A New Continuous High Shear Granulator

P.-C. Chao and K.-J. Steffens
Department of Pharmaceutical Technology
University of Bonn, Gerhard-Domagk-Str. 3, D-53121 Bonn, Germany

Introduction

In this study we investigated the granulation behaviour of a new continuous high shear granulator (Bohle Continuous Granulator, BCG) using different excipients and active ingredients. The continuous granulation was compared with a batch high-shear granulation (Bohle Mini Granulator, BMG). Tableting of the granules was carried out also and tablet properties were measured. The new Bohle Continuous Granulator (Fig. 1) is based on a high-shear-granulator with a continuous discharge of wet granules through the chopper. The impeller blades fit exactly to the cover of the granulator to avoid residues on the wall.

Fig. 1. Bohle Continuous Granulator

Results & Discussion

The compaction pressure – tensile strength diagrams of the tablets out the different granules are shown in fig. 2 – 5. In all cases the tablets made by continuous granulation showed higher tensile strength than those made by the batch process, although the basic mechanical principle of granulation was comparable. This could be due to the constant humidity in the wet powder mass during the continuous granulation, whereas during classical batch granulation the humidity is raising at a constant rate during the process.

Materials

- Lactose (Granulac 70, Meggle, Germany).
- Ibuprofen (Ibuprofen 25, BASF, Germany).
- Calcium carbonate heavy (Magnesia 449, Magensia, Germany) [1, 2].
- Calcium carbonate light (Magnesia 442, Magensia, Germany).

Methods

The raw material was mixed with 3 % Kollidon 25 (BASF, Germany) in a VMA70-Mixer (L.B. Bohle, Germany) for 3 minutes. Water was used as granulation liquid. Bohle Continuous Granulator A double screw conveyor transports the mixture into the granulator (3 kg/h). Water was supplied by a peristaltic pump (0.6 kg/h). The speed of the impeller/chopper was 300 rpm/500 rpm. Wet granules were discharged by the chopper continuously. The transit time of the material was about 1.5 minute.

Bohle Mini Granulator

The mixture was granulated for 5 minutes. During the granulation water was dropped slowly into the pot. The speed of impeller/chopper is 300 rpm/500 rpm.

Tableting For these laboratory experiments tray drying at 40 °C was used.

Tableting Round flat faced tablets were made by an instrumented pneumo-hydraulic press Flexitab™ (Roeltgen, Germany). The punch diameter was 10.0 mm. The six compression pressure levels were between 60 and 400 MPa. Magnesium stearate was used as external lubricant.

Analytics

- Scanning Electron Microscopy (SEM)

SEM pictures of the granules were taken using Hitachi S-2400N camera (Hitachi, Japan).

- Tablet dimension

Tablet height (h) and diameter (D) were determined with a precision of ± 0.01 mm.

- Crushing force (FC)

Diametrical crushing force was measured with TBN 210 (Erweka, Germany) 24 hours after compression. Ten tablets of each compactness were analyzed.

- Tensile strength (TS)

TS was calculated according to equation 1 [3]:

\[
TS = \frac{2 \times F_c}{\pi \times D \times h}
\]

Fig. 2. Compaction pressure – tensile strength diagram of Granulac 70 powder and granules

Fig. 3. Compaction pressure – tensile strength diagram of Ibuprofen 25 powder and granules

Fig. 4. Compaction pressure – tensile strength diagram of Calcium carbonate Magnesia 449 powder and granules

Fig. 5. SEM pictures of Calcium carbonate Magnesia 449 granules, BCG: left, BMG: right

Fig. 6. SEM pictures of Magnesia 449 granules, BCG: left, BMG: right

Fig. 7. SEM pictures of Ibuprofen 25 granules, BCG: left, BMG: right

Fig. 8. SEM pictures of Magnesia 442 granules, BCG: left, BMG: right

Fig. 9. SEM pictures of Calcium carbonate Magnesia 442 powder and granules

From the SEM-micrographs (Fig. 6 – 9) it can be seen, that the granules made by the continuous process seem to be more regular in size and shape.

Conclusion

Granules made by the new continuous high shear granulation process show slightly superior properties regarding granule size and shape and tableting behaviour than those made by the classical batch granulation. The reason for this could be the different distribution and amount of water during the process.

Acknowledgment

The authors would like to thank L.B. Bohle Maschinen und Verfahren, D-Ennigerloh, for technical support.

References