THE STYLCAM 200 R, A ROTARY TABLET PRESS SIMULATOR

K. Duchatsch, B. Fretter

Department of Pharmaceutical Technology, University of Bonn, Gerhard-Domagk-Str. 3, 53121 Bonn, Germany

universität bonn

INTRODUCTION

The Stylcam 200 R is a single punch tablet press, simulating speed profiles of various rotary tablet presses by controlling the speed of two cams electronically. It can be utilised for trouble shooting in production, scale-up problematics and R&D by using the force and height instrumentation of upper and lower punch. Equipped with just one pair of standard punches the Stylcam needs a minimum amount of powder. Being able to realise compaction velocities of high speed rotary presses and a precompaction force, the Stylcam has two big advantages over frequently used single stroke tablet presses, which have comparably slow tableting speeds. Tye et al.[1] demonstrated the correlation between tableting speed and tablet properties very clearly.

MATERIALS AND METHODS

Materials

- pharmaceutical excipients:
  Tablettose 80, Meggle, Lot 9685
  CPharmGel, Cerestar, Lot HE 3839
  Mg-Stearat, Bärlocher, Ch 2079
- Fette 102i, machine no 1478
- Stylcam 200 R, no 0709109
- Punch: 9mm R15 EU-B (both presses)
- parallel data acquisition system:
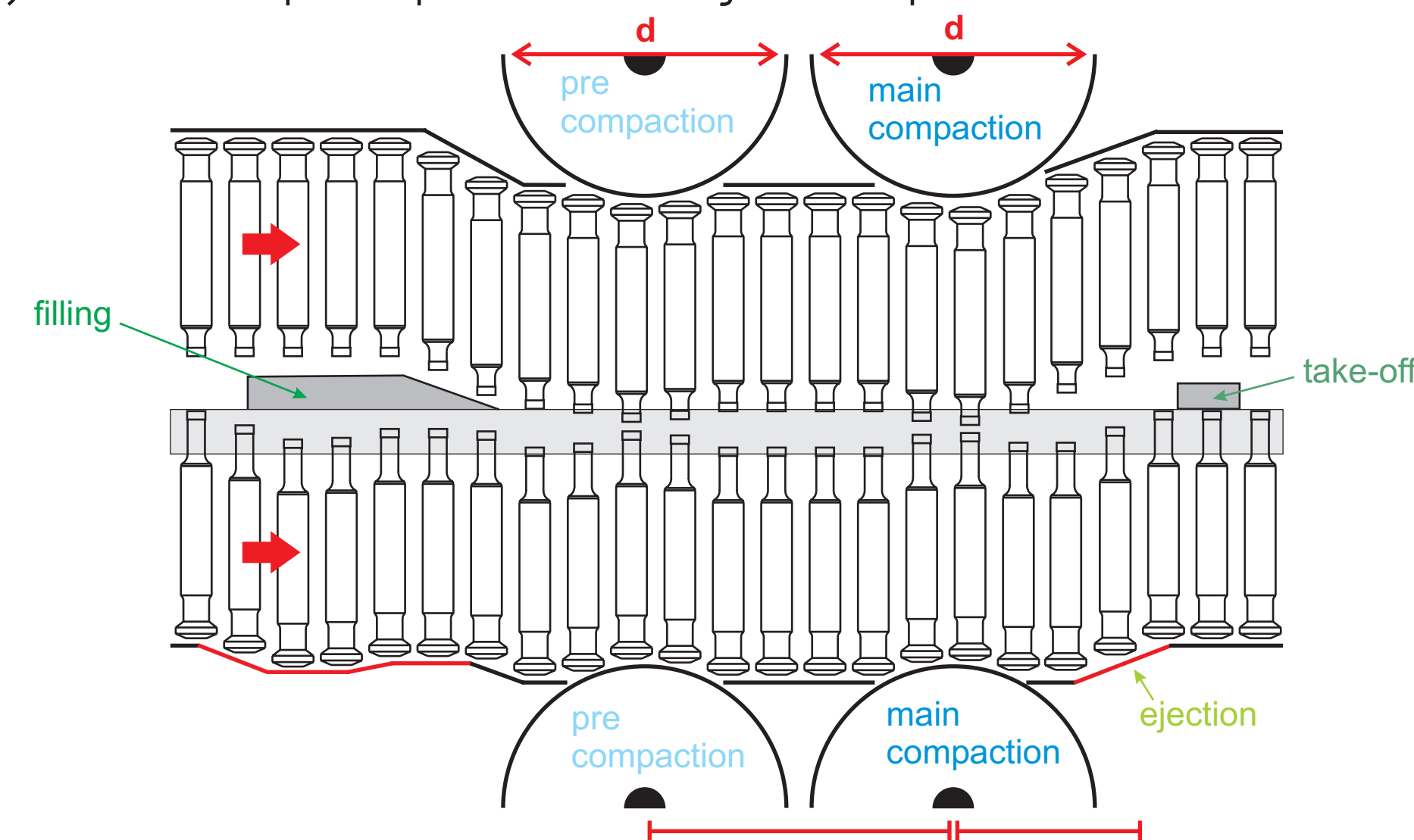 DAQ4 Hucke Software
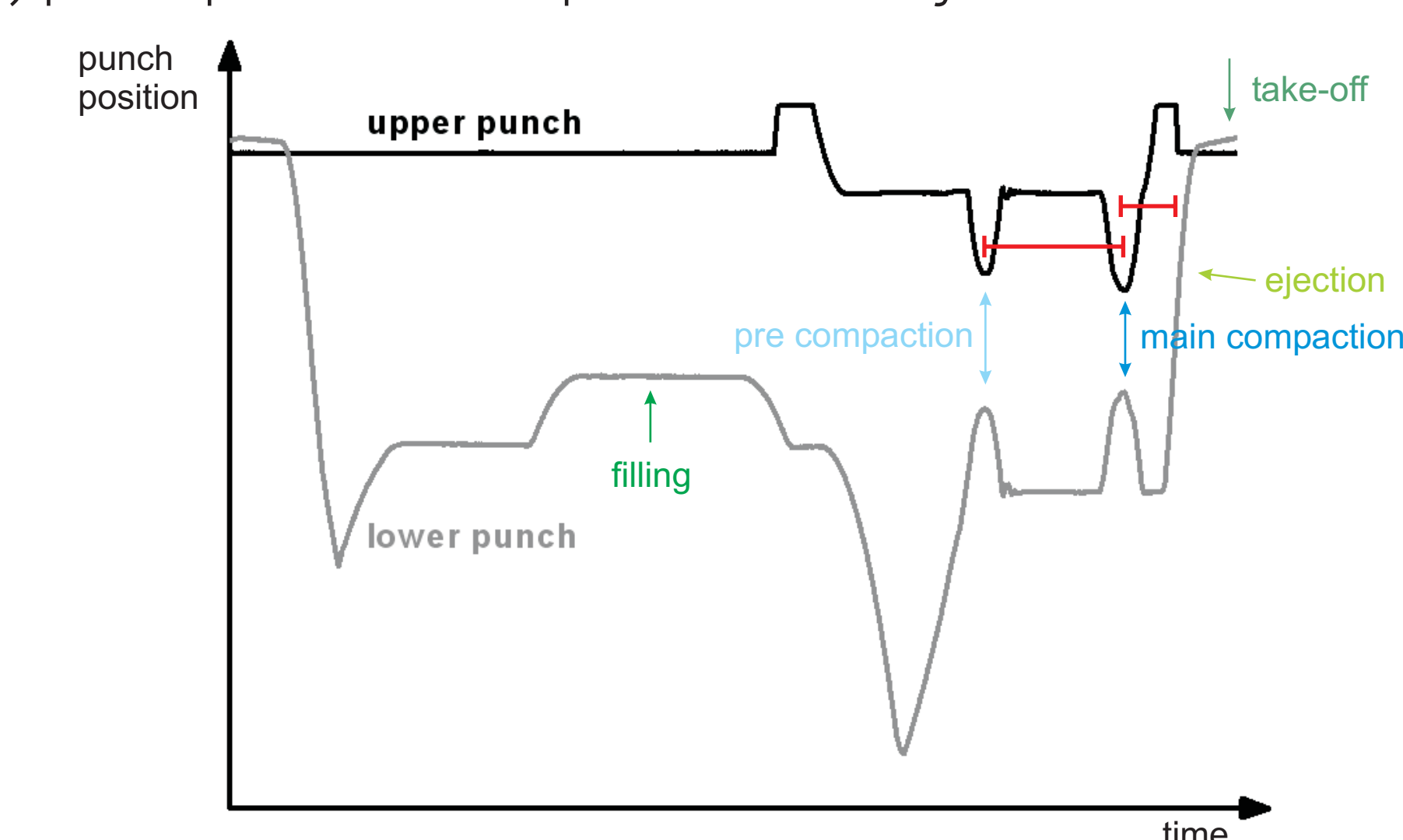

