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A REVIEW ON MICRO ENCAPSUATION

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ABSTRACT

The review of Microencapsulation is a well-established dedicated to the preparation, properties and uses of individually encapsulated novel small particles, as well as significant improvements to tried-and-tested techniques relevant to micro and Nano particles and their use in a wide variety of industrial, engineering, pharmaceutical, biotechnology and research applications. Its scope extends beyond conventional microcapsules to all other small particulate systems such as self-assembling structures that involve preparative manipulation. The review covers encapsulation materials, physics of release through the capsule wall and / or desorption from carrier, techniques of preparation, many uses to which microcapsules are put.

Keywords: Microencapsulation, Core Materials, Coating Materials.

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 Microcapsules. **Fundamental Consideration:** Generally Micro particles consist of two components.

a) Core material.
b) Coat or wall or shell material

Core Material: The material to be coated. It may be liquid or solid or gas. Liquid core may be dissolved or dispersed material.

Composition of core material:

The core materials consist of following materials

- ✓ Drug or active constituent
- ✓ Additive like diluents
- ✓ Stabilizers

Coating Material: Inert substance which coats on core with desired thickness.

Composition of coating:

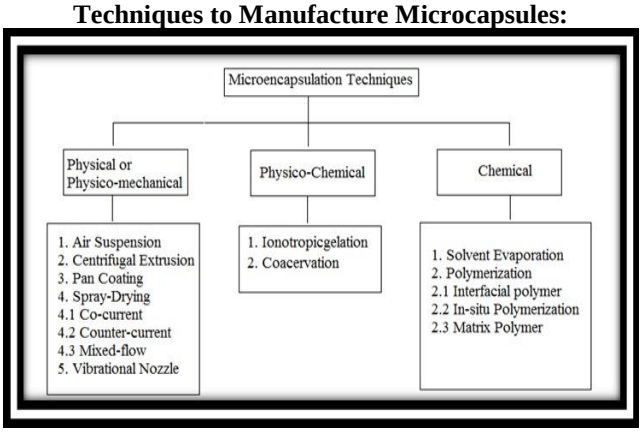
It will consist of following

- Inert polymer
- Plasticizer
- Coloring agent
- Resins, waxes and lipids
- Release rate enhancers or retardants

Reasons for Encapsulation

1. To protect reactive substances from the environment,
2. To convert liquid active components into a dry solid system,
3. To separate incompatible components for functional reasons,
4. To protect the immediate environment of the microcapsules from the active components.

Techniques to Manufacture Microcapsules:



Microencapsulation Techniques

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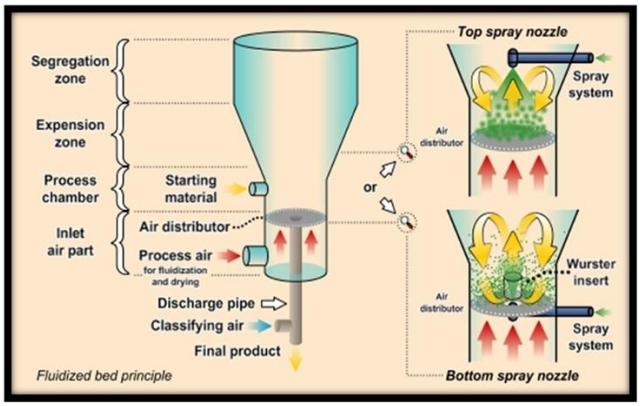
Physical or Physico-mechanical methods

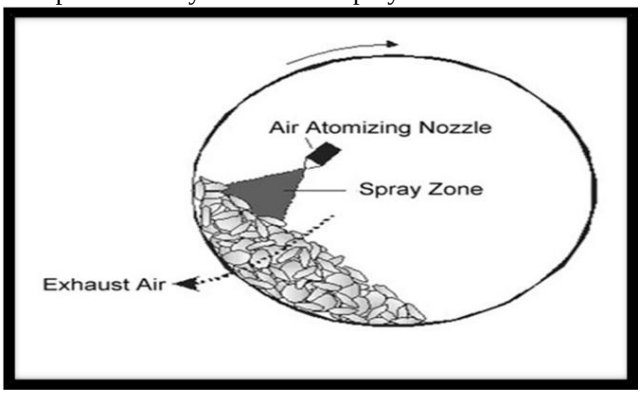
- **Air-suspension coating:** Inventions of Professor Dale E. Wurster
- Basically the wurster process consists of the dispersing of solid, particulate core materials in a supporting air stream and the spray-coating of the air suspended particles.
- Equipment ranging in capacities from one pound to 990 pounds.
- Micron or submicron particles can be effectively encapsulated by air suspension techniques**.**
- **Disadvantage-** Agglomeration of the particles to some larger size is normally achieved.



