Getting started with Simulis® Pinch
Water module

Use Case 4: Water integration of a refinery plant - Case study and specifications with Simulis Pinch Water

Release Simulis Pinch 2.0.0

Software & Services In Process Simulation

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Introduction

This getting started shows you the use of the **case study** functionality of Simulis Pinch Water to optimize the process integration.

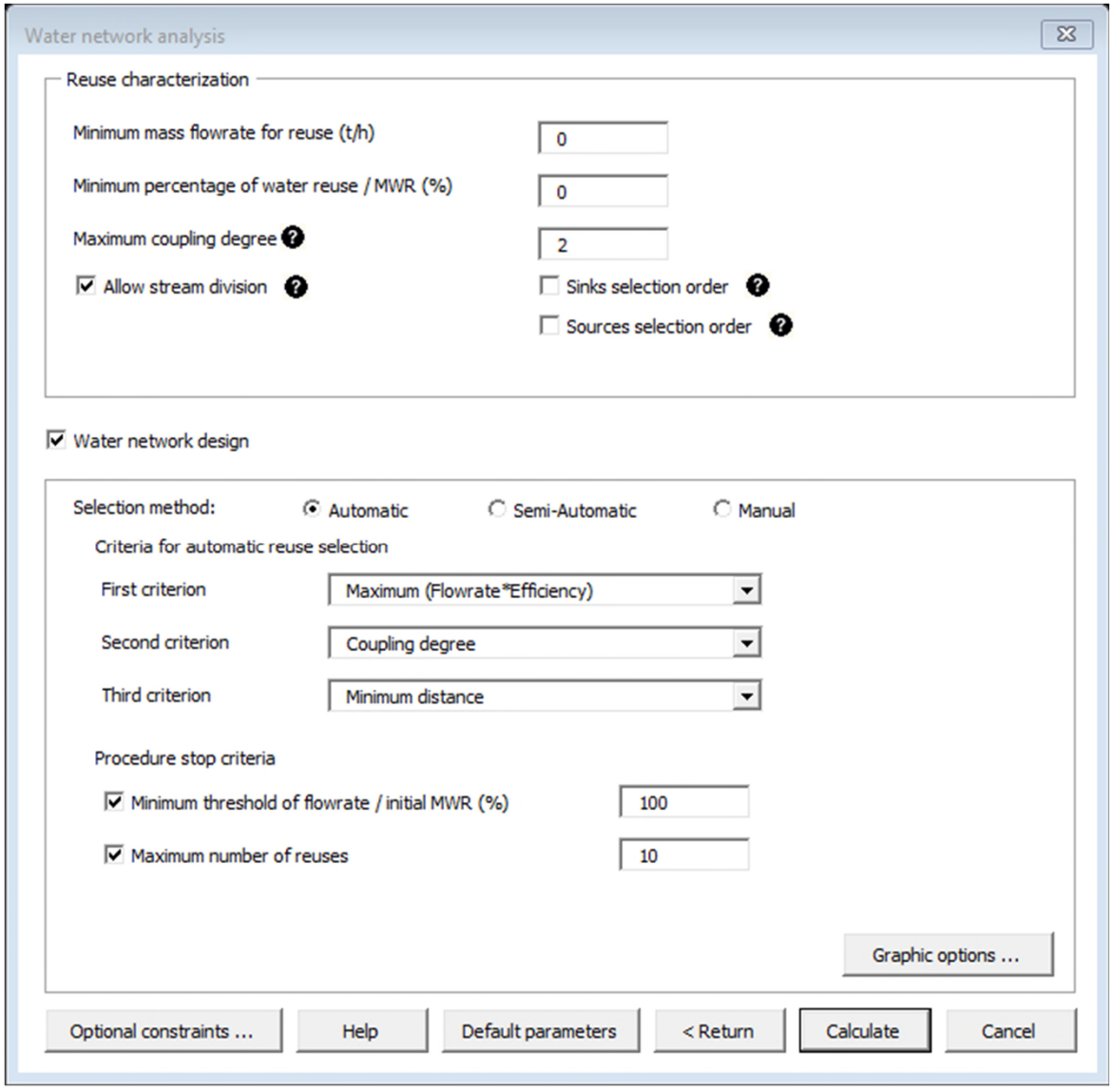
This document follows the getting started "Use Case 3: Water integration of an refinery plant – Multi contaminants analysis"

