An introduction to Process Simulation and Aspen Hysys for Net-Master students

Høgskolen i Sørøst-Norge

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Todays Agenda

- Short Introduction to Aspen Hysys (20 min.)
- HYSYS-demo I (25 min.)
- HYSYS-demo II (20 min.)
- Sample examples (10 min.)

What is process simulation?

- Rigorous computer calculations of material and energy balances and equilibrium data for a process unit and/or a whole plant.

Result:

- Sizing of unit operations are performed.
- All process conditions , material streams and energy streams are calculated

Process Simulation Tools

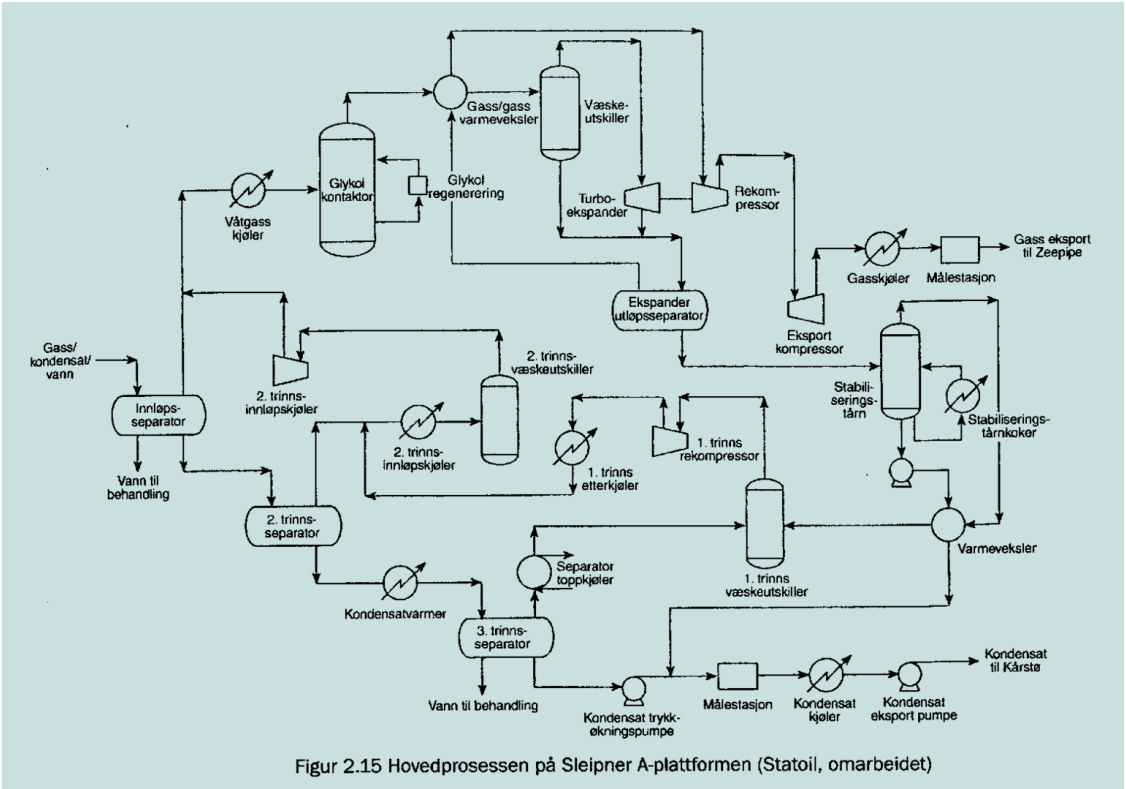
- PRO/II, PRO/VISION (Statoil)
- ASPEN PLUS (Statoil/TCM/HSN)
- (ASPEN) HYSYS (Aker Solutions/Statoil/HSN)

What can HYSYS do ?

