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REVIEW ON SPRAY DRYER: A TECHNIQUE USED TO DEVELOPE NDDS

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Spray drying, microencapsulation, controlled drug delivery system, microspheres as carriers for drugs

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ABSTRACT

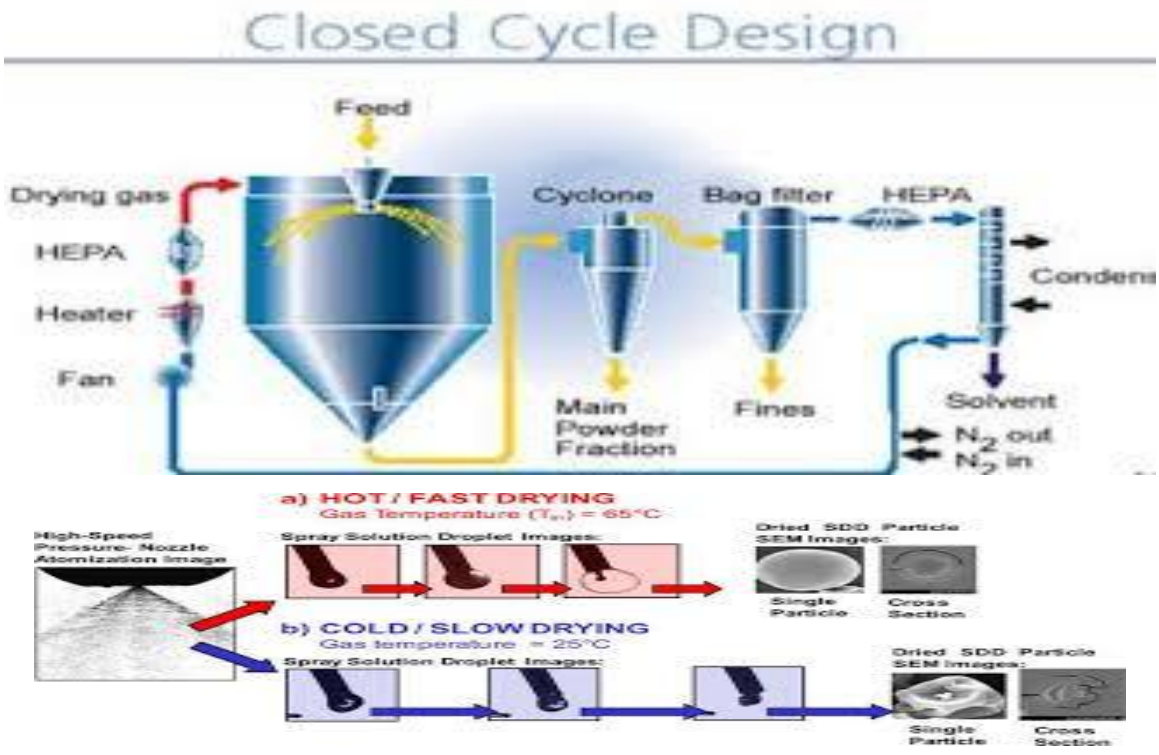
Spray drying is a ubiquitous industrial operation found in numerous industrial sectors. It is employed to produce engineered powders from liquid feedstock in a single step. Extensive research and development efforts in understanding the fundamentals and applications of spray drying in recent years has prompted .Recent research has seen developments in many aspects of spray drying technology. One end of the R&D spectrum concerns large scale design of such equipment, in certain cases incorporating very detailed flow and heat and mass transfer analysis, while the other end of the spectrum focuses on the functionality of the single particle. Novel drug delivery systems have several advantages over conventional multi dose therapy. Much research effort in developing novel drug delivery system has been focused on controlled release and sustained release dosage forms. Now considerable efforts are being made to deliver the drug in such a manner so as to get optimum benefits. There are various approaches in delivering a therapeutic substance to the target site in a sustained controlled release fashion. One such approach is using microspheres as carriers for drugs. Microencapsulation is a process whereby small discrete solid particles or small liquid droplets are surrounded and enclosed by an intact shell. Microencapsulation is used to modify and delayed drug release form pharmaceutical dosage forms. A well designed Controlled drug delivery system can overcome some of the problems of conventional therapy and enhance the therapeutic efficacy of a particular drug. It is the reliable means to deliver the drug to the target site with specificity, if modified, and to maintain the desired concentration at the site of interest without untoward effects. Microspheres received much attention not only for prolonged release, but also for targeting of anticancer drugs to the tumour. The intent of the paper is to highlight the potential of microencapsulation technique as a vital technique in novel drug delivery.

