Polymer-polymer interaction

It occurred when two oppositely charged lyophilic colloids are mixed (like acacia-gelatin system) to form a complex having such reduced solubility to cause phase separation coacervation.

Here, gelatin at a pH less than its isoelectric point (positively charged), acacia is negatively charged (acidic gum), under proper temperature (like 40°C), pH (~4) and concentration.

Chemical reaction is occurred between the two polymers.

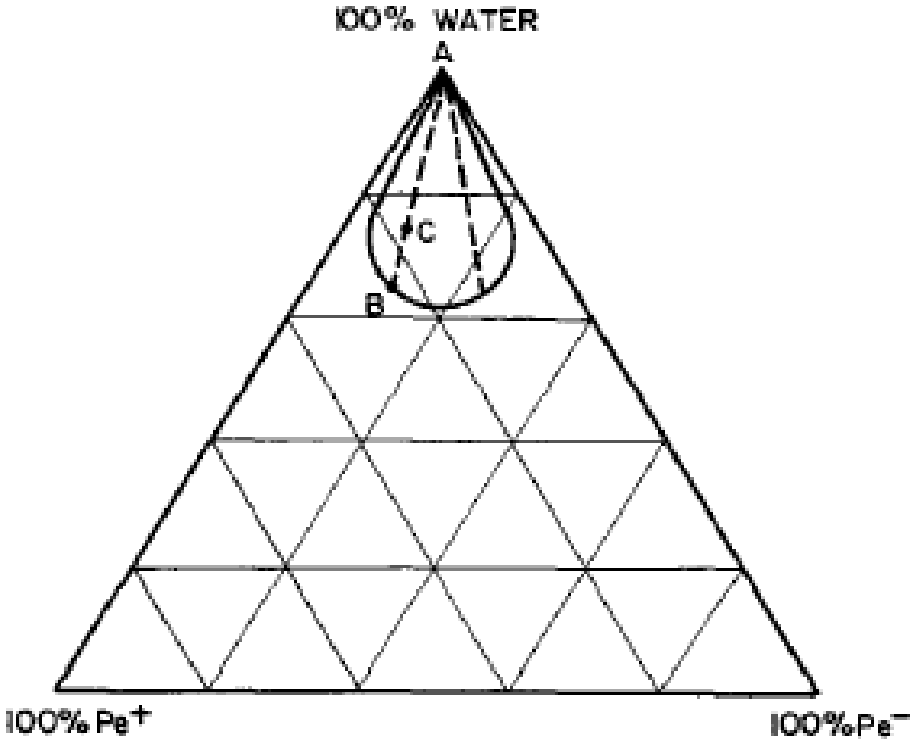
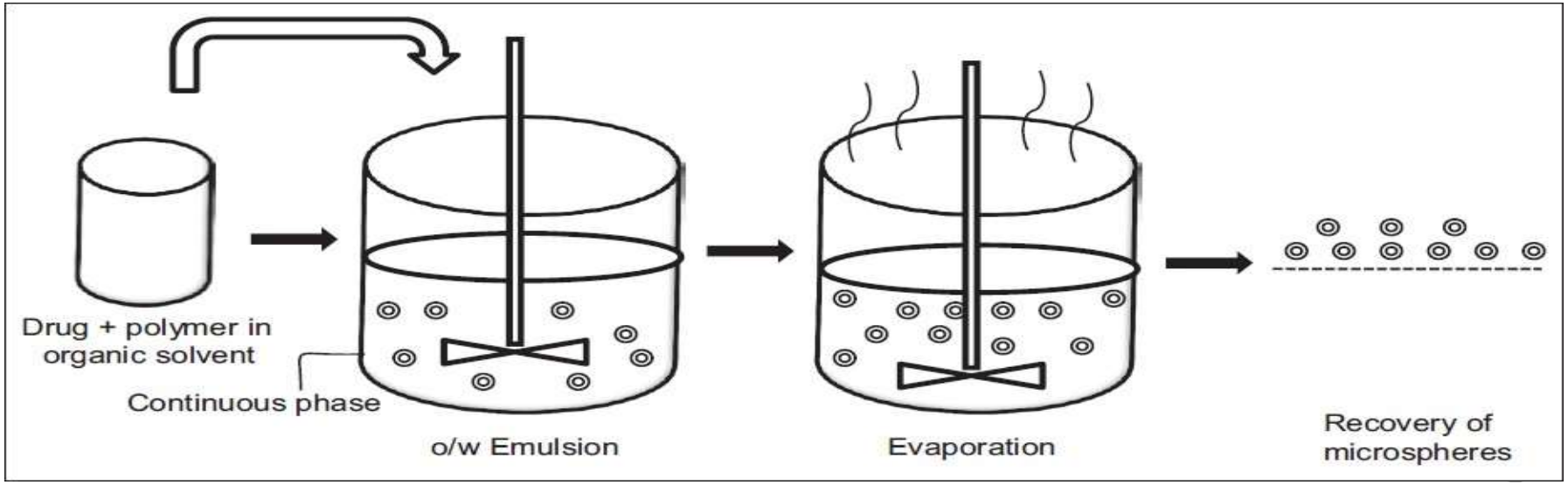