- Calculate heat and mass balances,
- Calculate thermodynamic data and equlibrium
- Sizing and capacity evaluation of various equipment (unit operations)
- Economic optimization of units/plants
- Dynamic simulation capabilities

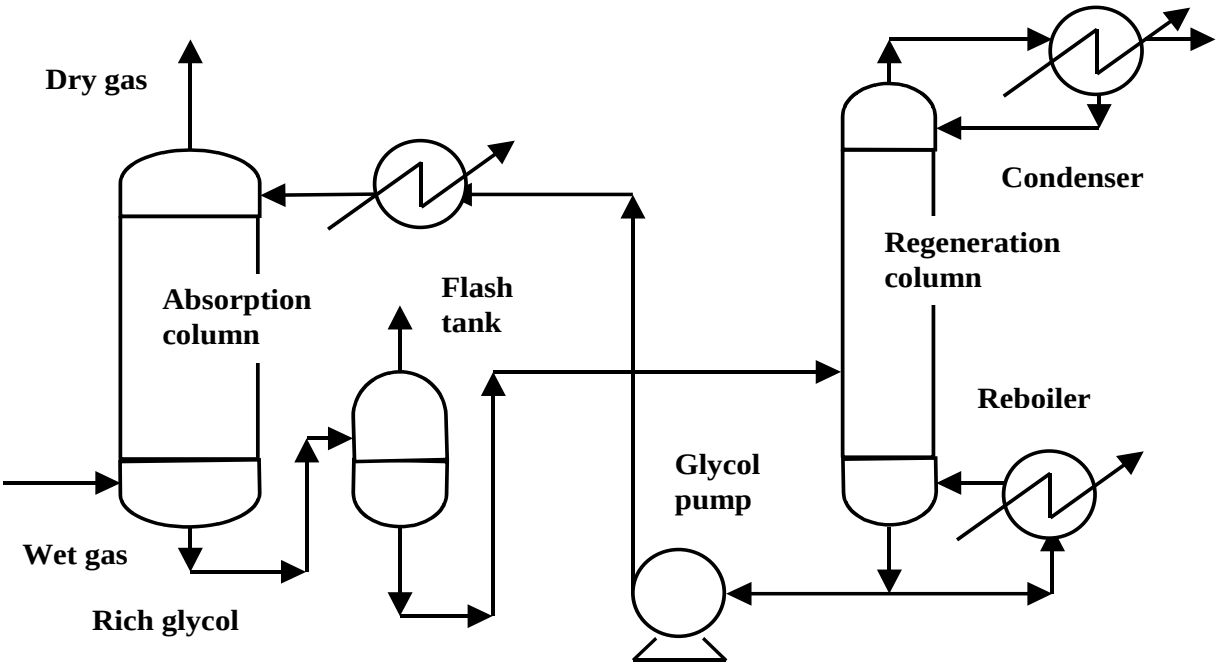
HYSYS can evaluate designs for profitability, operability, safety and for improvements.

