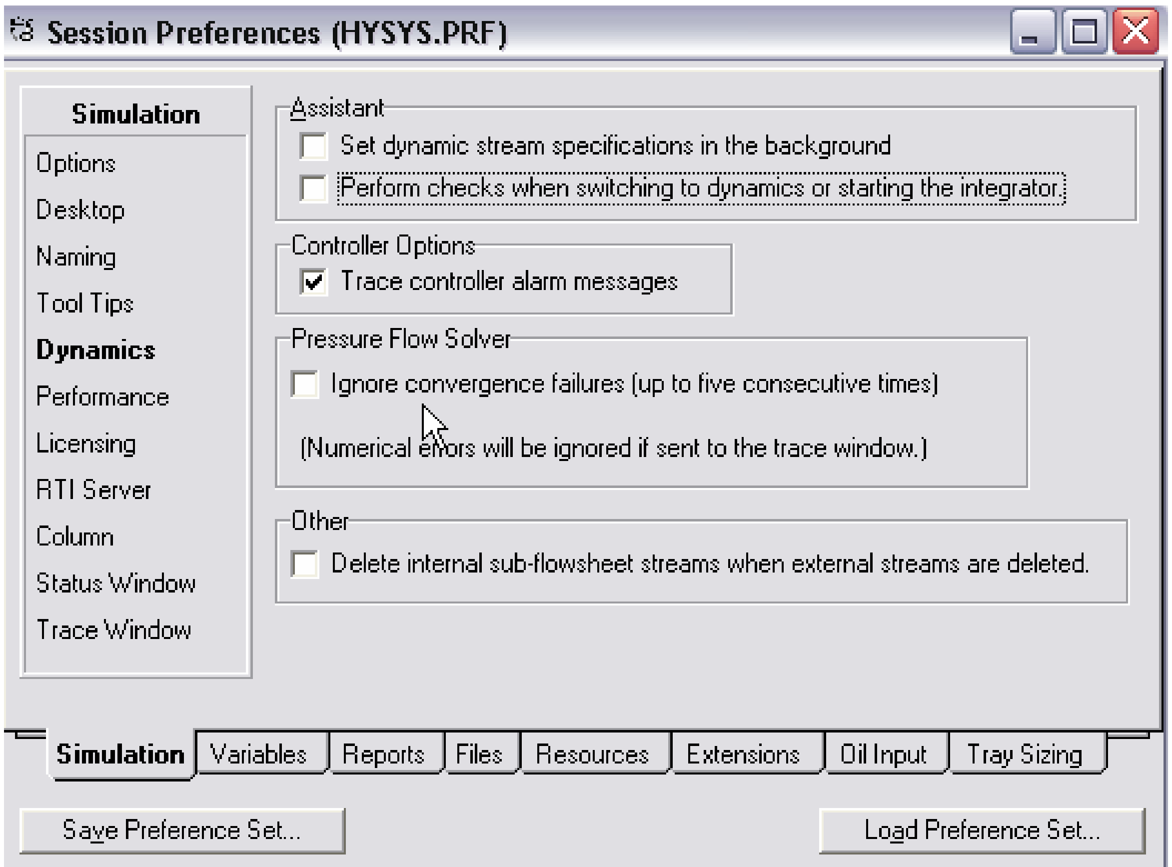
The HYSYS Dynamics Assistant

HYSYS contains a Dynamics Assistant that helps new users develop successful dynamic simulations. The Assistant performs many tasks that the new user may not be aware of, or familiar with.

The Assistant is capable of suggesting specifications that will produce a workable simulation; if, however, your simulation will deviate from the "standard," the Assistant may suggest specifications that are not desired in your simulation.

For the purposes of this course, the Assistant will be deactivated to allow you to become familiar with tasks that the Assistant would do automatically. It is important that you become familiar with these tasks, because while the Dynamics Assistant is a powerful tool for creating simple dynamic simulations, it is not as useful when creating non-standard dynamic simulations.

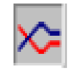
To turn off the Assistant, access the **Preferences** view from the Tools drop down menu and select the **Assistant** page. Remove both check marks on this page. This will deactivate both parts of the Dynamics Assistant. The page should look like this after these steps are completed.


Session Preferences (HYSYS.PRF)
Simulation
Options
Desktop
Naming
Tool Tips
Dynamics
Performance
Licensing
RTI Server
Column
Status Window
Trace Window
Assistant
Set dynamic stream specifications in the background
Perform checks when switching to dynamics or starting the integrator.
Controller Options
Trace controller alarm messages
Pressure Flow Solver
Ignore convergence failures (up to five consecutive times)
(Numerical errors will be ignored if sent to the trace window.)
Other
Delete internal sub-flowsheet streams when external streams are deleted.
Simulation
Variables
Reports
Files
Resources
Extensions
Oil Input
Tray Sizing
Save Preference Set...
Load Preference Set...