Fig. 1: Stylcam

Methods

- operating mode: single-punch (Fette102i), one-tablet-mode (Stylcam)
- rotor speed set by comparable tablets/h
- die filling and lubrication manually

a) functional principle of a rotary tablet press

b) punch position - time profile of the Stylcam

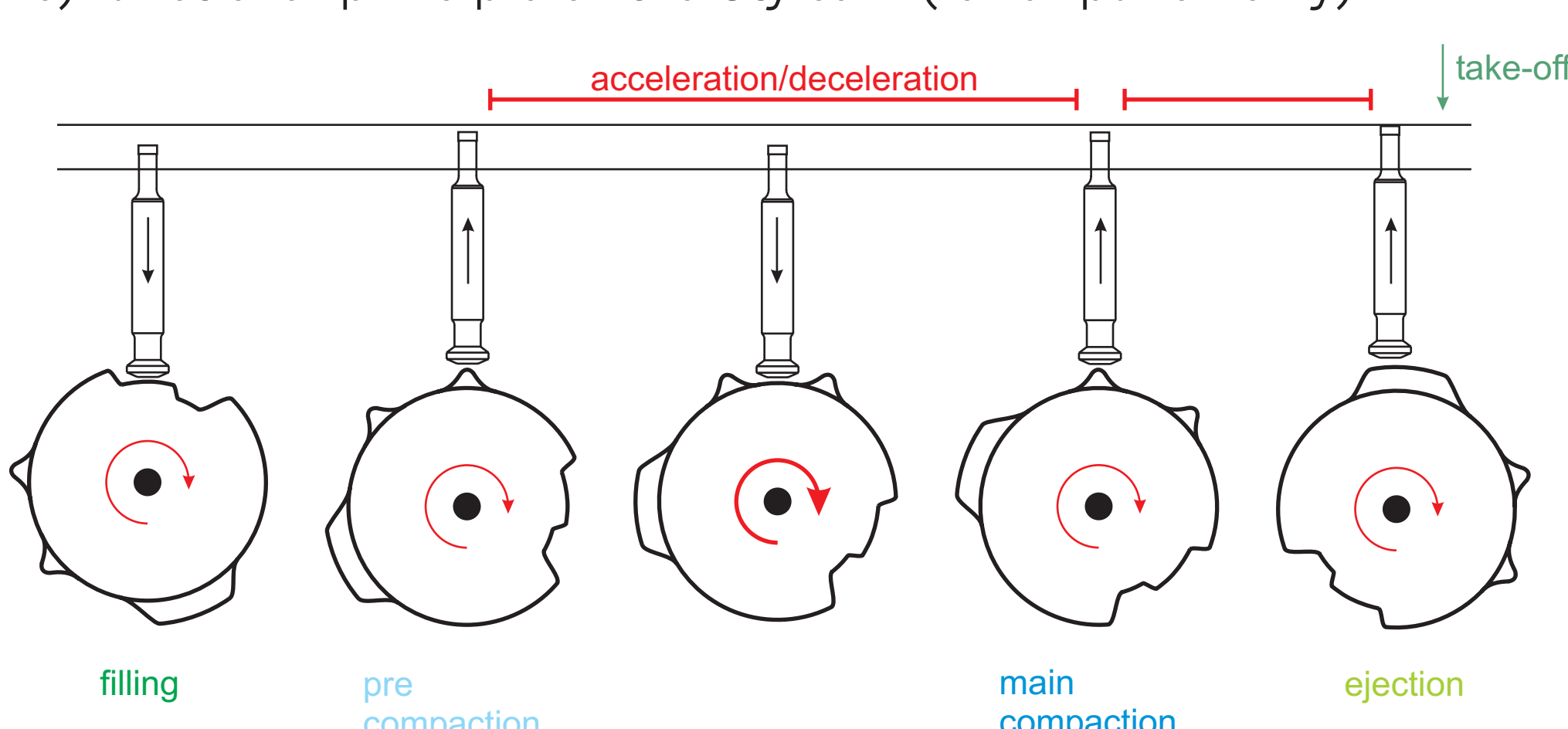c) functional principle of the Stylcam (lower punch only)