This guide presents the following parts:

- Step 1: Use of the ***Case study*** functionality
- Step 2: Results analysis
- Step 3: Use of the ***Specification*** functionality

Introduction

The input data and the parameters used in this example are identical to those provided in the getting started "Use Case 3: Water integration of a refinery plant – Multi contaminants analysis"



Step 1: Use of the case study function

To access the ***Case study*** function with Simulis Pinch Water, it is necessary to run the calculations one time to obtain results sheets.

In the sheet "Input data" generated as a result of calculations, the function is available by clicking on the ***Case study*** button:

PINCH

Type of pinch analysis	Water
Type of analysis	Multi contaminants
Data definition	Raw data (mass flowrates and measurements)
Number of contaminants	3
Mass flowrates unit	(t/h)

Case study

Specification

Stream names	Mass flowrate (F)	Contaminant (C) measurement 1	Contaminant (C) measurement 2	Contaminant (C) measurement 3
SK-O1	50,0	0,00E+00	0,00E+00	0,00E+00
SK-O2	34,0	2,00E+01	3,00E+02	4,50E+01
SK-O3	56,9	1,20E+02	2,00E+01	2,00E+02
SK-O4	8,0	0,00E+00	0,00E+00	0,00E+00
SK-O5	8,0	5,00E+01	4,00E+02	6,00E+01
SR-O1	- 50,0	1,50E+01	4,00E+02	3,50E+01
SR-O2	- 34,0	1,20E+02	1,25E+04	1,80E+02
SR-O3	- 56,9	2,20E+02	4,50E+01	9,50E+03
SR-O4	- 8,0	2,00E+01	6,00E+01	2,00E+01
SR-O5	- 8,0	1,50E+02	8,00E+03	1,20E+02

Step 1: Use of the case study function

As presented and explained in the sheet, the user has to define the parameters that he wants to change to perform the case study.

For this example, the minimum mass flowrate for each reuse is the variable of the case study.

The following pinch values will be used: 0, 5, 15, 25, 35, 45 and 55 t/h.

Case study

1) Fill one or more cells for parameters (blue cells)
2) Press button to complete with default values (if necessary)
3) Press button to execute the calculation
Note: To use a solver resolution, refer to the 'Specification' button on the input data sheet

Complete with default paramaters

Modifiable input data list

Input sheet name	Input data						
Type of pinch analysis	Water						
1 Minimum mass flowrate for reuse (t/h)	0	5	15	25	35	45	55
2 Minimum percentage of water reuse / MWR (%)							
3 Maximum coupling degree							
4 Allow stream division							
5 Satisfy the load							
6 Sinks selection order							
7 Sources selection order							
8 Minimum threshold of flowrate / initial MWR (%)							
9 Maximum number of reuses							

Step 1: Use of the case study function

When the different pinch values are indicated, the ***Complete with default parameters*** button is displayed. Click on this button to fill the missing parameters necessary for the case study.

