Problems

on Flash Calculations
using both Aspen Plus and PRO/II

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4th week

9/10, 2001 through 9/14, 2001

Ex-1 : Isothermal Flash Calculation

A liquid mixture consisting of 60 mole% benzene, 40 mole% toluene is flashed at 1.2 atm and 100^oC.

- Compute the amounts of liquid and vapor products and their composition.

  Assume ideal solutions and use the Antoine equation.

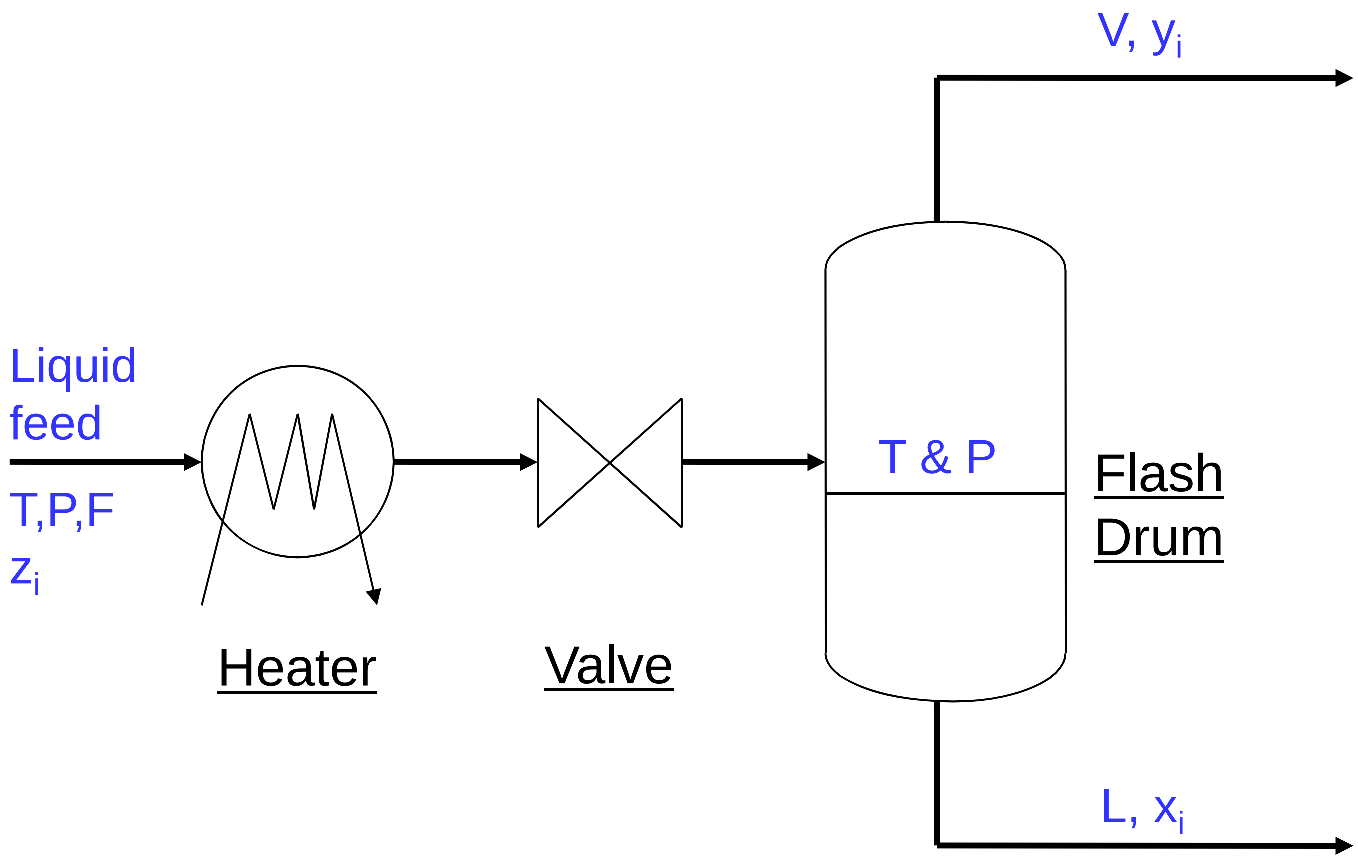
Component	Mole %
Benzene	60.0
Toluene	40.0
Temperature (^oC)	25.0
Pressure (bar)	3.0
Flow Rate (Kgmole/hr)	100