Process on Platform Sleipner A

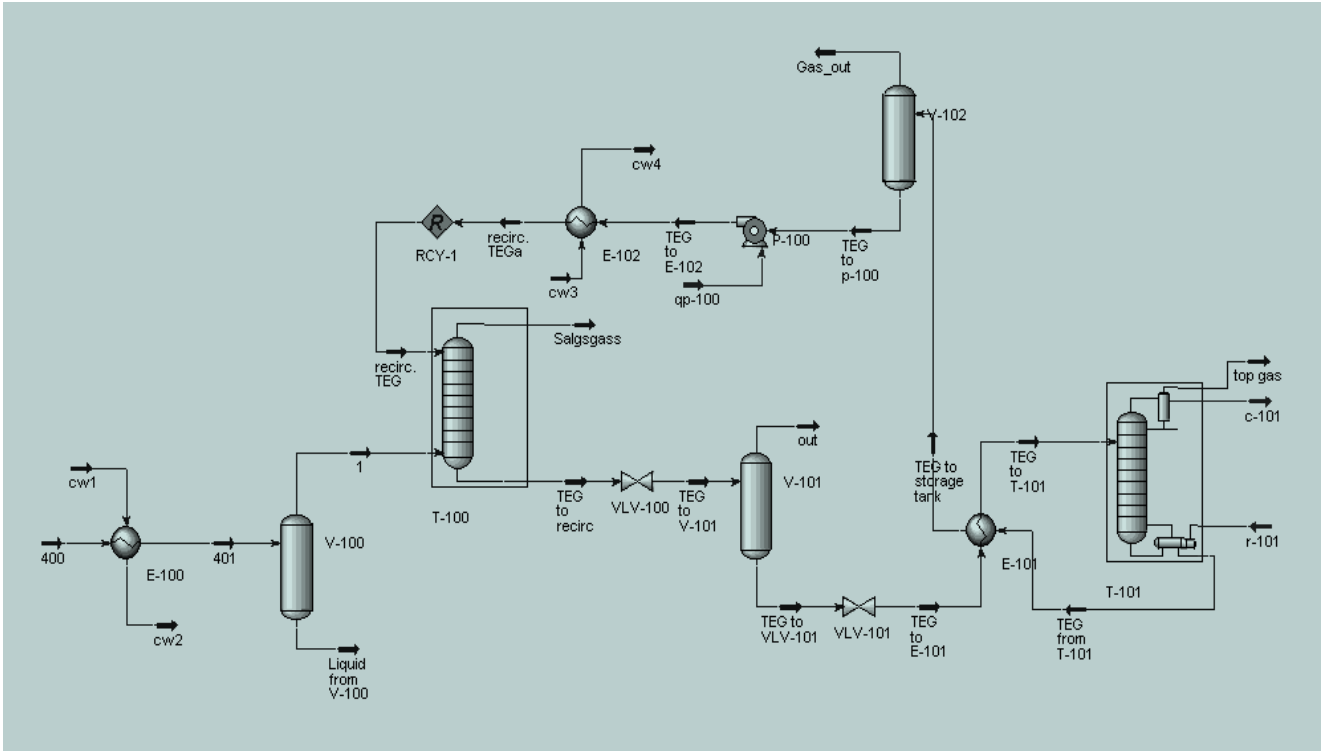


Figur 2.15 Hovedprosessen på Sleipner A-plattformen (Statoil, omarbeidet)

Glycol dehydration Process Diagram



Aspen HYSYS flowsheet model for Glycol Plant for removing water from natural gas



Purpose of Plant-simulation

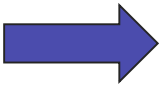
- Comprehensive Plant modeling:

1) To evaluate plants for profitability
2) To evaluate plants for operability
3) To evaluate plants for safety
4) To improve existing plants
5) To develop training simulators for operators

How does Aspen Hysys work (I)

- Interactive calculations

Calculations are run as soon as there is sufficient information for a stream or unit



So a minimum of information is needed.

How does Aspen Hysys work (II)

- Minimum information for a stream :

Given : Composition (mole or mass fraction),
Pressure (P) and Temperature (T),
Flow (mass or molar)

Hysys calculates vapour fraction and all other properties (density, enthalpy, energy, volume...)

How does Aspen Hysys work (III)

