MICROENCAPSULATION

INTRODUCTION

- **Microencapsulation** is a process by which very tiny droplets or particles of liquid or solid material are surrounded or coated with a continuous film of polymeric material.

- The product obtained by this process is called as micro particles, microcapsules.

- Particles having diameter between 3 - 800µm are known as micro particles or microcapsules or microspheres.

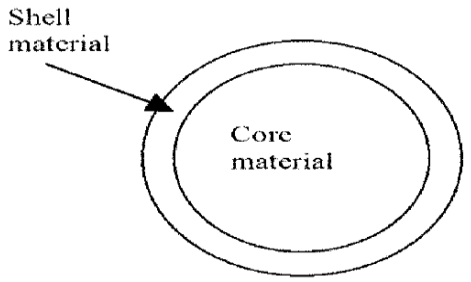
- Particles larger than 1000µm are known as Macro particles .

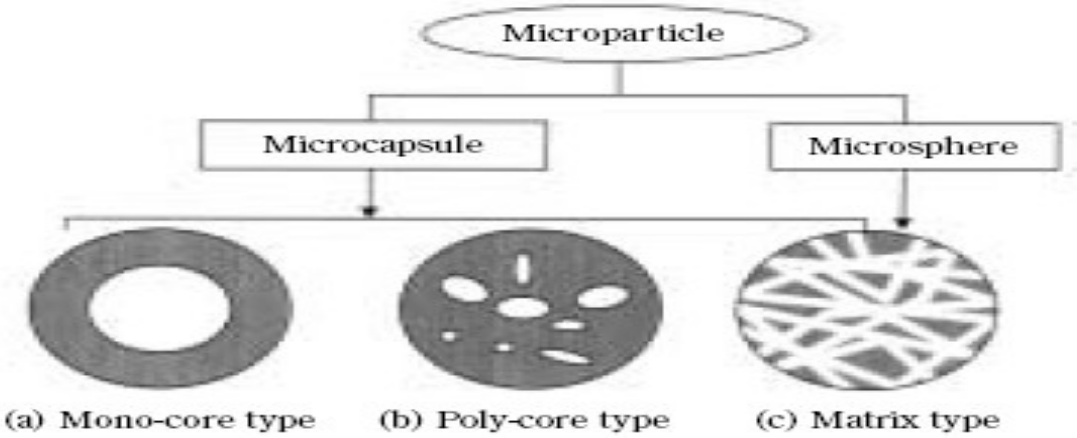
CLASSIFICATION OF MICROPARTICLE

Generally Micro particles consist of two components

a) Core material

b) Coat or wall or shell material.





1. **Microcapsules**: The active agent forms a core surrounded by an inert diffusion barrier.

2. **Microspheres:** The active agent is dispersed or dissolved in an inert polymer.

The polybutadiene, being quite soluble in toluene and incompatible with ethylcellulose, effects the demixing of the ethylcellulose from the polybutadiene toluene solution, and subsequently microencapsulation of the dispersed core material results.

The ethylcellulose coating is solidified by adding a non-solvent for the coating polymer, ethylcellulose, such as **hexane.**

The resultant, crystalline methylene blue hydrochloride coated with ethylcellulose, is collected by standard filtration and drying techniques.

(iii) Non-solvent Addition

A liquid that is a non-solvent for a given polymer can be added to a solution of the polymer to induce phase separation

A 5%, weight to volume methyl ethyl ketone solution of cellulose acetate butyrate is prepared, and in it, micronized methylscopolamine hydrobromide is dispersed with stirring.

The resulting mixture is heated to 55^{o}C, and **isopropyl ether**, a non-solvent for the coating polymer, is added slowly to effect phase-separation/coacervation and microencapsulation of the suspended core material.

The system is slowly cooled to room temperature, and the microencapsulated particles are separated by centrifugation

(iv) Salt Addition

Soluble inorganic salts that can be added to aqueous solutions of certain water-soluble polymers to cause phase separation

An oil-soluble vitamin is dissolved in corn oil and is emulsified in a 10% solution of high-quality **pigskin gelatin**

20 parts oil to 100 parts water, by weight, is used for the preparation of the oil/water emulsion. The emulsification process is conducted at 50^{o}C, will be above the gelation temperature of the gelatin.

phase-separation/coacervation is induced by slowly adding a 20% solution of **sodium sulfate**.