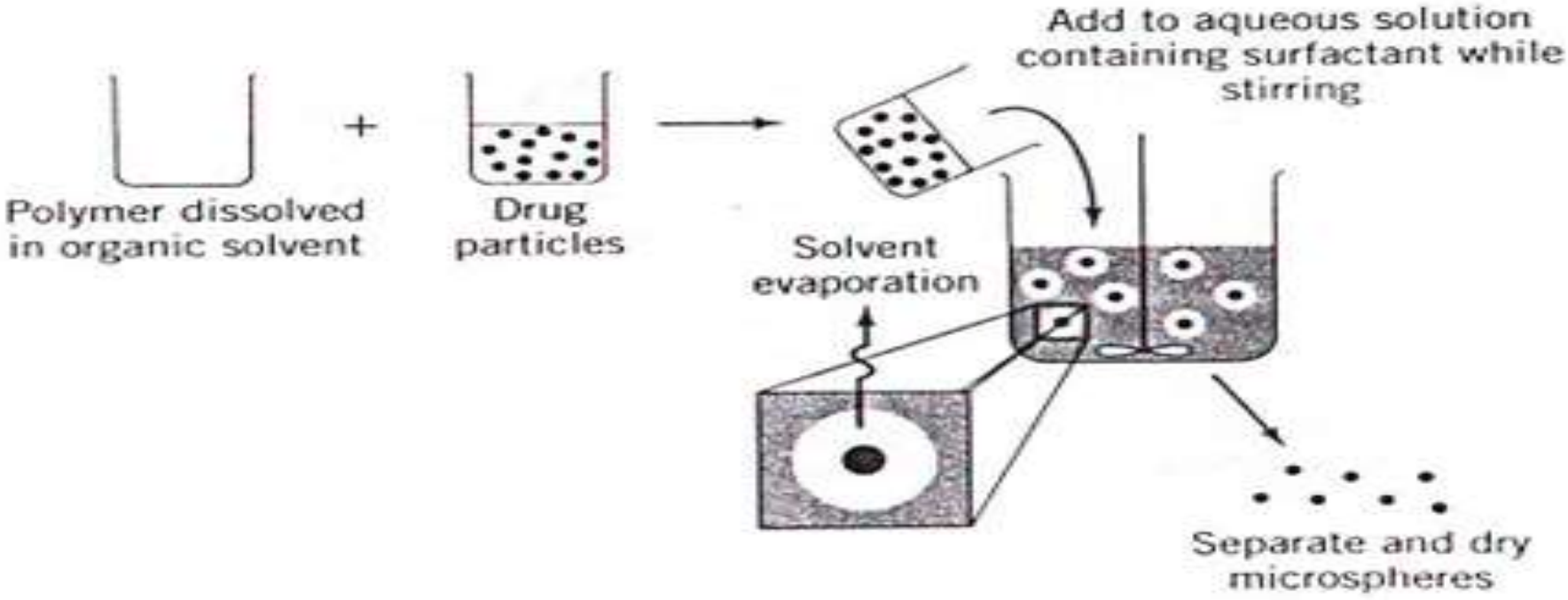
FIG. 13-43. *Phase diagram for phase-separation/coacervation by polymer interaction. (From Bakan.[28])*

Solvent evaporation

- Is the most popular, in which the core and wall materials are dissolved in water-immiscible volatile organic solvent and the resulting solution is emulsified in an aqueous solution.
- The solvent is allowed to evaporate, thereby producing solid microparticles.

