Selectivity:

The effectiveness of the solvent may be expressed by Comparing the ratio of solute to liquid A in B rich phase to that in the A-rich phase at equilibrium. This is defined as the "selectivity" of the solvent or the "separation factor" (similar to relative volatility in distillation). (*) C ⇒ solute.

$$\beta = \frac{(\text{mass fraction of C in B rich})/(\text{mass fraction of A in B rich})}{(\text{mass fraction of C in A rich})/(\text{mass fraction of A in A rich})}$$

E: B rich R: A rich.

$$\beta = \frac{y_{CE}/y_{AE}}{x_{CR}/x_{AR}} = \frac{y_{CE}}{x_{CR}} \cdot \frac{x_{AR}}{y_{AE}}$$

(زي K_D ∝) VLE زي

$\beta = \frac{K_C}{K_A}$

$\beta = \frac{y_{CE}/x_{CR}}{y_{AE}/x_{AR}}$

$\beta = \frac{K_C}{K_A}$ ← y, x, C →, ↳ B → C, ↳ $\frac{y_{AE}}{y_{AR}}$

For $K_C = \frac{y_{CE}}{x_{CR}}$; $K_A = \frac{y_{AE}}{x_{AR}}$

$$\boxed{\beta = \frac{K_C}{K_A}}$$

$K_C > K_A$

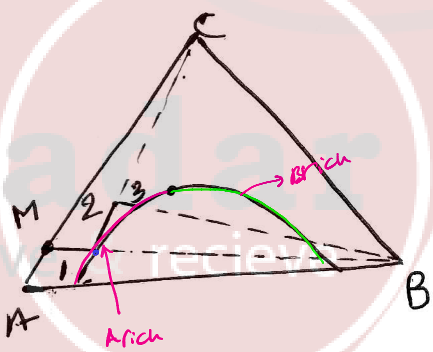
we want transfer from E → R

Experimental determination of data:

Solubility (binodal curve or demixing curve or solubility limit)

An isothermal binodal curve is determined as follows:

1. Start with a known mixture of A and C in the miscible range - Point M.
2. Add component B by titration until mixture becomes turbid (cloud point) point 1
3. Add known amount of C to obtain point 2 in the miscible range.
4. Add more B to obtain point 3
5. Continue to obtain the complete binodal curve



① ح/ أبدأ من عند M وبعدين أضيف B لحد ما يعكّر المحلول (Titration) قدرنا نحصل على ما يب نقطة

② وبعدين بضيف C عشان يرجع ما مي

③ أرجع أضيف B لحد ما يعكّر

ونعيد لـ rich إذا بدينا

Tie line determination:

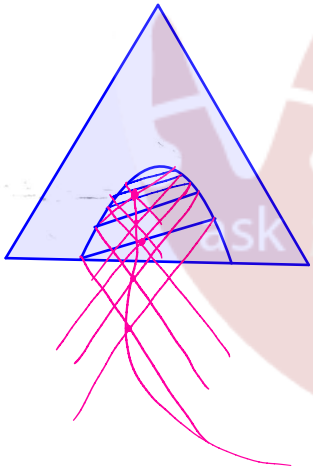
1. Starting with a suitable overall composition of A and B in the immiscible range, component C is added by titration
2. The two phases are then intimately contacted until equilibrium is reached and then they are left to settle.
3. Small samples of each phase are withdrawn and analysed in order to determine tie line data
4. The above procedure is repeated until a homogeneous phase is obtained

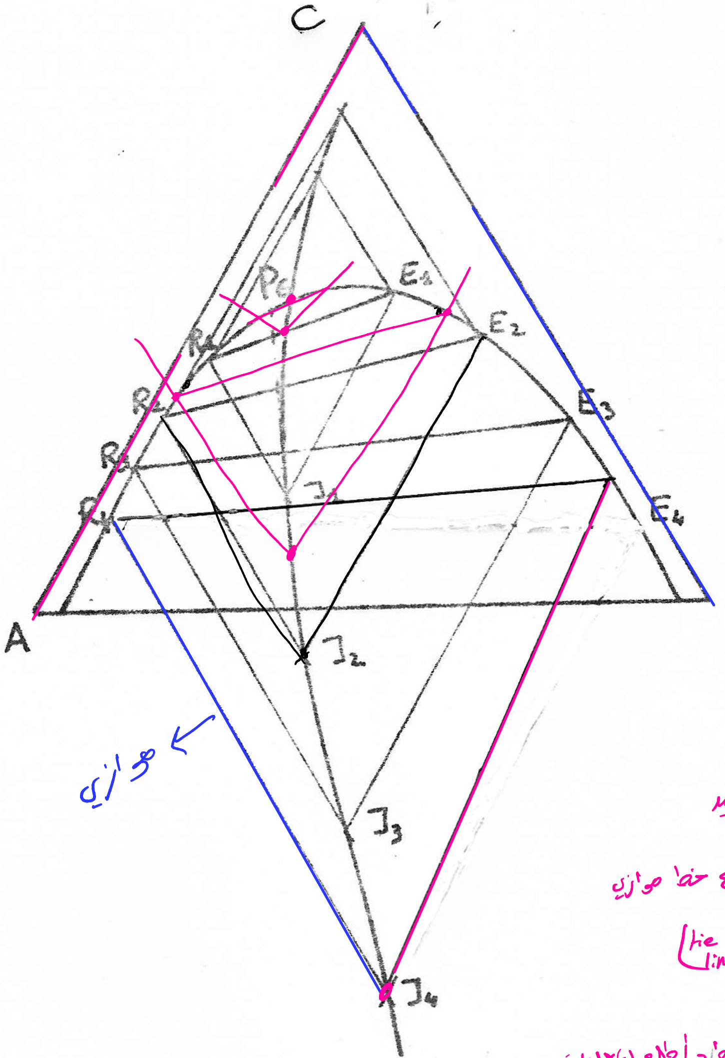
* each tie line is an equilibrium relationship

