

Process Simulation with ASPEN Plus

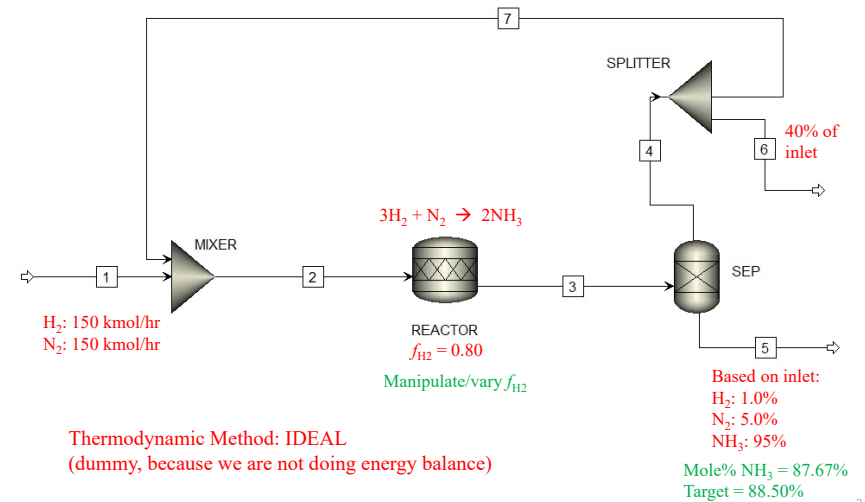
7505 Course Notes

Section 3: Mass-Balance Only Using Elementary Modules with Design Targets (Constraints)

These course materials are applicable to Version 14 of ASPEN Plus

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1st Design Target: Mole-Purity of NH₃ in Stream 5 = 88.5%



Mass-Balance Only: Stream Summary/Table

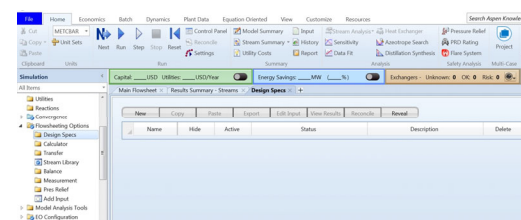
Material	Heat	Load	Work	Power	Vol.% Curves	Wt.% Curves	Petroleum	Polymers	Solids
Enthalpy Flow	cal/sec	-2.9885e+34							
Average MW		15.0147	18.3616	22.8559	24.5714	18.2974	24.5714	24.5714	
Mole Flows	kmol...	300	461.696	370.91	269.493	101.418	107.797	161.696	
H2	kmol...	150	170.222	34.0445	33.704	0.340445	13.4816	20.2224	
N2	kmol...	150	288.666	243.273	231.109	12.1636	92.4437	138.666	
NH3	kmol...	0	2.80779	93.5931	4.67965	88.9134	1.87186	2.80779	
Mole Fractions									
H2		0.5	0.36869	0.0917863	0.125065	0.00335686	0.125065	0.125065	
N2		0.5	0.625229	0.65588	0.857571	0.1119936	0.857571	0.857571	
NH3		0	0.00608148	0.252333	0.0173647	0.876707	0.0173647	0.0173647	
Mass Flows	kg/hr	4504.4	8477.49	8477.49	6621.82	1855.68	2648.73	3973.09	
H2	kg/hr	302.382	343.148	68.6296	67.9433	0.686296	27.1773	40.766	
N2	kg/hr	4202.02	8086.53	6814.92	6474.17	340.746	2589.67	3884.5	
NH3	kg/hr	0	47.8183	1593.94	79.6971	1514.25	31.8789	47.8183	

Design-Specification (Design-Spec) in A+

- ❑ A user is not allowed to enter the design target value of 88.5% directly into the A+ model.
- ❑ A user must use the Design-spec feature to achieve this.
- ❑ Design-spec is activated as follows:

Under the Simulation Environment, access

Flowsheeting Options --> Design Specs



Stream Summary: One Design Target

Simulation: Capital: USD Utilities: USD/Year Energy Savings: MW (%) Exchangers: Unknown: 0 OK: 0 Risk: 0 CO2e Scope 1: 0

Main FlowSheet: Results Summary - Streams (All) Control Panel REACTOR (RStoic) DS-1 Results

Material	Heat	Load	Work	Power	Vol.% Curves	Wt.% Curves	Petroleum	Polymers	Solids
Average MW									
1	15.0147	18.6415	23.6395	25.9139	18.2485	25.9139			
2	300	449.615	354.555	249.358	105.197	99.743			
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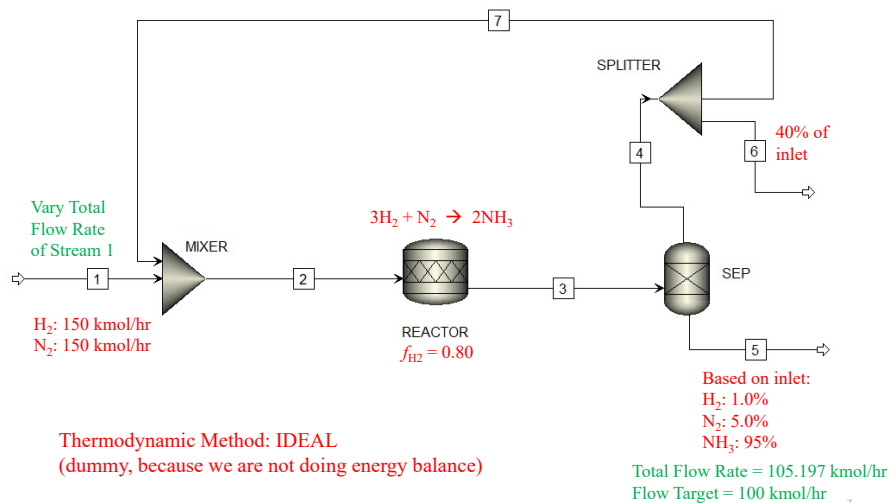
Design-spec Result: Reactor conversion = 88.65%

