IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

FLUIDISED BED TECHNOLOGY: REVIEW

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Abstract:

Innovative formulation development is the most emerging and upcoming face of pharmaceutical technology in the current era. It is contemporarily capturing the market leaps and bounds with recent trends and developments with its innovative techniques. Fluidized bed technology is a widely used technique of producing granules, coating, drying, cooling in pharmaceutical, food, detergent, and fertilizer industries. The Fluidized bed processor was developed in 1950 and it was one of the unique equipment widely used in Pharmaceutical Industry. At the beginning of its invention, it was used as a simple dryer and later on became highly effective with various modification like, addition of spray nozzle i.e. top spray, bottom spray or tangential spray granulators, rotor technology etc. With the development of rotor technology, the fluid bed system was used to manufacture pellets, granules, coating, drying etc. This review information regarding the advantages and the latest technology involved in the FBP which are utilized in pharmaceutical industry.

Index Terms **– fluidizing bed processing, granulation, top spray, bottom spray, tangential spray, coating/ pelletization.**

I. INTRODUCTION

Much equipment which is used for the process of coating, granulation and drying are being used in present day pharmaceutical industries. Use of such equipment helps reduce the processing steps involved in production of a product, cost and also the time. The latest technology called fluid bed processing helps in attaining the coating, drying and granulation of a product so that uniform drying and coating takes place[1]

Fluidization is when a gas is sent through a nozzle with a velocity of greater than the settling velocity of particles or solids, the particles tend to suspend in the air provided and continue in the stream of upward gas. When the particles are reaching to the top of the equipment, they tend to gravitational pull and so fall down and the process is suspending continues. This process is called as fluidization of suspended particles.

ADVANTAGES AND DISADVANTAGES

Advantages[4]

1) Liquid like behavior, easy to control

2) Uniform temperature, rapid mixing and concentrations.

3) Resists rapid temperature changes, hence responds slowly to changes in operating conditions and avoids temperature run away with exothermic reactions.

4) Applicable for small or large scale operations.

5) Heat and mass transfer rates are high, requiring smaller surfaces.

6) Continuous operation.

7) Ease of process control due to stable conditions.

Disadvantages [4]

1) Bubbling beds of fine particles are difficult to predict and are less efficient.

2) Particle comminution (breakup) is common.

4) Non-uniform flow patterns (difficult to predict).

5) Size and type of particles, which can be handled by this technique, are limited

6) Due to the complexity of fluidized bed behavior, there are often difficulties in attempting to scale-up from smaller scale to industrial.

GRANULATION/AGGLOMERATION

Granulated or agglomerated particles are more desirable than fine powders for several reasons. For pharmaceutical products, granulation often is performed

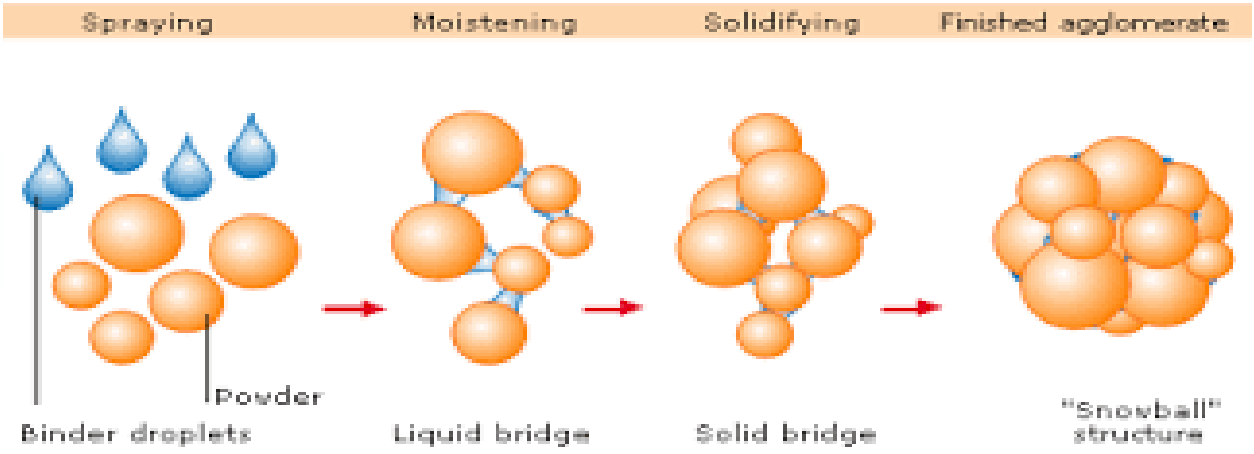

Figure 1: Process Principle of Spray Agglomeration.