Transitioning from Steady State to Dynamics

- Size equipment
- Define pressure flow specifications
- Add strip charts and controllers
- Run a simple dynamic simulation and observe the role of the various controllers

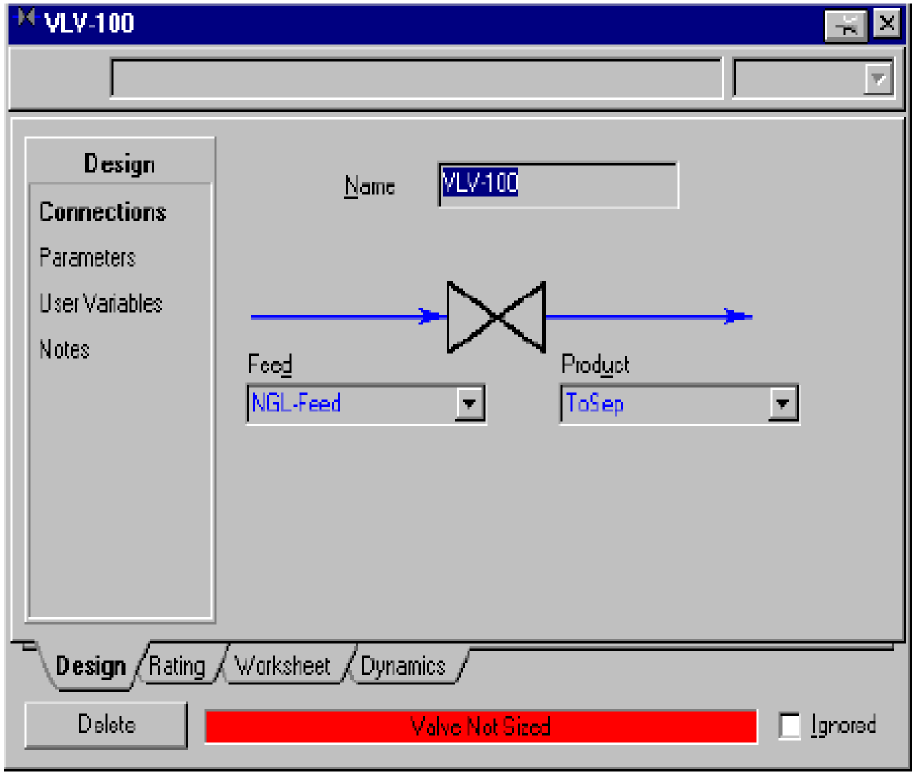
Transitioning from Steady State to Dynamics



Dynamic mode button

If you switch to Dynamics from Steady State, (click the **Dynamics** button and then Yes), you will notice that some pieces of equipment appear red in colour.

Upon opening the **Property** view of the Valves and Separator, HYSYS.Plant will indicate that each unit is missing some information necessary for dynamic simulation analyses. This is because the equipment is not sized. Equipment sizing is a very important step in dynamic modelling.



If you pressed the Dynamic Mode button, press the Steady State mode button to return to Steady State and size the equipment.

Flow in the plant occurs as a result of the pressure-flow relations between nodes.

Before a transition from Steady State to Dynamics occurs, the simulation Flowsheet should be set up so that a pressure drop exists across the plant.

This pressure drop is necessary because the flow in HYSYS.Plant is determined by the pressure drop throughout the plant. No pressure drop means no flow.

The following areas should be examined when setting up a simulation in Steady State and transitioning to Dynamics:

1. Adding Unit Operations
2. Equipment Sizing
3. Adjusting Column Pressure
4. Logical Operations
5. Adding Control Operations
6. Entering the HYSYS Dynamic Environment
7. Adding Pressure-Flow Specifications
8. Troubleshooting

Adding Unit Operations

Identify material streams which are connected to two unit operations with no pressure flow relation and whose flow must be specified in Dynamic mode. Unit operations without a pressure flow relation include the Separator, and tray sections in Columns. You will need to add unit operations such as Valves, Heat Exchangers, or Pumps, which define a pressure flow relation to these streams.

> *Which stream in this case has no pressure flow relation and will need an additional unit operation?* __________

Equipment Sizing

All unit operations in the simulation need to be sized using actual plant equipment or predefined sizing techniques. Vessels should be sized to accommodate actual plant flowrates and pressures while maintaining acceptable residence times.

