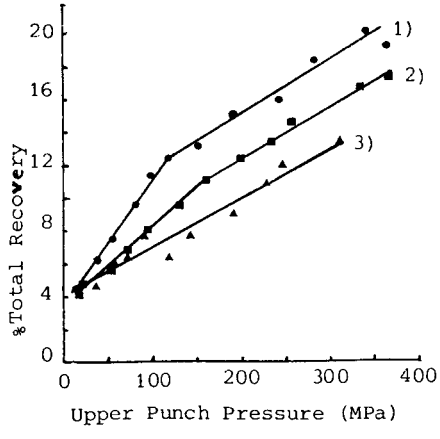
THE EFFECT OF DURATION OF COMPRESSION ON THE AXIAL RECOVERY PROPERTIES OF COMPACTS OF A CRYSTALLINE DRUG SUBSTANCE

P. V. Marshall, P. York and R. Richardson*, Postgraduate School of Studies in Pharmacy, University of Bradford, Bradford, West Yorkshire, BD7 1DP, U.K.
*The Boots Company PLC, Nottingham, NG2 3AA, U.K.

The axial recovery of a compact after compression is dependent on both the elastic and viscoelastic properties of the material. Travers et al (1983) demonstrated that elastic recovery occurred over a very short period of time within the die immediately the force was removed. A slower viscoelastic recovery of the compacts then followed. It is well documented that the release of elastic energy stored during compaction is responsible for tableting defects (e.g. Ritter and Sucker, 1980). To investigate the time dependent nature of the total axial recovery properties of ibuprofen, a model crystalline drug substance, the duration of the compression cycle was varied.

The sub 90 μm sieve fraction of ibuprofen crystals B.P., recrystallised from methanol, was compressed in an unlubricated die between flat-faced 10mm punches using a compaction simulator (Mand Testing Machines, Stourbridge), over the range 0-370 MPa. The resolution of the system was to 12 μm and 0.31 MPa for the punch position and pressure respectively. A punch displacement-time profile based on a sine wave was used for the upper punch to bring about compression, while the position of the lower punch was held constant until the ejection phase. Two hours after compression the thickness of the compact was measured (± 0.001 mm) using a micrometer. The percentage total recovery was calculated using the equation $((H-H_C)/H_C) \times 100$ where H_C and H are the thicknesses of the compact under pressure and after ejection respectively (Armstrong and Haines-Nutt, 1972). Figure 1 shows representative data obtained for compression cycles of 1, 3.16 and 10s.

FIG.1 Percentage Total Recovery Against Upper Punch Pressure For Compression Cycles Of 1) 1, 2) 3.16 And 3) 10s



The data suggest that once a critical pressure is reached the change in recovery with increasing pressure is similar for all three durations. However, prior to this, the duration of compression has a significant role to play in determining the extent of recovery. This is demonstrated by the biphasic form of the relationship between recovery and pressure at the shorter two durations but only monophasic at the longest duration. Pressure-porosity functions of the compacts were also shown to be dependent on the duration of compression and the porosity may be influencing the recovery properties, as has been seen with ceramics (Wachtman, 1969). The reduction in the extent of recovery at a given pressure with increasing duration is attributed to a shift in energy utilisation of compression from reversible to irreversible deformation. Similar trends were also observed for samples of ibuprofen recrystallised from different solvents.

These results suggest that the consolidation of ibuprofen is a balance between elastic deformation and time dependent plastic deformation. Studies are continuing to determine the extent of the effect of duration of compression on the elastic component of the total recovery of compacts.

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