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Topic: Particle Coating by Centrifugation Granulation Technology

Introduction:

Coating is a very commonly applied technology to enhance the properties of materials. When a thin layer of a polymer is placed around a particle it is called coating of the particle. There has been an increased interest in the use of dry particle coating technology because of its reduced risk of environmental impact and potential cost effectiveness. The first reference to tablet film coating appeared in 1930 but it was not until 1954 that Abbott Laboratories produced the first commercially available film coated tablet. This was made possible by the development of a wide variety of materials for example. the cellulose derivatives.[3] [5]

Simple extrusion method involves a device consisting of two side by side tubes which contain aligned fluid nozzles. The liquid material which is to be coated is extruded through the nozzle of inner tube into the coating fluid which is contained in the outer tube. The coating fluid forms a surface coat as these extruded droplets pass through the nozzle orifice of outer tube. which encases the extruded particle. The surface tension of the liquid causes particles of spherical shape to be formed.[6]

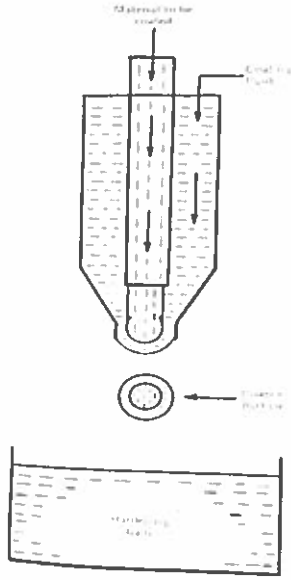

Fig.1 Schematic drawing of simple extrusion

There were some processing problems found in simple extrusion method. This includes certain limitations upon the size of capsules produced. Also. by using simple extrusion capsule uniformity was a problem. So to overcome these problems there was a need of such devices which involve the use of centrifugal force and which have multi orifice extrusion heads as shown in figure below.

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So in this way, the size of the capsule can be controlled by varying the factors such as the orifice size, rotational speed and the rate of flow of fluid which is to be encapsulated. So by keeping orifice size uniform, rotational speed constant and by increasing the fluid flow rate, capsules of increased size can be obtained. Similarly by keeping the orifice size uniform, fluid flow rate constant and increasing the rotational speed, capsules of reduced size can be obtained. Thus, by using centrifugation method we can obtain microcapsules ranging from 100-200μm in size.[3]

The critical parameters involved in this process are: orifice size, rotational speed and fluid flow rate.

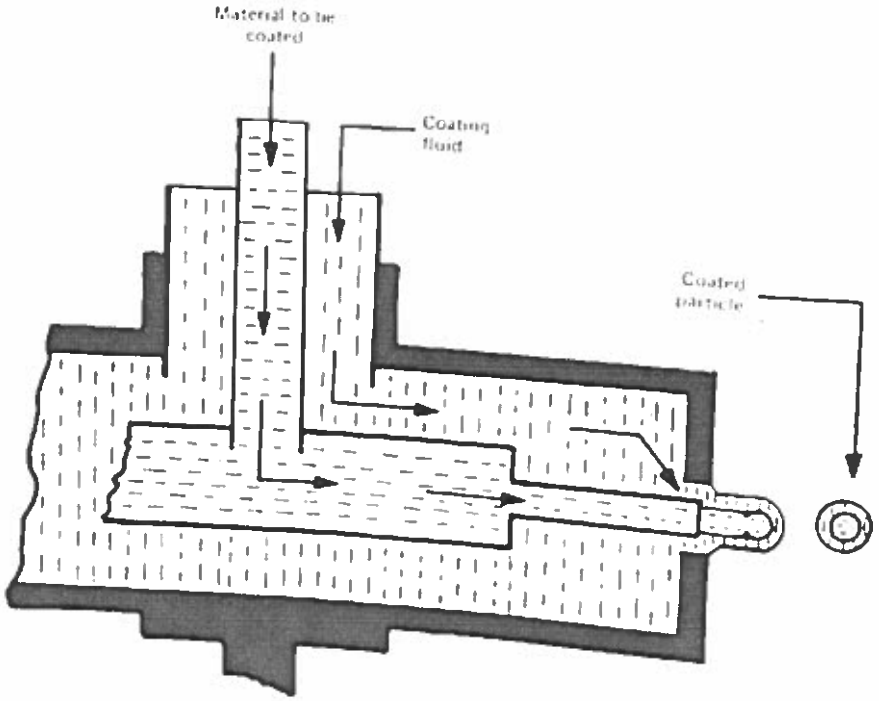


Fig 1.2 Schematic drawing showing one nozzle unit of a multi orifice centrifugal extrusion head

Centrifugation is one of the most important and widely applied research techniques in biochemistry, cellular and molecular biology, and in medicine. Centrifugation coating technique is a unique modified method of the simple extrusion technique to produce microcapsules.