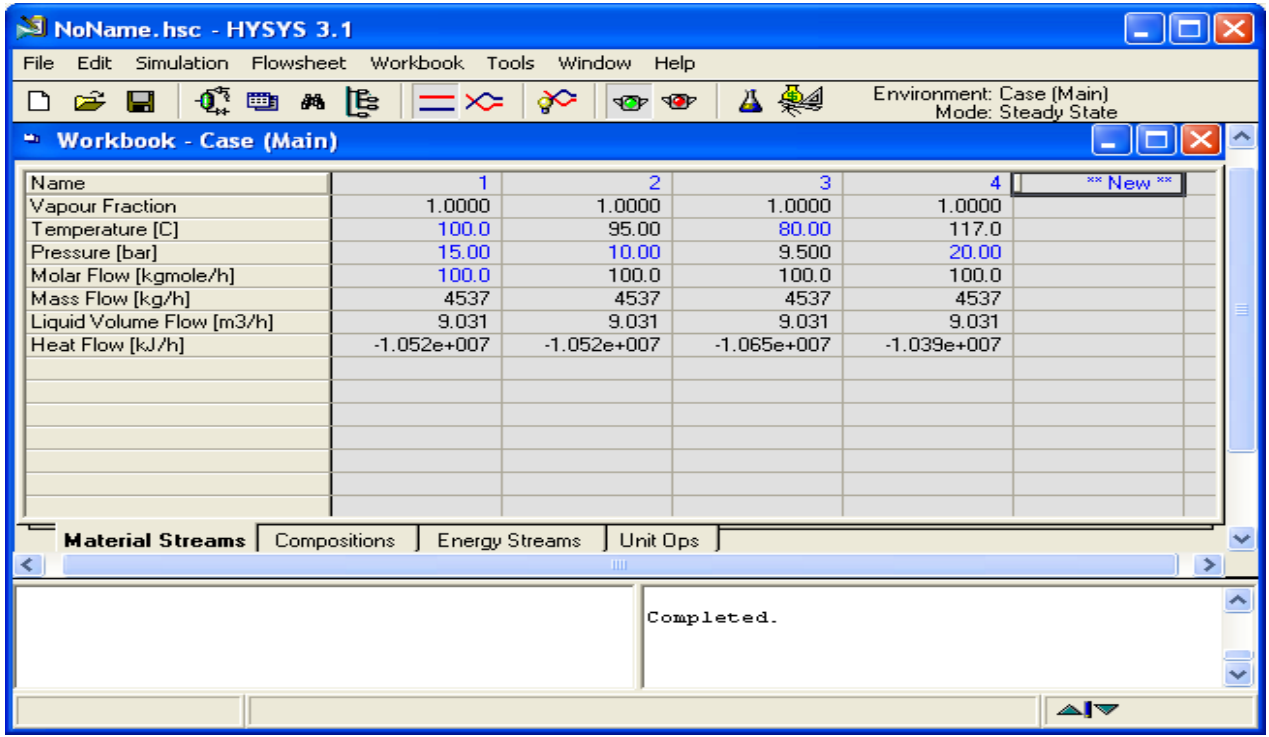
- Composition and flow must always be given to calculate a stream.
- Usually the last 2 variables is P and T

  But not always !

You must specify 2 of the 3 variables

P , T or vapour fraction

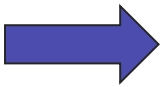
Workbook for Streams



Name	1	2	3	4	** New **
Vapour Fraction	1.0000	1.0000	1.0000	1.0000	
Temperature [C]	100.0	95.00	80.00	117.0	
Pressure [bar]	15.00	10.00	9.500	20.00	
Molar Flow [kgmole/h]	100.0	100.0	100.0	100.0	
Mass Flow [kg/h]	4537	4537	4537	4537	
Liquid Volume Flow [m3/h]	9.031	9.031	9.031	9.031	
Heat Flow [kJ/h]	-1.052e+007	-1.052e+007	-1.065e+007	-1.039e+007	

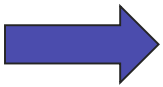
Bubble Point Calculations

- Given : Composition, P and vapor fraction = 0



Calculates bubble point Temperature

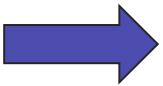
- Given : Composition, T and vapor fraction = 0



Calculates bubble point Pressure

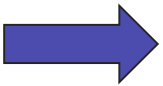
Dew Point Calculations

- Given : Composition, P and vapor fraction = 1



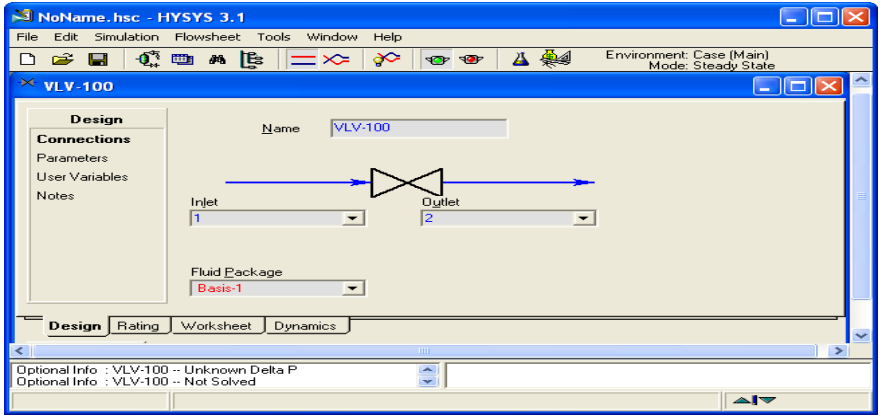
Calculates dew point Temperature

- Given : Composition, T and vapor fraction = 1



Calculates dew point Pressure

Valve calculation in Aspen Hysys



1) Inlet stream (1) must be specified/calculated

2) The valve operation is isenthalpic, meaning no entalphy change across valve (H inlet stream = H outlet stream)

