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MICROENCAPSULATION PROCESS MATERIALS, MANUFACTURING METHODS AND APPLICATIONS: A REVIEW

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ABSTRACT

Microencapsulation technology is of packaging solid, liquid, or gaseous materials in small capsules that release their contents at controlled rates. Its scope extends beyond conventional microcapsules to all other small particular systems such as self assembling structures that involve preparative manipulation. Microencapsulation process offers potential advantage over conventional drug delivery systems and also established as unique carrier system for many pharmaceuticals. It seems very likely that a number of applications both in-vitro and in-vivo will be found for these small objects .The review covers encapsulation materials, physical and chemicals manufacturing methods and it's applications in various fields.

KEYWORDS : *microencapsulation,core materials, coating materials*

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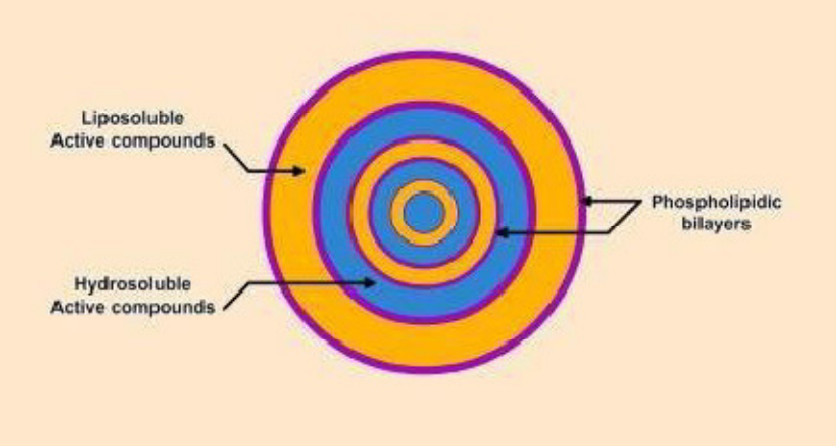
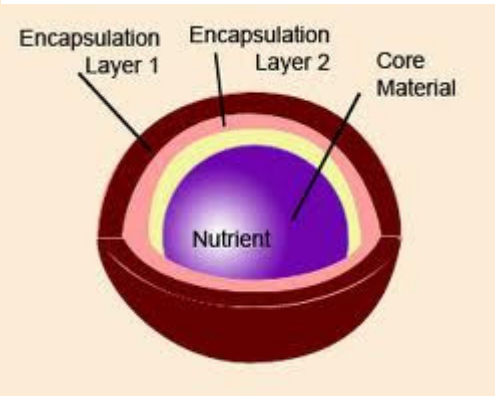
INTRODUCTION

Microencapsulation is a process by which solids, liquids or even gases may be enclosed in microscopic particles formation of thincoatings of wall material around the substances .A well designed controlled drug delivery system can overcome some of the problems of conventional therapy and enhancethe therapeutic efficacy of a given drug. To obtain maximum therapeutic efficacy, it becomes necessary to deliver the agent to thetarget tissue in the optimal amount in the right period of time there by causing little toxicity and minimal side effects. There arevarious approaches in delivering a therapeutic substance to the target site in a sustained controlled release fashion. One such approachis using microspheres as carriers for drugs. Microspheres are characteristically free flowing powders consisting of proteins or syntheticpolymers which are biodegradable in nature and ideally having particle size less than 200 µm.

Definition: It is the process by which individual particles or droplets of solid or liquid material (the core) are surrounded or coated with a continuous film of polymeric material (the shell) to produce capsules in the micrometer to millimetre range, known as microcapsules.





In its simplestform, a microcapsule is a small sphere with auniform wall around it. The material inside themicrocapsule is referred to as the core, internalphase, or fill, whereas the wall is sometimes calleda shell, coating, or membrane. Gelatin is a common wall-forming material butsynthetic polymers like polyvinyl alcohol, ethylcellulose, polyvinyl chloride and other materialsalso may be used. One of the advantages ofmicroencapsulation is that the administered dose ofa drug is subdivided into small units that are spreadover a large area of the gastrointestinal tract, whichmay enhance absorption by diminishing localizeddrug concentration. Custom-made microspheresand microcapsules are provided to customers in thefood, pharmaceutical, cosmetic, consumer andpersonal care products, agricultural, veterinary medicine, industrial chemicals, biotechnology,biomedical and sensor industries.

CLASSIFICATION:

Microcapsules can be classified on three basiccategories according to their morphology as Follows:

1. Mononuclear
2. Polynuclear and
3. Matrix types

1- Mononuclear (core-shell) microcapsules contain the shell aroundthe core.

2- Polynuclear capsules have many cores enclosed within the shell.

