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A REVIEW ON FLUIDIZED BED EQUIPMENT: A RELIABLE TECHNIQUE FOR GRANULATION

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ABSTRACT

The fluidized bed processing technology is the potential tool to develop newer trends and implication within the area of formulation and development with improve therapeutic efficacy. The fluidized bed processor is employed for coating, drying, layering and granulation. It is current capturing the market leaps and bounds with recent trends and development with its revolutionary techniques. Fluidized bed granulation technique is most rising and upcoming face of granulation technology of pharmaceutics. In pharmaceutics fluidized bed granulation is a key technique which improves the powder properties for preparing pharmaceutical dosage form with enhance the functional properties i.e, solubility, dissolution. Understanding and controlling the critical process. parameters obtained high quality granules. This article reviews the fundamentals of fluidized bed processor, fluidized bed granulation and detailed information regarding with principle, advantages, latest technology and troubleshooting were also described.

KEYWORDS: fluidization, fluidized bed granulation, granulation, drying.

INTRODUCTION

In the manufacturing of pharmaceutical solid dosage forms, one of the important unit operation is granulation, mostly in the tablets manufacturing and capsules filling. During the process of granulation, very fine or coarse particles are converted into large agglomerates known as granules. Generally, granulation starts after initial preblending or dry mixing of powder ingredients and active pharmaceutical ingredient with the help of these we can achieve uniform distribution of all ingredients throughout the mixture. They are primarily

produced as an intermediary to be either packed as a dosage form or be mixed with other ingredients before tablet compaction and capsule filling.

The process granulation utilizes the granulation fluid (binding liquid) which is made up of dry powder materials and a liquid. Binders may be by combining dry materials such as powders and perhaps crystals with granulation fluid also known as binder solution which is mixed in dry ingredients to achieve uniform distribution of the granulating solution. Formation of adequate granules, inter particle forces are responsible.

Purpose of granulation

- Spherical shape of granules is formed to improve flow properties of powder.
- Sufficient fines to fill void spaces between granules for better compaction.
- Narrow particle size distribution for content uniformity and volumetric dispensing.
- Compression characteristics, adequate moisture and hardness to prevent the breaking and dust formation during process.
- Increased the density of blend so that it occupies the less volume per unit weight for better storage and shipment,
- To facilitate volumetric and metering dispensing,
- To improve the appearance of the formulation,
- To reduce the dust formation during process of granulation,
- While powders are very fluffy and very fine, will not stay blended or will not compress, then they must be granulated, fluffy, it means that the specified amount of powder physically will not fit into the die cavity on the tablet press. The volume of fill (bulk density) is more than that which is mechanically allowed.

Granulation Fundamentals

Granulation is the physical operation which is design to the formulate large agglomerates by the fine powder particles, pellets and grains. In the granulation process mainly used granulation fluid i.e. binder solution or dry binder incorporating in granulating solution. These granulating fluids are incorporated in dry powder blend. Agglomerates are formed by combing the granulating solution and dry powder blend. Uniform distribution is achieved by continuous mixing and allowing formation of particle-particle interaction.

Types of liquid state of granules

1. Pendular State

This type of granulation is express as "too dry" In which particles have been exposed to granulating solution for liquid bridges to form.

2. Funicular state

Liquid bridges joining adjacent particles are interspersed less frequently by air. As moisture content increases, surface coverage by the granulation liquid also increases. Agglomerates are characterized by greater strength than agglomerates formed in the pendular state.

3. Capillary state

Incorporation of granulation fluid leads to complete liquid coverage of solid phase surface agglomerates formed in these phases have good strength and demonstrate minimum attrition on further processing.

4. By continuously incorporation of granulation fluid leads to complete wetting of all solid surface. If any small quantity of liquid added beyond this point has very less. possibility of adhering to solid surface and becomes associated with the part of the liquid film that covers the surface of particles in the granulator.

