RELATIONS BETWEEN VISCOELASTIC PARAMETERS AND COMPACTION PROPERTIES OF TWO MODIFIED STARCHES

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Modified maize starch is known to show time-dependent compaction behaviour. We have studied two types of modified starch to elucidate how differences in viscoelastic parameters may affect tableting performance.

The compression and recovery characteristics of two commercially available modified starches were evaluated using extended Heckel plots (Tsardaka et al, 1988a), ln(1/1-D) values being monitored not only up to peak force but also throughout decompression. The materials were vacuum dried at 60C over silica gel for 48h and then equilibrated at 25C and 53% R.H. for one week. Tablet weight was sufficient to produce a tablet thickness of 2.21mm at zero porosity. Compaction at 6, 12 and 18kN, (Tsardaka et al, 1988a) gave the results shown in Table 1. The tensile strength and work of failure values were derived from diametral strength measurements (J.J. Lloyd Instr., Type 5000K).

Table 1. Data derived from extended Heckel plots and from strength measurements

Material	Force (kN)	True work (J)	Expansion work (J)	Yield pressure (MPa)	Chord area (%)	Tensile strength (MPa)	Work of failure ($J \times 10^{-3}$)
Type I	6	4.98	0.16	60.5	2.87	0.22	1.23
	12	5.52	0.26	63.5	4.27	0.75	5.23
	18	7.39	0.34	66.5	6.53	1.20	8.60
Type II	6	4.17	0.13	41.7	3.90	1.18	10.2
	12	7.04	0.22	42.5	5.60	2.97	28.5
	18	8.34	0.30	45.5	8.33	3.64	34.5

Creep analysis was employed (Tsardaka & Rees, 1988b and 1989) to characterise the apparent viscosity coefficient (reciprocal of the slope, k_1 of the rectilinear part of the creep curve), the compliance due to retarded elastic deformation at infinite time (J_i), the time constant of viscoelastic deformation (k_2) and the instantaneous compliance (J_o). A range of loads was applied for 90s, while strain was recorded as a function of time. Table 2 gives values of the creep parameters interpolated from graphs plotted against relative density (R.D.).

Table 2. Creep parameters obtained for two types of modified starch at R.D.= 0.7

	$1/J_o$(MPa)	$1/k_1$(MPa s)	J_i $(MPa)^{-1}$	k_2 (s)
Type I	2.89×10^6	2.21×10^8	1.51×10^{-6}	1.93
Type II	3.40×10^6	2.21×10^8	1.51×10^{-6}	2.36

The lower yield pressure of II facilitated consolidation and, except at low loads, more work was required to achieve a given peak force. Type II underwent less reversible elastic deformation than I, as indicated by a higher modulus $1/J_o$, but the work of expansion values were not significantly different. Higher chord areas for II reflected more continuing retarded viscous flow under load during decompression though, surprisingly, the two materials showed no significant differences in the viscosity coefficients, $1/k_1$ at each relative density. Except at maximum relative density, the k_2 values were higher for II, showing that its retarded viscoelastic deformation is more time-dependent as reflected in the chord areas. Nevertheless, compacts of II had higher tensile strength and work of failure than those of I, emphasising the important advantage of a lower yield pressure and indicating stronger bonding in Type II compacts.

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