- To improve dispersibility.
- To improve compressibility for tableting.
- To reduce environmental safety and dust for operator.
- To improve flowability
- Uniformity by combining all ingredients together, or by distributing low-dose actives. uniformly by dissolving and spraying a solution of actives.
- Top-spraying and tangential-spraying typically are the methods chosen for granulation. Process conditions in the bottom-spray technique can be adjusted to produce granules.[2]

Variables Process:

During the granulation process, granules grow bigger and heavier. To keep with increased spray rate of the granulation liquid, a reduction in atomizing air pressure, and an increase in liquid viscosity for FDG with dual fluid nozzles.

The different Process variables affect the process of fluidized bed processor.

Table 1: Key process variables affect the process.

Process Variables Key Variable (Operating or Material)	Observation
Spray rate	Granule size, granule strength, size distribution, de-fluidization
Product loading	Granule density and strength, Proper differential pressure drop across the gas distribution plate is needed for good fluidization.
Particle density and size	Proper superficial gas velocity for good fluidization and minimum entrainment and attrition.
Relative humidity	Fluidization, granule growth when a critical value is exceeded
Granulation liquid Atomization	Spray drying, Granule size and its distribution.
Temperature	Granule strength and granule size, it is often used for determining the end point of drying stage
Superficial gas velocity	Product bed expansion, solids attrition, solids entrainment.

TYPES OF FLUIDIZED BED SPRAYING TECHNIQUES

With the modifications made in the Fluidized Bed technology, the spraying techniques are divided into three types:

1) Top spray process

2) Bottom spray process

3) Tangential spray process.

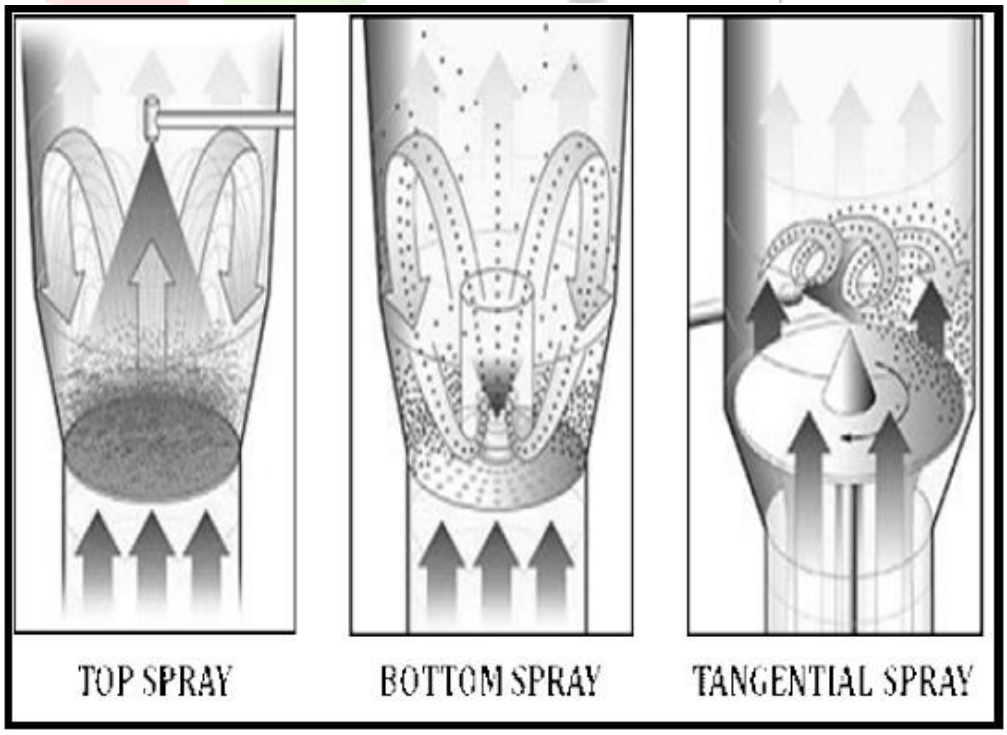

Figure 2 Different Patterns of Fluid Bed Processing

1. **Top spray process:**

Top-spraying is the most well known process for wet granulation, and it has been used in various industries like pharmaceutical, food, detergent, and fertilizer industries for more than 30 years. A top-spray processor has three components (Fig. 2).

