ELASTIC AND VISCO-ELASTIC PROPERTIES OF COMPRESSED TABLETS

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During diametral compression testing, different tablets deform by different amounts before failure (Rees & Rue, 1977). Small deformation usually indicates brittle behaviour whereas large deformation indicates viscous flow, part of the total deformation being non-recoverable. Using a displacement transducer the non-recoverable deformation (NRD) was determined for tablets of four direct-compression materials loaded to 75% of their breaking load. Plotting the log of NRD, expressed as percent total deformation, against the log of the rate of platten movement gave linear relations (Fig.1).

The brittle materials, anhydrous lactose and Emcompress, show little change in % NRD with rate of platten movement whereas the visco-elastic materials, Elcema and Sta-Rx show a decrease in % NRD as the rate increases indicating that higher strain rates produce a greater proportion of recoverable elastic deformation. For lactose and Elcema tablets at a given rate of testing, increasing the tensile strength decreases the % NRD. This is due to the larger area of interparticulate bonding created at higher compaction forces because for a given diametral load, the larger the total area of bonding, the lower the resultant stress; this decreases the amount of plastic deformation and reduces the % NRD. The larger negative gradient for Sta-Rx in Fig.1, indicates that plastic deformation is more time-dependent than for Elcema. This is confirmed by the effect of increasing compaction dwell time which we find has little effect on the amount of consolidation of Emcompress or lactose, some effect with Elcema, but markedly increases consolidation of Sta-Rx. Increasing the dwell time also increased the strength of microcrystalline cellulose tablets by 37% and Sta-Rx tablets by 135% (David & Augsburger, 1977).

Considerable deformation of Sta-Rx tablets occurs during diametral loading indicating extensive plastic flow. However the tablets possess an unexpected low tensile strength. We now attribute this to the inability of Sta-Rx particles to undergo extensive plastic deformation at high strain rates during compaction. This minimises the strength of interparticulate bonds. Furthermore, a high proportion of deformation is elastic. This will recover rapidly on decompression, rupturing bonds and decreasing the tablet strength.

We propose that such measurements may provide useful information regarding the compaction behaviour of materials and could facilitate prediction of the effect of variables such as rate of compaction.

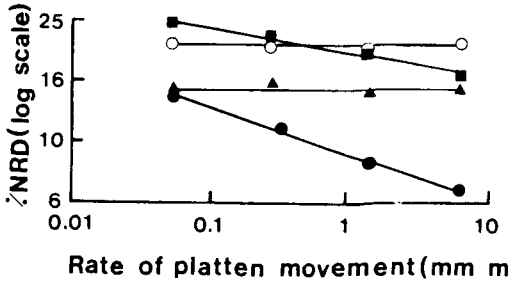

Fig.1 The effect of platten movement on the % NRD of tablets when loaded to 75% of their breaking force

- ■ Elcema G250 (microcrystalline cellulose)
- ● Sta-Rx 1500 (compressible starch)
- ▲ anhydrous lactose
- ○ Emcompress (dibasic calcium phosphate)

David, S.T. & Augsburger, L.L. (1977), J.Pharm.Sci., 66, 155-159
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