The salt solution is added in a ratio of 10 parts emulsion to 4 parts salt solution.

The addition of the salt solution to the continuously stirred emulsion affects the microencapsulation of the oil droplets with a uniform coating of gelatin.

The resultant protein coating is rigidized by transferring the mixture into a sodium sulfate solution that is 7% by weight and is maintained at 19^{o}C, with continued agitation

(v) Polymer-Polymer Interaction

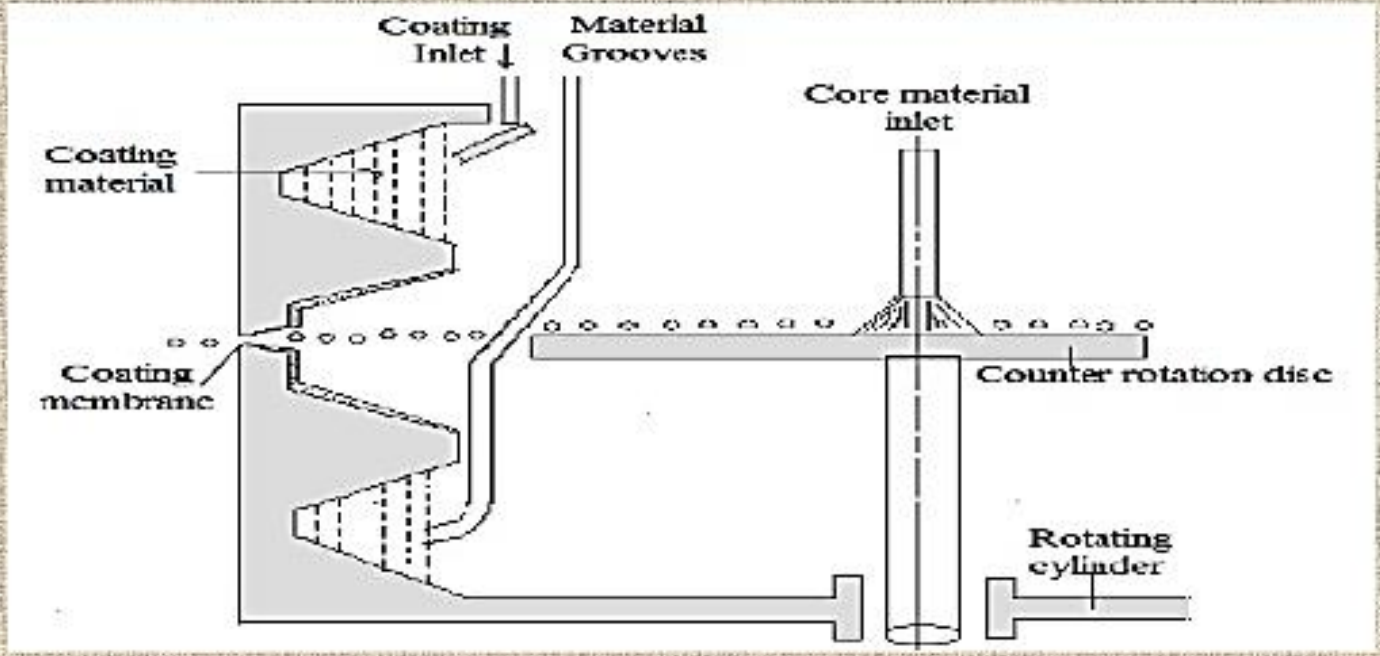
The interaction of oppositely charged polyelectrolytes can result in the formation of a complex having such reduced solubility that phase separation occurs.

Gelatin and gum Arabic are typical polyelectrolytes that can be caused to interact.

Gelatin, at pH conditions below its isoelectric point, possesses a net positive charge, whereas the acidic gum Arabic is negatively charged.