Tie line correlations:

Generally the published equilibrium data is presented in the form of solubility data with a limited number of tie line data, and for process calculations it is necessary to interpolate or extrapolate to cover the full range of interest. If sufficient data is available the distribution curve may be used.

Alternatively, tie line correlation or conjugation curves may be constructed. by drawing lines parallel to the sides of the triangle from the ends of available tie lines. The points of intersection of these lines lie on the conjugate curve. This curve can then be used to locate other tie lines.





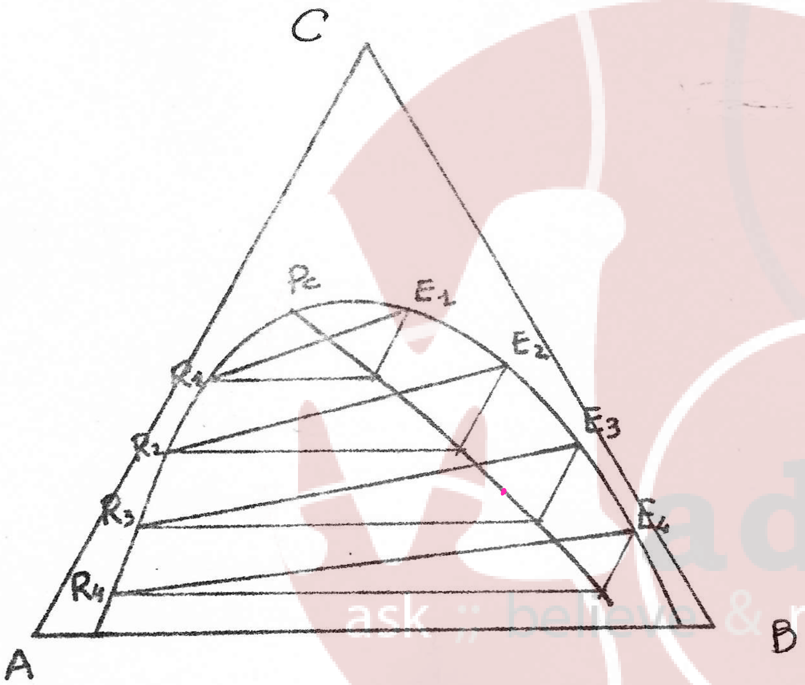
هيك عشان أرسم conjugate curve

هنا لو بدي أرسم tie line جديد

بحدد النقطة وبعدين برسم خط موازي
زي قبل لحد ما يقطع عند (tie line)

وبرسمه

أو ممكن استخدم النقاط وأطلع المعادلة
بس بتغير (عكسه)



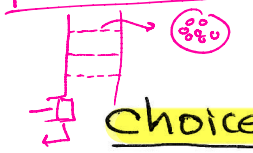
Types of Contactors:

- Mode of contact
  - continuous (differential)
  - Stagewise
    - Discontinuous (single stage)
    - Mixer settlers – Horizontal
      - Vertical.
- Agitation
  - Agitated – MS, RDC, Pulsed columns
  - non agitated – spray columns
- Separation of phases
  - By gravity
  - by centrifugal force

RDC = Rotating Disc contactors

- compactness
- high throughput
- very low residence time

Pulsed columns:



Choice of Solvent:

1. High selectivity for solute or separation factor β
2. Separation after mixing must occur quickly. ie reasonable differential density, interfacial tension and viscosity prevent emulsification.
3. low viscosity reduces pumping cost
4. Low vapor pressure to avoid high pressure operation
5. Check toxicity, inflammability and cost.

Limits high vapor pressure might be operated at high pressures

LL 10

Basic Extraction Calculations:

General:

All extraction systems are partially miscible to some extent; some systems can be considered as completely immiscible (Benzen and water)

For immiscible systems, flow rates of carriers (A and B ≡ R and E) can be considered constant and McCabe-Thiele type analysis or Kremser equations are used for the extraction calculations.

For partially miscible systems, a calculation method which allows for the variable flow rates must be used.

In the following, calculation procedures will be limited to isothermal ternary systems for the following arrangements:

- Single stage
- Cross flow
- Countercurrent multistage.

The solution may be handled in two ways

- Stage wise calculations (stage to stage)
- Graphical determination.

For ternary systems, the following sets of equations may be used:

- 3 independent mass balance equations
- 1 composition equation $\Sigma \text{conc} = 1$
- 1 eqm relationship for each stage.