Case study

1) Fill one or more cells for parameters (blue cells)
2) Press button to complete with default values (if necessary)
3) Press button to execute the calculation
Note: To use a solver resolution, refer to the 'Specification' button on the input data sheet

Complete with default paramaters

Modifiable input data list

Input sheet name	Input data						
Type of pinch analysis	Water						
1 Minimum mass flowrate for reuse (t/h)	0	5	15	25	35	45	55
2 Minimum percentage of water reuse / MWR (%)							
3 Maximum coupling degree							
4 Allow stream division							
5 Satisfy the load							
6 Sinks selection order							
7 Sources selection order							
8 Minimum threshold of flowrate / initial MWR (%)							
9 Maximum number of reuses							

The case study can also be multifactorial (e.g. change of the minimum mass flowrate for each reuse and the maximum number of reuses)

Step 1: Use of the case study function

When all input data has been provided, the ***Execute case study*** button is displayed.
Click on this button to run the case study

Case study

1) Fill one or more cells for parameters (blue cells)
2) Press button to complete with default values (if necessary)
3) Press button to execute the calculation
Note: To use a solver resolution, refer to the 'Specification' button on the input data sheet

Execute case study

Modifiable input data list

Input sheet name	Input data						
Type of pinch analysis	Water						
1 Minimum mass flowrate for reuse (t/h)	0	5	15	25	35	45	55
2 Minimum percentage of water reuse / MWR (%)	0	0	0	0	0	0	0
3 Maximum coupling degree	2	2	2	2	2	2	2
4 Allow stream division	True	True	True	True	True	True	True
5 Satisfy the load	False	False	False	False	False	False	False
6 Sinks selection order	False	False	False	False	False	False	False
7 Sources selection order	False	False	False	False	False	False	False
8 Minimum threshold of flowrate / initial MWR (%)	40	40	40	40	40	40	40
9 Maximum number of reuses	10	10	10	10	10	10	10

The parameters used to complete the input data are the ones of the "Input Data" sheet

Step 1: Use of the case study function

After clicking on the button for the case study run, Simulis Pinch Water performs the calculation loops on each case (several runs are achieved):

Modifiable input data list

Input sheet name	Input data			
Type of pinch analysis	Water			
1 Minimum mass flowrate for reuse (t/h)	0	5	15	25
2 Minimum percentage of water reuse / MWR (%)	0	0	0	0
3 Maximum coupling degree	2	2	2	2
4 Allow stream division	True	True	True	True
5 Satisfy the load	False	False	False	False
6 Sinks selection order	False	False	False	False
7 Sources selection order	False	False	False	False
8 Minimum threshold of flowrate / initial MWR (%)	40	40	40	40
9 Maximum number of reuses	10	10	10	10

Monitored variable list

1 Initial number of possible reuse	18	18	6	6
2 Cumulative percentage of water reuse	41,13148625	41,13149	32,07792	30,2139
3 Number of reuses	3	3	2	2
4 Total water reuse (t/h)	36,345	36,345	28,345	26,69789
5 Water flowrate available to reuse (t/h)	7,83069E-08	7,83E-08	8	8
6 Additional required amount of fresh water (t/h)	120,555	120,555	128,555	130,2021
7 Amount of waste water (t/h)	120,555	120,555	128,555	130,2021
8 Remaining number of Sinks	2	2	3	3
9 Remaining number of Sources	4	4	5	5

Results of the case study

Convergence status	The cumulative percentage of water reuse is exceeded!	The cumulative percentage of water	No acceptable reuse were found before	No acceptable reuse were found before