Fig. 2: Implementation of the simulation by the Stylcam

RESULTS

Simulation

One aim of the Stylcam is to simulate the tabletting behaviour of various rotary tablet presses. The position of upper and lower punch is controled by the shape and velocity of two cams. Based on the dimensions of the compaction rolls, the ejection bar and the turret diameter as well as the the time lag in between pre-, main compaction and ejection the cam movement can be calculated. Fig. 2 shows, how the Stylcam implements this. The red colour marks important parameters for the simulation. Being able to run the cams with several velocities, different speeds of the simulated rotary tablet press can be realised by the Stylcam. In the majority of cases the imitated rpm are not identical with the true mashine speed. The comparative parameter is the densification speed during the main compaction, which is implemented in the software by the number of tablets. As example: simulating a Fette 102i at 50 rpm (equivalent to 72,000 tablet per hour) leads to a Stylcam speed of 25 rpm.

For mimicking different geometries of rotary presses the Stylcam is able to accelerate and decelerate within one revolution, which leads to various force-time and displacement-time-profiles, respectively. Fig. 3 compares three force-time profiles at 25 rpm, two of them simulating a rotary press (Fette, Kilian). The third profile (direct cam) is generated with a constant cam speed, so no tablet press is simulated. It can be seen, that the Stylcam is able to realize different force-time-profiles concerning the time lag between pre-, main compaction and ejection.
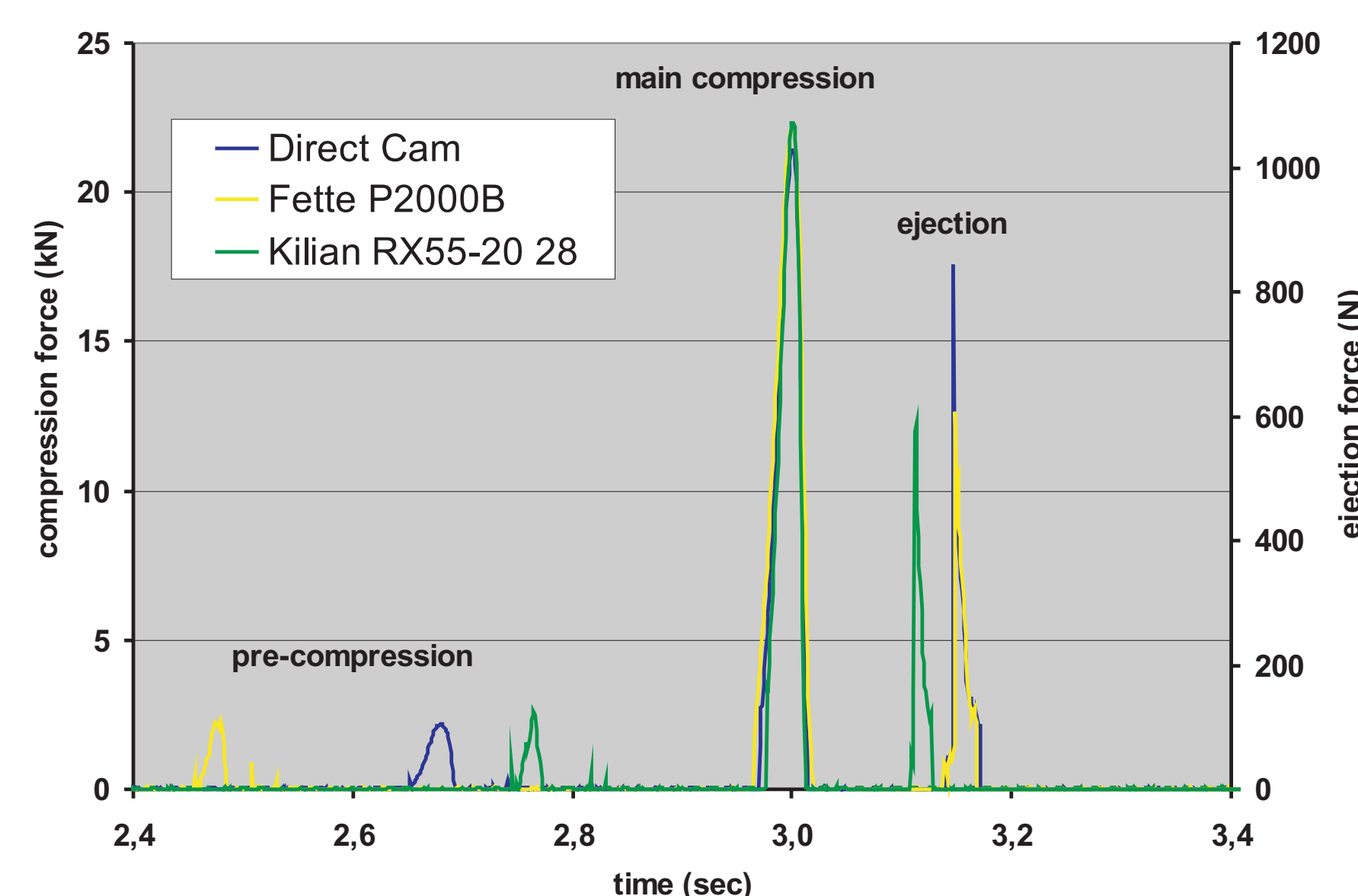