INTRODUCTION

Novel drug delivery systems have several advantages over conventional multi dose therapy. Much research effort in developing novel drug delivery system has been focused on controlled release and sustained release dosage forms. Now considerable efforts are being made to deliver the drug in such a manner so as to get optimum benefits. There are various approaches in delivering a therapeutic substance to the target site in a sustained controlled release fashion. There are many ways to create novel drug delivery system as Microencapsulation, microsphere, oral disintegrating dosage form, mouth dissolving tablet--etc. these ways suppose to be act by enhancing drug solubility of poorly water soluble drug in gastric content or acts as targeted release type drug delivery system. The spray drying technique is widely used now days for microencapsulation products and for microspheres, oral disintegrating dosage form, mouth dissolving tablet--etc. thus spray dryer technique is use to develop novel drug delivery systems.

INTRUMENTATION: Different Parts of Spray Dryer:

1) Air compressor
2) Hepa filter
3) Chamber
4) Aspirator
5) Cyclone
6) Scruber
7) Control unit.



PROCESS PARAMETERS OF SPRAY DRYER:

Spray drying is a transformation of feed from a fluid state into a dried particulate form by spraying the feed into a hot drying medium. The main aim of drying by this method in pharmaceutical technology is to obtain dry particles with desired properties. This review presents the hardware and process parameters that affect the properties of the dried product. The atomization devices, drying chambers, air-droplet contact systems, the collection of dried product, auxiliary devices, the conduct of the spray drying process, and the significance of the individual parameters in the drying process, as well as the obtained product, are described and discussed.

1) Inlet temperature –It is the temp.of hot air coming from air handler(HEPA –filter) to Chamber.It must be less than B.P.of feed solvent & M.P. of the drug.The temp.range is different

For different solvent which is going to be used.

2) Outlet temperature-It must be in similar range of inlet temp.

3)Aspirator flow rate –It is the rate of flow of vaccum to the chamber it must be maintained.

4)Feed pump flow rate- It is the rate of flow of feed solution. if feed flow rate is slow it will leads to generation of large size particles & vice versa.

5)D-Block on :Time interval of 1 to 60 sec of completing one cycle of machine.

6)Cycle time (min.)-It is time taken to complete the cycle

7) Data log interval- It is time taken to plot the parallel lines in trends

E.g. Set parameters for Aspirin (hydrophobic) , beta CD(hydrophilic polymer), methanol(solvent) system

1)Inlet temp.	35^0c
2)Outlet temp.	35^0c
3) Cool temp.	50^0c
4)Inlet high	60^0c
5)Outlet high	55^0c
6)Aspirator flow rate	40Nm^3/hr.
7)Feed pump flow rate	2ml/min.
8)D-Block on(sec.)	1
9)D-Block off(sec.)	60
10)Cycle time (min.)	120
11) Data log interval(sec.)	60

Solubility enhancement by spray dryer:

In pharmaceutical technology there exist numerous drug substances, including new chemical entities that in spite of their high therapeutic effectiveness are characterized by poor water solubility. The latter limits their potential uses in formulating bioavailable pharmaceutical products. In all those cases, the rate limiting factor for drug absorption becomes the