Convergence messages

Step 1: Use of the case study function

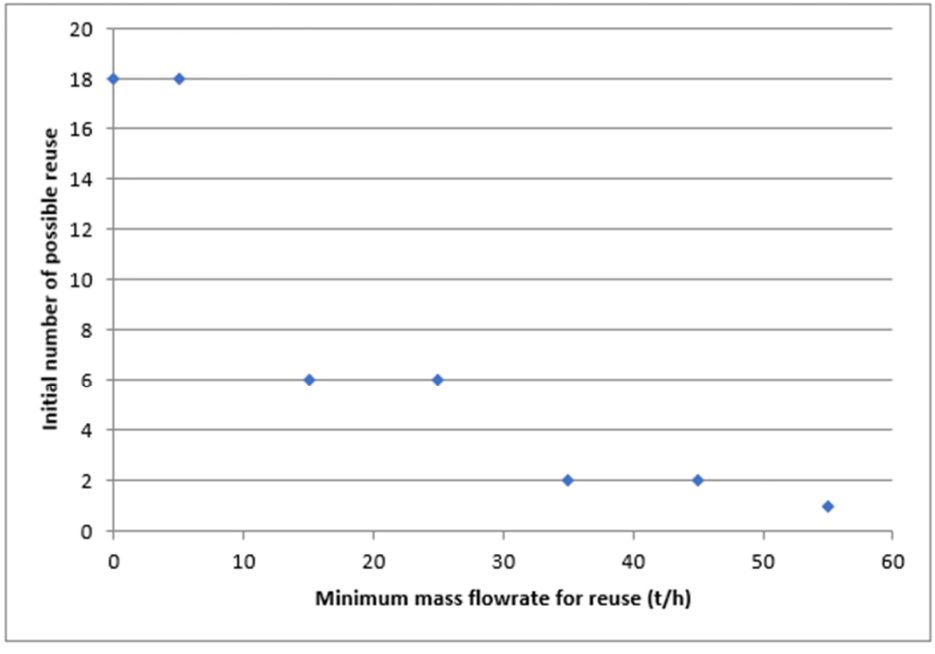
Under the results tables, you can also view the results profiles of the case study.

The user has the option to change the default displayed profiles. It is possible to change the x-axis and y-axis among the predefined list:

Profiles

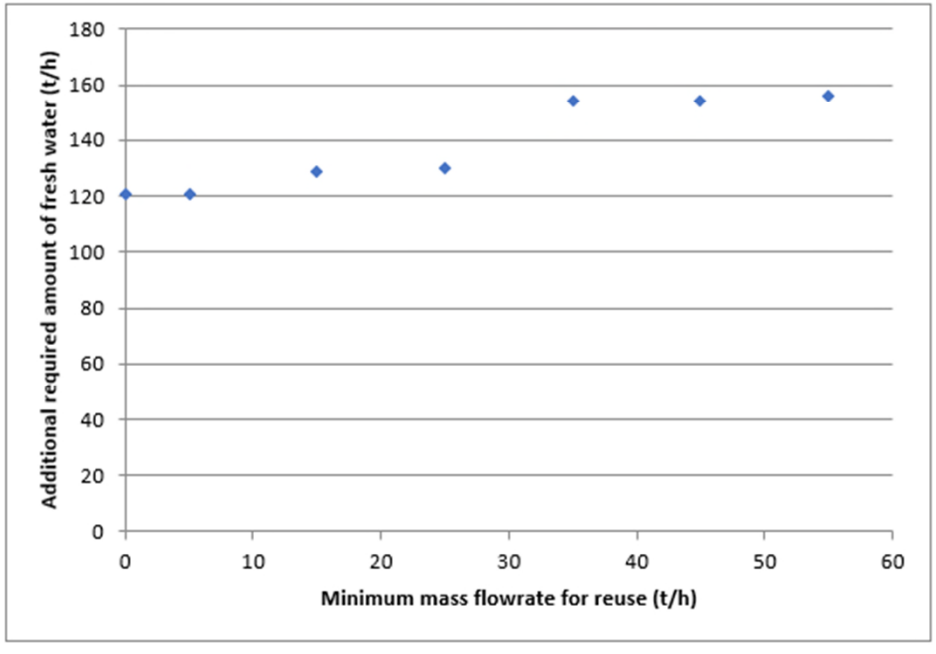
Abscissa selection: Minimum mass flowrate for reuse (t/h)