Air Suspension Apparatus

2. Pan coating:

- Oldest industrial procedures for forming small, coated particles or tablets.
- The particles are tumbled in a pan or other device while the coating material is applied slowly.
- Solid particles greater than 600 microns in size are generally considered essential for effective coating.
- Medicaments are usually coated onto various spherical substrates such as nonpareil sugar seeds, and then coated with protective layers of various polymers.



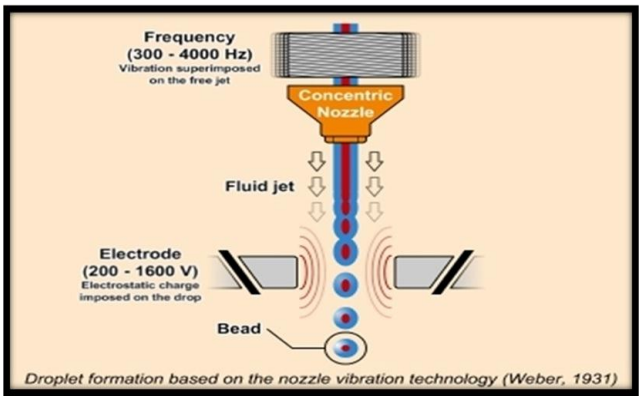
Representation of a typical pan coating

3. Spray-drying: In modern spray dryers the viscosity of the solutions to be sprayed can be as high as 300mPa.s

- **Spray drying and spray congealing-** dispersing the core material in a liquefied coating substance and spraying.
- Spray drying is effected by rapid evaporation of a solvent in which the coating material is dissolved.The equipment components of a standard spray dryer include An air heater, atomizer, main spray chamber, blower or fan, cyclone and product collector
- Spray congealing can be accomplished with spray drying equipment when the protective coating is applied as a melt.
- Core material is dispersed in a coating material melt rather than a coating solution.
- Coating solidification (and microencapsulation) is accomplished by spraying the hot mixture into a cool air stream.

4. Vibrational Nozzle

- The process works very well for generating droplets between 100–5,000 µm
- Units are deployed in industries and research mostly with capacities of 1–10,000 kg per hour at working temperatures of 20–1500 °C.
- Nozzles heads are available from one up to several hundred thousand are available.



Formation of Droplets Using Vibrational Nozzle Technique

Physico-chemical methods

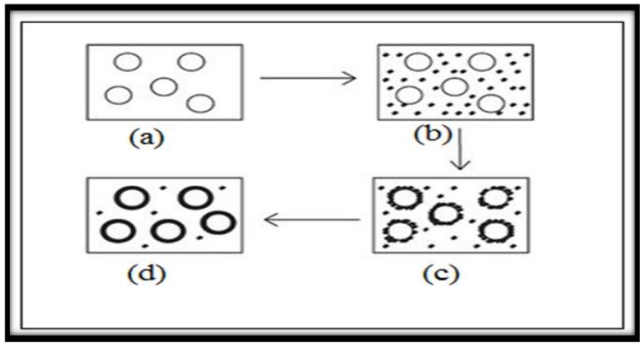
1. **Ionotropic gelation**

- Chemical reaction between sodium alginate and calcium chloride or other Counter ion solution such as barium chloride.
- Verapamil hydrochloride causes gastric irritation on sudden release. It is usually administered as conventional tablets containing 40-120 mg, 3 times a day. Due to its ready solubility in water and shorter half-life.
- Microparticulate system of verapamil hydrochloride for prolonged release delivery system.

2. Coacervation-Phase Separation

Three steps carried out under continuous agitation:

- Formation of three immiscible chemical phases
- Deposition of the coating
- Rigidization of the coating



Schematic representation of the coacervation process.
(a) Core material dispersion in solution of shell polymer;
(b) separation of coacervate from solution;
(c) coating of core material by microdroplets of coacervate;
(d) coalescence of coacervate to form continuous shell around core particles.

Chemical process

1. Solvent Evaporation

- In the case in which the core material is dispersed in the polymer solution, polymer shrinks around the core. In the case in which core material is dissolved in the coating polymer solution, a matrix - type microcapsule is formed.
- The core materials may be either water - soluble or water - insoluble materials.
- A variety of film - forming polymers can be used as coatings.