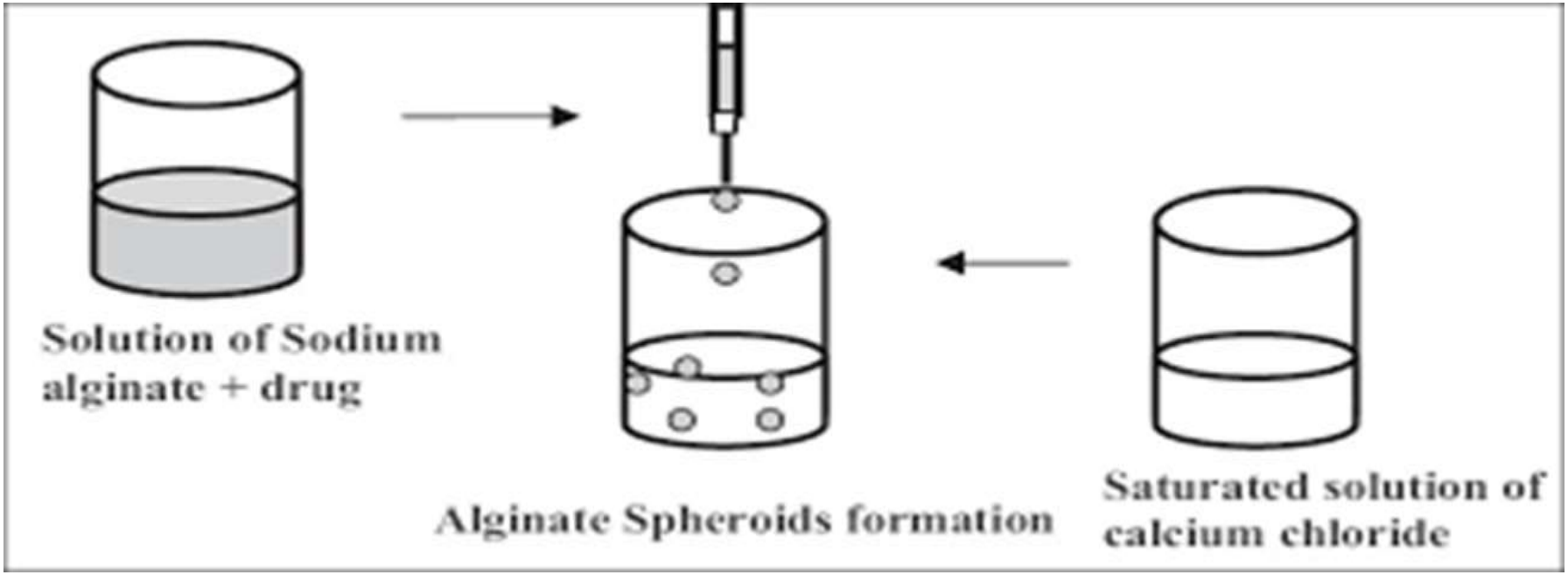


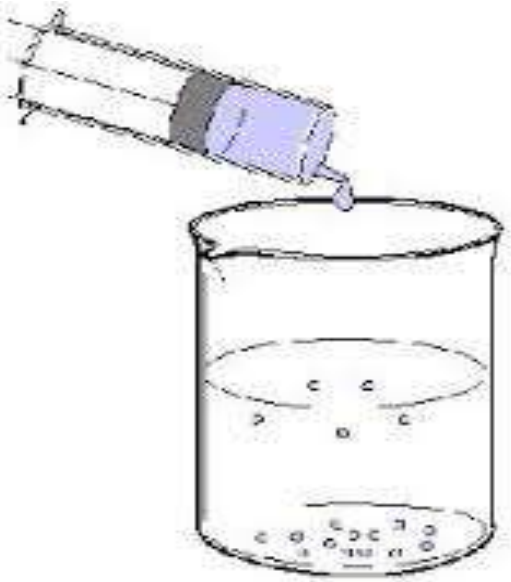
- **Also, the drug may be dispersed into second solvent (different beaker) and then added.**
- **We have different solvent systems (o/w), (o/o), (w/o/w)…**
- **There is limitation for use of aqueous dispersion phase in case of water soluble drugs?? Why and how treated??**