When finished, save as

Filename:

Example-1A.inp for PRO/II
Example-1A.bkp for ASPEN PLUS

Isothermal Flash Calculation



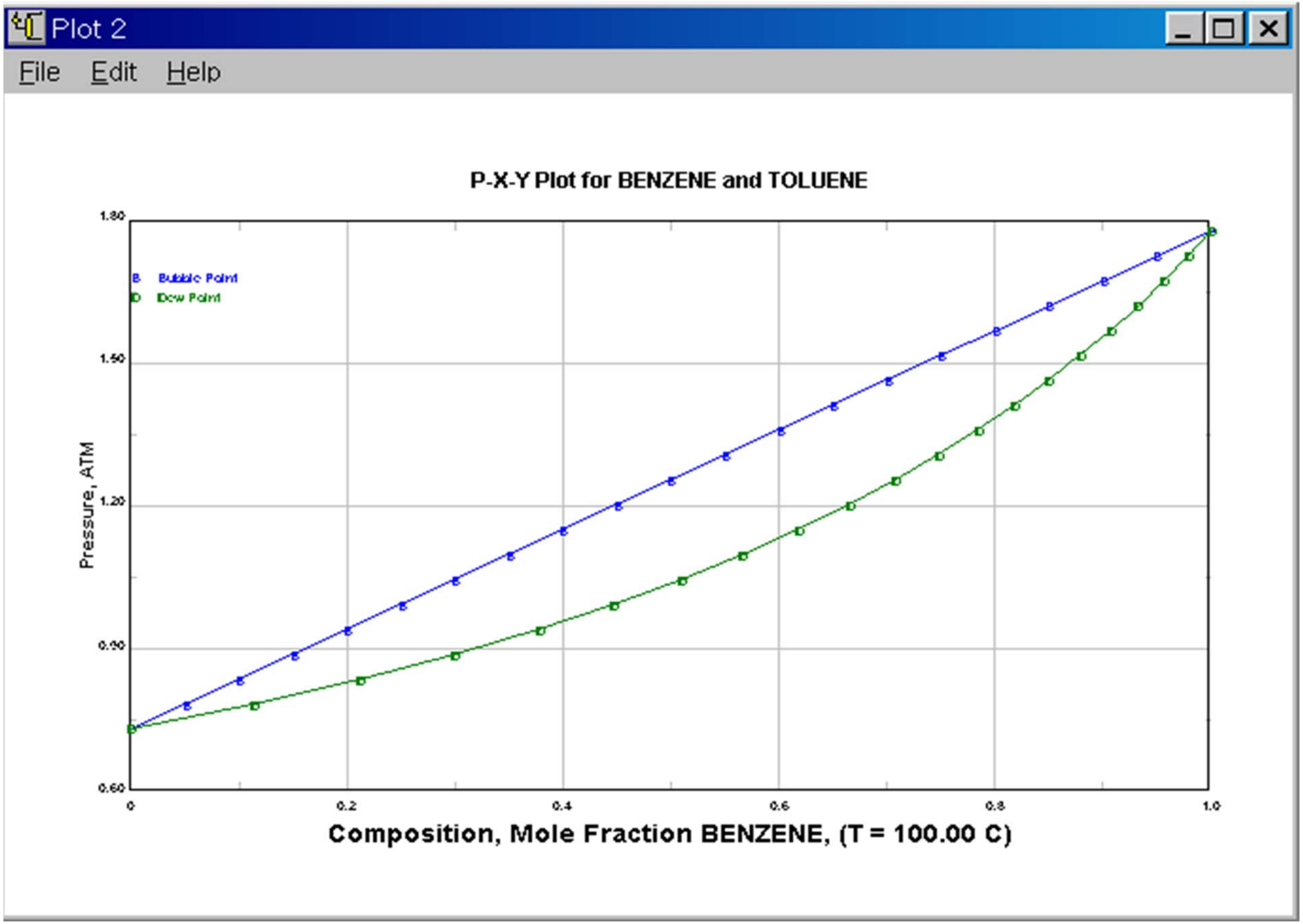
PRO/II Keyword Input for Flash Calculation

```
TITLE PROBLEM=PRBLEM-1A,PROJECT=CLASS,USER=JHCHO
 DIMENSION METRIC,PRES=ATM
 PRINT INPUT=ALL,PERC=M,FRAC=M
COMPONENT DATA
 LIBID 1,BENZENE/2,TOLUENE
THERMODYNAMIC DATA
 METHOD SYSTEM=IDEAL
STREAM DATA
 PROP STREAM=1,TEMP=25,PRES=1,RATE=100,COMP=1,60/2,40
UNIT OPERATION DATA
 FLASH UID=F01
  FEED 1
  PROD V=1V,L=1L
  ISO TEMP=100,PRES=1.2
END
```