Centrifugal granulation is an advanced method of producing drug-layered pellets. It has numerous advantages such as, lower manufacturing costs, flexibility in operation and ease of automation over other pelletisation techniques. Centrifugal granulators can be used for manufacturing multiple-unit, immediate or controlled-release drug products for oral use. Through the use of these systems, initial beads can be prepared and subsequently drug-layered and coated in the same equipment, resulting in highly spherical multi-layered granules with adequate controlled-release characteristics (Gajdos 1984, Ghebre-Sellassie et al. 1985, Niskanen 1992).[1]

Coating by centrifugation method helped to modify the drug release profile, e.g. enteric coating, sustained release coating, osmotic pumps, etc. improve appearance, facilitate identification, facilitate swallowing by masking taste and odor, protect the core from external environmental factor like oxidation , humidity, light etc., obtain easier product handling, to separate incompatible substances by using the coat to contain one of them or to coat a pellet this was previously compressed into a core. The coated tablet is packed on a high-speed packaging unit. The coating reduces friction and increases the production rate.[1]

Types of particle coating

There are basically two types of particle coating found in pharmaceutical applications. Some new innovations are made which are described later in this article.

1) Wet Particle Coating

2) Dry Particle Coating

1) Wet particle coating (WPC)

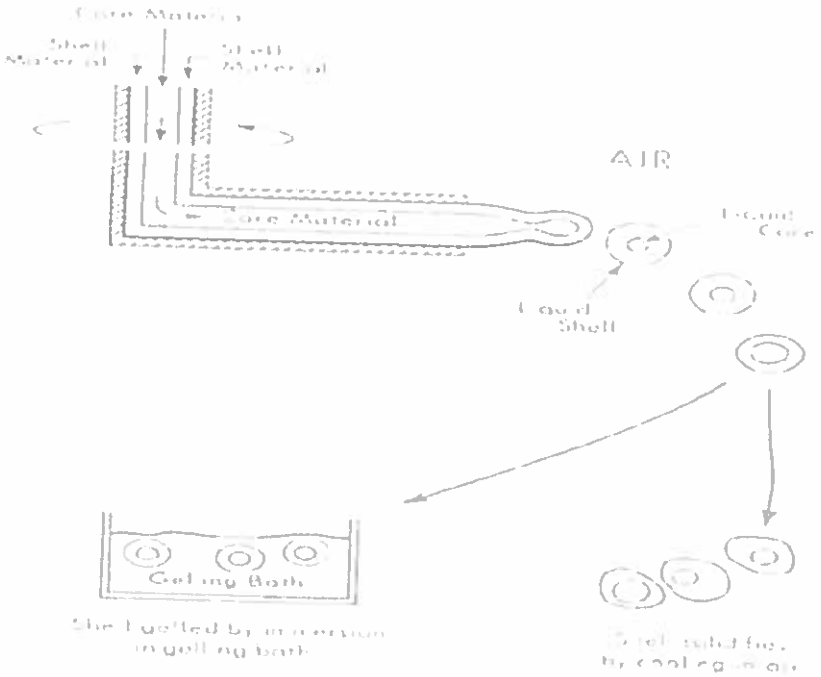
At present, the commercially used technology for coating solid dosage forms is the liquid coating technologies which incorporate any kind of solvent in coating. Generally, a mixture of polymers, pigments and excipients is dissolved in an appropriate organic solvent (for water insoluble polymers) or water (water soluble polymers) to form a solution, or dispersed in water to form dispersion, and sprayed onto the dosage forms and dried by continuously providing heat until a dry and smooth film coating film is formed. WPC solution may be volatile and toxic which needs consideration. Apart from that it requires post treatment and waste processing which subsequently increase the cost. [6]

Multi orifice centrifugation

It is the type of wet particle coating.

The liquid material to be coated is extruded through the nozzle of the inner tube into the coating fluid contained in the outer tube. Initially, the fluid extrudes as a surrounded by the coating fluid, but the rod ultimately breaks up into droplets, which are then immersed, in the coating fluid. As the extruded droplets pass through the nozzle orifice of the outer tube, the coating fluid forms a surface coat, which encases the extruded particle then passed through hardening bath where coated particles are strengthened. The centrifugation method is capable of producing microcapsules 100 to 200 micrometer in the Centrifugal extrusion processes generally produce capsules of a larger size, from 250 microns up to a few millimeters in diameter. 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 breakup into droplets each coated with the wall solution. 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 to 2000 micrometer in diameter.



MULTI ORIFICE CENTRIFUGAL EXTRUSION METHOD

2) Dry particle coating technology

Dry particle coating is used to create new-generation materials by combining different powders having different physical and chemical properties to form composites. which show new functionality or improve the characteristics of known materials. Materials with relatively large particle size (1–200 μm) form a core and these core (host) particles are mechanically coated with fine submicron (guest) particles: no liquid of any kind (solvents. binders or water) is required. Dry particle coating involves mechanically fixing fine particles (guests) onto the surface of relatively larger particles (hosts).