(vi) Multiforce centrifugal process

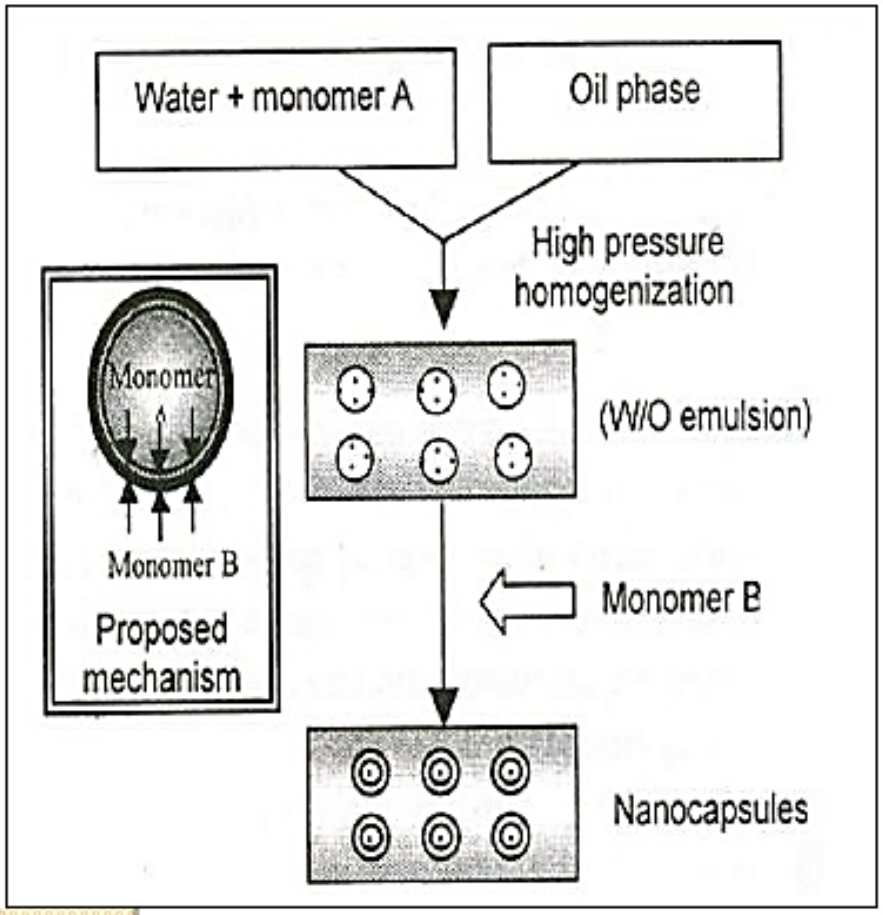
It utilizes centrifugal forces to hurl a core material particle through an enveloping microencapsulation membrane .[4]



Advantages:

- Encapsulates both solid and liquid materials.
- Production rate is more.

INTERFACIAL POLYMERIZATION TECHNIQUE



When two reactive monomers are dissolved in immiscible solvents, the monomers diffuse to the oil-water interface where they react to form a polymeric membrane.

Drug is incorporated either by being dissolved in the polymerization medium or by adsorption onto the nanoparticles after polymerization completed.

The nanoparticle suspension is then purified to remove various stabilizers and surfactants employed for polymerization by ultracentrifugation and re-suspending the particles in an isotonic surfactant-free medium.

This technique has been reported for making polybutylcyanoacrylate or poly (alkylcyanoacrylate) nanoparticles.

Particle size analysis

For size distribution analysis, different sizes in a batch were separated by sieving by using a set of standard sieves. The amounts retained on different sieves were weighed [5].

Encapsulation efficiency [8]

Encapsulation efficiency was calculated using the formula:

Encapsulation efficiency = **Actual Drug Content / Theoretical Drug Content ×100**

Estimation of Drug Content

Cefotaxime sodium drug content in the microcapsules was calculated by UV spectrophotometric (Elico SL159 Mumbai India) method.

The method was validated for linearity, accuracy and precision. A sample of microcapsules equivalent to 100 mg was dissolved in 25 ml ethanol and the volume was adjusted upto 100 ml using phosphate buffer of pH 7.4. The solution was filtered through Whatman filter paper. Then the filtrate was assayed for drug content by measuring the absorbance at 254 nm after suitable dilution [9].

