System of three liquids - (one pair partly soluble) ⇒ (A & B)

⇓

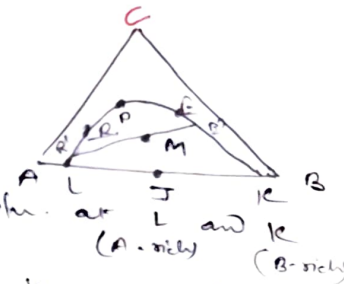
most common type.

Ex. - water (A) + acetone (C) ⇒ Chloroform (B)

- benzene (A) + Acetic Acid (C) ⇒ water (B)

- liq (C) dissolve completely in A and B.

- (A) + (B) dissolve only to limited ⇒ Sat. liq soln. are L and K (A-rich) (B-rich)



- Binary mix J any where between L and K will separate in to two insoluble liquid phases of composition at L and K.

- Curve L R P E K ⇒ Solubility curve

⇓

change in solubility of A rich and B rich phase by addition of C.

→ mixture outside this curve → homogeneous soln.

→ any ternary mix underneath the curve (M) will form 2 insoluble sat. phases of equilibrium composition (R' and E')

→ Line joining the eqm composition is tie line.

+ there are infinite no. of tie line.

+ they are rarely parallel and change their slope slowly in one dirn.

+ Plait point → last tie line

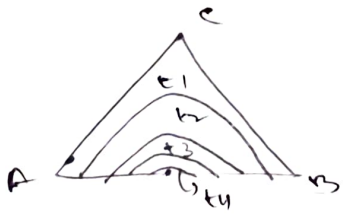
→ point E lies above point R ⇒ $\frac{y^*}{x}$ (distribution coeff.) > 1

+ if tie line slope in the opposite dirn, the distribution curve (y^*/x) will lie below the diagonal.

Effect of Temp:

T ↑ ⇒ Solubility of A in B (↑)

above critical temp complete dissolution takes place.



Effect of Pressure)

effect of — negligible effect of on equm.

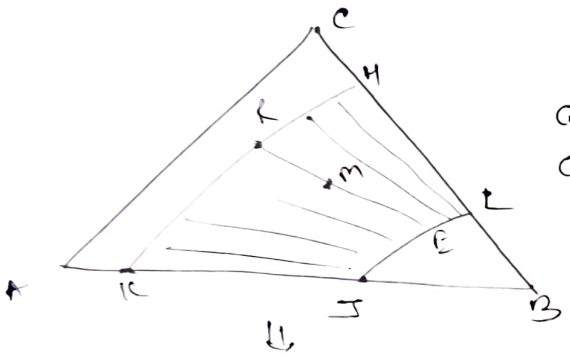
→ Sufficient high Pres to maintain ⇒ Condensed sys.
⇓
above the V.P of the solution

→ lower pres ⇒ vap. phase
⇓
it will delt differently.

System of three liquids - (2 pairs partly soluble)
A & B and B & C.

Eg. Chloro benzene (A) + water (B) + Methyl ethyl ketone (C)

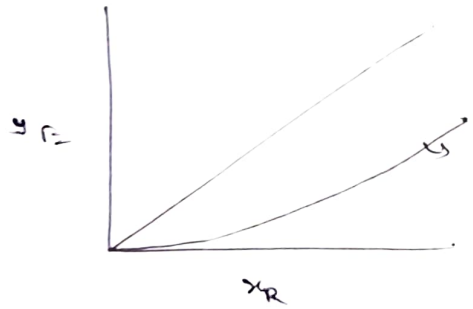
A-C ⇒ completely soluble.
AB and BC ⇒ partly soluble.



IC and J ⇒ mutual solubility of A and B.
H and L ⇒ " " " B and C

Curve K R H ⇒ A rich
Curve J E L ⇒ B rich.

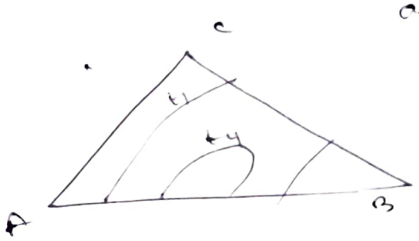
mix outside band ⇒ homogenous single phase liq soln.



⇒ distribution curve.

Effect of temp) T(↑) ⇒ Solubility (↑)

above critical solution temp of the binary B-C (t_3)
System is similar to first type.

