Development and Evaluation of Immediate Release Granules using Gansons Fluidized Bed Processor (GFBP)

Background

Granulation is a process of agglomeration of fine powder particles due to the formation of liquid bridges in the presence of a binding agent. It improves flow properties, compactability, compressibility of powders and prevents segregation of the individual constituents of a mixture.

Fluid bed or top spray granulation is a single step, enclosed operation wherein mixing, granulation and drying can be achieved in the same equipment. Using fluidized bed processors, granulation is achieved by suspending the powders in a stream of fluidized air and spraying the binder solution from nozzles situated above the powder bed, opposite to the airflow. Top spray granulation provides multiple advantages to the formulators including reduced process time and equipment, and uniform drying and granulation of the powder mixture. Additionally, formation of porous granules using a fluidized bed processor (FBP) facilitates wicking of liquids in tablets, thereby leading to quick *in-vivo* disintegration and dissolution.

Objectives

- To determine the granulation and drying efficiency of a pharmaceutical placebo formulation using Gansons Fluidized Bed Processor (FBP) using the Cyklon® air distribution plate {Patent Pending}
- To evaluate the formulated granules for flow properties, compressibility and particle size distribution
- To assess the compressed placebo tablets for weight variation, hardness, friability and disintegration time

Methodology

Materials: Lactose Monohydrate, Avicel PH-101, Pregelatinized Starch, Poly-vinyl Pyrrolidone (PVP K-30)

Equipment: Gansons Fluidized Bed Processor (2 litres)

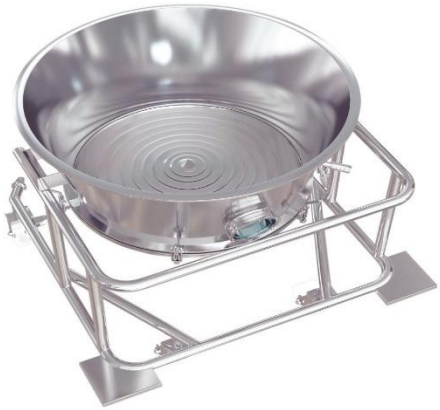
Granulation and drying: PVP K-30 (10% solution) was sprayed using a single port nozzle gun on the powder bed until the granulation process was complete. The granules were dried using Gansons FBD until the desired value of LOD (loss on drying) was achieved.

Compression: The formulated granules were lubricated with Talc (0.5%) and subjected to compression on a single station tablet press (Make: Karnavati)

Description of Equipment

The premixing, granulation and drying operations were performed simultaneously using Gansons FBP with Cyklon® air distribution plate in the present study (Figure 1). This plate consists of concentric, overlapping, solid stainless-steel rings of progressively smaller diameters placed one above the other. The base of each ring is made of curved ridges/fins to guide the movement of air in horizontal direction. This provides a unique cyclonic movement to the particles and reduces the generation of fines owing to their spiral motion.

Figure 1: Cyklon® Air Distribution Plate



Process Parameters

Batch size: 600 grams

Granulation parameters:

- Inlet temperature: 60 ± 5°C
- Product temperature: 40 ± 5°C
- Spray rate: 5 - 6 gm/min
- Dosing rpm: 12 - 20
- Atomization: 1 - 1.2 bar
- Inlet blower rpm: 800 – 1,200
- Exhaust blower rpm: 1,000 – 1,500

Drying parameters:

- Inlet blower rpm: 500 – 1,500
- Exhaust blower rpm: 1,000 – 2,000

Total process time: 90 minutes

Results and Discussion

The inlet, exhaust and dosing rpms were optimized in the GFBP to arrive at the desired granule size distribution. After completion of the process, uniform granules were obtained due to the steady growth pattern in FBP and alternate spraying and drying cycles. The formulated granules were evaluated for various parameters including bulk density, tapped density, Hausner ratio, compressibility index, loss on drying, particle size distribution. Results are depicted in Table 1.

The granules exhibited a porous structure with low bulk density values and desirable flow properties. Also, the fine granule size was attributed to the higher atomization pressure during the process.

Table 1: Evaluation of Placebo Granules Formulated using GFBP

Test	Result
Bulk density (g/cc)	0.333
Tapped density (g/cc)	0.416
Hausner ratio	1.249
Compressibility Index (%)	19.95
Particle size distribution (%)	Retained on 25#: 1.88 Retained on 36#: 0.24 Retained on 60#: 3.4 Retained on 100#: 60.96 Pass through 100#: 33.52
Loss on drying (%)	3.36

The granules were further compressed into tablets using a standard 11.9 mm round shape punch on a 16-station compression machine. The compressed tablets were evaluated for weight variation, thickness, hardness, friability and disintegration time. The results are represented in Table 2. The compressed tablets exhibited excellent hardness and low friability owing to the porous structure of granules.

Table 2: Evaluation of Compressed Placebo Tablets

Test	Result
Average Tablet Weight (mg)	0.572 mg (Passes the weight variation test)
Hardness (kg/cm^2)	10.8
Thickness (mm)	4.96
Friability (%)	0.04%
Disintegration time (mins)	8 minutes 34 seconds

Conclusion

Fluid bed granulation saves labour, time and losses during material transfer in pharmaceutical processes. The use of Cyklon® Air Distribution Plate assists in granulation of materials due to the spiral motion of particles and improves their drying efficiency. Hence, fluid bed granulation in the presence of Cyklon® plates hold potential in product development process in the pharmaceutical industry.

Please contact us for more information:

Global: sales@gansons.com
Europe: engineeringUK@gansons.com