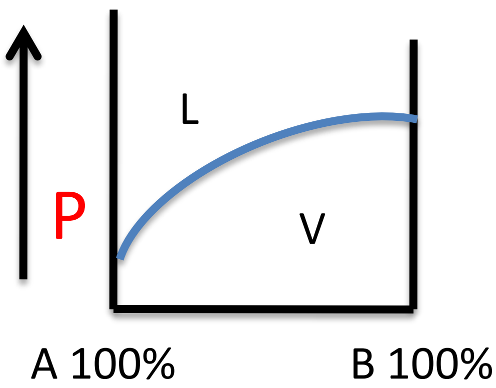
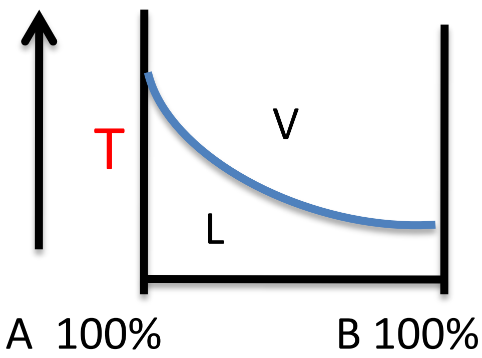
Distillation of

Real solution

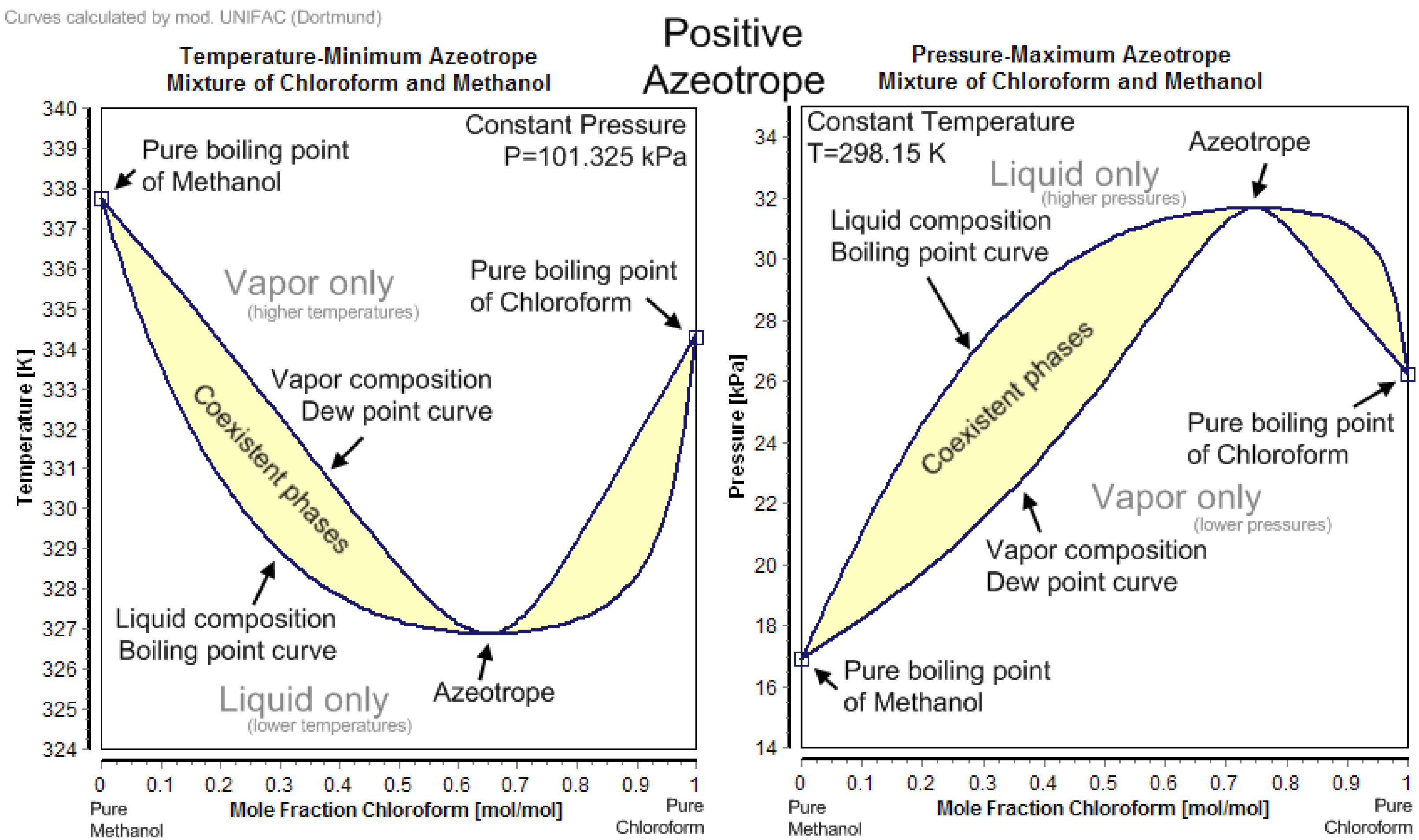
A- Positive deviation

- The distillation give azeotropic mixture which produce more volatile constituent plus mixture of constant composition and constant Tb.