3- Matrix encapsulation in which the core material is distributedhomogeneously into the shell material.

. In addition to these three basic morphologies,microcapsules can also be mononuclear withmultiple shells, or they may form clusters ofmicrocapsules.

CORE MATERIAL:

The core material defined as the specific materialto be coated can be liquid or solid in nature.

The composition of the core material is varied, asthe liquids core can include dispersed and/ordissolved material. The solid core can be a mixtureof active constituents, stabilizers, diluents,recipients and release-rate retardants oraccelerators. The ability to vary the core materialcomposition provides definite flexibility andutilization of this characteristic often allowseffectual design and development of the desiredmicrocapsule properties.

COATING MATERIAL:

The coating material should be capable offorming a film that is cohesive with the corematerial; be chemically compatible and nonreactivewith the core material; and provide the desiredcoating properties, such as strength, flexibility,impermeability, optical properties, and stability.

The coating materials used in micro encapsulationmethods are amenable, to some extent, to in situmodification.

The typical coating properties such ascohesiveness, permeability, moisture sorption,solubility, stability and clarity must be consideredin the selection of the proper microcapsule coatingmaterial.

Coating material properties:

•Stabilization of core material.
•Inert toward active ingredients.
•Controlled release under specific conditions.
•Film-forming, pliable, tasteless, stable.
•Non-hygroscopic, no high viscosity, economical.
•Soluble in an aqueous media or solvent, or melting.
•The coating can be flexible, brittle, hard, thin etc.

Examples of coating materials:

Water soluble resins : Gelatin, Gum Arabic, Starch, Polyvinylpyrrolidone, Carboxymethylcellulose, Hydroxyethylcellulose, Methylcellulose, Arabinogalactan, Polyvinyl alcohol, Polyacrylic acid

Water insoluble resins : Ethylcellulose, Polyethylene, Polymethacrylate, Polyamide (Nylon), Poly (Ethylene Vinyl acetate),cellulose nitrate, Silicones, Poly lactideco glycolide.

Waxes and lipids : Paraffin, Carnauba, Spermaceti, Beeswax, Stearic acid, Stearyl alcohol, Glyceryl stearates.

Enteric resins : Shellac, Cellulose acetate phthalate, Zein .

Manufacturing methods:

Physical methods:

- Spray drying
- Spray chilling
- Rotatory disc atomization
- Fluid bed coating
- Stationary nozzle coextrusion
- Multiorifice centrifugal process
- Submerged nozzle coextrusion
- Pan coating
- Air suspension coating
- Centrifugal extrusion.

Chemical methods:

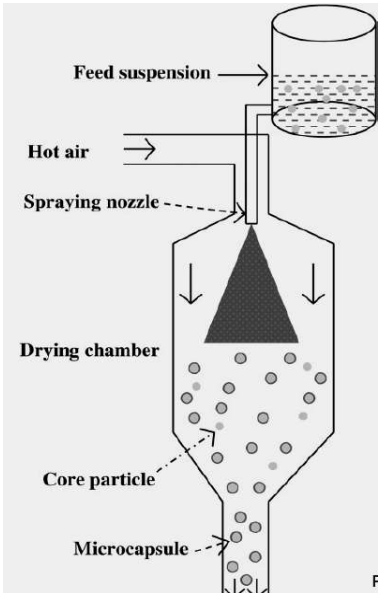
- Coacervation phase separation
- Solvent evaporation
- Solvent Extraction
- Interfacial polymerization
- Simple andComplex coacervation
- In-situ polymerization
- Liposome technology
- Nanoencapsulation
- Matrixpolymerization.

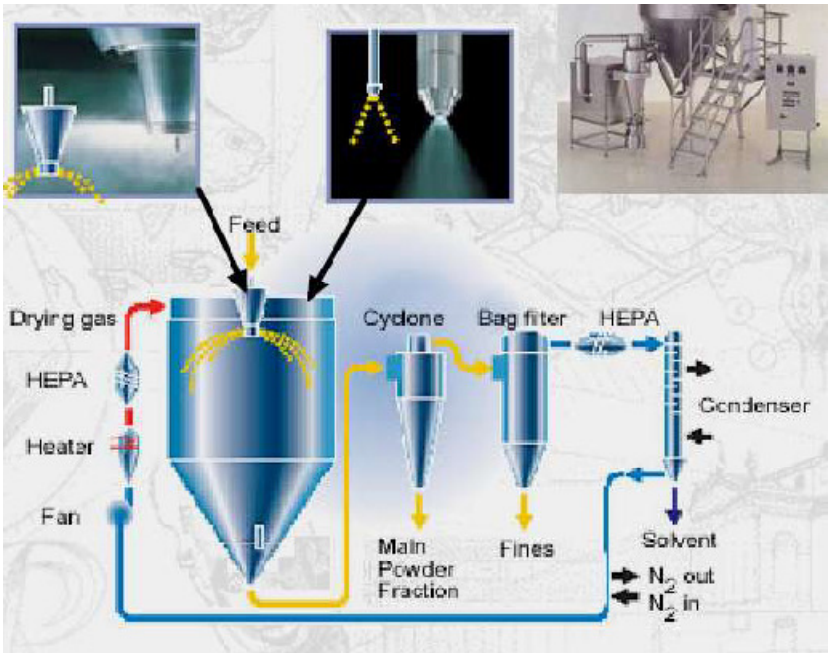
Spray drying:

Microencapsulation by spray-drying is a low-cost commercialprocess which is mostly used for the encapsulation of fragrances,oils and flavors.

Steps:

- Core particles are dispersed in a polymer solution and sprayed intoa hot chamber.
- The shell material solidifies onto the core particles as the solventevaporates.
- The microcapsules obtained are of polynuclear or matrix type





Spray-congealing:

This technique can be accomplished with spraydrying equipment when the protective coating isapplied as a melt.

- The core material is dispersed in a coating materialmelt.
- Coating solidification (and microencapsulation) isaccomplished by spraying the hot mixture into a coolair stream.

e.g. microencapsulation of vitamins with digestablewaxes for taste masking.

Fluidized-Bed Technology:

Different types of fluid-bed coaters include top spray, bottomspray, and tangential spray.

used for encapsulating solid or liquids absorbed into porousparticles.

***Steps*:**

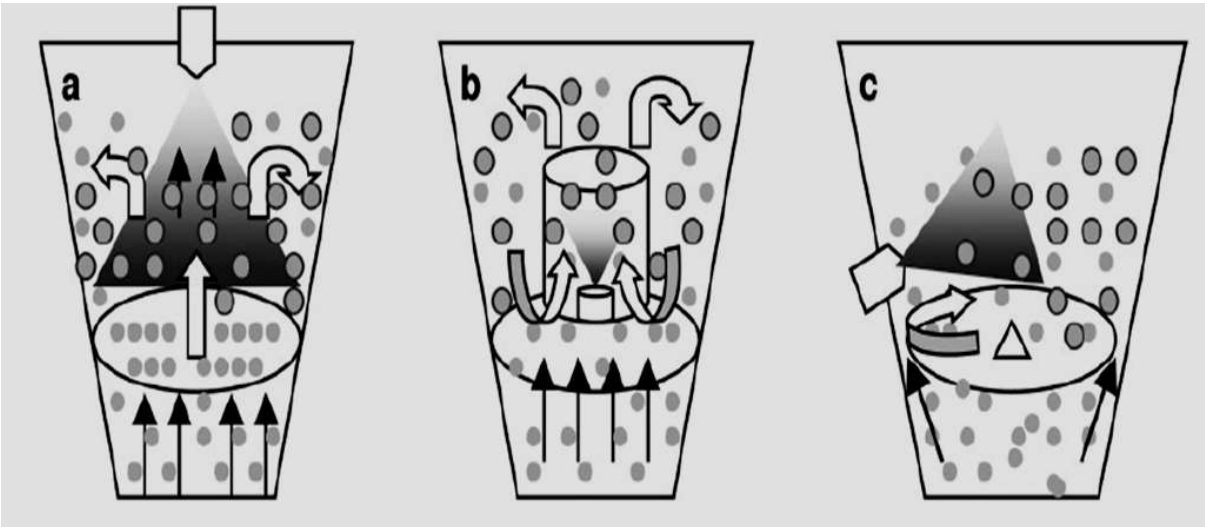
- Solid particles to be encapsulated are suspended on a jet of airand then covered by a spray of liquid coating material.
- The rapid evaporation of the solvent helps in the formation of anouter layer on the particles.
- This process is continued until the desired thickness and weightis obtained.

Schematics of a fluid-bed coater.

(a) Top spray;

(b) Bottom spray;

(c) Tangential spray



Pan coating:

- Solid particles are mixed with a dry coating material.
- The temperature is raised so that the coating material melts andencloses the core particles, and then is solidified by coolingor, the coating material can be gradually applied to core particlestumbling in a vessel rather than being wholly mixed with the coreparticles from the start of encapsulation

Air-suspension coating:

Microencapsulation by air suspension technique consist of the dispersing of solid, particulate core materials in a supporting air stream and the spray coating on the air suspended particles. Within the coating chamber, particles are suspended on an upward moving air stream. The design of the chamber and its operating parameters effect a recirculating flow of the particles through the coating zone portion of the chamber, where a coating material, usually a polymer solution, is spray applied to the moving particles.