Gelation

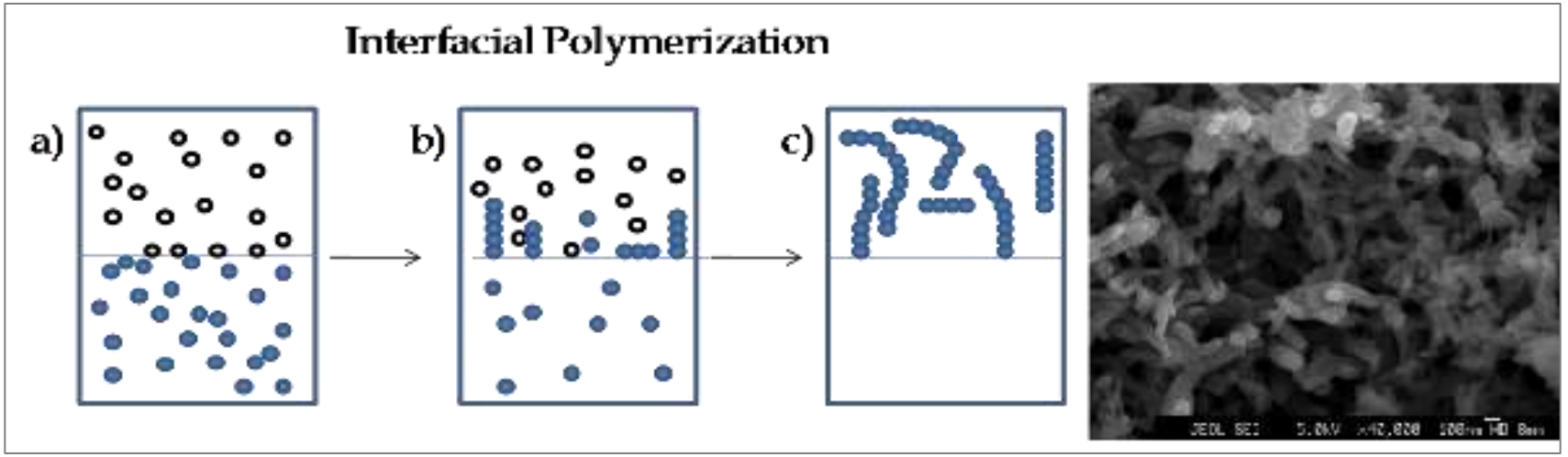
- Is a specific method using alginate salts (like sodium) as wall material by forming gels from reaction with calcium salts (ex, 1% of calcium chloride).
- The method involve dissolving of polymer into water, dispersing of the core into polymer solution, dropping into calcium chloride solution to form calcium alginate beads or spheroids of drug (beads are aggregates of microcapsules).

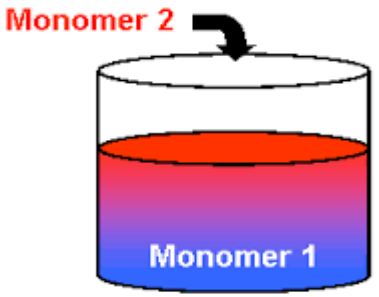

Solution of Sodium alginate + drug
Alginate Spheroids formation
Saturated solution of calcium chloride



Interfacial polymerization

- Involves the condensation of two monomers at the interface of the organic and aqueous phases (like water and n-hexane), forming the polymeric membrane.





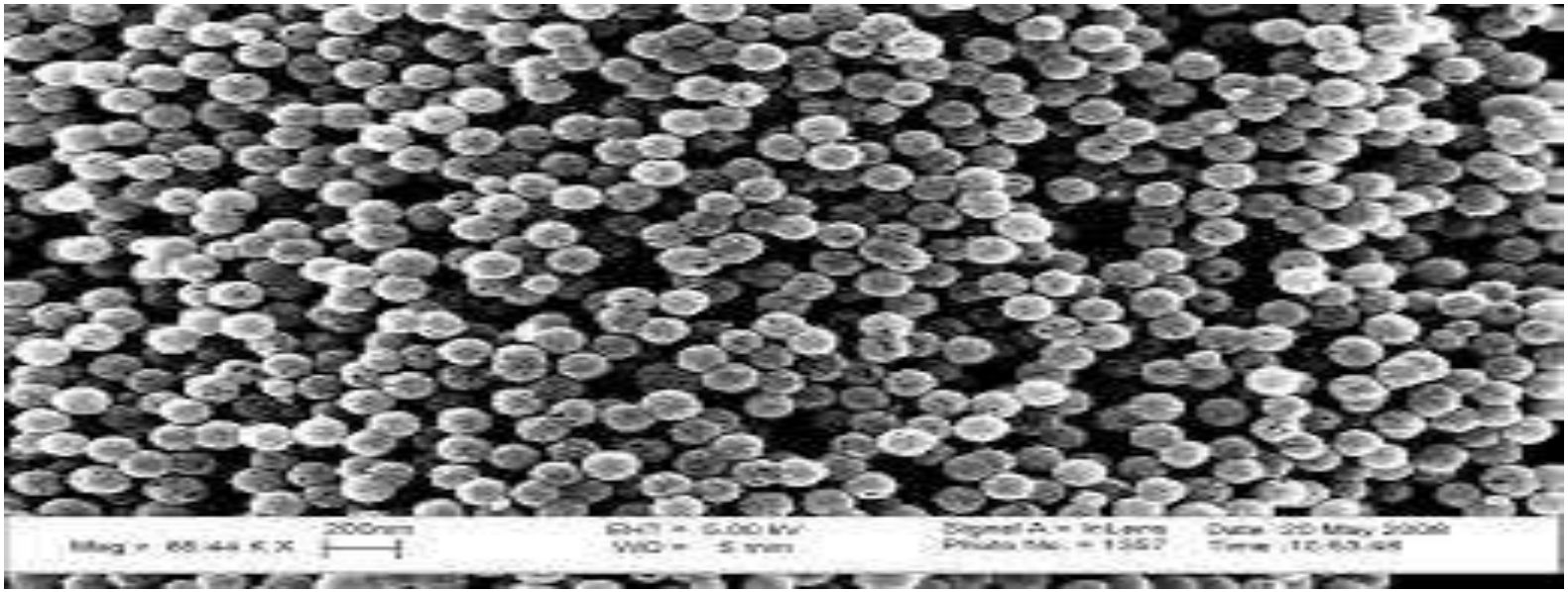
Note:

For each methods there are factors affecting the quality of microcapsules, which are either general or specific ??.

As general factors are:

1) **Polymer type and amount**
2) **Core type and amount**
3) **Solvent system type and amount**
4) **Core: wall ratio**

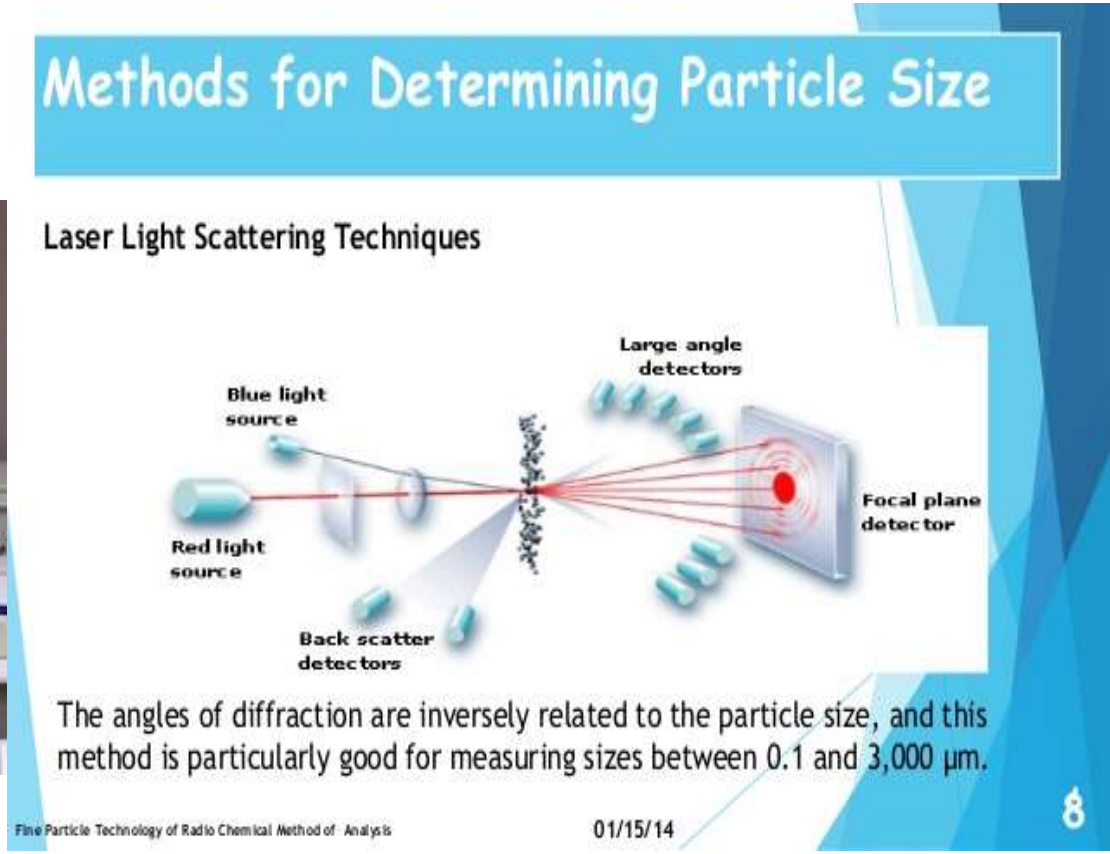
Evaluation



Evaluation of microcapsules

- **Generally involves:**

1) Particle size distribution (size, density and shape) using microscopical methods, light scattering methods and density measurement methods.