PRO/II Output Summary for Flash Calculation

STREAM ID	1	1L	1V
NAME			
PHASE	LIQUID	LIQUID	VAPOR
FLUID MOLAR FRACTIONS			
1 BENZENE	0.6000	**0.4476**	**0.6629**
2 TOLUENE	0.4000	**0.5524**	**0.3371**
TOTAL RATE, KG-MOL/HR	100.0000	**75.6710**	**24.3290**
TEMPERATURE, C	25.0000	100.0000	100.0000
PRESSURE, ATM	1.0000	1.2000	1.2000
ENTHALPY, M*KCAL/HR	0.0865	0.2800	0.2681
MOLECULAR WEIGHT	85.1285	85.8632	82.8433
MOLE FRAC VAPOR	0.0000	0.0000	1.0000
MOLE FRAC LIQUID	1.0000	1.0000	0.0000

PRO/II BVLE Calculation

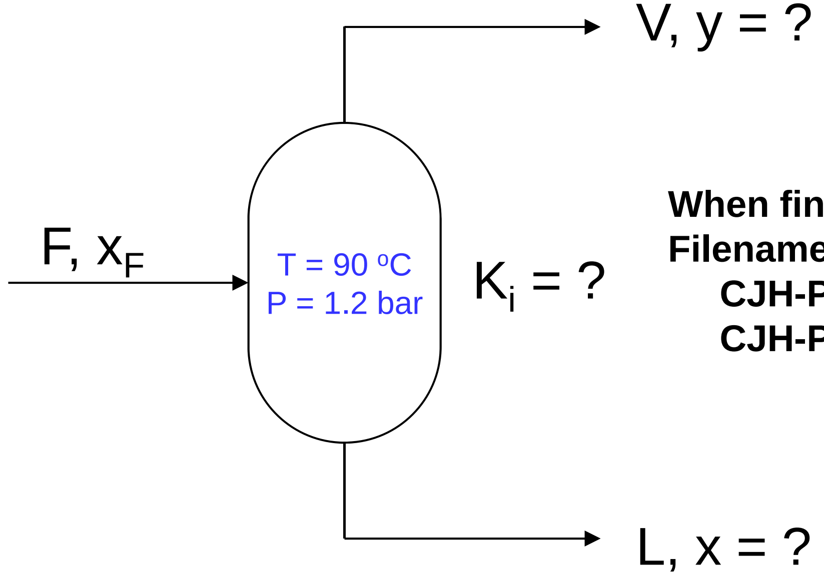


Problem-1 : Two Phase Flash

- A binary mixture stream of methanol and water, at 95°C and 3.5 bar, is fed a flash vessel, where it is flashed to 1.2 bar with vapor products in equilibrium at 90 °C.
- Use ideal Raoult's law for the simulation of this system.
- Calculate equilibrium compositions, K-values for each components and flow rates of vapor and liquid leaving the flash drum.

Feed Characterization	
Methanol	**??** mole %
Water	**100-??** mole %
Temp.	95 °C
Press.	3.5 bar
Flowrate	100 Kgmol/hr

?? : 본인의 생일 **2**자리 숫자



When finished, save as Filename:

CJH-Prob-1.bkp for ASPEN PLUS

CJH-Prob-1.inp for PRO/II.

Dew & bubble point calculation

- **Dew Point** is the very state at which condensation is about to occur.