Mechanism of granule formation

1. Nucleation.
2. Transition.
3. Ball growth.

FLUIDIZED BED PROCESSOR

The concept of fluidized solids actually invented in the field of catalytic cracking method. In the process of fluidization the standard oil development has many benefits and contribution. The Prof. W.K Lewis and E.R Gilliland carried out individualistic research on flow properties of solid suspended particles in gases and developed the Fluid bed process. The fluid solid technique principle was the first industrial plant implemented into operation in 1930 for non-pharmaceutical application but this process was first invented by Wruster in 1960. In 1953 Dale Wruster invented the coating of tablets by spraying the coating solution on tablets bed stream of warm air suspended in warm air in 1953 this process also known a wruster process. In 1960 Dr. Dale Wruster carried out the granulation of powders. Then in 1980s have seen an

explosion in the research, application and commercialization of fluid bed process. Application of such equipment helps to reduce the cost, time and also the processing steps included in manufacturing of formulation. The latest technology known as fluid bed processing technology. Fluid bed processing involves coating, granulation, drug layering and drying of powder material. The most commonly known fluid bed process for coating in the pharmaceutical industry is the bottom spray (wurster) process.

Concept of Fluidization

The concept involved in such technique may be either by top spray or bottom spray or tangential spray process. Those principle depends on the spray gun poisoning in equipment. The top spray positioning helps in obtaining the uniform granulation and pelletization. And the bottom spray positioning process utilizes wurster coating unit for the spray.

➢ Lighter particles or objects float on top of the bed.

➢ The solid substances can flow through an opening in the vessel.

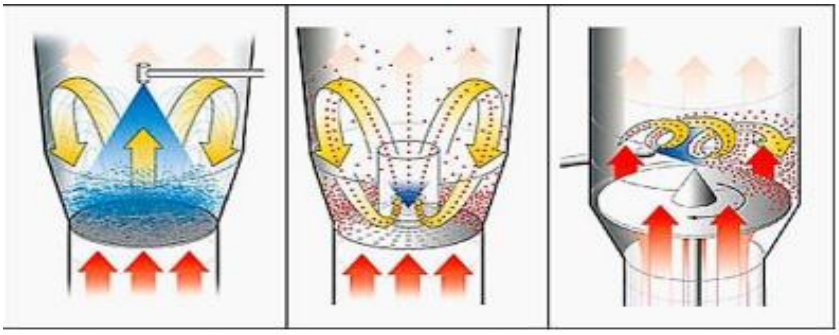
➢ The bed have a static pressure head because of the gravity.

➢ It has a zero angle of repose. The three patterns of the fluid bed processor could be characterized by the position/location of the spray nozzle i.e.

➢ a. Top Spray

➢ b. Bottom Spray

➢ c. Tangential spray



FLUIDIZED BED GRANULATION

Introduction Process of granulation is converting fine size solid particles into large particles by continuous mixing in presence of granulating fluid. The process of granulation is very vast and multistep process have many disadvantages and such drawbacks overcome by the novel

technique i.e, fluidized bed granulation and drying in fluidized bed processor. Fluidized bed granulation [FBG] is one of most widely used technique in manufacturing of solid pharmaceutical products such as Granulation is also known as agglomeration. Fluidized bed granulator (FBG), a highly economical and efficient one pot process, is a popular technique in the pharmaceutical. Fluidized bed granulation is one of the many techniques i.e, drum granulation, pneumatic dry granulation, high shear granulation, and so on to produce agglomerates. Fluidized bed granulation technique is preferred over other techniques because it provides properly mixing, high heat and mass transfer rates, continues the bed more or less at uniform temperature. In operation of fluidized bed granulation fine droplets of granulating solution are sprayed at the surface of fluidizing particles. when particles are wetted and collide to each other and formation of liquid bridges are converted into solid bridges. When they received adequate amount of heat form the fluidizing air, to drive off the solvent present. Hence the particles are adhere to each other to form agglomerates/ granules. Fluidized bed granulation technique Recently, a method for preparation of solid dispersion using fluid bed granulation process. Solid dispersion using fluidized drawbacks and problems arising in other multistep granulation and solid dispersion manufacturing processes. Principle of Fluidized bed granulation process.

In the tablet manufacturing process, a continuous production line, involving several operations like coating, drying and granulation, can be performed in fluid bed equipment. Fluid bed granulation process involves the spraying of binder solution, suspension or dispersion onto a physical mixture i.e powder bed, where particles are suspended in air stream. These particles are wet by granulating or binder solution and when they collide to each other than formation of the liquid bridges which leads to acquisition of granules. The liquid bridge that adheres the particle to each other in two mechanisms. Bed granulation process has been attracting attention as a manufacturing process because it overcomes so many drawbacks and problems arising in other multistep granulation and solid dispersion manufacturing processes

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stream. These particles are wet by granulating or binder solution and when they collide to each other then formation of the liquid bridges which leads to acquisition of granules. The liquid bridge that adhere the particle to each other in two mechanism.