Distillation diagram

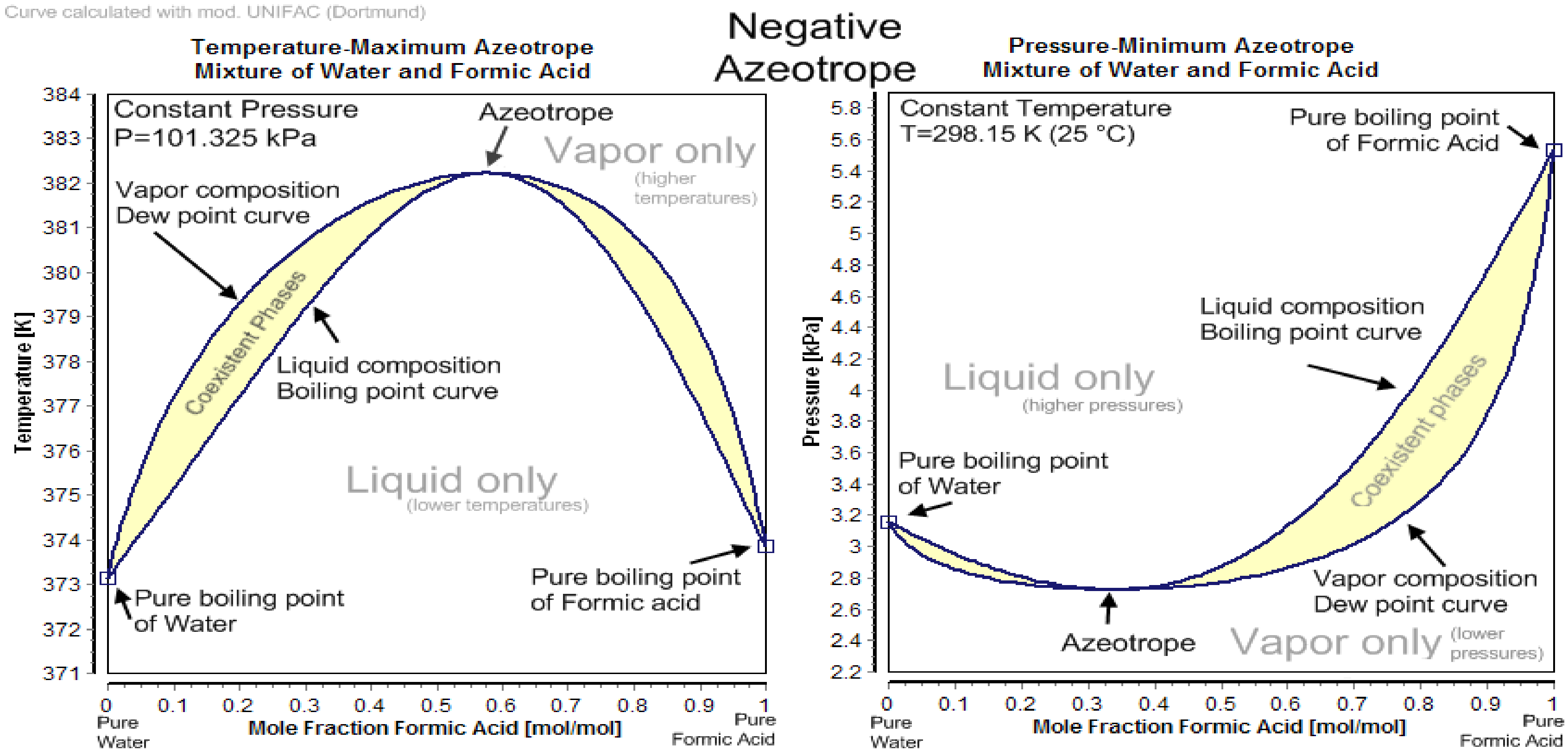


The distillation give low boiling point azeotrope or high V.P azeotrope

For example ($EtOH+H_2O$) and ($MeOH+ C_6H_6$)

B- Negative deviation

- The distillation give high boiling azotrope or low V.P. azeotrope for example
- (H_2O+HOAC) and ($CHCl_3$+ Me_2CO)