Fig. 3: Stylcam simulating various rotary tablet presses at 25 rpm (time normalised on the force maximum) Tablettose
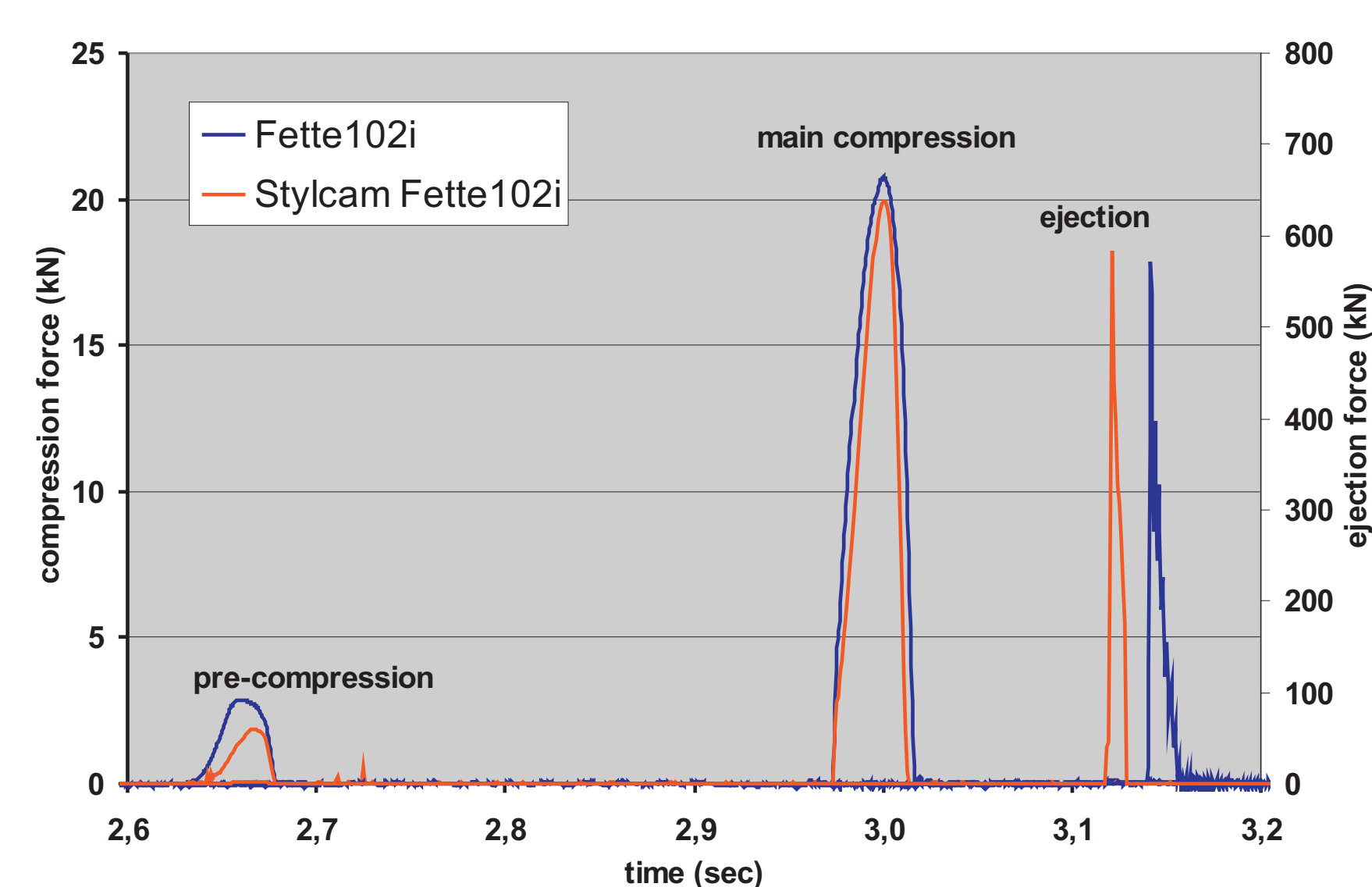