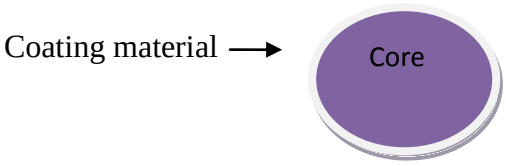
dissolution rate of the active ingredient in the gastro-intestinal liquids [3]. Therefore, the enhancement of oral bioavailability of such poor water-soluble drugs and the preparation of solid oral dosage forms is currently one of major objectives and greatest challenges in the area of new formulations development. Various studies have been done in attempt to improve solubilities of poorly water soluble drugs; they include micronization, solid dispersion, solvent deposition, ordered mixture, roll-mixing and complexation. Among these, a solid dispersion is one of the effective methods for enhancing the drug dissolution rates. The term solid dispersion refers to solid state mixtures, prepared through the dispersion, typically by solvent evaporation or melt mixing, of one or more active ingredients in an inert carrier matrix

[4]. In these dispersions, the drug can be present in a fully crystalline state (in the form of coarse drug particles), in a semi crystalline state, and in fully amorphous state (in the form of a fine particle dispersion, or molecularly distributed within the carrier). Such systems prove to be very effective for enhancing the dissolution rate of low solubility drugs. [5] Pharmaceutical materials that are processed by high energy processes such as spray drying, spray drying, jet milling, melt extrusion and so forth are often rendered at least partially amorphous.

DEVELOPMENT OF NEW DRUG DELIVERY SYSTEM BY SPRAY DRYING:

1)MICROENCAPSULATION:

Microencapsulation is a process by which solids, liquids or even gases may be enclosed in microscopic particles formation of thin coatings of wall material around the substances. Microspheres are characteristically free flowing powders consisting of proteins or synthetic polymers which are biodegradable in nature and ideally having particle size less than 200 µm [3].

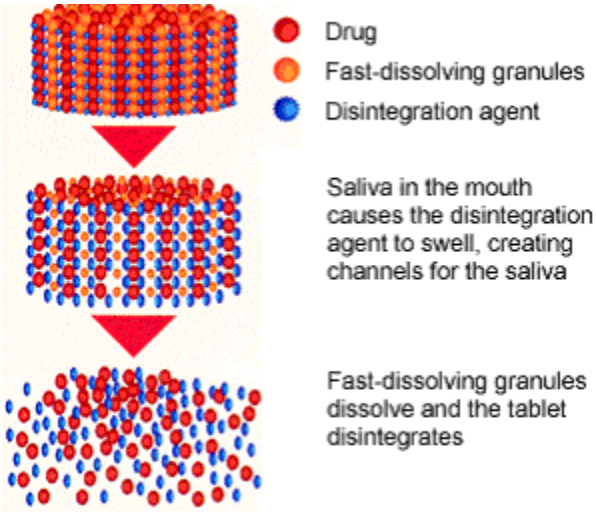


Spray drying and spray congealing methods have been used for many years as microencapsulation techniques. Because of certain similarities of the two processes, they are discussed together. Spray drying and spray congealing processes are similar in that both involve dispersing the core material in a liquefied coating substance and spraying or

introducing the core coating mixture into some environmental condition, whereby relatively rapid solidification of the coating is affected. The principal difference between the two methods, for purpose of this discussion, is the means by which coating solidification is accomplished. Coating solidification in the case of spray drying is effected by rapid evaporation of a solvent in which the coating material is dissolved. Coating solidification in spray congealing method however is accomplished by thermally congealing a molten coating material or solidifying a dissolved coating introducing the coating core material mixture into a nonsolvent. Removal of the nonsolvent or solvent from the coated product is ten accomplished by sorption extraction or evaporation techniques.