It helps to coat particles without using of organic solvent or water dispersion. Compared to solvent and water based coating, the dry coating method is favorable regarding environmental friendliness. safety and cost. It might be a very suitable coating method in order to coat foods and drugs which are sensitive to organic solvents or water. During the traditional coating process based on organic solvent. the solvent needs to be recovered due to environmental pollution. Coating processes with aqueous dispersions are time and energy consuming caused by the low concentration of coating polymer and large amounts of water which need to be evaporated. [7] [10]

2) Rotating (Centrifugal) fluidized bed granulator/ coater

It is the type Dry coating technology.

It consists of a chamber and a porous cylindrical air distributor made of stainless sintered mesh. The horizontal cylinder (air distributor) rotates around its axis of symmetry inside the chamber. There is a stationary concentric cylindrical metal filter inside the air distributor to retain any elutriated fine powder. [8]

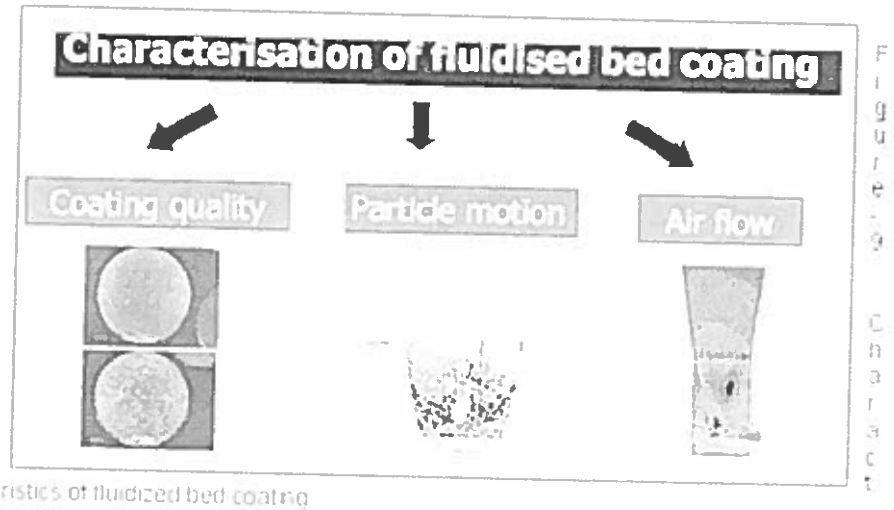
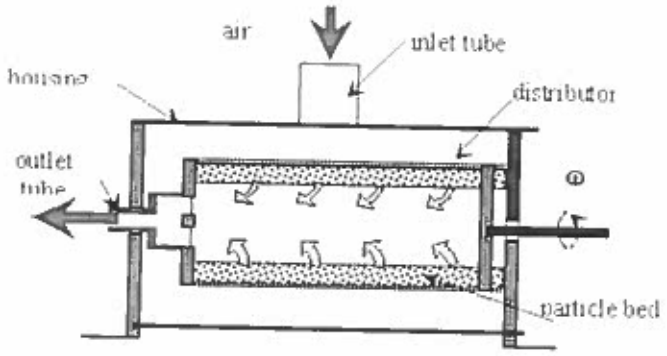


Figure 9 Characteristics of fluidized bed coating

Coating procedure includes following steps

.The powder sample was fed into the cylinder air distributor. The air distributor is also placed inside the metal filter, which cleans the surface of the metal filter in order to prevent it from clogging. An air knocker is installed outside the chamber to prevent powder adhesion onto the air distributor mesh and the front cover. In a rotating fluidized bed, powder samples are introduced inside the air distributor and are forced to the wall by centrifugal force due to the rotation of the distributor. Air flows radially inward through the air distributor, and the forces on the powder are balanced by the airflow and the centrifugal force. coating material was sprayed onto the powder bed.



Rotating Fluidized Bed Coater

Process variables:

Centrifugal granulation is a typical multivariate process and, consequently, it is important to identify and control all critical process variables and conditions. The most important process variables related to this technique include fluidized air flow rate, air temperature, humidity, atomizing liquid flow rate, atomizing air flow rate and pressure, spraying regime, droplet size, spray angle, powder dropping rate, batch size, rotor rotation speed and distance of the nozzle from the product bed (Aulton and Banks 1981, Hodges et al. 1990, Niskanen 1992).

The powder addition rate is the most critical parameter because of its influence on particle moisture. The binder spray rate is the net significant critical parameter. It has negative effect on the yield which is assumed to be because of the shortage of friction of the twin pellets and agglomerates at the wall of the processing chamber.

When indobufen pellets are made by the centrifugal rotary fluidised-bed technique without starting seeds from a mixure of indobufen and microcrystalline cellulose, the water spray rate is found to be an important parameter for the pellet growth . The average pellet growth is proportional to the spray rates of the water added. With increasing spray rate the average particle sizes increases accordingly [1]