Ordinate selection: Initial number of possible reuse



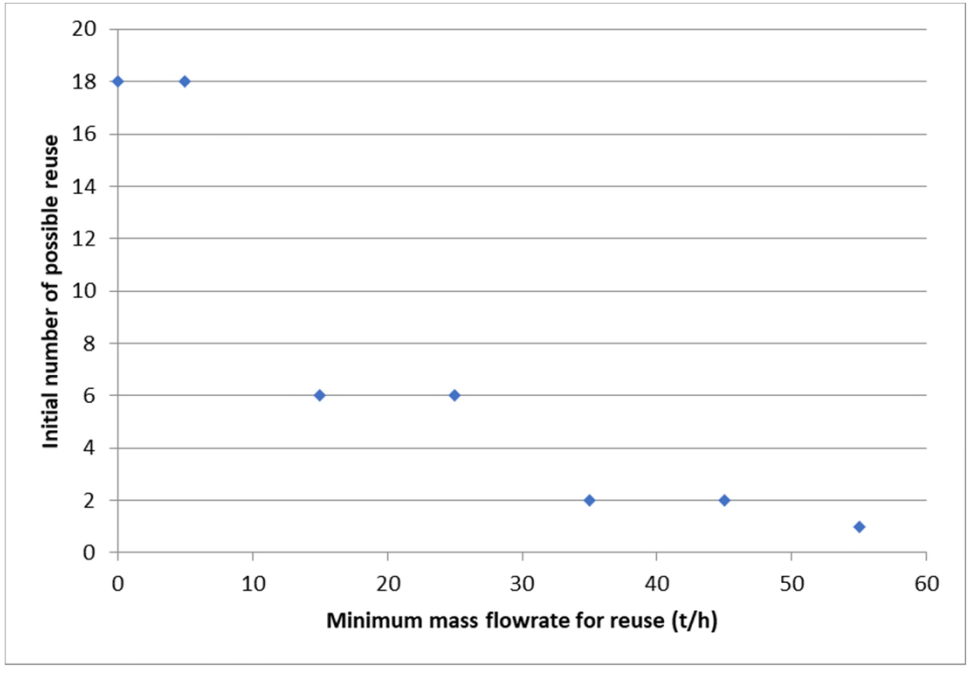
Abscissa selection: Minimum mass flowrate for reuse (t/h)

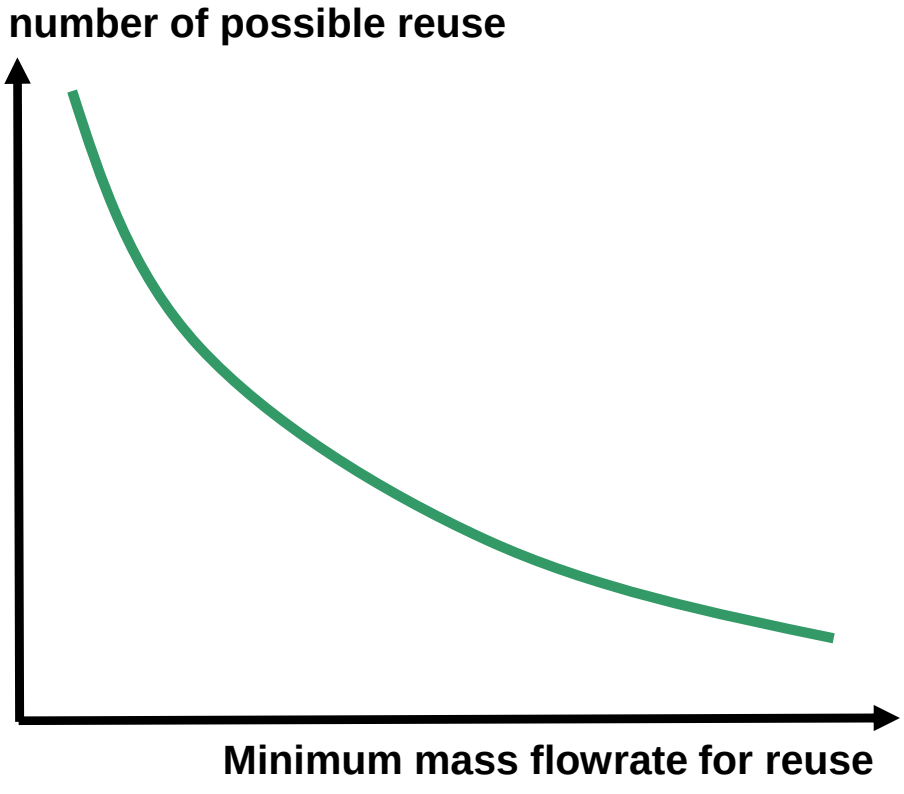
Ordinate selection: Additional required amount of fresh water (t/h)