During each pass through the coating zone, the core material receives an increment of coating material. The cyclic process is repeated, perhaps several hundred times during processing, depending on the purpose of microencapsulation the coating thickness desired or whether the core material particles are thoroughly encapsulated. The supporting air stream also serves to dry the product while it is being encapsulated. Drying rates are directly related to the volume temperature of the supporting air stream.

Air-suspension coating of particles by solutions or melts gives better control and flexibility. The particles are coated while suspended in an upward-moving air stream. They are supported by a perforated plate having different patterns of holes inside and outside a cylindrical insert.

Just sufficient air is permitted to rise through the outer annular space to fluidize the settling particles. Most of the rising air (usually heated) flows inside the cylinder, causing the particles to rise rapidly. At the top, as the air stream diverges and slows, they settle back onto the outer bed and move downward to repeat the cycle. The particles pass through the inner cylinder many times in a few minutes methods.

The air suspension process offers a wide variety of coating materials candidates for microencapsulation. The process has the capability of applying coatings in the form of solvent solutions, aqueous solution, emulsions, dispersions or hot melts in equipment ranging in capacities from one pound to 990 pounds. Core materials comprised of micron or submicron particles can be effectively encapsulated by air suspension techniques, but agglomeration of the particles to some larger size is normally achieved.

Centrifugal extrusion:

Liquids are encapsulated using a rotating extrusion head containing concentric nozzles. In this process, a jet of core liquid is surrounded by a sheath of wall solution or melt. As the jet moves through the air it breaks, owing to Rayleigh instability, into droplets of core, each coated with the wall solution. While

the droplets are in flight, a molten wall may be hardened or a solvent may be evaporated from the wall solution. Since most of the droplets are within ± 10% of the mean diameter, they land in a narrow ring around the spray nozzle. Hence, if needed, the capsules can be hardened after formation by catching them in a ring-shaped hardening bath. This process is excellent for forming particles 400–2,000 µm (16-79 mils) in diameter. Since the drops are formed by the breakup of a liquid jet, the process is only suitable for liquid or slurry. A high production rate can be achieved, i.e., up to 22.5 kg (50 lb) of microcapsules can be produced per nozzle per hour per head. Heads containing 16 nozzles are available

Spinning disk method:

Mechanical encapsulation process is rotational suspension separation, or the spinning disk method. The internal phase is dispersed into the liquid wall material and the mixture is advanced onto a turning disk.

Droplets of pure shell material are thrown off of the rim of the disk along with discrete particles of core material enclosed in a skin of shell material.

After having been solidified by cooling, the microcapsules are collected separately from the particles of shell material**.**

Multiorifice centrifugal process:

This process is to produce microcapsules that utilizes centrifugal forces to hurl a core material particle through an enveloping microencapsulation membrane, there by effecting mechanical microencapsulation.

The apparatus consists of a rotating cylinder within it three circumferential grooves are present. The upper and lower grooves located circumferentially around the cylinder, carry the polymer or coating material in molten or solution form via inlet tubes to the respective grooves.

The intermediate groove,are a plurality of orifices spaces closely and circumferentially around the cylinder.The ridges of the coating material grooves ,upper and lower,serves as a weir over which the coating or polymer material overflows when the volume of the upper and lower grooves is exceeded bythe volume of the material pumped into the system .Under centrifugal force the coating material imparted by the cylinder rotation flows outward along the countersunk portion and forms a film across the orifice.

A counter rotating disc atomizes or disperses the core material fed through the centrally located inlet. The counter rotating disc flings the particulate core materials toward the orifices.

Then the core material arrives at the orifices and encounters the coating material membrane and the impact and centrifugal forces hurls the core material through the enveloping coating membrane .

The embryonic microcapsules are then hardened ,congealed,or voided of coating solution by a variety of means(Bakan 1986).Processing variables include the rotational speed of the cylinder ,the flow rate of the coating and core material. The process is capable for microencapsulating liquids and solids of varied size ranges, with diverse coating or polymer materials.

Rotating (spinning) disk atomization

Spinning disk atomization is a technique which is based on the disintegrating of a feed liquid performed on disc(s) to produce droplets . When a liquid is dropped onto the surface of a rotating disk it is centrifugally accelerated to a high velocity and distributes as a thin film on the disc. Depending on the flow rate of the feed, droplets/microspheres are then released due to the centrifugal forces at the tip (teeth) of the rotating disk or from ligamentry streams released from the edge of the disk. The size of the droplets produced is determined mainly by the rotation speed of the disk. This simplistic technique has shown the capability to produce microspheres ≥ 200 µm in diameter,with a narrow size distribution and is easily scalable, with possible production capacities of tons/day using a multi-disk system .