- Dew Point Temperature Calculation at a Given Pressure
- Dew Point Pressure Calculation at a Given Temperature
- Vapor Fraction is ‘1’ at Dew Point

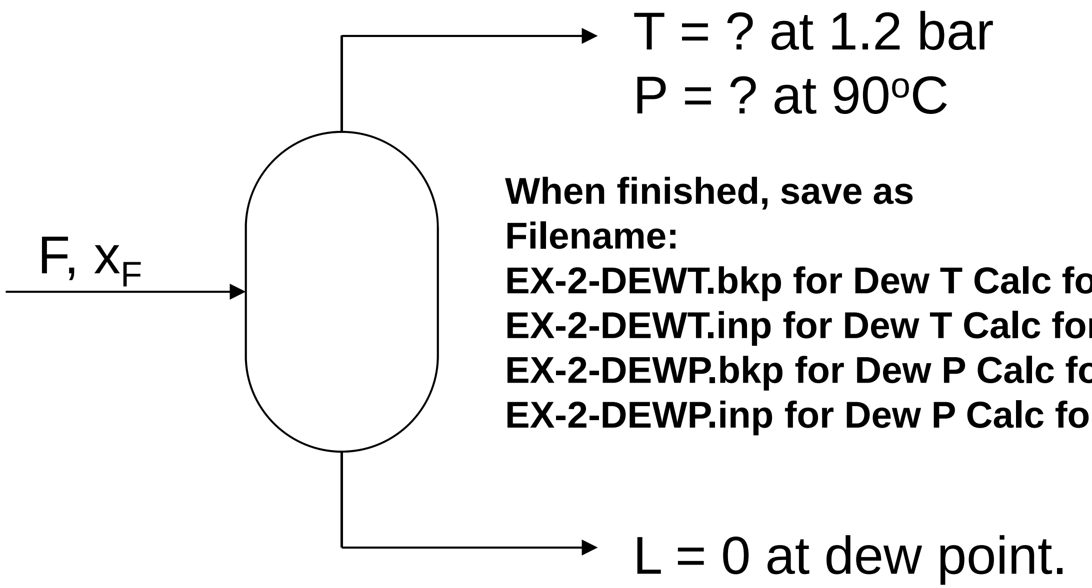
- **Bubble Point** is the very state at which vaporization is about to occur.

- Bubble Point Temperature Calculation at a Given Pressure
- Bubble Point Pressure Calculation at a Given Temperature
- Vapor Fraction is ‘0’ at Bubble Point

Ex-2 : Dew Point Calculation

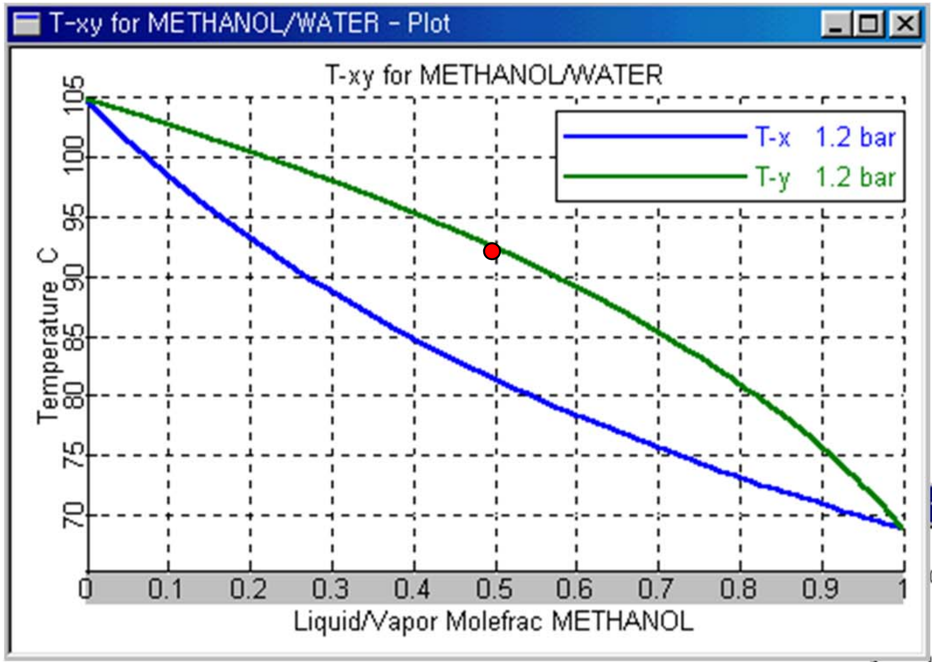
- Let us suppose that you are ordered to estimate the dew point temperature at 1.2 bar for an equimolar stream of methanol and water in order for a binary mixture not to condense.
- Use ideal Raoult's law for the simulation of this system.
- Calculate the dew point pressure at 90°C.
- Note that the feed condition does not affect the dew point.

