THE MEASUREMENT OF THE RHEOLOGICAL PROPERTIES OF WET POWDER MASSES

P.J. Harrison*, J.M. Newton*, R.C. Rowe**, *Pharmacy Dept., Chelsea College, Manresa Road, London SW3 6LX, **ICI Pharmaceuticals Division, Alderley Park, Macclesfield, Cheshire SK10 2TG

The rheological properties of wet powder masses are important in the field of wet granulation, especially where extrusion processes are involved. A system whereby these properties can be measured has been developed based on the extrusion of a mass through narrow single holed dies.

The equipment used is based on the design described by Benbow (1968) and consists of a piston with a steel barrel of a uniform internal diameter, to which are attached a set of interchangeable dies of varying lengths and diameters.

The piston is attached to a load cell mounted on the moving crosshead of a servo hydraulic press (Dartec Ltd), thus permitting the continual measurement of force on the piston at varying crosshead speeds. The piston pressure at steady state flow through the die can be easily calculated from the force displacement curve, as the point at which the measured force remains constant with increasing displacement.

A typical plot of the piston pressure at steady state flow, as a function of the length to radius ratio of the die is shown in Fig. 1, for an Avicel/Lactose/Water mass (33.3% w/w for each component).

The slope of the graph can be interpreted in terms of the shear stress at the die wall. This will be dependent on the velocity of throughput, and hence shear stress/shear rate profiles can easily be determined.

The intercept can be considered to represent the pressure loss at a zero die length; i.e. the pressure loss before the material enters the die. This is caused by the yielding of the material and the convergence of flow from an upstream reservoir into the die. Unlike the results for polymers (Bagley 1957), the intercept in this work is dependent on the velocity of throughput.

These graphs and the resultant shear stress/shear rate profiles provide important information on the rheological properties of the wet powder mass, and can therefore be used to aid both formulation and control of process variables.

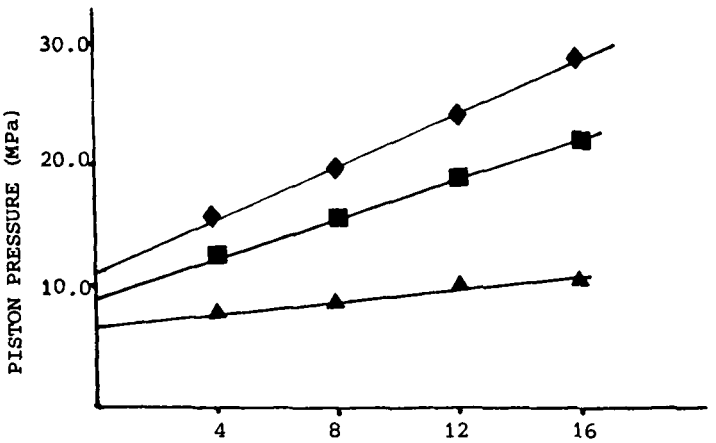

Fig. 1. The effect of length to radius ratio of the die on piston pressure.

Crosshead Speed
♦ 6.0 mm/sec
■ 3.0 mm/sec
▲ 1.0 mm/sec

Bagley, E.B. (1957) J.Appl.Phys. 28:624-627
Benbow, J.J., Ovensten, A. (1968) Trans.Br.Ceram.Soc. 67:543-567

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