Fig. 4: force time profile: original Fette 102i vs. Stylcam simulating Fette 102i Tablettose

Fig.4 looks closer at an original Fette 102i profile and a Stylcam simulating a Fette 102i profile to demonstrate the simulation performance of the Stylcam. Both profiles were aquired under comparable conditions like rotor speed, compression force, tooling, tablet weight and raw material. It is obvious that pre-and main compaction occur at the same time. The time lag to the ejection force is not exact, which is due to a rough estimation of the distance between main compaction roll and ejection ramp at the Fette 102i. So one striking point of the
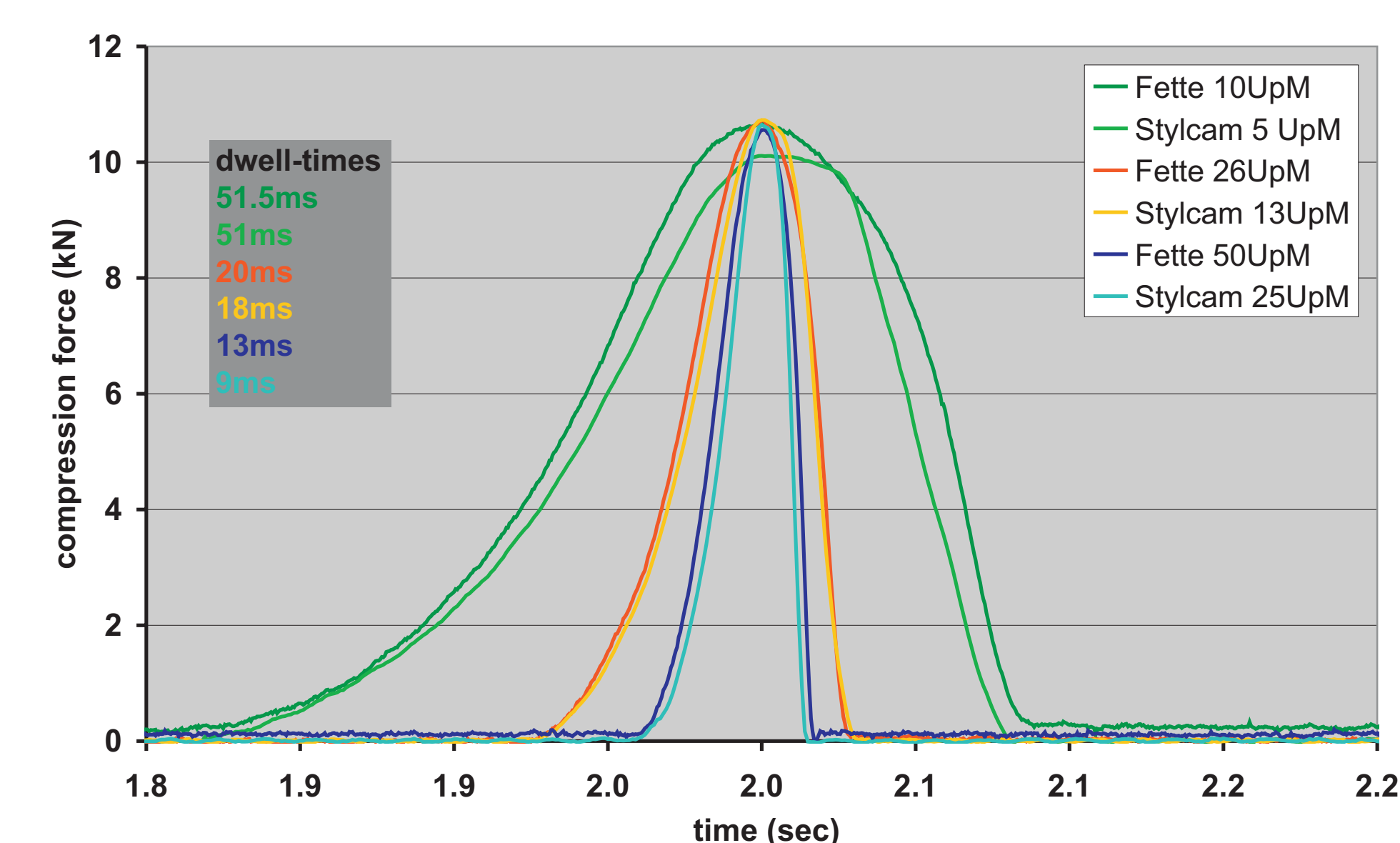

