A COMPLETE REVIEW ON MICROENCAPSULATION

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***Abstract*: In the review article of microencapsulation involved the classification of microcapsules, drug release mechanism, materials used for microencapsulation, applications of techniques used in the preparation of microcapsules and evaluation parameter of microcapsules. Microencapsulation is the process of surrounding or enveloping one substance within another substance on a very small scale, yielding capsules ranging from less than one micron to several hundreds of microns in size. This technology brings a huge impact in the area of pharmaceutical research which also offers special appearance in controlled and target drug delivery systems. Micro encapsulation is a basic phenomenon in which the drug compounds are safely encapsulated as a small capsule in order to achieve more stable product.**

***Keywords*: Polymeric drug delivery devices, drug release mechanism, microencapsulation.**

1. INTRODUCTION

Microencapsulation is a process by which individual particles of an active agent can be stored within a shell, surrounded or coated with a continuous film of polymeric material to produce particles in the micrometer to millimeter range, for protection and/or later release.

1.1 Classification: - Microencapsulation mainly classified into three categories they are as follow

1) Mononuclear:-Mononuclear which contain the shell around the core & in second category

2) Polynuclear:-Polynuclear in which capsules have a many cores enclosed within the shell & in third category

3) Matrix:- matrix encapsulation in which the core material is distributed homogenously into the shell material.

2. TYPES OF DRUG RELEASE MECHANISM

2.1) Dissolution control system:

Dissolution is a rate controlling step in dissolution control system. The drug is coating with slow dissolving substances. There are two types of dissolving substance they are as follow

2.1.1. Encapsulation:

In encapsulation cellulose is used as slow dissolving material for coating or encapsulated drug particle by micro encapsulation techniques. The dissolution rate is based upon there solubility and thickness of coating.

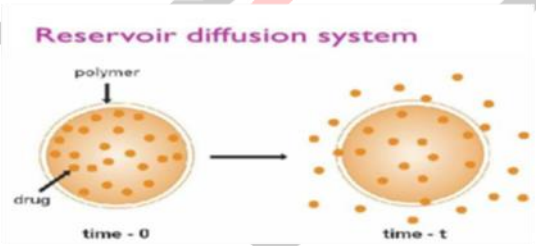


Fig.1 Reservoir diffusion system

2.1.2. Matrix:

It is also known as "**MONOLITHS**". In matrix waxes such as bees wax, hydrogenated castor oil is used to control drug dissolution by controlling rate of dissolution fluid penetration into matrix.

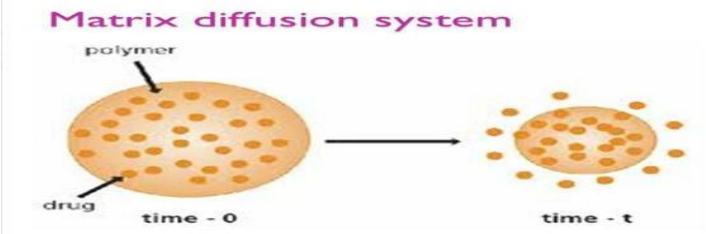


Fig 2.Matrix Diffusion System

2.1.3. Diffusion control system:

In this system diffusion is a rate limiting step in which drug is diffusion through inert water insoluble membrane barrier. These are of two types of diffusion control system they are as follow

2.1.4 Water penetration control system:

In this system rate controlling step is penetration of water. There are two types of this system

1) Swelling control system:

These types of systems is basically dry & which is placed in body, in this system water is absorb & it swells. In the formulation aqueous solvent of swelling is increases with increasing the polymer mesh size.

2) Osmotically control system:

In this type of system combination of osmotically inactive drug & osmogene is enclosed with semi permeable membrane which is made up of biocompatible polymer like cellulose acetate.

2.1.5. Chemically control system:

In this system polymer is degraded which get hydrolysis which is biologically safe, smaller moieties. In this system there are two types they are as follows

A. Pendent:

Pendent is a linear or homo copolymers attached to the drug. By hydrolysis or enzymatic degradation of the linkage drug is released from polymer.

B. Hydrogels:

1. Hydrogels is a water swollen 3-D structure which is composed of primarily hydrophilic polymers.
2. Because of physical or chemical cross links they are insolvable.
3. In physical cross links crystallites weak association like hydrogen bonds is included.
4. It gives protection to labile drugs, proteins and peptides.

3. Materials Used for Micro Encapsulation

3.1. CORE MATERIAL:

Core material is known as specific material which can be coated, it is either liquid or solid. Dispersed or dissolved material is a composition of core material which can be varied as a liquid core & in solid core material there is a combination of active ingredients, stabilizers, diluents, excipients.