Sizing the Valves

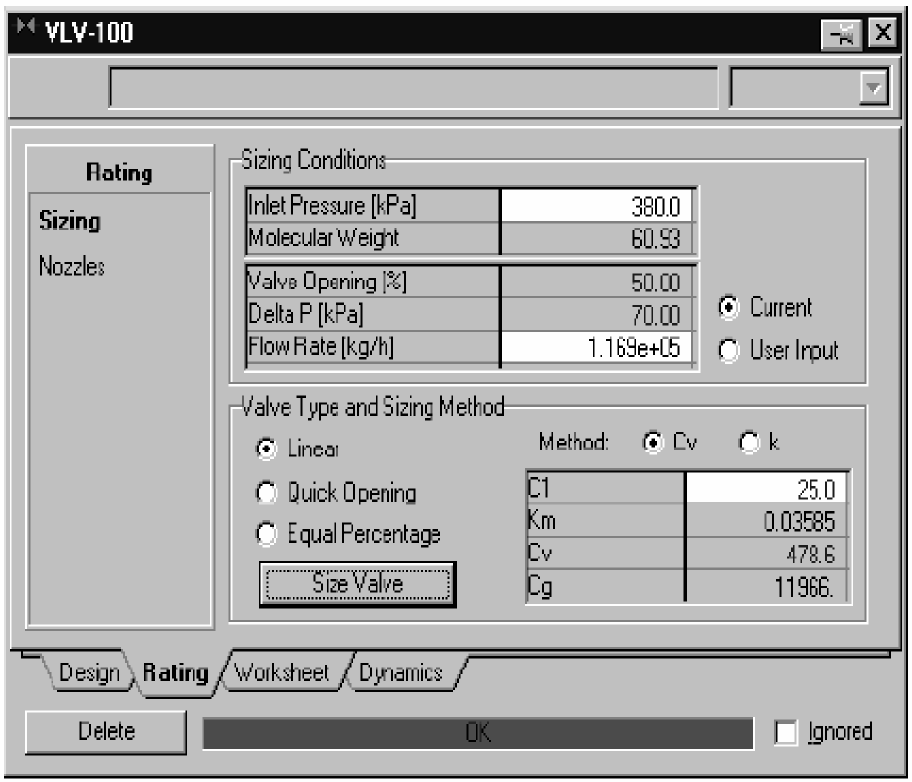
For dynamic operation, it is necessary to size every valve in the simulation. HYSYS.Plant automates valve sizing based on the:

- Valve type (linear, quick opening or equal percentage)
- The normal valve opening position
- The pressure drop across the valve
- The current Flowrate

HYSYS.Plant calculates the C_v that will allow the valve to pass 100% of the upstream Flowrate through the valve at the design valve opening position.

Double click on the control valve VLV-100.

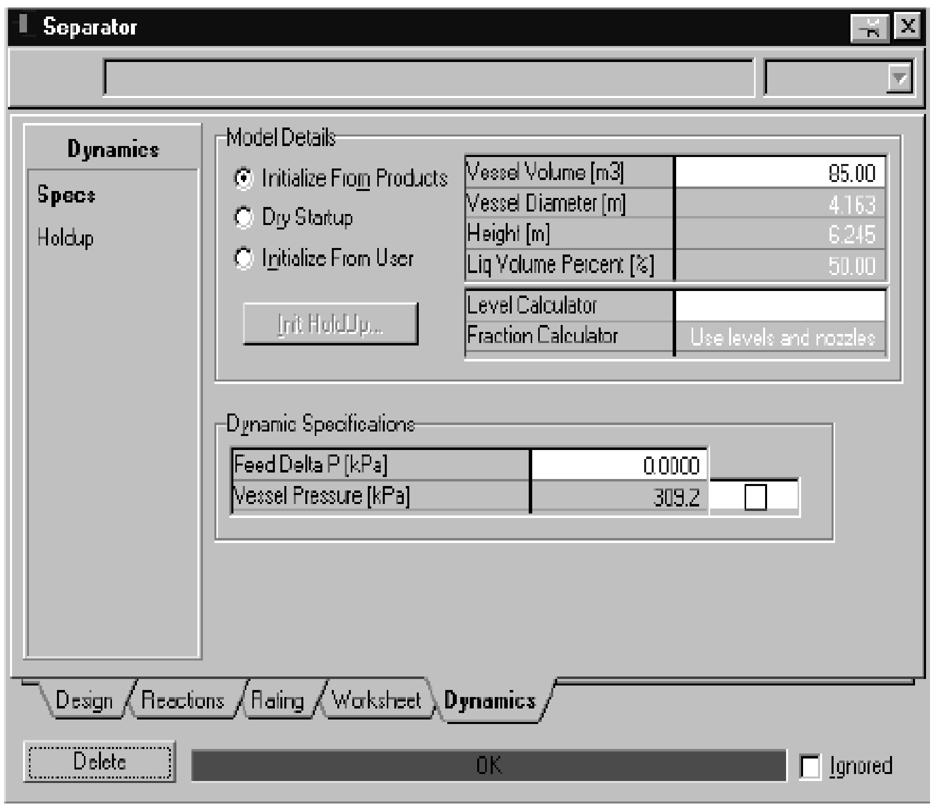
On the Rating tab of the Valve property view, select Linear as the Valve Type. Set the Valve Opening (%) in the Sizing conditions group to 50%. Press the *Size Valve* button to complete the sizing. If you are using SI units the screen should look like the one below. If you are using field units, the numbers may be different, but the C_v value should be about the same as the one shown below.



