THE EFFECT OF TEMPERATURE ON THE TABLETING OF POWDERS

J.R. Britten & N.Pilpel, Dept. of Pharmacy, Chelsea College
London SW3

The compression of 2 representative pharmaceutical powders, lactose and palmitic acid, has been carried out over a range of pressure and temperature from 0-200 MNm^{-2} and from -20° to +180°(where appropriate). The pressure-density relationships of the tablets have been analysed by use of the Heckel (1961) equation and their tensile strengths measured by means of a flexure tester similar to that described by David & Augsburger (1974).

3g , 2.5cm diameter, flat-faced tablets were prepared using a hand operated hydraulic press and then stored in a desiccator over silica gel at room temperature for 24 hours. Triplicate samples were prepared.

The dimensions and weight of each tablet were recorded before calculating its tensile strength T (MNm^{-2}) from the breaking load P (MN) by means of the equation

$T = \frac{3Pb'}{4Dt^2}$ where b' = distance between fulcrums, D = tablet diameter and t = tablet thickness.

The Heckel equation is: $\ln \frac{1}{1 - P_f} = KP + A$ where $P_f = \frac{\text{Tablet density}}{\text{Particle density}}$

K = constant = $\frac{1}{P_y}$ (P_y = mean yield pressure), A = a constant, P = compressive stress.

Fig.1 below illustrates plots of $\ln \frac{1}{1 - P_f}$ vs P for each material at 3 different temperatures.

Having calculated Py values from the slopes of these plots, it was possible to plot these together with the corresponding tensile strength values vs.homologous temperature, T_h (Fig.2) (where $T_h = \frac{\text{temperature of powder}}{\text{melting point of powder}}$ °K)

FIG. 1

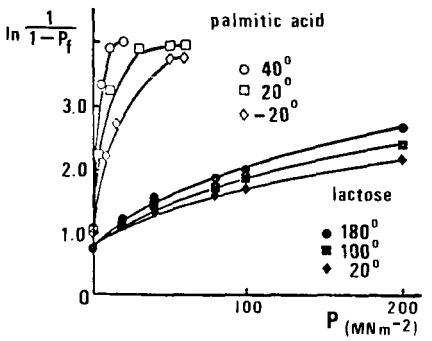
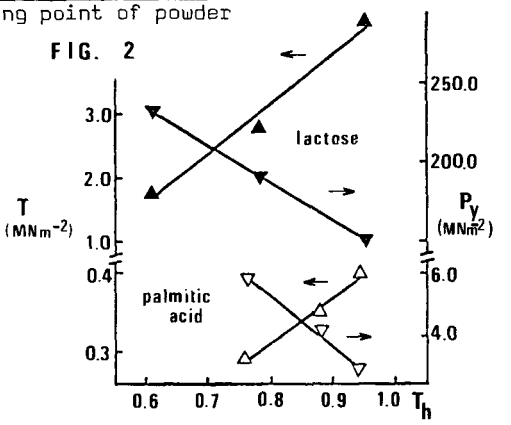


FIG. 2



In Fig.1 it can be seen how the slope of each plot increases with temperature indicating a fall in yield pressure of the material; and in Fig.2 how this fall is matched by a corresponding increase in tablet tensile strength.

The results show that the temperature of compression has a marked effect on the ultimate mechanical strength of the tablet. This is due to increased interparticular plastic deformation occurring as the yield pressure of the powder particles is reduced.

David S.T. & Augsburger, L.L. (1974). J.Pharm.Sci., 63, 933.
Heckel, R.W. (1961). Trans.Metall.Soc. A.I.M.E., 221, 671-5.