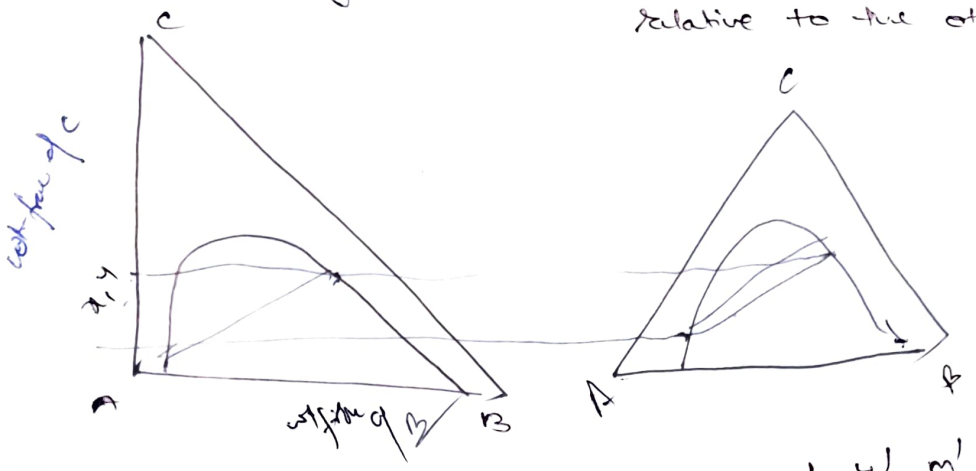


Ex

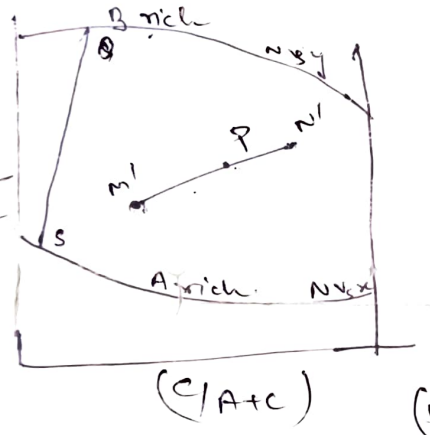
Partly soluble liq. A & B and solids (C)
Aniline (A) + isooctane (B) and naphthalene (C)
(P → 1 atm Tregtal)

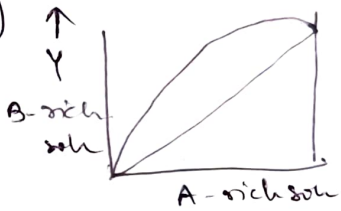
Other co-ordinates

(1) - Rectangular co-ordinates ⇒ Expand one conc scale relative to the other.



(2) on B-free basis. (Brine) → x', y', m'



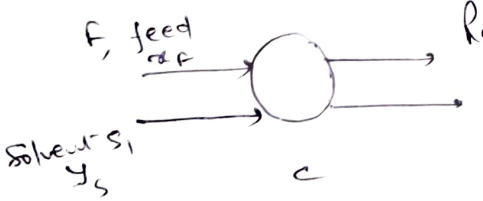


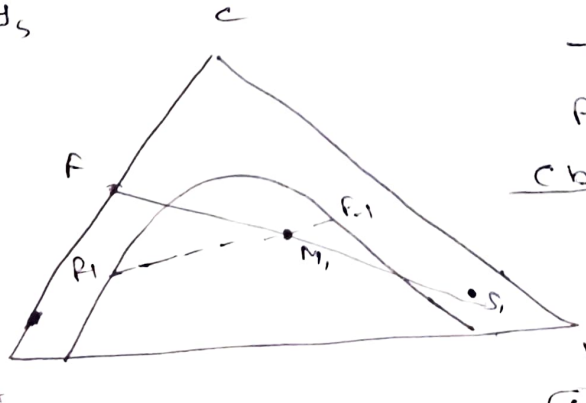
≡ similar to Enthalpy-Conc.

$$\frac{m'}{N'} = \frac{Y_N - Y_P}{Y_P - Y_M} = \frac{X_N - X_P}{X_P - X_M} = \frac{\text{line } NP}{\text{line } PM}$$

distillation → addition of heat —
Extraction → " " " solvent — ⇒ heat and solvent or analogous.

Stage-wise Contact: ⇒ batch or continuous. (x, y are eqm)





Total material balance

$$F + S_1 = M_1 = E_1 + R_1 \quad \text{—— (1)}$$

C balance

$$F x_F + S_1 y_S = M_1 x_{M_1} \quad \text{—— (2)}$$

from (1) and (2) eliminating M_1

$$\frac{S_1}{F} = \frac{x_F - x_{M_1}}{x_{M_1} - y_S} \quad \text{—— (3)}$$

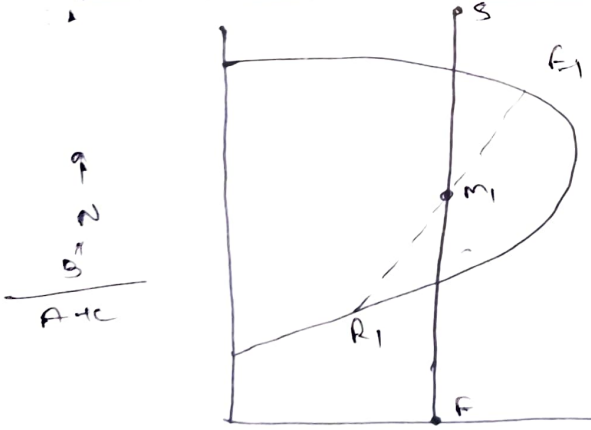
$$E_1 y_1 + R_1 x_1 = M_1 x_{M_1} \quad \text{—— (4)}$$

$$R_1 = M_1 - E_1, \quad \text{—— (5)}$$

$$E_1 = \frac{M_1 (x_{M_1} - x_1)}{y_1 - x_1} \quad \text{—— (6)}$$

– Key point L ⇒ lowest possible C conc.

Similar method for two pairs partly soluble ⟶



if S is pure B ⇒ vertical line ($N = \infty$)

General Eqn >

Total

$F' + S' = M_1' = E_1' + R_1'$ ($S' \rightarrow$ B)

C Balance

$F' x_F + S' x_S = M_1' x_{M_1} = E_1' Y_1 + R_1' x_1$

$x_F = \frac{B}{A+C}$

B Balance

$F' N_F + S' N_S = M_1' N_M = E_1' N_{E_1} + R_1' N_R$

generally ⇒ $N'_F = 0$

$E_1' = \frac{M_1' (x_{M_1} - x_1)}{(Y_1 - x_1)}$ ⇒ ($R' = M' - E_1'$)

$R' =$ ✓

Total weight of Extract (E) and Raffinate (R)

$E = E'(1 + N_{E_1})$ ⇒ $R_1 = R'(1 + N_{R_1})$