2. Polymerization

- **Interfacial polymer**

In Interfacial polymerization, the two reactants in a polycondensation meet at an interface and react rapidly.

- **In-situ polymerization**

In a few microencapsulation processes, the direct polymerization of a single monomer is carried out on

The Particle surface.
e.g: Cellulose fibers are encapsulated in polyethylene while, Immersed in dry toluene. Usual deposition rates are about 0.5µm/min. Coating thickness ranges 0.2-75µm.

3. Matrix polymer: In a number of processes, a core material is imbedded in a polymeric matrix during formation of the particles.

- Prepares microcapsules containing protein solutions by incorporating the protein in the aqueous diamine phase.
- National Lead Corporation- utilizing polymerization techniques

Figure 1. Microcapsules

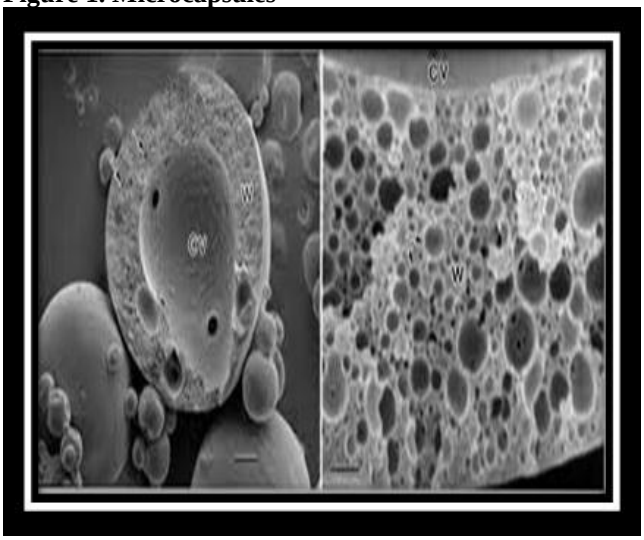


Figure 2. Type of Core materials, Coting materials and Vehicles used in Microencapsulation

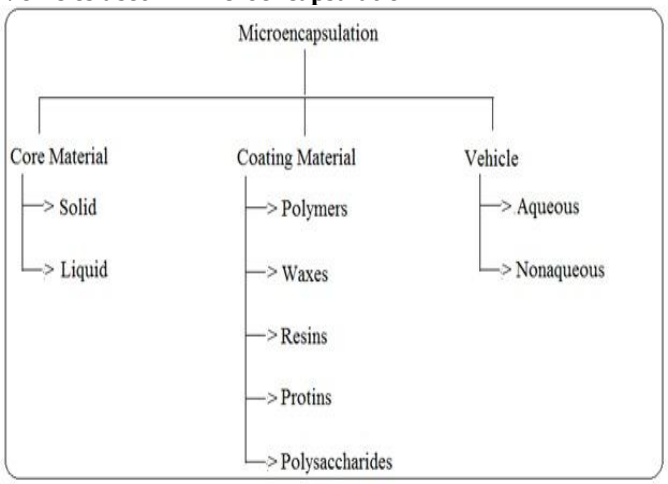


Table 1. Properties of Some Microencapsulated Core Materials

Core Material	Characteristic Property	Purpose of Encapsulation	Final Product Form
Aspirin	Slightly water- soluble solid	Taste-masking; sustained release; reduced gastric irritation; separation of incompatibles	Tablet or capsule
Vitamin A Palmitate	Nonvolatile liquid	Stabilization to oxidation	Dry powder
Isosorbide dinitrate	Water soluble solid	sustained release	Capsule

APPLICATIONS OF MICROENCAPSULATION

Some of the applications of microencapsulation can be described in detail as given below:

- Prolonged release dosage forms.
- Prepare enteric-coated dosage forms selectively absorbed in the intestine rather than the stomach
- It can be used to mask the taste of bitter drugs.
- To reduce gastric irritation.
- Used to aid in the addition of oily medicines to tableted dosage forms.
- To protect drugs from environmental hazards such as humidity, light, oxygen or heat. eg. vitamin A and K have been shown to be protected from moisture and oxygen through microencapsulation.
- The separations of incompatible substances, eg. pharmaceutical eutectics.
- In the fabrication of multilayered tablet formulations for controlled release of medicament contained in medial layers of tableted particles.
- Microencapsulation has also been used to decrease potential danger of handling of toxic or noxious substances. Such as fumigants, herbicides, insecticides and pesticides

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