Must specify : Pressure in outlet stream or pressure drop (Δ P)

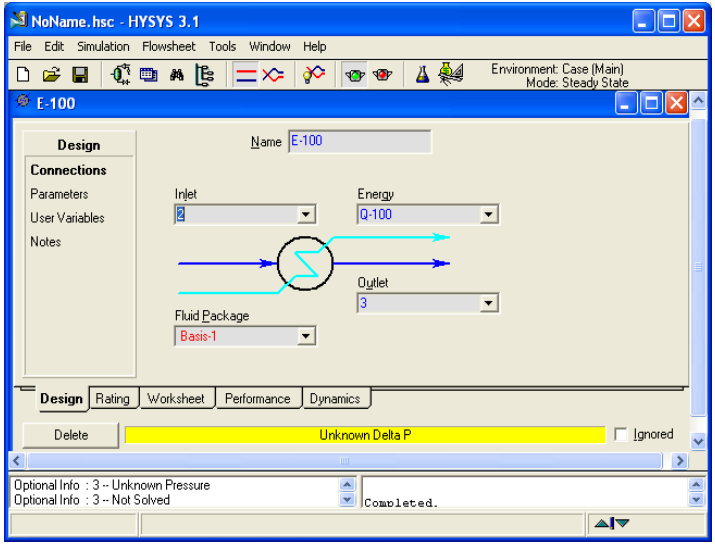
→ Outlet Stream is calculated completely

Cooler/Heater calculations in Aspen Hysys

- One sided heat-exchanger :
- Inlet stream is specified
- Must specify :

1)Temperature in outlet

2) Pressure drop (Δ P)



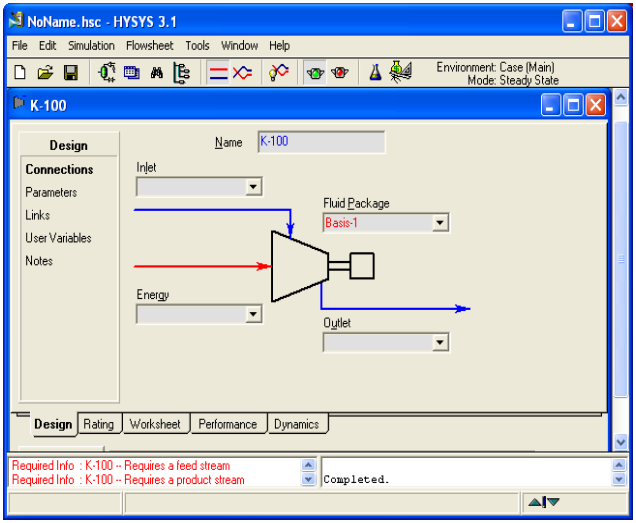
Hysys calculates : The energy removed or added (duty)

Compressor calculations in Hysys

Inlet stream specified

Normally Specify:

1) Pressure in outlet stream
2) Compressor Efficiency



Hysys calculates : Outlet temperature and energy
(energy is the compressor work)