Sizing the Separator

Appropriate vessel sizing is important for dynamic simulation analyses. The vessel hold-up will affect the system's transient response during dynamic analyses as the user moves from one operating regime to the next. In addition, the vessel size affects the pressure calculations that are associated with this unit operation.

4. On the **Dynamics** tab of the Separator enter a Vessel Volume of 85 m^3 (3000 ft^3).

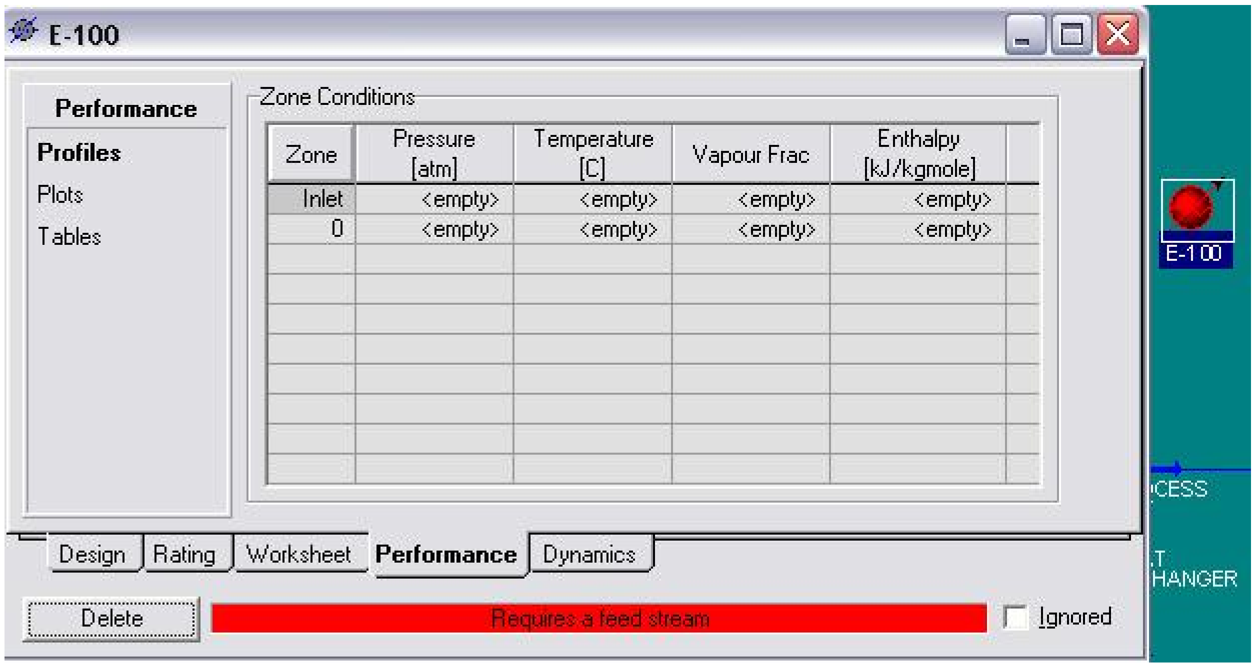


If you do not know the dimensions of your process equipment, calculate the vessel size based on an appropriate residence time:

- 10 minutes is typically a suitable residence for liquid phase hold-ups

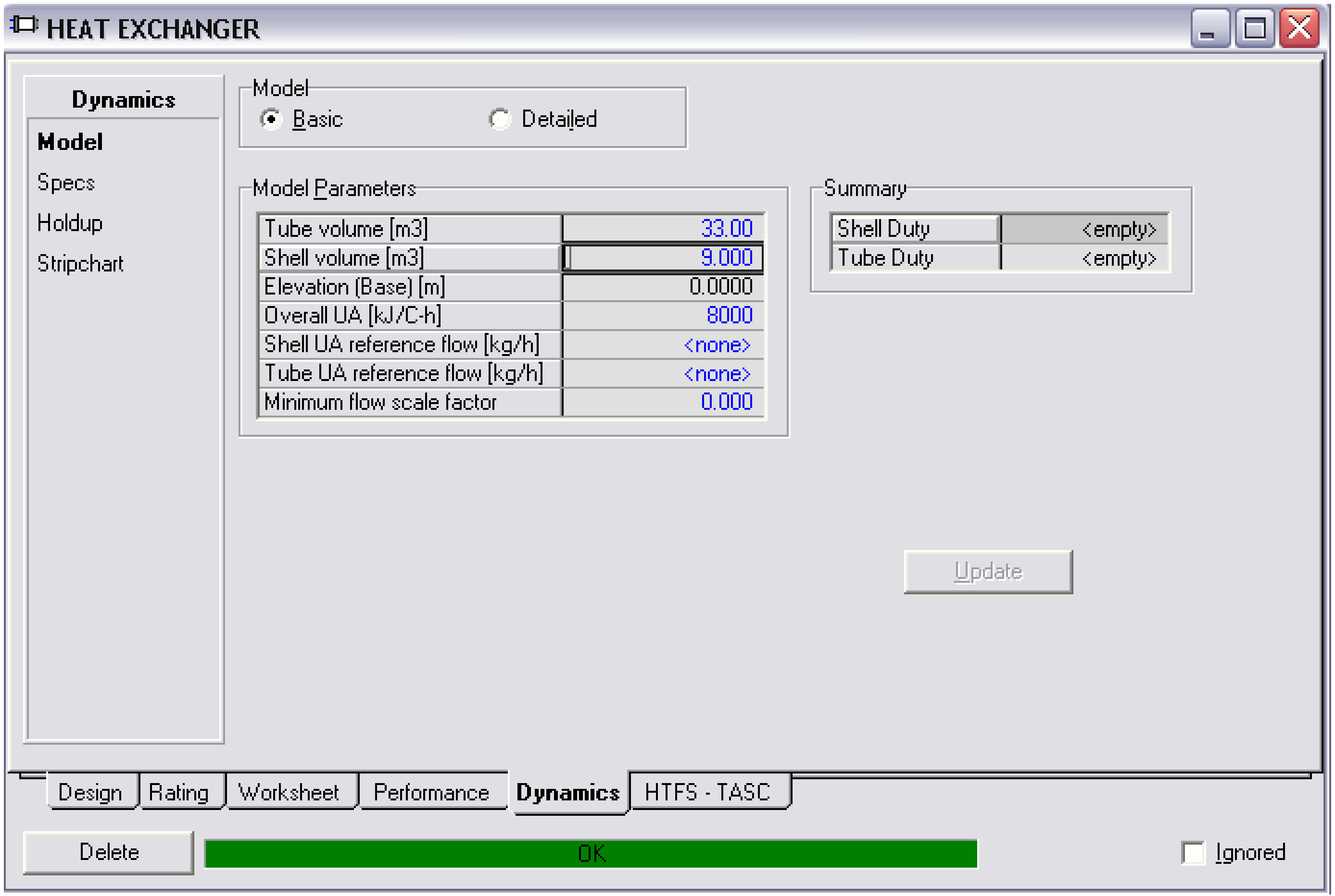
- 2 minutes is typically a suitable residence time for vapour phase hold-ups

Unlike the Separator, a number of unit operations have equipment volumes that are defaulted - for example heat exchangers, coolers and heaters. When adding these unit operations to your Flowsheet, care should be taken to ensure that reasonable equipment volumes are specified.


E-100
Performance
Profiles
Plots
Tables
Zone Conditions
Zone
Pressure [atm]
Temperature [C]
Vapour Frac
Enthalpy [kJ/kgmole]
Inlet
0
<empty>
Design
Rating
Worksheet
Performance
Dynamics
Delete
Requires a feed stream
Ignored
E-100
HANGER