3.2 COATING MATERIAL:

The inert material is surrounding to the core material and which is used to form a protective polymer film around each individual drug particle.

Classification of coating materials

1) Water soluble resins

- Gelatin
- Starch
- Hydroxy ethyl cellulose

2) Water insoluble resins

- Ethyl cellulose
- Polyethylene
- Polyamide
- Poly methyl acrylate

3) Waxes and lipids

- Bees wax
- Stearic acid
- Steryl alcohol

4) Enteric resins

- Shellac
- Zein
- Cellulose acetate phthalate

3.3. VEHICLE:

Vehicle used for dissolving coating material.

3.3.1) Aqueous vehicle: - Water

3.3.2) Non- aqueous vehicle: - Alcohol**,** Isopropyl alcohol**,** Poly vinyl pyrrolidine**,** Poly ethylene glycol**,** Isopropyl myristate

4. METHODS OF MICRO ENCAPSULATION

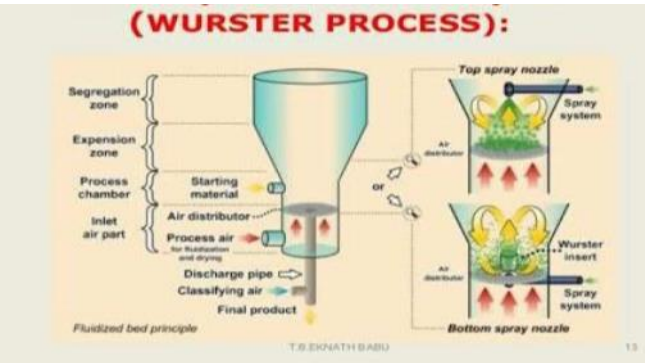
There are two method of microencapsulation

4.1. PHYSICAL METHODS

- Air suspension method.
- Coacervation phase separation
- Spray drying.
- Spray congealing
- Multi orifice centrifugal process
- Pan coating

4.2. CHEMICAL METHODS

4.2.1. AIR SUSPENSION TECHNIQUE.



Principle:

It was introduced by "**DALE E. WURESTER**". Generally it consists of dispersion of solid core material in suspending air stream and spray coating of the suspended particles.

Process:

1. Within the air suspension channel, the core material is suspended towards upward by vaporized air stream applied from the air distribution plate.
2. The coating material is passed through nozzle which gets sprayed on the core material by uniform distribution'
3. The process is continued till desired thickness is obtained.

Process variables:

1. Density, surface area, melting point, solubility, friability, crystallinity and flow ability of core material.
2. Coating material concentration.
3. Rate of applying the coating material.
4. Air volume is required for support and fluidize.
5. Amount of coating material required.

Advantages:

1. It is applicable to coat the materials in the form of solution, aqueous solution, emulsion or hot melts.
2. Applicable for both micro and macro encapsulation due to small particle size.
3. Improved control and flexibility compared to pan coating.

Disadvantages:

1. Only applicable for solids.
2. High skill is required.
3. Agglomeration of solid may takes place

4.2.2. **COACERVATION PHASE SEPERATION**

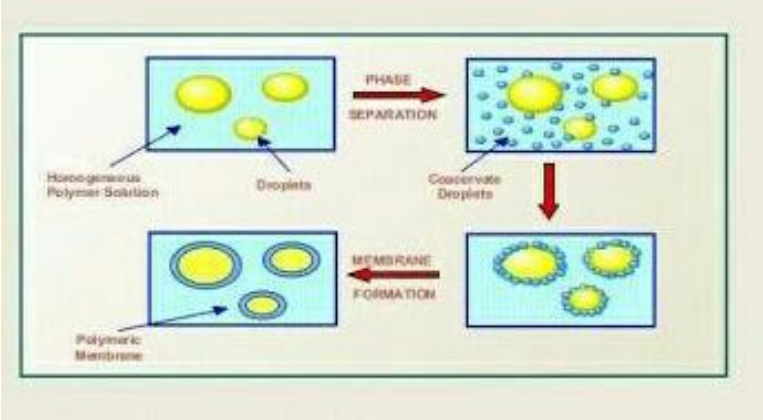


Fig.4.2.2. COACERVATION PHASE SEPERATION

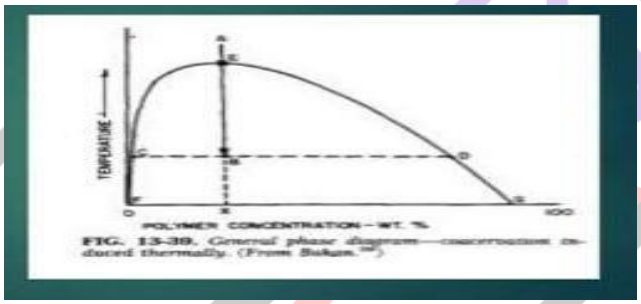
Principle:

Desolation of coating material mixture forms the coacervates. The chain of coacervates surrounds each individual particle to form microcapsules, these are collected and dried.