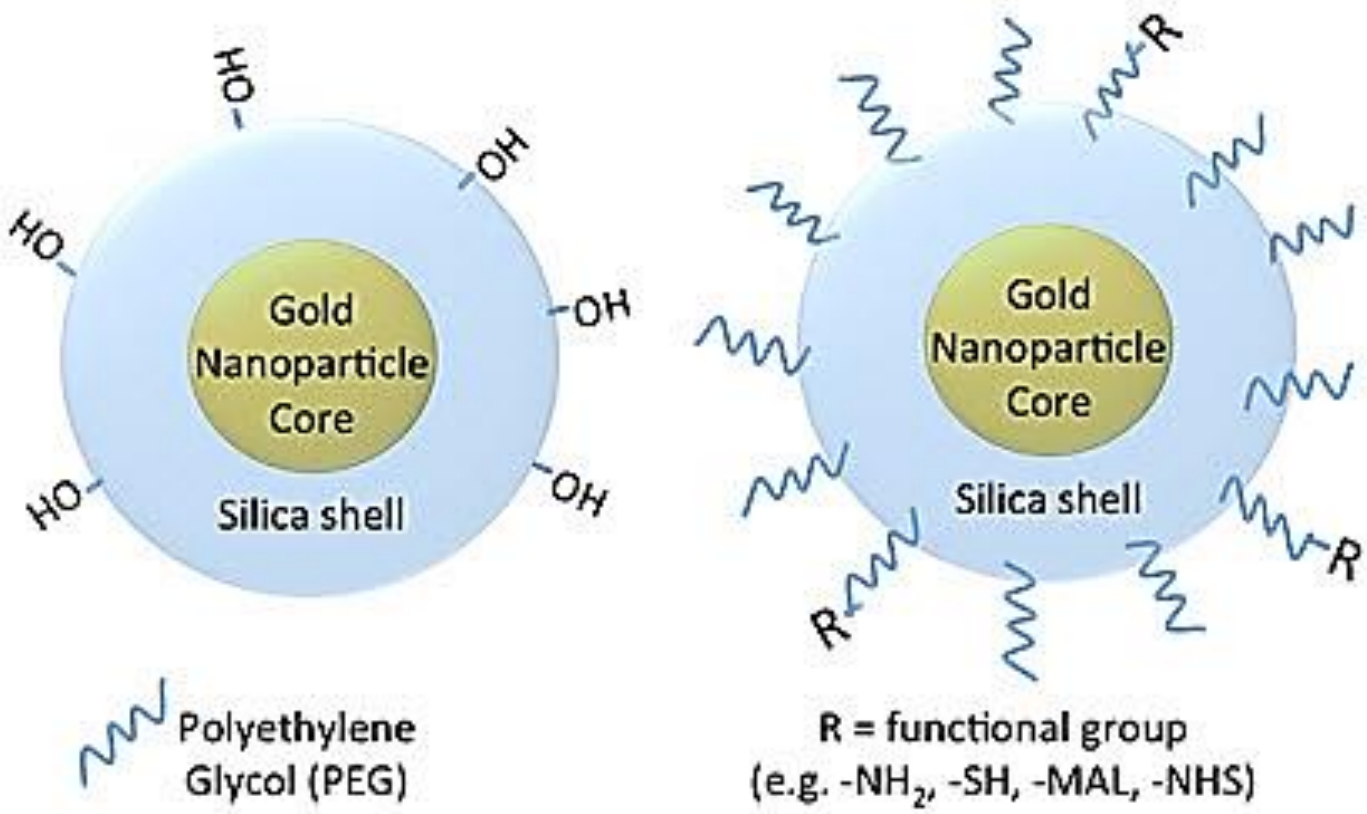
Invitro Drug release Studies

Drug release was studied by using USP type II dissolution test apparatus (Electrolab TDT 08L) in Phosphate buffer of pH 7.4 (900 ml). The paddle speed at 100 rpm and bath temperature at 37 ± 0.5°c were maintained through out the experiment.