- An exhaust system (including the processor's filter housing).
- An air-handling system, which can be equipped with de-humidification or humidification and dew-point control.
- A expansion chamber and product container[5]

2. Bottom spray Process:

This process employs a cylindrical product container with perforated plates. In the container, there is a second cylinder (coating partition), which is raised slightly above the perforated plate. Centrally, in the plate below this partition, there is a nozzle used to dispense the coating solution. The perforated plate is designed with large holes in the area under the coating partition & smaller holes in the remainder of the plate, excluding the one ring, of larger holes at the perimeter. Bottom-spray coating provides a highly organized particle flow & high quality reproducible film so this system is used extensively for sustained release/ controlled release/ extended release and delayed/ enteric coating. This process is capable of handling solvents, emulsions, suspension, Aqueous Solutions, films & hot melts. It is used for coating small particles, capsule shell, pellets & tablet with batch size from a few hundred gm to 600 kg.[6]

3. Tangential spray process:

The physical technique and processing principles are quite similar to bottom spray process, only that the production motion is provided by a motor driven rotor disc. The spraying nozzles are located tangentially in the chamber. A significant advantage of tangential spraying over bottom spray or top spray processes is the option of connecting a powder feeder to decrease the exposure of compounds to solvent or water. This technique permits the production of pellets with high dose loading of activities in relatively short time. Tangential spraying can be used to produce pellets or granules that require successive coating for modified release and controlled release. This process is most suitable for preparing spheres (spheronized granules) from powders. It also serves the purpose of applying modified release drug layering and coating.[7]

Coating / pelletizing powdered layering:

Fluidized bed coating is a process that takes place inside a fluidized bed whereby a coat is introduced to cover the intended object in order to protect it or modify its behavior. Particulate coating is a form of fluidized bed coating involving the coating of solid particles inside the bed. In the process, a layer is deposited onto the surface of fluidized solid particles by spraying with a solution of the coating material. The fluidizing gas is also use to dry the deposited solution to form a coat on the surface of the particle. There is another process that is sometimes also referred to as fluidized bed coating, which involves building up a protective coating around metals especially those used in appliances, electrical, power distribution, pipelines etc. (Gutfinger and Chen, 1969). The object to be protected is preheated and then immersed in a fluidized bed containing a polymer powder resin. The temperature of the object is maintained above the softening or melting point of the resin. The resin particles melt onto the heated surface and thus create a protective coating covering the object. This study deals exclusively with particulate fluidized bed coating. Therefore the terms particulate coating, fluid-bed coating or merely coating, as far as this study is concerned, mean fluidized bed particulate coating.

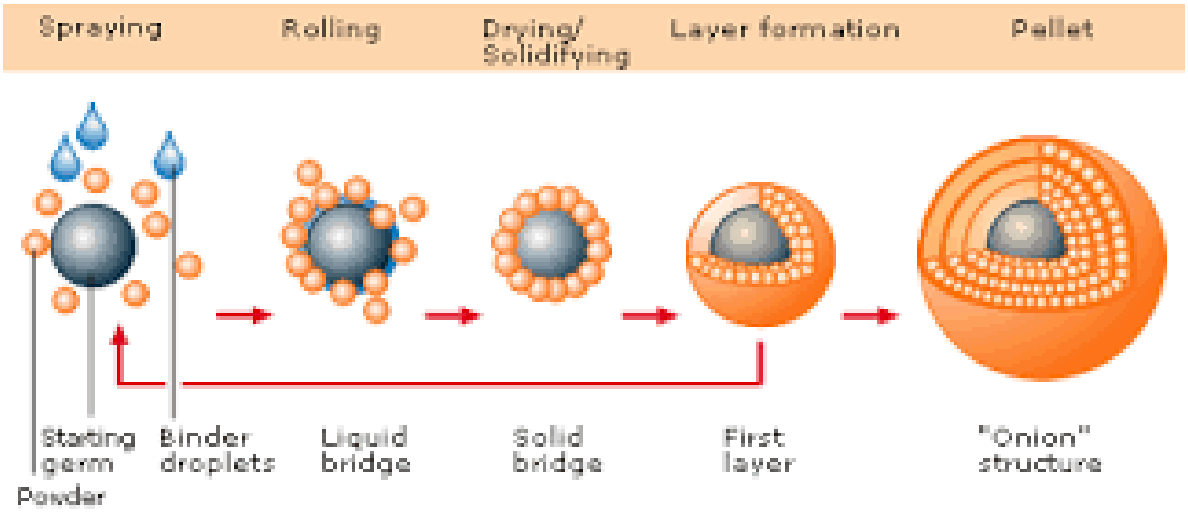

Figure 3 Process of coating /pelletizing

The coating of particles is practiced in various industries for several reasons. For pharmaceuticals, coatings are used

1) To mask unpleasant tastes or odors

2) For product identification

3) To enhance stability (e.g., to act as a moisture barrier)

4) To modify or control drug release

5) To improve product flowability.

