Hybrid modeling of roll compaction with the Styl'One Evolution - Granule size distribution -

H.L. Reimer, P. Kleinebudde

Institute of Pharmaceutics and Biopharmaceutics, Heinrich Heine University, Universitätsstraße 1, 40225 Duesseldorf, Germany
☎ 0049 211 81 10076+, ✉ hannah.reimer@hhu.de

Purpose

Roll compaction/dry granulation (RC/DG) is a widely used method in pharmaceutical industry. Nevertheless, in R&D problems can occur because it is a time and material consuming process. In previous trials it was shown that hybrid modeling of RC with the Styl'One Evolution can identify the settings to obtain ribbons with the desired solid fractions (SF).

Beside the SF the granule size distribution (GSD) is of great importance because it strongly influences the quality of the final tablets. In this study was investigated whether the milling of ribbon like compacts – called ribblets - (Styl'One) and of real ribbons (Mini-Pactor) results in the same GSD.

Materials and Methods

Microcrystalline cellulose (Vivapur 102, JRS Pharma) was used as model substance.

Roll compaction was performed with a Mini-Pactor (Gerteis) at gap widths of 2 and 4 mm. Four different specific compaction forces (SCF) from 4 to 13 kN/cm were applied at a constant roll speed of 2 rpm. A rim roll sealing system was used.

Hybrid modeling of roll compaction – principle shown in figure 1 - was performed with the Styl'One Evolution (Medelpharm). The ribblets were produced by mimicking the same settings as used on the Mini-Pactor (4-13 kN/cm, 2 and 4 mm gap width, 2 rpm; Kp value = 0,667). Granulation: The ribbons (Figure 2a) and ribblets (Figure 2b) were milled into granules with the Mini-Pactor star granulator (1 mm mesh size). The ribbons were produced and milled in a continuous process whereas the ribblets were milled two days after production by feeding the granulator continuously for 1 minute with the ribblets (appr. 180 g). The granule size distributions were determined in triplicate with a CamSizer XT (Retsch Technology).

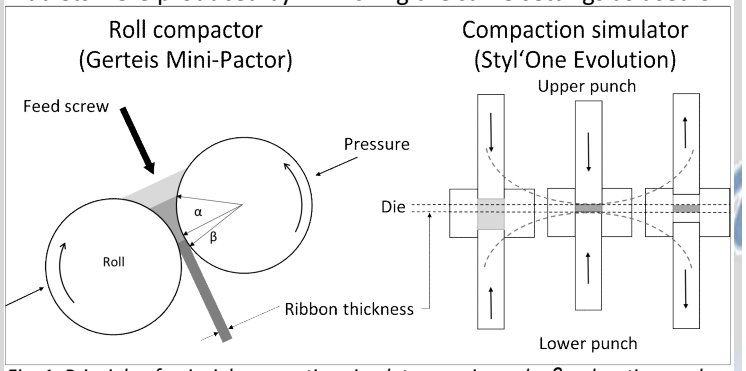

Fig. 1: Principle of uniaxial compaction simulator; α: nip angle; β: relaxation angle

a) b)

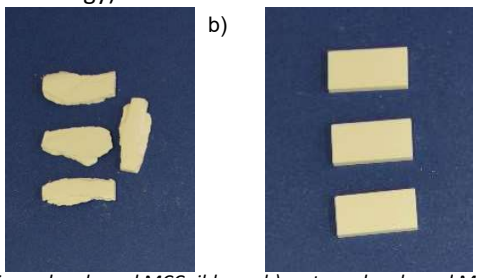

Fig. 2: a) irregular shaped MCC ribbons b) rectangular shaped MCC ribblets

Results and Discussion

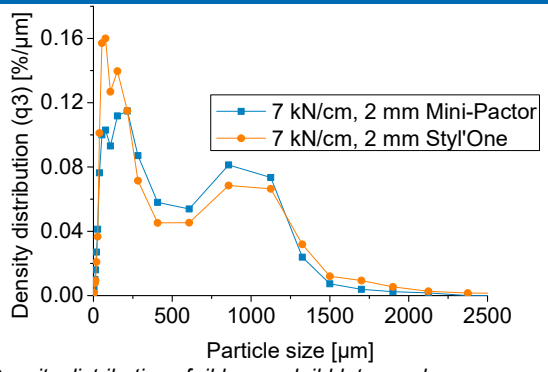

Fig. 3: Density distribution of ribbon and ribblet granules

The results show that the obtained granules have a similar bimodal GSD (exemplarily shown in figure 3). Generally, the x10 and x50 increases with an increasing SCF and a decreasing gap width. The granulation of the ribbons results in higher x10 and x50 values than the granulation of the ribblets (figure 4).

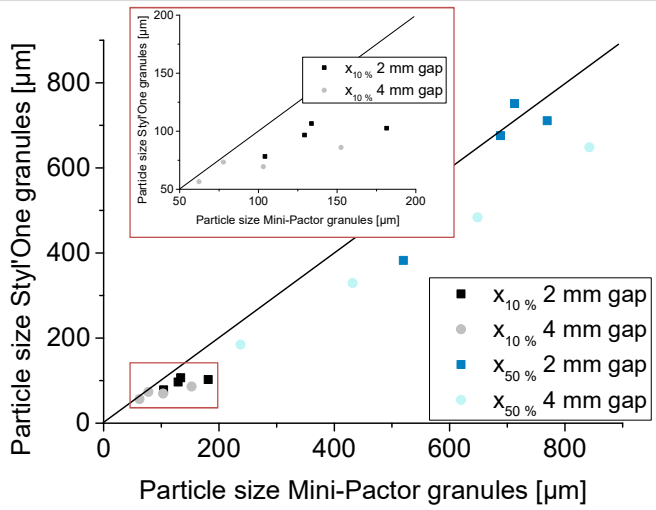

Fig. 4: comparison of x10% and x50 % of ribbon and ribblet granules

The higher amount of fines in ribblet granules might be due to the clearly defined cuboid form of the ribblets that leads to more abrasion in the granulator than the irregular shaped Mini-Pactor ribbons. Another explanation might be the longer residence time of the ribblets in the granulator due to the non-continuous granulation method in comparison to the Mini-Pactor.

Conclusion

The milling of Styl'One ribblets results in bimodal GSD similar to the ones found for real ribbons but with a higher amount of fines. These promising results indicate that hybrid modeling is not only able to produce compacts with the same SF but also granules with similar properties.

Further investigations need to be carried out to evaluate the influence of the milling process on the amount of fines and to confirm the results also for other materials.

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