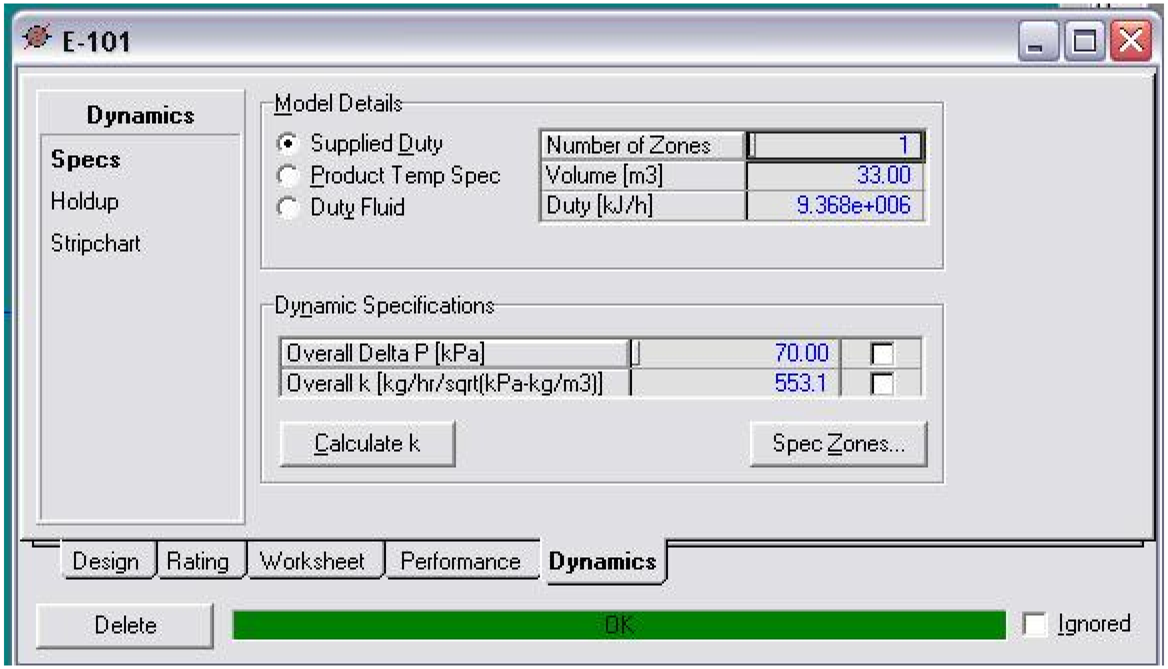
Sizing the Heat Exchanger

5. On the **Dynamics** tab of the Heat Exchanger enter a Tube volume of 33m^3 (1165 ft^3) and a Shell volume of 9 m^3 (315 ft^3).



Sizing the Heater

6. On the **Dynamics** tab of the Heater enter a volume of 33 m^3 (1165 ft^3).



Some rules to remember:

In the table on the following page are some rules that will help guarantee a consistent, properly specified Flowsheet all the time.

Dynamic Specifications	
Boundary Streams	Insert a valve on all boundary streams (feed/ product streams) within the Flowsheet that are not connected to conductance devices (i.e., heat exchangers, coolers, heaters)
Pressure Specifications	Place a pressure specification on all boundary streams (feed/product streams) within the Flowsheet
Distillation Columns	Distillation columns with condensers require an extra specification around the condenser. Make a flow specification for the reflux flow
Valves	Use the "pressure/flow relationship" as the dynamic specification for a valve
K value	Use the "overall K value" as the dynamic specification for coolers, heaters, and heat exchangers and LNG exchangers
Pressure gradients	Be sure to account for pressure gradients throughout the Flowsheet. Moreover, be sure to specify reasonable pressure drops/rises in the Flowsheet. Pressure differentials are the driving force for flow through the process Flowsheet
Tray Sizing	Use the tray sizing utility to estimate the column geometry and pressure profile
Mixers	Use the Equalize All option as the pressure specification for mixers
Tees	Remove Use Splits as Dynamic Flow Specs on tees
Rotating Equipment Pumps, Compressors, Expanders	Use Efficiency and either Head or Pressure Rise as dynamic specifications for rotating equipment. Compressor and Pump Curves, if available, make excellent dynamic specifications.
Hold-ups	Be sure to properly size equipment with hold-ups

Making Pressure-Flow and Dynamic Specifications

Analysis of the Process Flowsheet

- For the current simulation, the boundary streams are NGL-Feed, SepVap, Shell-In, Shell-Out and ColFeed.
- NGL-Feed is connected to valve VLV-100, so the addition of a valve is not required. See first rule on previous page.
- Shell-Out and Process-Out are connected to the conductance device Heat Exchanger, so the addition of valves to these streams is not required.
- ColFeed is connected to the conductance device Feed Heater, so the addition of valve to this stream is not required.
- SepVap, however, is not connected to a conductance device. Therefore, a Valve needs to be added to this stream.

1. SepVap is NOT connected to a conductance device. Add a Valve downstream of **SepVap**.
2. Choose **SepVap** as the **Feed** and enter **SepVap 1** as the **Product**.
3. Specify a delta P of 70 kPa (10 psi) and size the valve as you did VLV-100 and VLV-101.