Step 2: Results analysis

Profiles automatically displayed by Simulis Pinch Water make it easy to analyze the results.
Regarding this example, it is interesting to observe the change of the initial number of possible reuses depending on the minimum flowrate for reuse:





The more the minimum flowrate for a reuse is high, the more it is difficult to find reuses that satisfy this criterion.
The case study makes it easy to vary one or more parameters to observe the results obtained with Simulis Pinch Water. It is thus possible to quickly visualize the evolution of the observed parameters and to detect any points of inflection or optimum for the design of the water network.

Step 3: Use of the specification function

To access to the ***Specification*** function with Simulis Pinch Water, it is necessary to run the calculations one time to obtain results sheets.

In the "Input data" sheet generated as a result of calculations, the function is available by clicking on the ***Specification*** button:

PINCH

Type of pinch analysis	Water
Type of analysis	Multi contaminants
Data definition	Raw data (mass flowrates and measurements)
Number of contaminants	3
Mass flowrates unit	(t/h)

Case study

Specification

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SK-O2	34,0	2,00E+01	3,00E+02	4,50E+01
SK-O3	56,9	1,20E+02	2,00E+01	2,00E+02
SK-O4	8,0	0,00E+00	0,00E+00	0,00E+00
SK-O5	8,0	5,00E+01	4,00E+02	6,00E+01
SR-O1	- 50,0	1,50E+01	4,00E+02	3,50E+01
SR-O2	- 34,0	1,20E+02	1,25E+04	1,80E+02
SR-O3	- 56,9	2,20E+02	4,50E+01	9,50E+03
SR-O4	- 8,0	2,00E+01	6,00E+01	2,00E+01
SR-O5	- 8,0	1,50E+02	8,00E+03	1,20E+02

Step 3: Use of the specification function

The "Specification" sheet offers the same functionality as the "Case study" sheet.
The only difference with the ***Case study*** function is that the calculation is performed automatically (autorun).
The user has to provide only one value and the calculation runs.

Specification

1) Fill one or more cells for parameters (blue cells)
2) Calculation is done automatically
Note: A solver resolution is available
A goal seek or Data table analysis is unavailable

Modifiable input data list

Input sheet name	Input data
Type of pinch analysis	Water
1 Minimum mass flowrate for reuse (t/h)	
2 Minimum percentage of water reuse / MWR (%)	
3 Maximum coupling degree	
4 Allow stream division	
5 Satisfy the load	
6 Sinks selection order	
7 Sources selection order	
8 Minimum threshold of flowrate / initial MWR (%)	40
9 Maximum number of reuses	

The parameters used for the calculation are the input data of the "input data" sheet

Only value supplied by the user

Monitored variable list

1 Initial number of possible reuse	1
2 Cumulative percentage of water reuse	1,355652522
3 Number of reuses	1
4 Total water reuse (t/h)	1,197894737
5 Water flowrate available to reuse (t/h)	42,00000009
6 Additional required amount of fresh water (t/h)	155,7021053
7 Amount of waste water (t/h)	155,7021053
8 Remaining number of Sinks	4
9 Remaining number of Sources	5

Results of the autorun

This ***Specification*** function is interesting for the use of Microsoft™ Excel solver or any other type of external solver or optimizer with Simulis Pinch Water.

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