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A Review on Microencapsulation: Their Methods and Types

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ABSTRACT

Microencapsulation is a process by which very tiny droplets or particles of liquid or solid material surrounded or coated with a continuous film of polymeric material. Sustained and prolonged drug release get beneficial use of microencapsulation. Microencapsulation has various types, and methods. This has several advantages and also disadvantages this article gives information about it.

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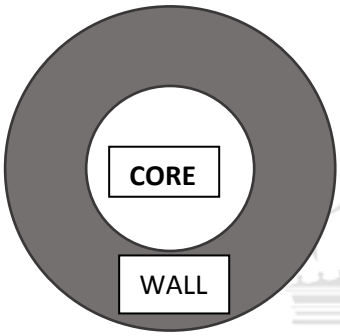
INTRODUCTION

Microencapsulation is the process of enclosing a substance inside a capsule. Drug / API / Particle coated with polymer or coating in terms of a microgram (ug) that's why is called microencapsulation.

It is also called as 'micro balloons'. Process of enclosing micron-sized particles of solid or droplets of liquid or gases in an inert shell. It means applying a thin coating to a small particle of solid or droplet of liquid and dispersion.

Two components: 1) Core material

2) Coating material



CORE MATERIAL: Specific material to be coated may be liquid or solid.

COATING MATERIAL: Material which encloses the core material is called coating material.

IDEAL PROPERTIES OF COATING MATERIAL ARE AS FOLLOWS:

1) Cohesiveness

2) Chemically compatible and non-reactive with core material.

3) Provide strength, flexibility, impermeability, optical properties, and stability.

4) Appropriate solubility, good clarity.

ADVANTAGES:

1) Converting liquid to solid.

2) Separating reactive compounds.

3) Providing environmental protection.

4) Controlled drug release.

DISADVANTAGES:

1) Formulation difficulties.

2) Adaption of process.

3) Stability/shelf life.

4) Cost

REASONS FOR MICROENCAPSULATION:

1) The primary reason for microencapsulation is for sustained or prolonged drug release.

2) This technique can be used to prevent the drug from oxidation.

3) Alteration in the site of absorption can also be achieved by microencapsulation.

4) Several drug molecules hazardous.

5) This technique may be used for masking the taste and odor of many drugs to improve patient compliance.

TYPES OF MICROENCAPSULES:

1) Simple microcapsule.

2) Enteric-coated microcapsule.

3) Mucoadhesive microcapsule.

4) Floating microcapsule.

5) Magnetic microcapsule.

6) Nanosphere.

7) Floating and mucoadhesive micro capsulation.

8) Colonic micro capsulation.

9) Sugar-coated micro capsulation.

METHODS FOR MICROENCAPSULATION:

1) Chemical

2) Physicochemical

3) Physio-mechanical

- **CHEMICAL PROCESS**:

1) Interfacial polymerization.

2) In situ polymerization.

- **PHYSICOCHEMICAL PROCESS:**

1) Coacervation phase separation

a) By temperature change

b) By incompatible polymer addition

c) By nonsolvent addition

d) By salt addition

e) By polymer-polymer interaction.

COACERVATION PHASE SEPRATION

STEPS:

I. Formation of three immiscible chemical phases.

- A liquid manufacturing vehicle.

- A core material phase.
- A coating material phase.

II. Deposition of coating.

III. Rigidization of the coating.

BY TEMPERATURE CHANGE:

CORE MATERIAL: N, acetyl p- aminophenol

POLYMER: Ethylcellulose

SOLVENT: Cyclohexane

Ethylcellulose + cyclohexane (2 % polymer solution)

Polymer solution + N,acetyl p-amino phenol (1:2)

Gelation and solidification of coating occur

Collected by filtration and centrifugal technique

BY INCOMPATIBLE POLYMER ADDITION:

CORE MATERIAL: crystalline methylene blue HCL

COATING MATERIAL: Ethylcellulose

SOLVENT: Toluene

INCOMPATIBLE POLYMER: Polybutadiene.

Ethyl cellulose + Toluene (2% solution) → solution + methylene blue HCL (1:4)

↓

Addition of polybutadiene (formation of microcapsule)

↓

Solidify by nonsolvent addition → collected by filtration and drying technique.

BY NONSOLVENT ADDITION:

CORE MATERIAL: Methylscopulamine hydrobromide

COATING MATERIAL: Cellulose acetate

SOLVENT: Methyl ethyl ketone

NONSOLVENT: Isopropyl ether

Polymer + solvent (5% solution) → addition of core material to solution (2:1)

↓

Heat at 55 temps.

Addition of nonsolvent

↓

Collected by filtration and drying technique

BY SALT ADDITION

CORE MATERIAL: Oil-soluble vitamin

COATING MATERIAL: Gelatin

SOLVENT: Water

SALT: Sodium sulfate

Vitamin solution in oil ⟶ oil solution + 10% aq. The solution of gelatin (emulsion Formation at 50degree Celsius temp)

↓

Addition of salt solution (with stirring) ⟶ Rigidization by addition into sodium Sulfate solution.

PHYSICO - MECHANICAL METHOD:

Microencapsulation process	Nature of the core material	Approximate particle size (um)
Air suspension	Solids	35-5000
Coacervation and phase separation	Solids and Liquids	2-5000
Multi orifice centrifugation	Solids and Liquids	1-5000
Pan coating	Solids	600-5000
Spray drying and congealing	Solids and Liquids	600
Solvent evaporation	Solids and Liquids	5-5000

APPLICATIONS OF MICROENCAPSULATION:

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

1. To improve the flow properties. e.g. Thiamine, riboflavin.
2. To enhance stability. e.g. Vitamins.
3. To reduce the volatility of materials.eg. peppermint oil.
4. To avoid incompatibilities.eg. Aspirin.
5. To mask unpleasant taste and odor. e.g. Castor oil.
6. To convert liquids into solids. e.g. Eprazinone.
7. To reduce gastric irritation. e.g. Nitrofurantoin, Indomethacin.

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