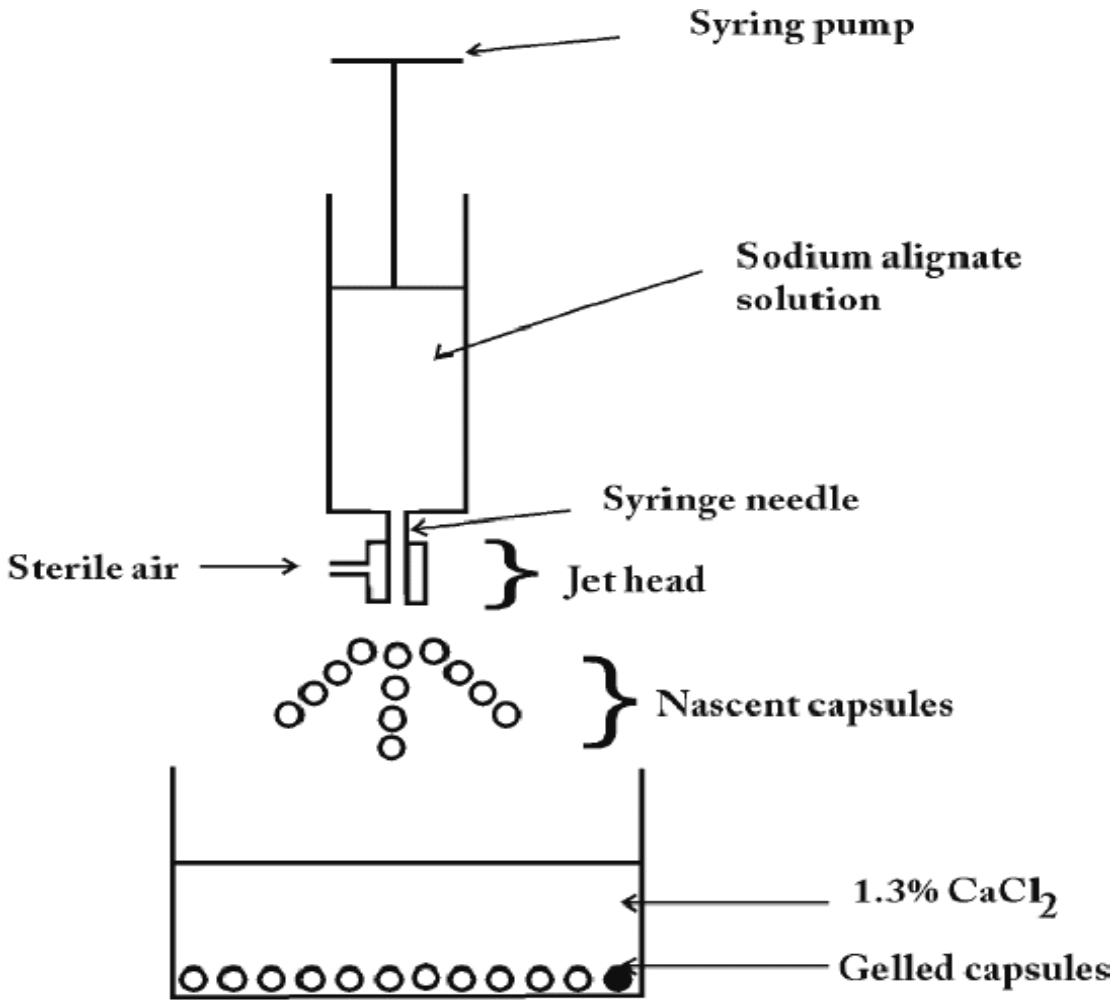
A sample of microcapsules equivalent to 100 mg of cefotaxime sodium was used in each test. Aliquot equal to 5ml of dissolution medium was withdrawn at specific time interval and replaced with fresh medium to maintain sink condition. Sample was filtered through Whatman No. 1 filter paper and after suitable dilution with medium; the absorbance was determined by UV spectrophotometer (Elico SL159) at 254 nm.

All studies were conducted in triplicate (n=3). The release of drug from marketed sustained release tablet was also studied to compare with release from microcapsules.