2) Mouth Dissolving Tablet (MDT):

It is a tablet that disintegrates and dissolves rapidly in the saliva, within a few seconds without the need of drinking water or chewing. A mouth dissolving tablet usually dissolves in the oral cavity within 15 s to 3 min. Most of the MDTs include certain super disintegrants and taste masking agent.



A highly porous and fine powder is prepared by spray drying an aqueous composition containing support matrix and other components. This is then mixed with active ingredient and compressed into tablet. Allen and Wang used this technique to prepare mouth--dissolving tablets, which disintegrated within 20 s.

3) MICROSPHERES:

Microspheres constitute an important part of these particulate DDS by virtue of their small size and efficient carrier characteristics. Microspheres have many applications in medicine, with the main uses being for the encapsulation of drugs and proteins. The drug loaded microspheres are delivered to the target area by passive means (trapping by size) or active

means (magnetic targeting)[7] and slowly release the encapsulated drug over a desired time period, the length of which is determined by the drug's biological half-life and release kinetics of the microsphere matrix. The bio-distribution of the drug from microspheres is highly dependent on the size and % drug entrapment of the microspheres. Release kinetics of the microsphere matrix is depend on the various factors i.e. type of polymer used [8], concentration of polymer [8, 9-13], drug to polymer ratio, solubility of drug, dispersed phase to continuous phase ratio etc. These variables directly affect the loading efficiency of the microspheres. Polymeric microspheres and microcapsules have received much attention for the delivery of therapeutically useful proteins in a controlled way[14] Microparticulate systems can be made by various techniques involving physicochemical processes (solvent evaporation method, phase separation method) and mechanical processes (e.g., spray drying)[15]. In this process, the drug may be dissolved or dispersed in the polymer solution and spray dried. The quality of spray-dried microspheres can be improved by the addition of plasticizers, *e.g.* citric acid, which promote polymer coalescence on the drug particles and hence promote the formation of spherical and smooth surfaced microspheres. The size of microspheres can be controlled by the rate of spraying, the feed rate of polymer drug solution, nozzle size, and the drying temperature. This method of microencapsulation is particularly less dependent on the solubility characteristics of the drug and polymer and is simple, reproducible, and easy to scale up.

4) ORALY DISINTEGRATING TABLETS:

Oral dosage forms like tablets and capsules possessing great problem of swallowing mainly for pediatrics, geriatrics, and bedridden, nauseous or non-compliant patients'. Orally disintegrating dosage forms has to be placed in mouth and then get dispersed in saliva without the need of water [16, 17]. Orally disintegrating tablets are also called as orodisperse, mouth dissolving, rapidly disintegrating, fast melt, and quick dissolve system. From past decade, there has been an increased demand for more patient-friendly and compliant dosage forms. As a result, the demand for developing new technologies has been increasing day by day [18]. Spray drying can produce highly porous and fine powders that dissolve rapidly. This technique is based on a particulate support matrix, which is prepared by spray drying an aqueous composition containing support matrix and other components to form a highly porous and fine powder. This then mixed with active ingredients and compressed into tablets. The formulations are incorporated by hydrolyzed and non hydrolyzed gelatins as supporting agents, mannitol as bulking agent, sodium starch glycolate or cross carmellose sodium as

disintegrating and an acidic material (e.g. citric acid) and / or alkali material (e.g. sodium bicarbonate) to enhance disintegration and dissolution. Tablet compressed from the spray dried powder disintegrated within 20 seconds when immersed in an aqueous medium.

Allen et al. used a spray drying technique to prepare fast dissolving tablets. The tablets made from this technology are claimed to disintegrate within 20 seconds [19].

CONCLUSION

The spray drying technique is nowadays widely used in formation of NDDS or intermediates of the same. The main aim is to overcome shortcomings arising due to certain physicochemical properties of drugs. There are many ways to create novel drug delivery system as Microencapsulation, microsphere, oral disintegrating dosage form, mouth dissolving tablet--etc.which are ultimately used to form NDDS.

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