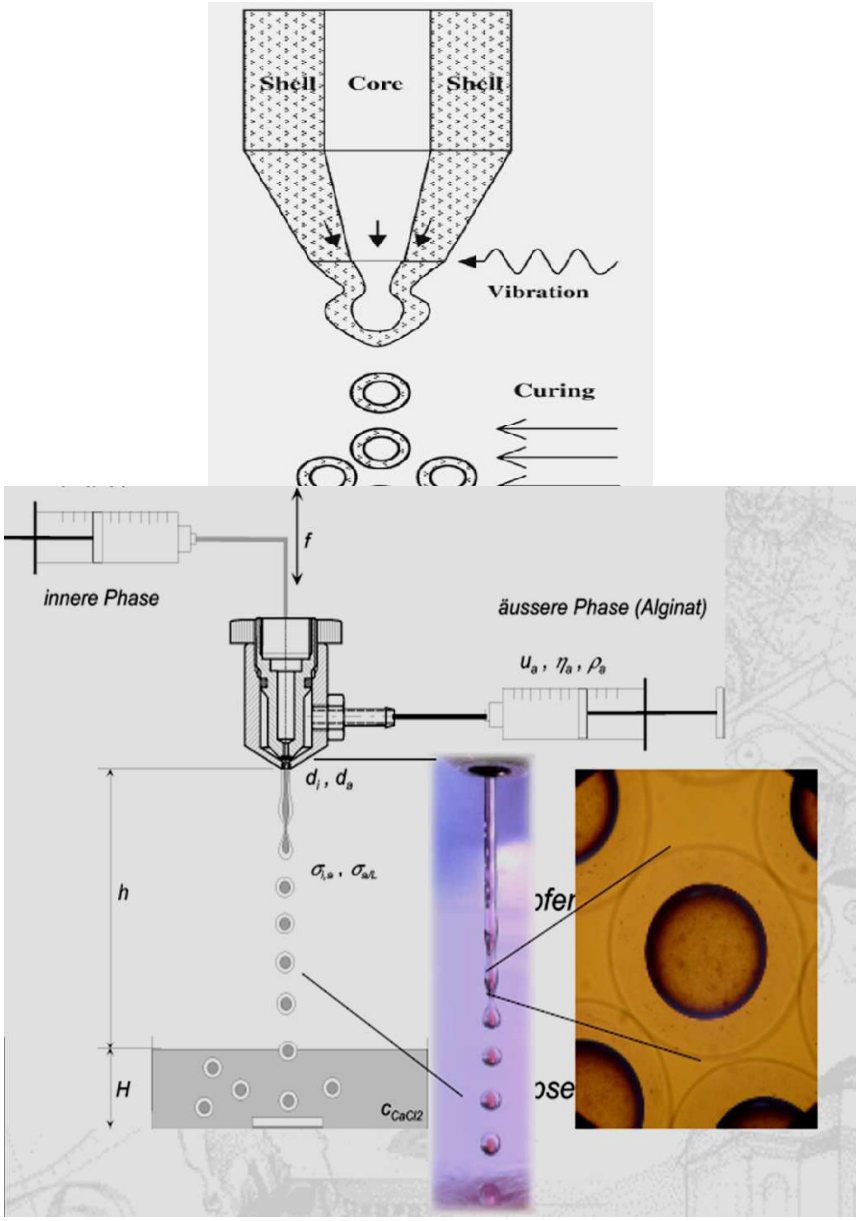
Co-extrusion:

The co-extrusion process was developed by the southwest research institute in the united states and has a lot of applications in food ,cosmetic or pharmaceutical industry.

A dual fluid stream of liquid core and shell materials is pumped through concentric tubes and

forms droplets composed of a droplet of core fluid entrapped by a layer of shell fluid, under the influence of vibration. The shell is then hardened by chemical crosslinking, cooling , or solvent evaporation. In order to optimize the process different types of extrusion nozzles are used.

Extrusion processes lead to matrix or core-shell morphologies, depending on nozzle configuration and narrowly distributed particles are produced.



Chemical methods:

Interfacial polymerization:

In Interfacial polymerization, the two reactants in a polycondensation meet at an interface and react rapidly. The basis of this method is the classical Schotten Baumann reaction between an acid chloride and a compound containing an active hydrogen atom, such as an amine or alcohol, polyesters, polyurea, polyurethane. Under the right conditions, thin flexible walls form rapidly at the interface. A solution of the pesticide and a diacid chloride are emulsified in water and an aqueous solution containing an amine and a polyfunctional isocyanate is added. Base is present to neutralize the acid formed during the reaction. Condensed polymer walls form instantaneously at the interface of the emulsion droplets.