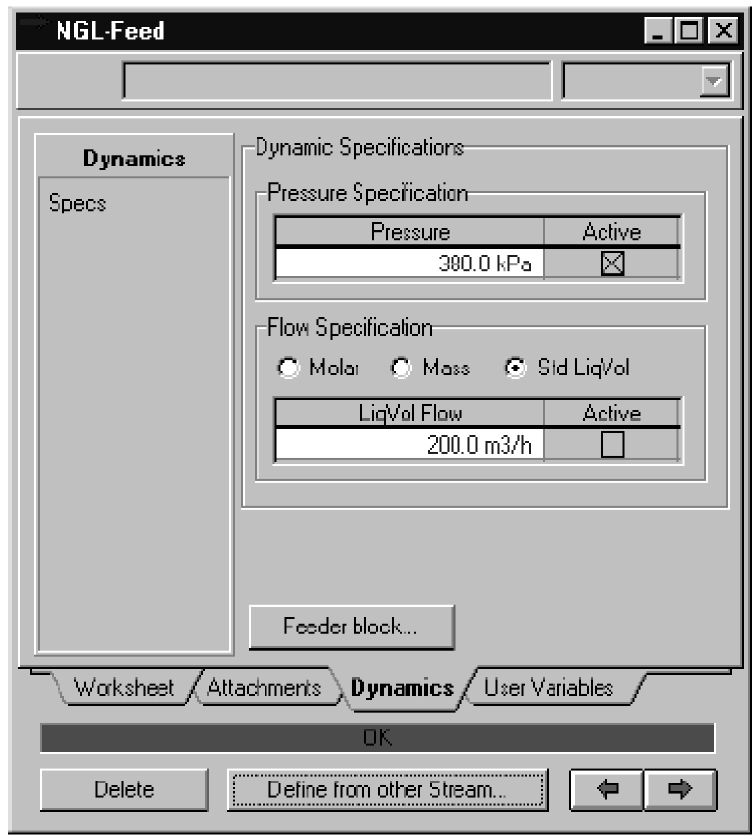
Make the Appropriate Pressure-Flow Specifications

All boundary streams in the Flowsheet must have a pressure specification. The boundary streams are: NGL-Feed, SepVap 1, Shell-In, Shell-Out, and ColFeed.

Note that SepVap is no longer a boundary stream. It has been replaced by SepVap 1.

1. On the **Dynamics** tab of the **NGL-Feed** stream select the Pressure Specification by checking the box **Active**.

Make sure that only the pressure specification is active. If the Flow specification is active "click" the active box to remove this specification.



2. On the Dynamics tab of streams SepVap 1, Shell-In, Shell-Out and ColFeed select the Pressure Specification by checking the box. Again, in each instance make sure that only the Pressure Specification is Active.

3. On the Dynamics – Specs tab of the Heat Exchanger click the *Calculate k* button.

"k" is the conductance to flow constant for the Heat Exchanger tube/ shell side. The value of k is calculated based on the current deltaP, density and Flowrate through the shell/tube side of the Heat Exchanger.

4. Once the k values for the shell/tube side have been calculated, remove the delta P specification and activate the k (conductance) specification.

5. On the Dynamics – Specs tab of the Heater click the *Calculate k* button.

Having the "k" value as the active specification means that the pressure drop across that unit will change with the flow.
This is more realistic then having a constant pressure drop across a unit.

6. Once the "k" value for the Heater has been calculated, remove the delta P specification and activate the overall k (conductance) specification.
7. On the Dynamics-Specs tab of the Pump, ensure that the Efficiency (75%)and Pressure Rise (1900 kPa (275 psi)) specifications are Active. Make sure all other Dynamic Specification options are inactive.

Save your case as: FHT-Specs.hsc

Integrator Active button (green)

The model is now ready to run in Dynamics. Press the Dynamic Mode button and start the Integrator by clicking the Integrator Active button.

Summary

1. Pressure specifications have been made on all Boundary streams. NO pressure or flow specifications have been made on the internal Flowsheet streams (i.e., ToSep, PumpOut, Process-In, Process-Out). Open the property view for any one of these streams to verify that this is so.

2. Resistance to flow specifications (Pressure Flow Relations) have been selected for Valves (automatic by HYSYS.Plant). Open the property view Dynamics-Specs tab to verify that this is correct.

3. Conductance specifications have been made on process equipment (Heat Exchanger, Heater).

4. Process equipment has been sized (Valves, Separator, Heater, Heat Exchanger).

Strip Charts and Controllers

While the Flowsheet is now running dynamically, it is difficult to observe the simulation variables. Individual variable can be observed while in the PFD environment, or multiple variable can be seen on the workbook. All variables are updated constantly as the dynamic simulation is running. Using a strip chart allows the user to observe several variables in real time as the dynamic simulation runs.

Adding Strip Charts

It is recommended that you use multiple Strip Charts with fewer variables. This improves the legibility of the strip chart.