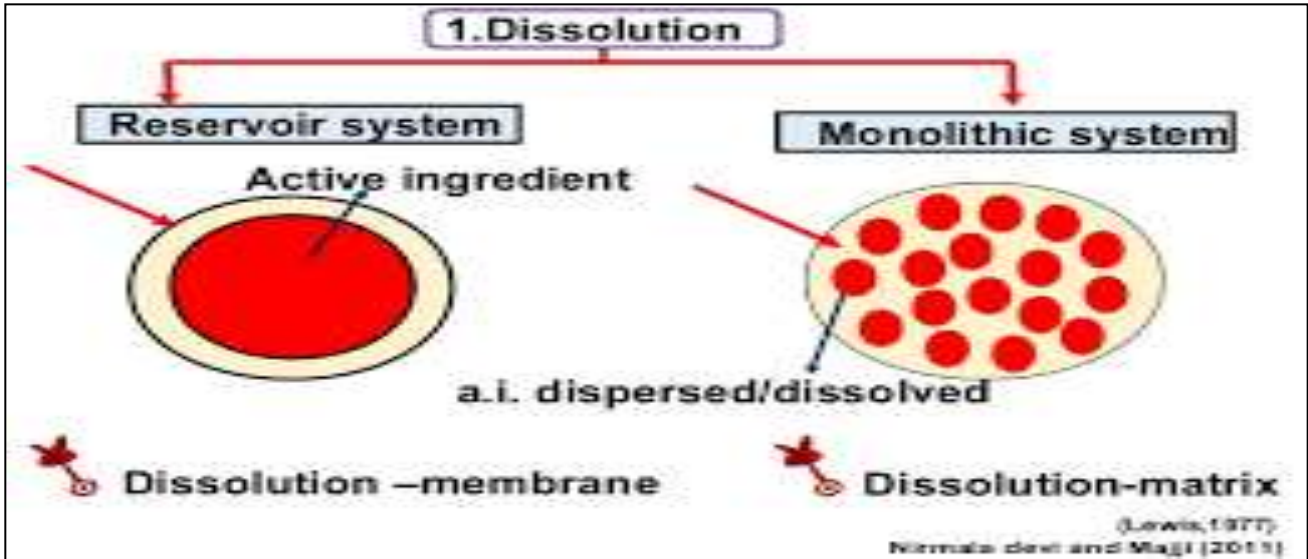
2- Yield % and encapsulation efficiency (drug loading)

3- Thermal analysis : (DSC, DTA, TGA)…….are important for detection if there are physical changes.

4- FTIR study (for chemical changes)