- Distillation of $HCl+H_2O$ azotropic mixture with 20.22% composition at 108.08 ^0C (High boiling) or (Low V.P.) azotrope.
- The composition of this mixture is constant and sufficiently accurate and reproducible so that the solution at 20.22% composition can be used a standard solution in analytical chemistry

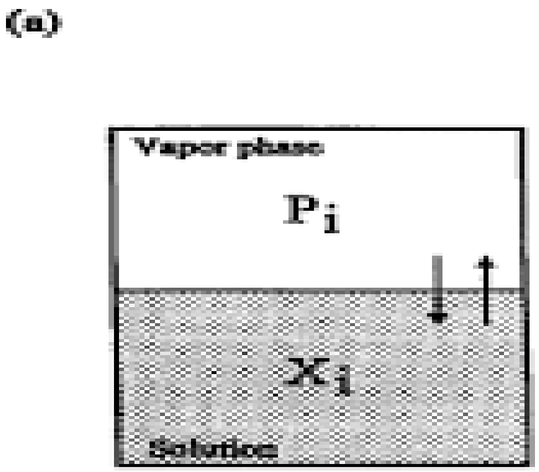
C- Immiscible liquids

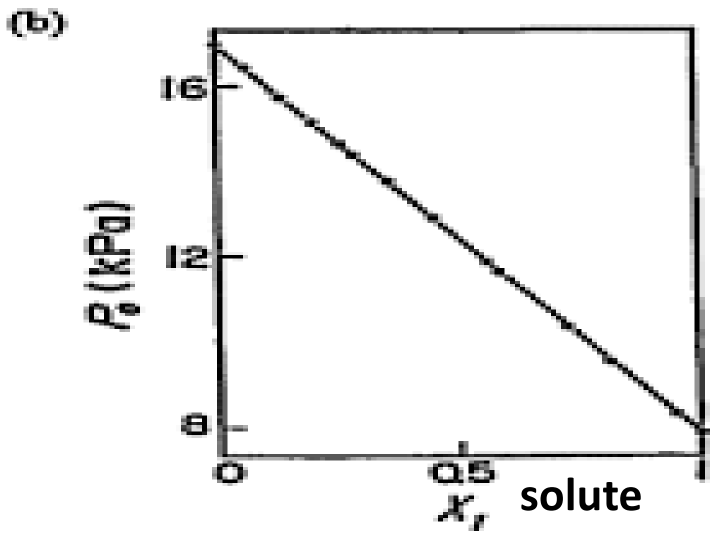
- When a mixture of two immiscible liquids heated, the distillation may be effected when the sum of the partial pressure ($\sum P_i$) is exceeds to atmospheric pressure.
    - $\sum P_i$ = 1 atmosphere
- This principle is applied in steam distillation for many organic compound insoluble in water.

- Steam distillation occurs below the normal boiling temperature so that it is useful to obtaining volatile oils from plant tissues with out decomposed the oils.
- Example:
- Bromobenzene boils in steam distillation at 95 ^{0}C
- Tb Bromobenzene =156.2 ^{0}C
- Tb water = 100 ^{0}C

Colligative properties

When a non volatile (solute) combined with a volatile (solvent), the solute reduces the escaping tendency (V.P.) of solvent on basis of Rault's law.





The colligative properties can be summarized as the following:

1- lowering of V.P. ($\Delta P \; \alpha \; C$)

2- Osmotic pressure ($\pi \; \alpha \; C$)

3- Depression of T_f ($\Delta T_f \; \alpha \; C$)

4- Elevation of T_b ($\Delta T_b \; \alpha \; C$)

These 4 properties called colligative properties depend chiefly on the number rather than the nature of the constituents (on the concentration)

Lowering of vapor pressure

For a dilute solution, according to Rault,s law

$P = X_1 P^0_1$

$X_1 = 1 - X_2$ .... (1) solvent, (2) solute

$P = (1 - X_2) P^0_1 \Rightarrow P = P^0 - P^0_1 X_2 \Rightarrow P^0_1 - P = P^0_1 X_2$

$(P^0_1 - P)/P^0_1 = X_2$ or $\Delta P/P^0_1 = X_2 = n_2/(n_1 + n_2)$

Where ΔP: lowering vapor pressure

$\Delta P/P^0_1$:relative V.P, lowering

Now:

In very dilute solution n1>>n2 so that

$n_2/(n_1+n_2) \approx n_2/n_1$

And $\Delta P/P^0_1 = X_2 = n_2/n_1 = (W_2/Mw_2)/(w_1/Mw_1)$

$[(W_2/Mw_2)/(w_1/Mw_1) * 1000/1000)]$

$= m * Mw1/1000$

$\Delta P/P^0_1 = X_2 = m * Mw_1/1000$

$\Delta P/P^0_1 = 0.018\ \mathbf{m}$ ……… for aqueous solution