Fig. 5: main compaction in detail at various rpm CPharmGel

simulation gets obvious: the mimicking can only be as good as the knowledge of the system to be simulated.

In Fig. 5 the main compaction forces at different speeds of the Fette 102i and the Stylcam simulating this is focused. At all velocities the Stylcam emulates the curve progression pretty well. Looking at the dwell times, it gets obvious, that the Stylcam is always a bit faster. The reason for that is unknown by now. It has to be examined if the simulation has to be adapted or if the true velocity of the Fette 102i differs a bit from the nominated one.

Differences to rotary presses

The main focus of simulation lays on the tabletting process which contains pre-compaction, main compaction and ejection. Also the filling with the following weight adaption is simulated. One big difference in the punch position profil is the time between take-off and pre-compaction, which lasts longer than at rotary presses. This is due to technical reasons because the cams have to do one complete time-consuming revolution. But as the tablet properties are not influenced this is neglectable.

Of course there are also some aspects, which can not be simulated by the Stylcam. Everything that is correlated with fill shoe problematics on rotary presses can not be reproduced on the Stylcam, as it's fill shoe system is different designed. Additionally the fill shoe is moving like on an excentric press. Furthermore all phenomenons concerning vibration and centrifugal force cannot be copied by the Stylcam.

SUMMARY AND OUTLOOK

It is possible to simulate various force-time-profiles of different rotary tabet presses with the Stylcam by realising several speeds and different lags between pre- and main compaction. Comparing the original force-time-profiles of a Fette 102i with the simulated ones, the Stylcam shows good conformity concerning the lag between pre- and main compaction and the curve progression of the main compaction. This applies also for different mashine velocities.
Next steps will be comparing the simulation performance of the Stylcam with other rotary tablet presses and looking at the resulting tablet properties.

REFERENCES

[1] Tye et al.: Evaluation of the effects of tabletting speed on the relationships between compaction pressure, tablet tensile strength, and tablet solid Fraction. Journal of Pharmaceutical Sciences, 94 (3), 465-472 (2005)

ACKNOWLEDGEMENTS