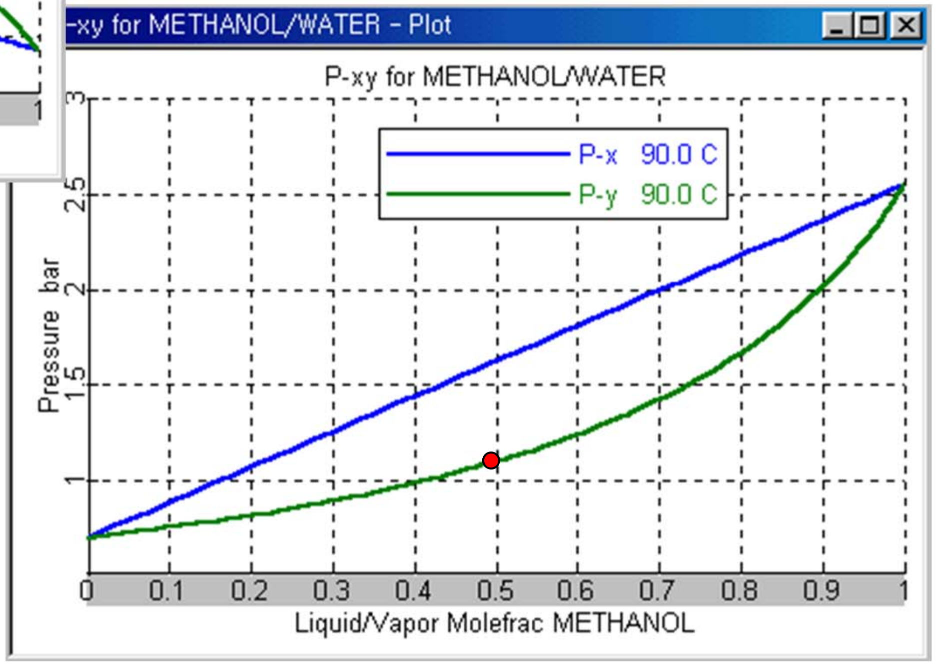
Feed Characterization	
Methanol	50 mole %
Water	50 mole %
Temp.	90 °C
Press.	3.5 bar
Flowrate	100 Kgmol/hr



When finished, save as Filename:
EX-2-DEWT.bkp for Dew T Calc for A+
EX-2-DEWT.inp for Dew T Calc for P2
EX-2-DEWP.bkp for Dew P Calc for A+
EX-2-DEWP.inp for Dew P Calc for P2.

Results for Ex-2



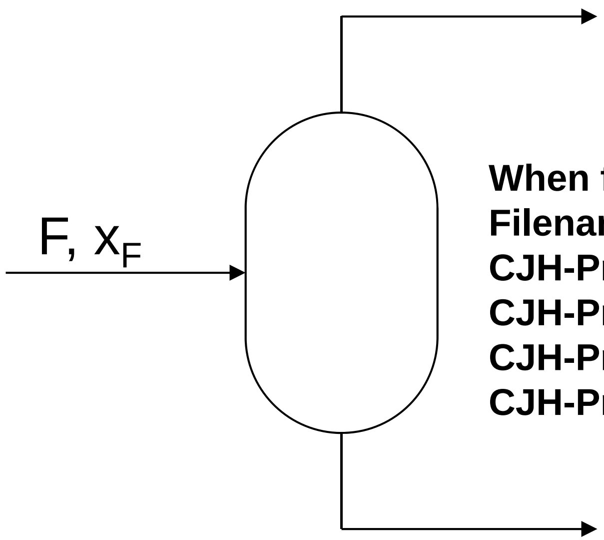


Problem-2 : Dew Point Calculation

- Let us suppose that you are ordered to estimate the dew point temperature at 1.2 bar for a given stream of methanol and water in order for a binary mixture not to condense.
- Use NRTL model for the simulation of this system.
- Calculate the dew point pressure at 90°C.
- Note that the feed condition does not affect the dew point.