Coacervation and microencapsulation

Coacervation is a colloid phenomenon. If one starts with a solution of a colloid in an appropriate

solvent, then according to the nature of the colloid, various changes can bring about a reduction of the solubility of the colloid. As a result of this reduction a large part of the colloid can be separated out into a new phase. The original one phase system becomes two phases. One is rich and the other is poor in colloid concentration. The colloid-rich phase in a dispersed state appears as amorphous liquid droplets called coacervate droplets. Upon standing these coalesce into one clear homogenous colloid-rich liquid layer, known as the coacervate layer which can be deposited so as to produce the wall material of the resultant capsules. Coacervation may be initiated in a number of different ways. Examples are changing the temperature, changing the pH or adding a second substance such as a concentrated aqueous ionic salt solution or a non-solvent.

As the coacervate forms, it must wet the suspended core particles or core droplets and coalesce into a continuous coating for the process of microencapsulation to occur. The final step for microencapsulation is the hardening of the coacervate wall and the isolation of the microcapsules, usually the most difficult step in the total process.

This process of microencapsulation is generally referred to The National Cash Register (NCR) Corporation and the patents of B.K. Green.

This process consists of three Steps:

• Formation of three immiscible phases; a liquid manufacturing phase, a core material phase and a coating material phase

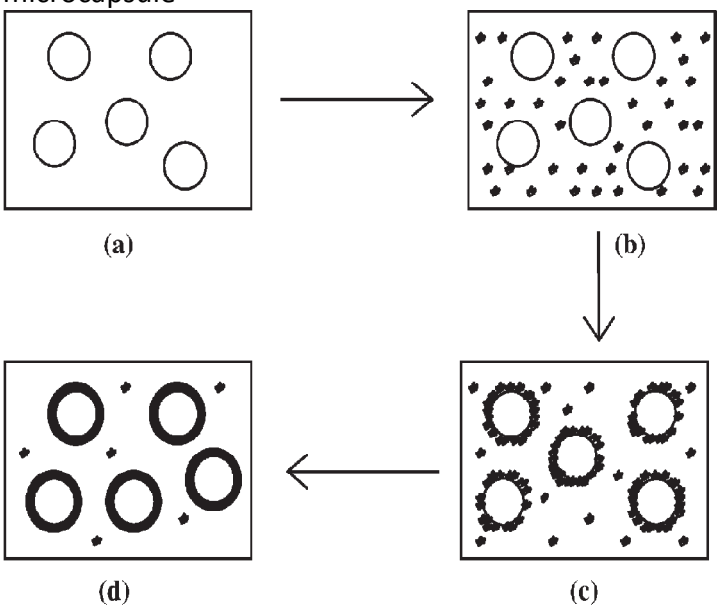
• Deposition of the liquid polymer coating on the core material

• Rigidizing of the coating material

Step-1: The first step of coacervation phase separation involves the formation of three immiscible chemical phases: a liquid vehicle phase, a coating material phase and a core material phase. The three phases are formed by dispersing the core material in a solution of coating polymer, the vehicle phase is used as a solvent for polymer. The coating material phase consists of a polymer in aliquid phase, is formed by using one of the of phase separation- coacervation method, i.e. .by changing the temperature of the polymersolution, by adding a solution, or by inducing a polymer-polymer interaction.

Step-2: It involves the deposition of the liquid polymer coating upon the core material. This is done by controlled mixing of liquid coating material and the core material in the manufacturing vehicle. The liquid coating polymer deposited on the core material if the polymer is adsorbed at the interface formed between the core material and liquid phase. The reduction in the total free interfacial energy of the system help to promote the deposition of the coating material, brought by the decrease of the coating material surface area during coalescence of the liquid polymer droplets.

Step-3: In the last step rigidizing of the coating material done by the thermal, cross linking desolvation techniques, to forms aself supporting microcapsule



Coacervation process:

(a) Core material dispersion in solution of shell polymer

(b) Separation of coacervate from solution

(c) Coating of core material by micro droplets of coacervate

(d) Coalescence of coacervate to form continuous shell around core particles.

Simple coacervation:

Simple coacervation involves the use of either a second more-water soluble polymer or an aqueous non-solvent for the gelatin. Thisproduces the partial dehydration/desolvation of the gelatin molecules at a temperature above the gelling point. This results in theseparation of a liquid gelatin-rich phase in association with an equilibrium liquid (gelatin-poor) which under optimum separation conditions can be almost completely devoid of gelatin.

Simple coacervation can be effected either by mixing two colloidal dispersions, one having a high affinity for water, or it canbe induced by adding a strongly hydrophilic substance such as alcohol or sodiumsulfate . The water soluble polymer isconcentrated in water by the action of a water miscible, non-solvent for the emerging polymer (gelatin) phase. Ethanol, acetone,dioxane, isopropanol and propanol have been used to cause separation of coacervate of gelatin, polyvinyl alcohol and methylcellulose. Phase separation can be effected by the addition of an electrolyte such as an inorganic salt to an aqueous solution of apolymer such as gelatin, polyvinyl alcohol or carboxymethyl cellulose.