5- Stability study

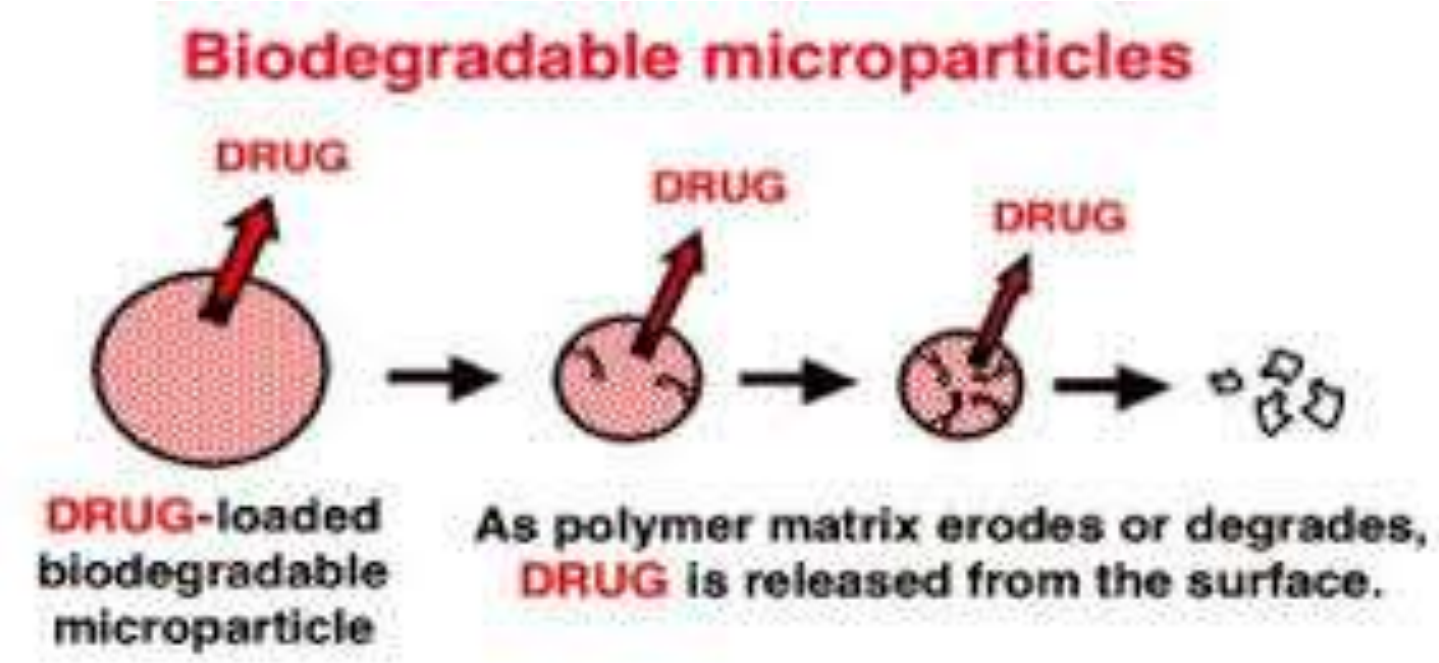
6- Study of release mechanisms : mainly depend on the shape of microparticles.



The release mechanisms

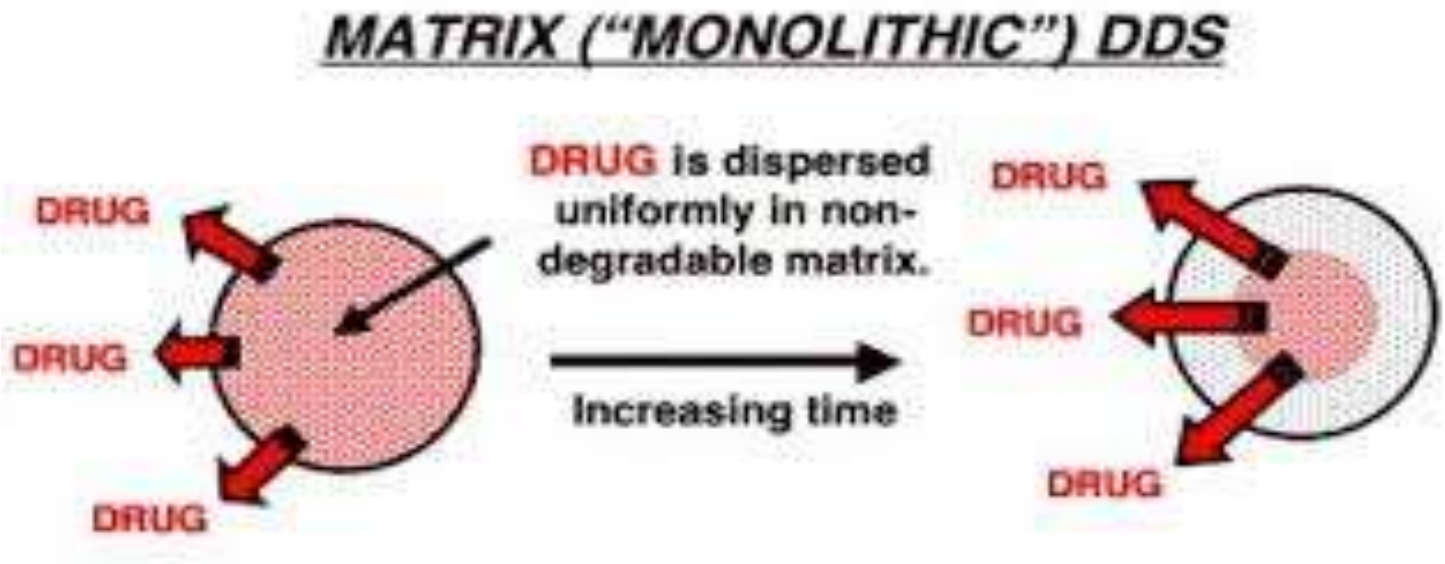
1) Degradation controlled monolithic system:

- The drug is dissolved in matrix and is distributed uniformly through out. The drug is strongly attached to the matrix. The diffusion of the drug is slow as compared with degradation of the matrix.