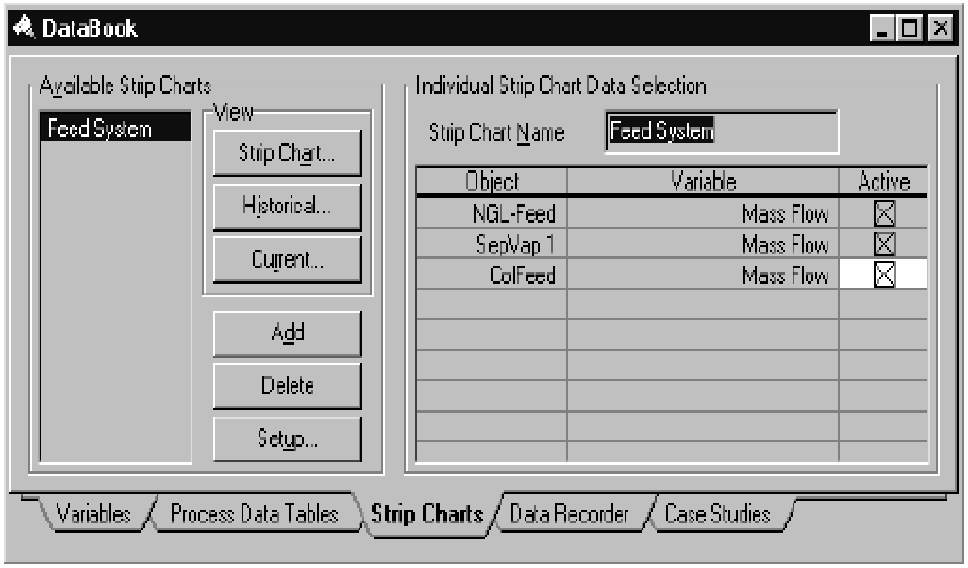
The Strip Chart provides a method for easily monitoring key process variables in a graphical environment.

Strip Charts are installed individually via the **Strip Charts** page. Variables can only be connected to the Strip Chart via this page. Multiple Strip Charts are allowed, and each of these can have an unlimited number of variables charted. Now we are going to create a Strip Chart to monitor the flow rates of NGL-Feed, SepVap1 and ColFeed.

1. Create a Strip Chart called **Feed System**. From the Menu Bar, select **Tools-Databook**, or press the hot key **<Crtl><D>.**
2. Select the **Variables** page and press the **Insert** button.
3. Add the following three variables:
   - NGL-Feed Mass Flow
   - SepVap1 Mass Flow
   - ColFeed Mass Flow
4. Select the **Strip Charts** page tab.
5. Select the **Add** button in the **Available Strip Charts** group.
6. HYSYS installs the new Strip Chart and automatically names it. In this case, the name is **StripChart1**.
7. Change the name to **Feed System.**

8. In the **Individual Strip Chart Data Selection** group box, check the **Active** check box for the variables:

- NGL-Feed Mass Flow
- SepVap1 Mass Flow
- ColFeed Mass Flow



9. To view existing Strip Charts use one of the following methods:

- Highlight the Strip Chart name in the Available Strip Charts group and press the ***Strip Chart*** button in the View group.
- Double click on the name of the Strip Chart.

All strip chart variables must first be entered into the Databook before they are available to the strip chart.

If the Integrator is Active, you should see the Mass flow of the streams updating.

11. Create a second strip chart called Heat Exchanger and insert the following variables on this Strip Chart:

- Process-In Mass Flow
- Process-In Temperature
- Process-Out Temperature
- Shell-In Mass Flow
- Shell-In Temperature
- Shell-Out Temperature

سخن پایانی

به نظر می رسد در عصری که آن را عصرانفجار اطلاعات نامیده اند ومن آن را عصر روشن ایران می نامم، مهمترین دغدغه برای پیشرفت و ترقی پیدا کردن منابع درست مطالعاتی می باشد.در جزوات اخیر سعی شده است بر اساس تجربه و مطالعه چندین منبع مختلف بهترین سیستم آموزشی برای سریعترین نتیجه گیری ارائه شود.

مطمئن باشید که با بخشش علمی به اطرافیان درهای پنهان و ناگشوده علم را بر روی خود گشوده خواهید دید! این درسی است که از طبیعت گرفتم .قدرتمندی و ویران کنندگی یک گردباد به میزان خلا درون آن بستگی دارد.انتقال دانش به دیگران همان منشا خلا علمی شماست.

این جزوه تقدیم می شود به پدر و مادرم که پشتوانه ای بی بدیل برای این حقیر بودند.

و با تشکر از تمام کسانی که صمیمانه در این راه یاورم بودند

به طور قطع این جزوه خالی از اشکال نمی باشد. خواهشمند است در تصحیح و بهتر نمودن آن اینجانب را یاری نمایید.

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