A typical simple coacervation using gelatin colloid is as follows: to a 10 percent dispersion of gelatin in water, the corematerial is added with continuous stirring and at a temperature of 40°C. Then a 20 percent sodium sulfate solution or ethanol is addedat 50 to 60 percent by final total volume, in order to induce the coacervation. This system is cooled to 50°C; then, it is necessary toinsolubilize the coacervate capsules suspended in the equilibrium liquid by the addition of a hardening agent such as glutaraldehydeand adjusting the pH. The resulting microcapsules are washed, dried and collected .

Complex coacervation:

Complex coacervation' can be induced in systems having two dispersed hydrophilic colloids of opposite electric charges.

Neutralization of the overall positive charges on one of the colloids by the negative charge on the other is used to bring aboutseparation of the polymer-rich complex coacervate phase.

The gelatin-gum arabic (gum acacia) system is the most studied complex coacervation system. Complex coacervation ispossible only at pH values below the isoelectric point of gelatin. It is at these pH values that gelatin becomes positively charged, but gumarabic continues to be negatively charged. A typical complex coacervation process using gelatin and gum arabic colloids is asfollows: The core material is emulsified or suspended either in the gelatin or gum arabic solution. The aqueous solution of both thegelatin and gum arabic should each be below 3 percent by weight. Then, the gelatin or the gum arabic solution (whichever was notpreviously used to suspend the core material) is added into the system. The temperature of the system must be higher than the gelpoint of an aqueous gelatin solution (greater than 35°C). The pH is adjusted to 3.8-4.3 and continuous mixing is maintainedthroughout the whole process. The system is cooled to 50°C and the gelled coacervate capsule walls are insolubilized by either addingglutaraldehyde or another hardening agent or adjusting the pH. The microcapsules are washed, dried and collected .

In-situ polymerization:

The concept of this encapsulation method is to use an emulsion droplet containing a dissolved monomer .The polymerisation begins and the growing polymer molecules precipitate in the aqueous medium to form primary nuclei.As the polymerization proceeds ,these nuclei grow gradually and the polymeric phase separates leading to the deposition at the interface creating the shell .Simultaneously, it entraps the core material to form the final microcapsules.

Generally ,lipophilic materials are suitable for encapsulation by this technique(polymeric shell-oily core in an aqueous continuous phase are obtained).

Solvent evaporation:

The solvent evaporation process to produce microspheres is applicable to a wide variety of liquid and solid core materials. The emulsion

solvent evaporation technique was fully developed at the end of the 1970s.

At first the coating material is dissolved in a volatile solvent, which is immiscible with the liquid manufacturing vehicle phase. Then the core material is dissolved or dispersed in the coating polymer solution .

The core coating material mixture is then dispersed in the liquid manufacturing vehicle phase with continuous agitation to obtain the desired size microcapsule. When the desired emulsion droplet size is formed ,the stirring rate is reduced and evaporation of the solvent for the polymer is done under atmospheric or reduced pressure at an appropriate temperature. Subsequent evaporation of the solvent for the polymer yields solid polymeric microcapsules entrapping the core.

Polymer shrinks around the core if the core material is dispersed in the polymer solution and matrix type microcapsules are formed when the core material is dissolved in the coating polymer solution.The prepared microcapsules are collected by centrifugation or filtration and then freeze-dried.

There are several process and formulation parameters that may effect the properties of microcapsules prepared by solvent evaporation method .The parameters would include, but not limited to, the aqueous solubility of the core material to be encapsulated ,the types and concentration of dispersing agent ,the polymer/drug ratio, and the agitation rates.

It is advantageous over other methods like spray drying ,sonication and homogenization, etc ,because it requires only mild conditions such as constant stirring and ambient temperature.

This process has several problems and limitations. The solvent evaporation methods require use of toxic organic solvents, such as dichloromethane and ethyl acetate ,as a solvent for dissolving biodegradable polymers.

Another limitation is the drug encapsulation efficiency into the microspheres is not high. Solvents commonly used in this method, such as methylene chloride or chloroform, may be retained in the microspheres as organic volatile impurity or residual solvents.

Another disadvantage of any kind of solvent evaporation method includes solvent residues in polymer and the polymer degradation. Presence of residual solvents may alter the polymer properties which directly leads to different release patterns. They can have a negative influence on drug stability and also cause tissue irritation after subcutaneous or intramuscular injection of microspheres. Therefore, during the development of a parenteral depot system based on biodegradable microspheres, requires evaluation of solvent-elimination and drying techniques to eliminate residual organic solvents as far as possible.