In general, there are two types of coating applications: film coating (using a wax, aqueous, latex, or organic coating system) and substrate layering. The latter produces pellets or spherical forms of a substrate by layering it, in powder or liquid form (e.g., solution, suspension, or emulsion), onto inert carriers such as sugar spheres. [17-18] the pellets are then coated for modified or controlled-release dosage forms. Common coating materials can be grouped into three categories: waxes, water-insoluble polymers, and water soluble polymers. Water-insoluble polymers can be applied via an organic solvent system or an aqueous system such as latex or pseudo latex dispersions. Because of environmental concerns regarding the use of organic solvents, aqueous dispersions have gained popularity. [17-20]Fluid bed technology offers different methods of pelletizing depending upon the functionality of the products and the given properties of the substrate.

CONCLUSION:

The purpose of this review article is to get knowledge of fluidized bed technology. In this review article we try to discuss the introduction, and techniques of the fluidized bed technology also presented a varied description of the fluid bed process such as drying, granulation, coating and pelletization. We focused on process variables affect the process on Fluidized bed technology.

REFERENCES:

1. Ravi Teja Pusapati, T. Venkateswara Rao. Fluidized bed processing: A review. Indian Journal of Research in Pharmacy and Biotechnology ISSN: 2321-5674(Print) ISSN: 2320 – 3471(Online)

2. Saurabh Srivastava, Garima Mishra. Fluid Bed Technology: Overview and Parameters for Process Selection. International Journal of Pharmaceutical Sciences and Drug Research 2010; 2(4): 236-246

3. Kamal Sharma, Nitika Ahuja, Pankaj Soni, Sushil Ahlawat, Dr Hema Chaudhary, Dr. Arun Garg. Fluidized Bed Granulation: A Novel Strategy for Development of Low Dose Formulations. Received on: 11-06-2012; Revised on: 18-07-2012; Accepted on: 27-08-2012

4. Kishor S. Amale, Kishor S. Salunkhe, Sachin S. Gaikwad, Machindra J. Chavan. A Review on Fluidized Bed Technology. IJPT| July-2019| Vol. 11 | Issue No.2 | 6869-6890

5. G. V. Pulgamwar, R. S. Pentewar, R. U. Bharti, S. S. Talde, N. A. Inamdar, N. V. Kshrisagar. Fluid bed technology: A Review. IJPRBS, 2015; Volume 4(4): 89-110

6. Jitendra Chauhan and Poonam Yadav. Study of Scale up parameters of Fluidized bed Coating, Pelagia Research Library Der Pharmacia Sinica, 2011, 2 (1): 228-238

7. Anitha Sri S. Fluidized Bed Processing Technology: A Short Review. Research and Reviews: Journal of Pharmaceutics and Nanotechnology

8. Vuppala MK, Parikh DM, Bhagat HR. Application of powder-layering technology and film coating for manufacture of sustained-release pellets using a rotary fluid bed processor. Drug Dev Ind Pharm. 1997; 23: 687-694.

9. www.chemicalonline.com; Accessed on 15.11.2010.

10. Pardhi D, et al. Evaluation of the Potential of Natural Biodegradable Polymers (Echinochloa Colonum Starch) and its Derivatives in Aqueous Coating of Hydrophilic Drugs. J Pharm Sci Emerg Drugs. 2016; 4:1.

11. Lokesh BVS and Kumar PV. Enhanced Cytotoxic Effect of Chemically Conjugated Polymeric Sirolimus against HT-29 Colon Cancer and A-549 Lung Cancer Cell Lines. J Pharm Drug Deliv Res. 2015; 4:2.

12. Leuenberger H, Luy B, Struder J, New development in the control of a moist agglomeration and pelletization process, STP Pharma Sci, 6, 1990, 303-309

13. L. Lachman, H.A. Lieberman, J.L Kanig, Third edition Granulation , The Theory and practice of industrial pharmacy,Verghese Publishing House, Bombay, 5859, 1991.

14. Hilligardt K,Werther JW. Local bubble gas hold-up and expansion of gas/solid fluidized beds. Germ. Chem. Engng 1986; 9: 215– 221.

15. Gao J, Motheram A, Hussain D. Fluid bed granulation of poorly water soluble, low density, micronized drug: comparison with high-shear granulation. Int. J. Pharm 2004; 237: 114.

16. Watano S, Sato Y, Miyanami K, Murakami T, Oda N. Scale-up of agitation fluidized bed granulation. Part 1: preliminary experimental approach for optimization of process variables. Chem Pharm Bull (Tokyo). 1995; 43: 1212-1216

17. Fluid Bed Processor: GEA Pharma Systems