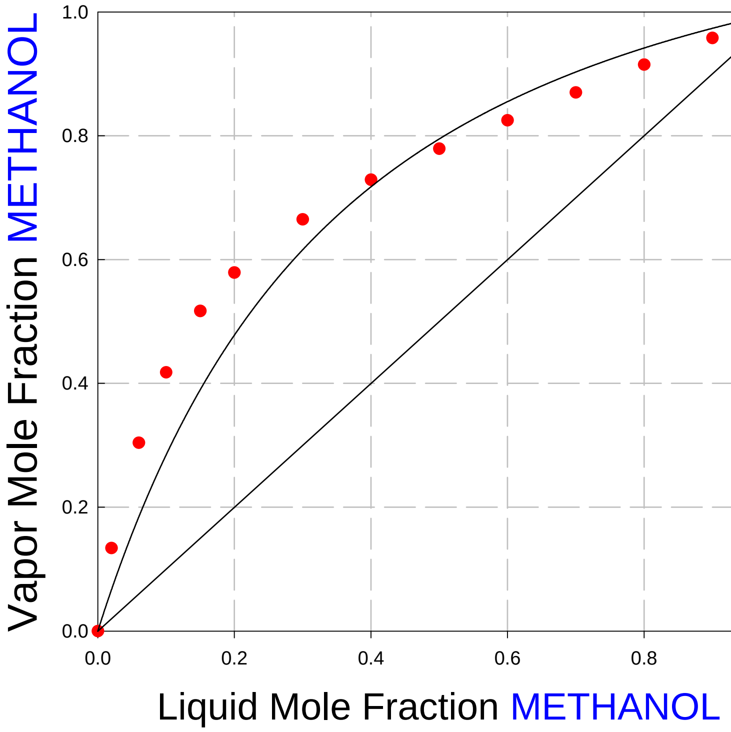
Feed Characterization	
Methanol	**??** mole %
Water	**100-??** mole %
Temp.	95 °C
Press.	3.5 bar
Flowrate	100 Kgmol/hr

?? : 본인의 생일 **2**자리 숫자

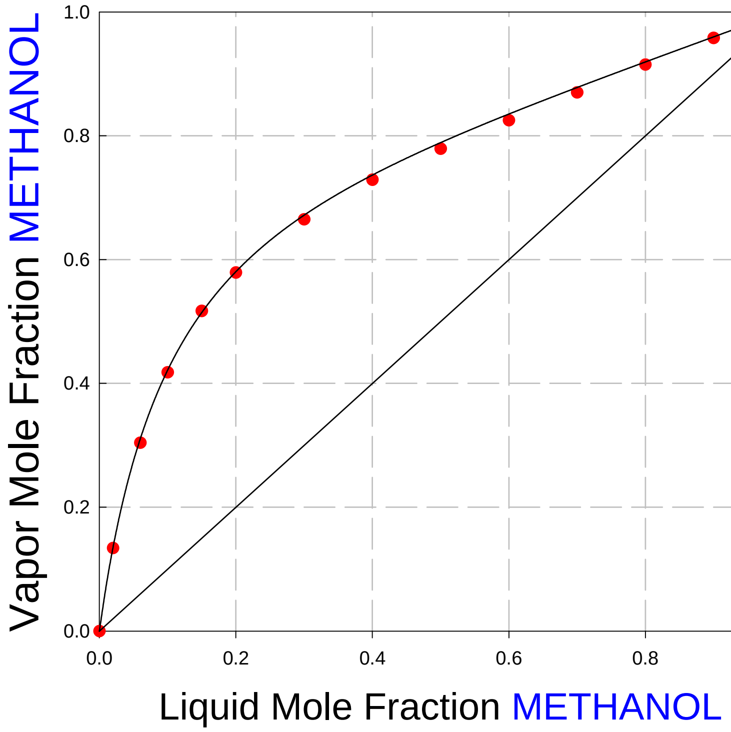


When finished, save as Filename:
CJH-Prob-2-DEWT.bkp in A+ &
CJH-Prob-2-DEWT.inp in P2 for Dew T Calc.
CJH-Prob-2-DEWP.bkp in A+ &
CJH-Prob-2-DEWP.inp in P2 for Dew P Calc.

Why NRTL Model instead of using Ideal Raoult's law ?