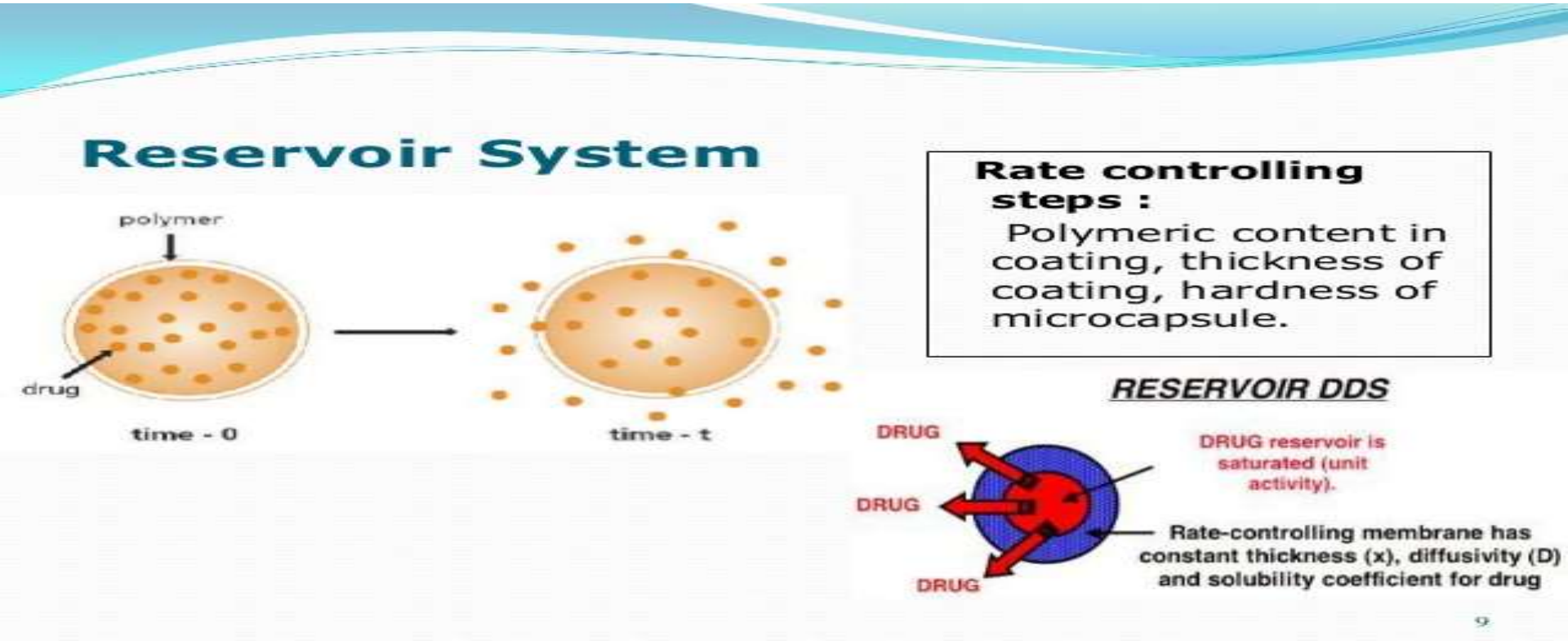
2) Diffusion controlled monolithic system :

The drug is released by diffusion prior to, or concurrent with the degradation of the polymer matrix. The rate of release also depend upon where the polymer degrades by homogeneous or heterogeneous mechanism.



3) Diffusion controlled reservoir system:

The drug is encapsulated by a rate controlling membrane through which it diffuses and the membrane erodes only after its delivery is completed. Then the drug release is unaffected by the degradation of the polymer.



4) Erosion :

Erosion of the coat due to pH and enzymatic hydrolysis causes drug release with certain coat material like glyceryl mono stearate, bees wax and stearyl alcohol..

Erosion controlled

Polymer or wax degradation brought about by:

- enzyme,
- pH change
- osmotic pressure

- Bulk erosion(A)
  - homogeneous erosion
- Surface erosion(B)
  - heterogenous erosion
  - when water penetration is restricted to surface