Nano encapsulation:

Southwest Research Institute works extensively with manynanoencapsulation techniques to produceNano sized particles and capsules to addressthe high performance needs of many applications.Nanocapsules can be used in combinationwith other microencapsulation methodsto provide new release characteristics.

Applications:

n Protein, DNA and RNA stabilization
n Small molecule delivery
n Extending circulatory half-life
n Modifying drug transport
n Clear liquid formulations
n Stable colloid dispersions
n Controlled release
n Targeted delivery
n Triggered release

Characteristics:

n Particle sizes from 10nm
n Tunable colloid properties
n Chemically functional surfaces
n Hydrophobic or hydrophilic payloads
n Low payloads
n Organic or inorganic compositions
n High surface area particles

Applications of microencapsulation:

There are many reasons why drugs andrelated chemicals have been microencapsulated.

Applications in pharmaceutical industry:

The various applications of microencapsulation arepresented below . The technology(microencapsulation) has been used widely in thedesign of controlled release and sustained releasedosage forms. It includes,

1. To mask the bitter taste of drugs likeParacetamol, Nitrofurantoin etc.
2. To reduce gastric and other gastro intestinal(G.I) tract irritations, For eg., sustainedrelease Aspirin preparations have beenreported to cause significantly less G.I.bleeding than conventional preparations.
3. A liquid can be converted to a pseudo-solidfor easy handling and storage,

eg.,Eprazinone.

4. Hygroscopic properties of core materialsmay be reduced by microencapsulation

eg., Sodium chloride.

5. Carbon tetra chlorides and a number ofother substances have beenmicroencapsulated to reduce their odourand volatility.
6. Microencapsulation has been employed to provide protection to the core materials against atmospheric effects, e.g., Vitamin-A Palmitate.
7. Separation of incompatible substance has been achieved by encapsulation.
8. Physicochemical evaluation characterization: The characterization of the microparticulate carrier is an important phenomenon, which helps to design a suitable carrier for the proteins, drug or antigen delivery. These microspheres have different microstructures. These microstructures determine the release and the stability of the carrier.
9. Sieve analysis: Separation of the microspheres into various size fractions can be determined by using a mechanical sieve shaker.

Application in food industry:

Microencapsulation is a useful technique to preserve the beneficial properties of these food ingredients and to control their release at both the right place and the right time. Spray drying techniques is generally used in food industry to decrease the water content and there by ensure a microbiological stability of products. This process is used to encapsulate liquid flavour compounds in a carrier matrix to provide dry free-flowing materials protected against degradative reaction and the loss of flavours during food processing.Two encapsulation techniques such as microencapsulation in cyclodextrin and spray drying were reported for flavour encapsulation.

Applications in agricultural industry:

One of the important application in the pesticide industry is to improve handling safety of the pesticides by hazard and exposure reduction .The heavy use of herbicides has given rise to serious environmental and public health problems. It is therefore important to develop new herbicide formulations that are highly effective, safer for the worker and for the environment.

Aldicarb is a carbamate pesticide, highly toxic to mammals .In order to over come these problems microspheres of aldicarb by using carboxy methyl cellulose as the biodegradable support material cross-linked with aluminium chloride .

Applications of biotechnological industry:

Polymeric micro spheres are used for the separation and purification of biomaterials. Effective separation depends on the micron size of microspheres with high porosity to obtain high load capacities .Magnetic supports have found application in increasingly diverse areas of biotechnology ,including purification of proteins ,viruses and nucleic acids ,cell sorting and isolation ,enzyme immobilization, and biosensors.

Applications in cosmetic industry:

In the field of cosmetics microencapsulation technology has been used for making products like deodorants ,shampoos ,spray to improve their stability or bioavailability .The particulate delivery systems used in cosmetics include microparticulates, porous polymeric systems, nanoparticulates ,cyclodextrin complexes. Generally microparticles are used in cosmetics to avoid incompatibility of substances ,reduce odour of actives and for protection of substances prone to oxidation or action by atmospheric moisture. Nylon microspheres are being used in cosmetic make-up and skin care products because of the feel and skin adhesion they impart. Chemical inertia of nylon microspheres allows them to hold

hydrophilic and lipophilic ingredients including vitamins, sun filters, moisturizers, fragrances and many other actives.

CONCLUSION:

Microencapsulation system offers potential advantages over conventional drug delivery systems and also established as unique carrier systems for many pharmaceuticals targeted drug delivery systems .Microencapsulation process have now-a-days become an answer for the questions regarding targeted delivery . Because of their micron size , they can be easily targeted . It is having Improved shelf life due to preventing degradative reactions (dehydration,oxidation) So,microencapsules can set a better mark for targeted drug delivery system.

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