Ideal Raoult's law

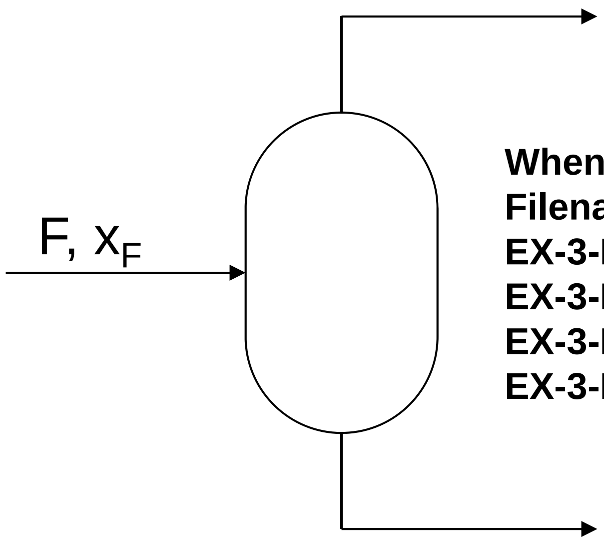


NRTL model

Ex-3 : Bubble Point Calculation

- Let us suppose that you are ordered to estimate the bubble point temperature at 1.2 bar for an equimolar stream of methanol and water in order for a binary mixture not to vaporize.
- Use ideal Raoult's law for the simulation of this system.
- Calculate the bubble point pressure at 90°C.
- Note that the feed condition does not affect the bubble point.

Feed Characterization	
Methanol	50 mole %
Water	50 mole %
Temp.	90 °C
Press.	3.5 bar
Flowrate	100 Kgmol/hr

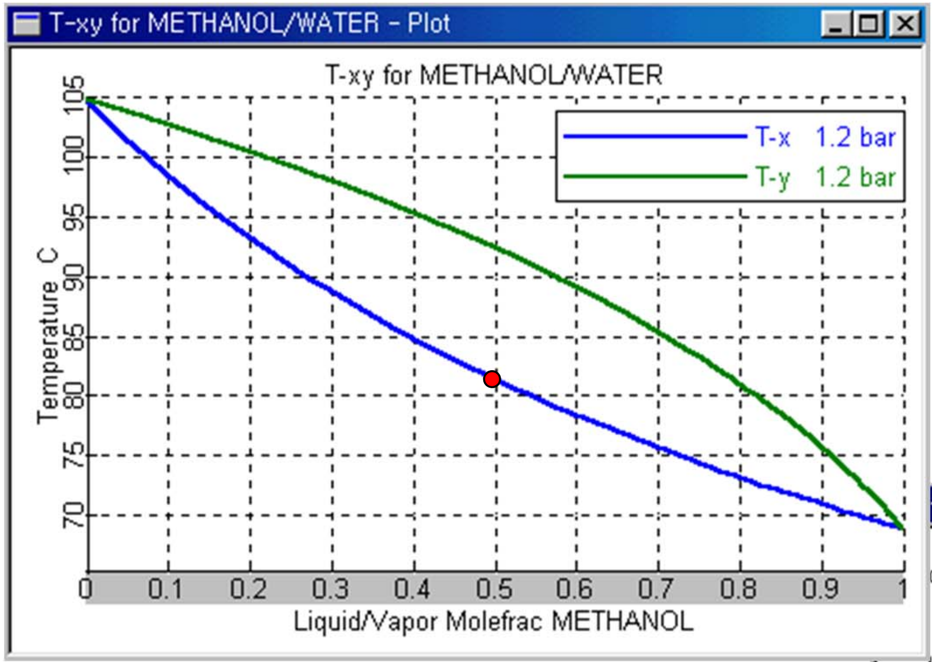


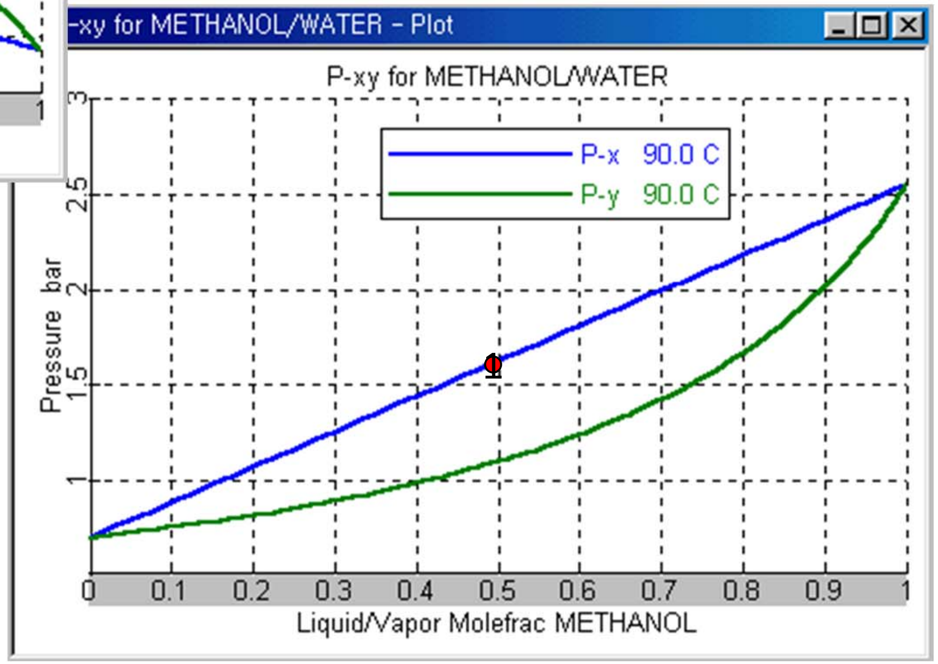
V = 0 at bubble point.

