Measuring Particle-Size-Distribution of roller-compacted granulates: Comparing Focused Beam Reflectance Measurement (FBRM) with Air Jet Sieving

S. Wiesweg(1), J. Schöll(2), R. F. Lammens(3) and K.-J. Steffens(1)

(1) Department of Pharmaceutical Technology; Rheinische Friedrich-Wilhelms-University, 53123 Bonn, Germany
(2) Mettler-Toledo AG, AutoChem, 8603 Schwerzenbach, Switzerland
(3) Technical Services Consult Lammens, 51373 Leverkusen, Germany

Introduction

The primary objective of any roller compaction process is to transform a poorly flowable powder into a granulate having sufficiently large flowability and compactability properties. The most important parameter determining flowability is the particle size distribution of the granulate. With regard to the containment requirements in pharmaceutical manufacturing areas and hazardous APIs, the Focused Beam Reflectance Measurement (FBRM) seems to be a fast and safe possibility for characterising granulate size via Chord Length Distributions (CLDs) during the manufacturing process online. The purpose of these preliminary trials was to compare FBRM CLDs with the standard air jet sieving Particle Size Distributions (PSDs) and to investigate, whether a change in parameters like compaction force or granulator speed has an influence on the CLDs/PSDs and whether this effect could be observed by both methods.

Experimental Methods

Roller Compaction

Lactose (Granulac 140; Meggle) and Microcrystalline cellulose (Avicel PH101; FMC BioPolymer) were compacted with a Macropactor 100 (Gerteis Maschinen + Processengineering AG; Jona; Switzerland) with the following settings:

- **a. Settings for Influence of Compaction Force**
  - Force: 3; 5; 7; 10 and 15 kN/cm
  - Gap: 3 mm (gap control on)
  - Auger ratio (delivered volume): 250%
  - Roll Speed: 2.5rpm
  - Granulator: 60/40rpm 320/280° CW/CCW
  - square-wire sieve Ø 0.8mm

- **b. Settings for Influence of Roll Speed**
  - Force: 5 kN/cm
  - Gap: 3 mm (gap control on)
  - Auger ratio (delivered volume): 250%
  - Roll Speed: 2.5rpm and 15rpm
  - Granulator: 60/40rpm 320/280° CW/CCW
  - square-wire sieve Ø 0.8mm

FBRM Measurements

- **Granulac 140 - Air-Jet-Sieve vs. FBRM**
- **Avicel PH101 - Air-Jet-Sieve vs. FBRM**

Results & Discussion

FBRM Measurements

The FBRM is a particle measurement technique based on the backward scattering of a laser beam upon incidence with solid material (Fig. 1). The probe based FBRM technique allows in situ monitoring of the product particle size analysis even at large solid concentrations. The system employs a laser beam that rotates at a constant velocity of 2 m/s inside a tubular probe which is directly introduced in the process at the point of interest. The backscattered light is processed by the device electronics, which calculates the chord length of the detected particles as the product of the measured reflection time and the beam velocity. For a given PSD, during a user defined time interval a given chord length distribution (CLD) will be obtained. [1]

In this case, the CLDs of the granulates were measured during the granulation process until the distribution was constant. At the same time, the collecting of the sample for Air Jet Sieving started.

Influence of Granulator Speed

Changing the Granulator Speed from 60/40 rpm CW/CCW to 150/120 rpm seems to have no influence in both the PSDs and the CLDs. (Fig. 4)

Conclusion

Process dynamics of the roller compaction could be monitored in situ using FBRM. Product granule size exhibited the same trends in both measurement techniques. Further studies are needed to elaborate on the comparison between the two measurement techniques.

Furthermore, an influence of Roll Speed an Granulator Speed was obatined. The influence of Granulator Speed is negligible.

References