Simulation: Capital: USD Utilities: USD/Year Energy Savings: MW (%) Exchangers: Unknown: 0 OK: 0 Risk: 0 CO2e Scope 1: 0

Main FlowSheet: Results Summary - Streams (All) Control Panel REACTOR (RStoic) DS-1 Results

Variable	Initial value	Final value	Units
MANIPULATED	0.886682	0.886526	
XXH43	0.885023	0.885	

2nd Design Target: Stream 5 Total Molar Flow = 100 kmol/hr



Stream Summary: One Design Target

Simulation: Capital: USD Utilities: USD/Year Energy Savings: MW (%) Exchangers: Unknown: 0 OK: 0 Risk: 0 CO2e Scope 1: 0

Main FlowSheet: Results Summary - Streams (All) Control Panel REACTOR (RStoic) DS-1 Results

Material	Vol.% Curves	Wt.% Curves	Petroleum	Polymers	Solids
Molar Density					
Mass Density					
Enthalpy Flow					
Average MW					
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Stream Summary: Two Design Targets

Mass-Balance Only A+ Model - With Two Design-specs.bkp - Aspen Plus V14 - aspenONE

Simulation: Capital: USD Utilities: USD/Year Energy Savings: MW Exchangers: Unknown: 0 OK: 0 Risk: 0 CO2e Scope: 1

Results Summary - Streams (All) | Control Panel | REACTOR (RStoc) | DS-1 | DS-1 - Results | DS-2 |

Material	Vol% Curves	Wt% Curves	Petroleum	Polymers	Solids	Status
Molar Density						mol/cc
Mass Density						gm/cc
Enthalpy Flow						cal/sec
Average MW						18.2485
Mole Flows						kmol/hr
H2						0.173542
N2						11.3264
NH3						88.5
Mole Fractions						

Model Palette: Mixers/Splitters, Separators, Exchangers, Columns, Reactors, Pressure Changers, Manipulators, Solids, Solids Separators, User Models.

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Design-spec Result: Feed Flow Rate = 285.179 kmol/hr

Mass-Balance Only A+ Model - With Two Design-specs.bkp - Aspen Plus V14 - aspenONE

Simulation: Capital: USD Utilities: USD/Year Energy Savings: MW Exchangers: Unknown: 0 OK: 0 Risk: 0 CO2e Scope: 1

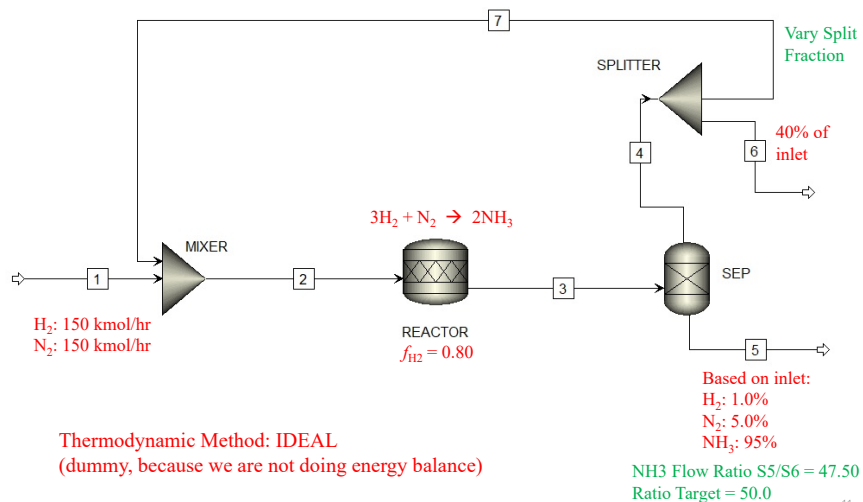
Results Summary - Streams (All) | Control Panel | REACTOR (RStoc) | DS-1 | DS-1 - Results | DS-2 |

Variable	Initial value	Final value	Units
MANIPULATED	285.178	285.179	kmol/hr
TFLOWSS	99.9996	100	kmol/hr

Model Palette: Mixers/Splitters, Separators, Exchangers, Columns, Reactors, Pressure Changers, Manipulators, Solids, Solids Separators, User Models.

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3rd Design Target: NH₃ Molar Flow Ratio S5/S6 = 50.0



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Stream Summary: Two Design Targets

Mass-Balance Only A+ Model - With Two Design-specs.bkp - Aspen Plus V14 - aspenONE

Simulation: Capital: USD Utilities: USD/Year Energy Savings: MW Exchangers: Unknown: 0 OK: 0 Risk: 0 CO2e Scope: 1

Results Summary - Streams (All) | Control Panel | REACTOR (RStoc) | DS-1 | DS-1 - Results | DS-2 |

Material	Heat	Load	Work	Power	Vol% Curves	Wt% Curves	Petroleum	Polymers	Solids	Status
Enthalpy Flow										cal/sec
Average MW										15.0147
Mole Flows										kmol/hr
H2										142.59
N2										271.71
NH3										0
Mole Fractions										
Mass Flows										kg/hr
										4281.88
										7967.37
										7967.37
										6142.49
										1824.85
										2457

Model Palette: Mixers/Splitters, Separators, Exchangers, Columns, Reactors, Pressure Changers, Manipulators, Solids, Solids Separators, User Models.

Handwritten calculation: 88.5 / 1.86316 = 47.50

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