When finished, save as Filename:
EX-3-BUBT.bkp in A+ &
EX-3-BUBT.inp in P2+ for Bubble T Calc.
EX-3-BUBP.bkp in A+ &
EX-3-BUBP.inp in P2 for Bubble P Calc.

T = ? at 1.2 bar
P = ? at 90°C

Results for Ex-3



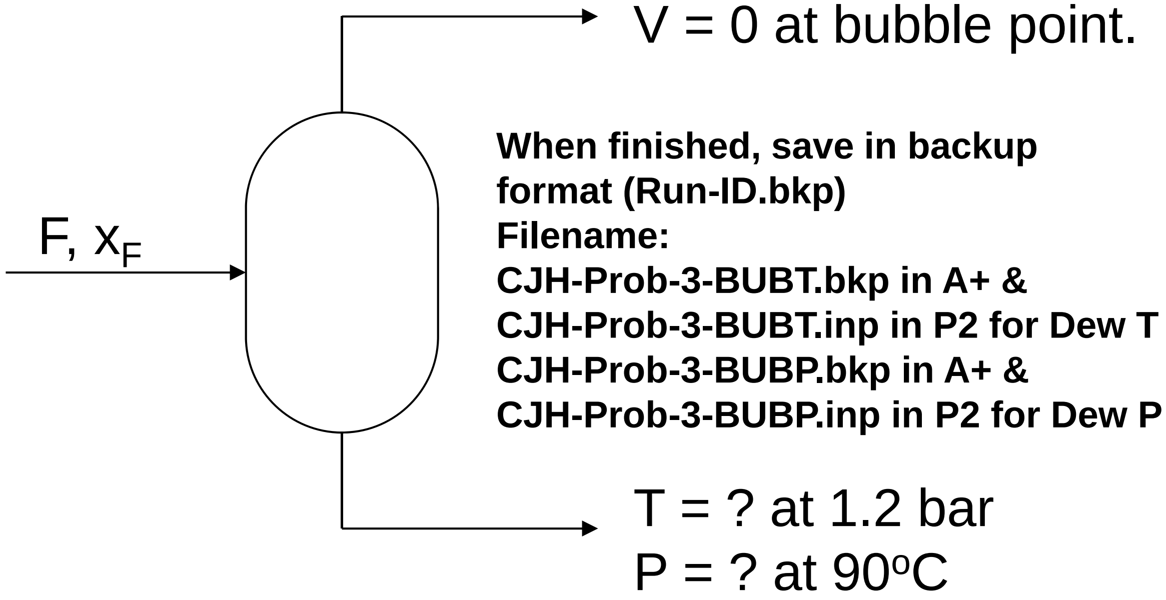


Problem-3 : Bubble Point Calculation

- Let us suppose that you are ordered to estimate the bubble point temperature at 1.2 bar for a given stream of methanol and water in order for a binary mixture not to vaporize.
- Use NRTL model for the simulation of this system.
- Calculate the bubble point pressure at 90^{o}C.
- Note that the feed condition does not affect the bubble point.

Feed Characterization	
Methanol	**??** mole %
Water	**100-??** mole %
Temp.	95 ^{o}C
Press.	3.5 bar
Flowrate	100 Kgmol/hr

?? : 본인의 생일 2자리 숫자



When finished, save in backup format (Run-ID.bkp)
Filename:
CJH-Prob-3-BUBT.bkp in A+ &
CJH-Prob-3-BUBT.inp in P2 for Dew T Calc.
CJH-Prob-3-BUBP.bkp in A+ &
CJH-Prob-3-BUBP.inp in P2 for Dew P Calc.