1. By surface tension at interface 2. By hydrostatic suction

Bed moisture level and Granule microstructure can be affected by many conditions, such as the primary particle size, Fluidizing air velocity, concentration and spray rate of binder solution, manufacturing processes which can leads minimizes the rate of granule breakage. However, despite the recognized application of the fluid bed granulation for improving the solubility and dissolution rate of poorly water-soluble drugs. The solidification of liquid bridges is dried then formation of cluster of solid particles such as granules or agglomerates. fluidized bed granulation it involves continuously preblending of dry excipients, wetting and drying of particles. Hence, the factors controlling in fluidized bed granulation process technology becomes difficult process. If the granulating solution is excess or if it is maldistributed, large region of the bed may defluidize and particle adhered to each other to form a large lumps of particles, such process is known as wet quenching. On the other hand minimum fluidization velocity occurs because of excessive particle growth minimum fluidization velocity is proportional to square of particle diameter which will exceeds the operating velocity, which leads to fluidization, known as dry quenching. Granulators The density of each granule increase by increasing the quantity of granulating solution as well as the mechanical action of the mixer. Consequently, controlling the amount binder, granulating solution and mechanical action allows one to control the density and strength of the agglomerates/ granules. Equipment or machines that are applicable for this method are known as granulators. Granulators may be low shear, medium shear or high shear. Shear is term describes the amount of mechanical force of the granulators. A low-shear granulators utilizes very low mechanical force to mixing powders and binding solution

COMMON PROBLEMS ARISES IN FLUIDIZED BED GRANULATION

- Excessive fine
- In sufficient quantity of binder
- Air flow or high fluidized velocity
- Too low Binder spray rate
- Atomization air pressure is high
- Weak binder or low concentration of binder solution.

- High Inlet temperature
- Fine droplet size of the binder.

❖ Excessive coarse granulation
- High binder spray rate.
- Inlet air temperature is low
- Low fluidization velocity or air flow
- Nozzle position is too low
- Stronger binder or higher concentration of spraying liquid

❖ Final moisture inconsistency
- Temperature probe out of calibration
- Fluidization is improper
- Outside air humidity

❖ Fluidization is poor
- Air velocity is low
- Processor fan does not have adequate pressure drop
- No proper cleaning of air distributor
- High quantity of product in product container
- Air distribution plate is incorrect
- Exhaust is blocked
- Porosity of exhaust is small

❖ Finished product non uniformity
- spraying time is Insufficient
- Lumps in raw material
- insufficient Filter shaking
- Product homogeneity before granulation is not adequate

❖ Low yield
- At the end of process filter bag is not shake
- Material sticks to expansion chambers
- Wrong porosity exhaust filter

- Air distributor with coarser screen opening

Advantages

- To improve compressibility for tableting.
- Applicable for large or small-scale operations
- Continuous operation
- Time and cost effective.
- Reduce product loss.
- To reduced dust formation operator and environmental safety.
- Improve housekeeping and workers safety.
- Saving labour cost

Disadvantages

- Cleaning was labour intensive and time consuming
- Erosion of internals. Pipe and vessel walls erode due to collisions by particles
- Attrition of catalyst particles.
- Hot melt granulation method required more attention because sometimes product degradation by excess heat
- Due to the complexity of fluidized bed behaviour, there are often difficulties in attempting to scaleup from smaller scale to industrial units

CONCLUSION

Very fine and small size particle have a negative impact on the flow properties of powders. And will not stay blended or will not compress in die cavity for tablet manufacturing. To overcome these problems, they must be granulated, granulation is used to improve the functional properties of the powders. During the granulation process, powder particles are adhered to each other and formation of cluster, increasing the particle size. Numerous agglomeration methods can be employed depending on the end use properties of granules. The fluidized bed granulation technique is widely used in the industry because it produces granules with high porosity and homogeneity. To overcome all possible problems and achieve the desired products and controlling and understanding mechanism of the parameters affecting granulation process and properties of granules; e.g., mixing rate, binder property, moisture content, inlet air temperature etc such a properly investigated and controlled.

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