How to start a simulation in Aspen Hysys

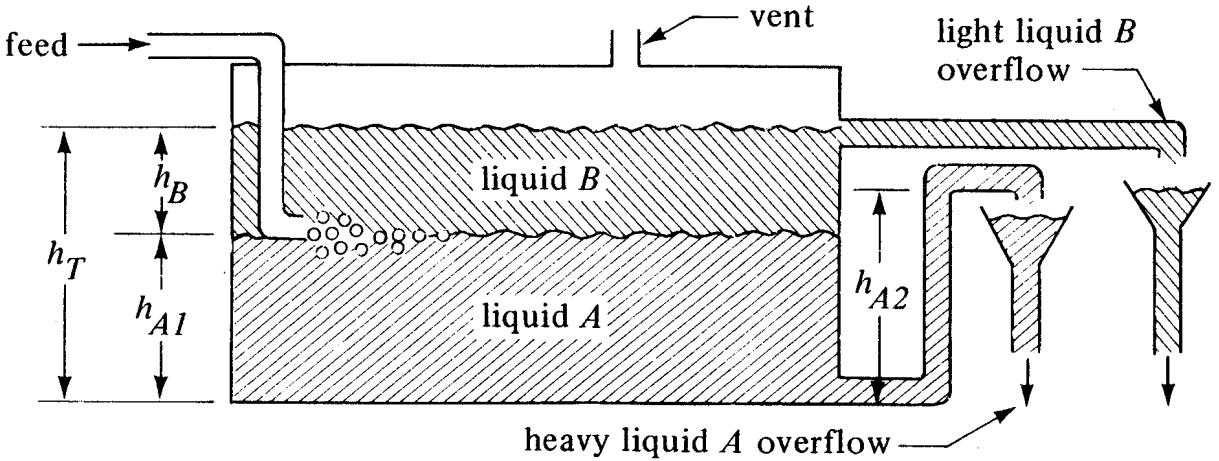
1) Start Aspen Hysys from the menu
2) Define a New case
3) Define all the components in your case
4) Choose Peng Robinson (Equation of state)
5) Enter the ”simulation environment”
6) To specify composition: Left click on mole flow or mass flow and specify fractions or flows of each component

Aspen HYSYS demo I

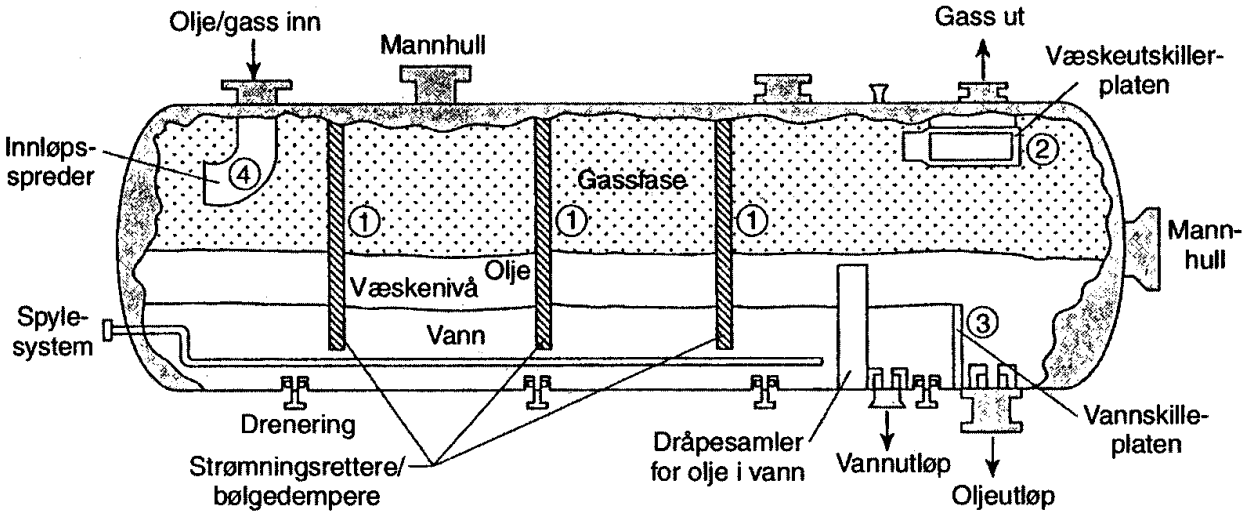
- Specified oil/gas/water flow in
- 100 kmol each of n-decane, methane, water
- Temp. in = 60 C, pressure = 90 bar
- Pressure reduction to 1 bar (~ 1 atmosphere)
- Three phase separation at 1 bar
- (Re)compression to 60 bar
- What is then the compressor effect?

Oil/Water-separator

Pressure(height) = ρ*g*h



Oil/Gas/Water-separator



Figur 2.7 Horisontal separator

Aspen HYSYS demo II

- Specified oil/gas/water flow in
- 100 kmol each of n-decane, methane, water
- Temp. in = 60 C, pressure = 90 bar
- Pressure reduction to 60 bar and 1 bar
- Three phase separation at 60 and 1 bar
- (Re)compression to 60 bar
- What is then the compressor effect?