Process:- In coacervation phase seperation process three steps are involved

1. Formation of three immiscible phases
2. Deposition of coating material
3. Rigidization of micro capsules

Step 1 Three phases of core material is dispersed in a solution of coating polymer, liquid solvent is used as a polymer for manufacturing vehicle phase. In order to make the coating material phase immiscible with the solvent, these techniques are followed changing the temperature of polymeric solution: Due to the change in temperature, coating material separates from polymeric solution and forms coacervates.



Graph of Formation of three immiscible phases

Step 2 Deposition of the liquid polymer upon the core material. Application of coating material on the core material occurs if the polymer is adsorbed at the interface between core and coating material.

Step 3 Formation of self-sustaining micro capsule which involves rigidizing the coating by thermal or cross linking or desolvation techniques.

Advantages:

1. Versatile process.
2. Uniform coating can be obtained
3. It is easy and fast process.
4. Uniform size of the capsules can be obtained

Disadvantages:

1. Scale up is difficult.
2. Agglomeration may occur.

4.3.3. MULTI-ORIFICE CENTRIFUGAL PROCESS

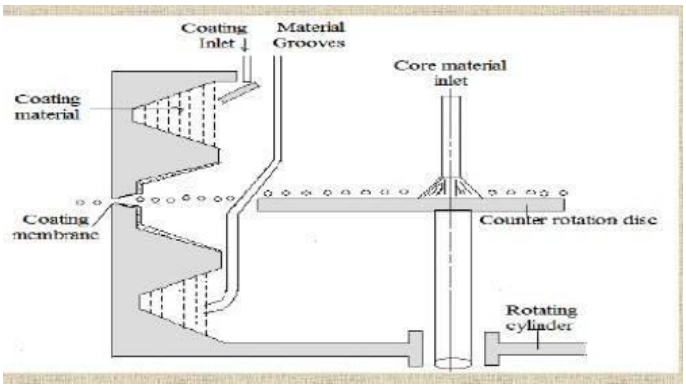
The Southwest Research Institute has developed a mechanical process for production of microcapsules by using centrifugal force.

Principle:

The process utilizes the centrifugal force to hurl the core material into coating material to obtain microcapsules

Process:

1. The coating material enters through the coating material inlet which is passed through the 1 and 3 circumferential grooves.
2. The coating material is pumped such that it should overflow through the grooves and edges of the intermediate grooves.
3. The coating material enters into the counter-sunk portion and forms a film across the orifice.
4. Counter rotating disc makes each core particle to hurl and move towards the orifice.
5. The core material are arrive at the orifice and encounters the coating material membrane.



Process variables:

- Concentration of core and coating material.
- Surface tension of coating material.
- Viscosity of the core material and coating material.

Advantages:

1. Capable to encapsulate liquid and solid core material.
2. Diverse coating material can be used.

Disadvantages:

1. Wastage of coating material may take place.
2. High temperature is needed for drying of microcapsules
2. It provides good control of final properties such as particle size, flow ability, bulk density and mechanical strength.
3. It is suitable for vitamins, hormones, plasma, serum, dextrin's, chloramphenicol can be encapsulate

5. APPLICATIONS OF MICRO ENCAPSULATION

Microencapsulation is widely used for masking the organoleptic properties like taste and odour of many drugs.

- The drugs can be protected which are sensitive to moisture, light and oxygen. e.g.: Nifedipine
- It prevents the incompatibility between the drugs.
- The drugs which are volatile in nature may vaporize at room temperature like Aspirin and Peppermint oil can be prevented by micro encapsulation.
- It used for the sustain release or prolonged action of drug
- It used in manufacturing of powders and suspensions.
- Immobilization of microbes and microorganisms to prevent oxidative degradation.
- Is used to separate incompatible substances.
- It Protect the gastro intestinal tract.
- It is used in genetic engineering

6. CONCLUSION

These capsules protect the active ingredient from surrounding environment. . This technology brings huge impact in the area of pharmaceutical research which also offers special appearance in controlled and target drug delivery system. Micro encapsulation generally refers to drug compounds for safely encapsulated as a small capsule in order to achieve more stable product.

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