Poly (ethylene glycol) coated nanospheres



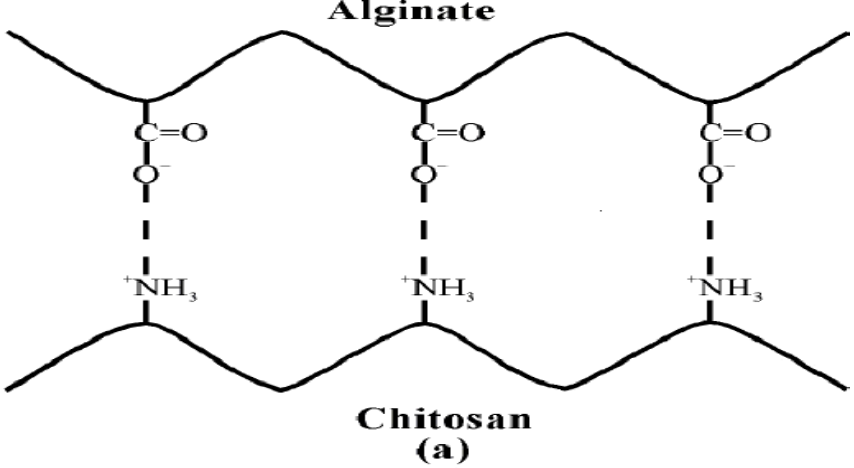
Coated alginate microspheres



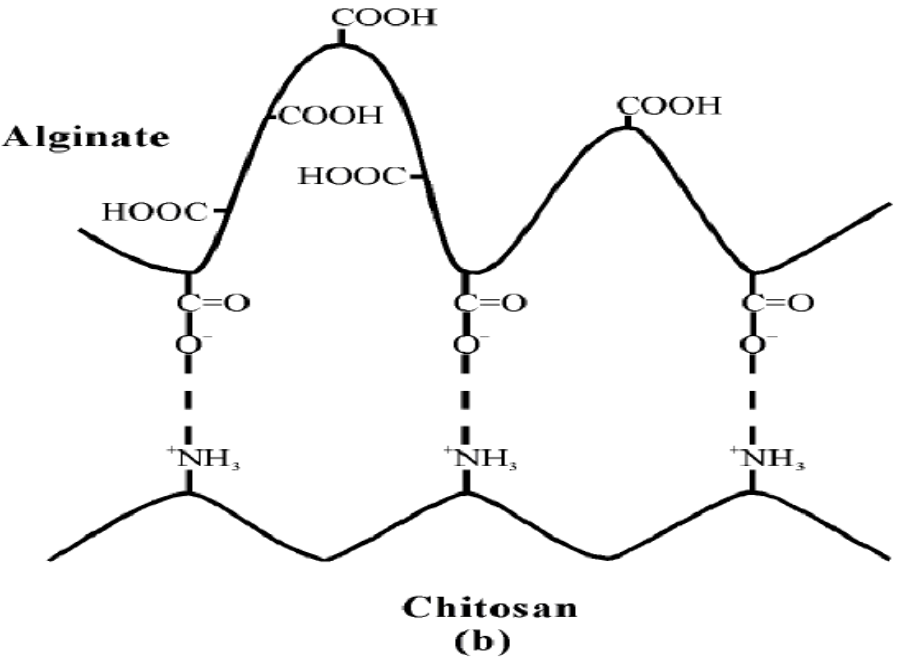
Chitosan/calcium alginate beads

In the first process, the mixture of hemoglobin and sodium alginate is added dropwise to the solution of chitosan and the interior of capsules thus formed in the presence of $CaCl_2$ is hardened.

In the second method, the droplets were directly pulled off in a chitosan-$CaCl_2$ mixture. Both procedures lead to beads containing a high concentration of hemoglobin (more than 90% of the initial concentration (150 g/L) were retained inside the beads) provided chitosan concentration is sufficient.


Alginate
C=O
O⁻
⁺NH₃
Chitosan

(a)


COOH
COOH
COOH
Alginate
HOOC
HOOC
C=O
O⁻
⁺NH₃
Chitosan

(b)


Thank You