STRESS RELAXATION OF COMPRESSED SINGLE AND MULTICOMPONENT SYSTEMS

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Several workers have investigated the plastic behaviour of pharmaceutical materials by following the stress relaxation of compressed tablets. However, most studies have been of single materials and many studies neglect the stress relaxation at short or long times.

The 90-125μm sieve fractions of materials shown in Table 1 were conditioned at 43% r.h., 20°C before use. Sufficient powder to give tablets 3mm thick at zero porosity was compressed in a 12mm diameter plane-faced punch and lubricated die set using a Caleva COMP2500. The powder was compressed at a strain rate of 1mm/min. to maximum upper punch pressures of 75MPa or 162.5MPa and the decay in stress followed for 1200 seconds. Five tablets of each sample were compressed and the results averaged and corrected for relaxation of the apparatus.

The results were analysed using several methods (e.g. David & Augsburger 1977; Hiestand 1972; Shott 1983). Qualitatively similar results were obtained whichever method was used but none was found to linearise the data over the full timescale. The results were therefore expressed simply as a percentage of the maximum upper punch pressure at various times.

Table 1 - % Max. upper punch pressure at various relaxation times.

Max. upper punch pressure /MPa:	75			162.5		
Relaxation time /s:	4	60	1200	4	60	1200
Paracetamol	98.85	96.73	92.27	99.11	98.18	95.78
Aspirin	96.91	91.40	81.32	98.62	96.18	92.16
Emcompress	95.76	92.39	87.09	96.70	93.97	90.45
Zeparox	95.18	92.00	88.25	96.53	93.62	90.58
Sucrose	94.32	90.59	84.79	96.67	94.25	92.16
Sodium Chloride	93.67	87.80	80.94	96.24	91.24	84.66
Avicel PH102	91.38	82.34	74.08	95.76	90.18	85.35
Starch 1500	88.40	74.77	62.75	95.29	88.52	83.05

The rank order of materials changes with time at each pressure and vice versa. Similar results were also found when stress relaxation of tablets of mixed composition was studied (Table 2). The results indicate that relaxation characteristics must be determined at different pressures as well as the different strain rates previously reported by Huckle (1985).

Table 2 - % Max. upper punch pressure at various relaxation times for Aspirin - Emcompress mixtures (% v/v).

Max. upper punch pressure /MPa:	75			162.5		
Relaxation time /s:	4	60	1200	4	60	1200
100% Aspirin	96.91	91.40	81.32	98.62	96.18	92.16
86.9% A 13.1% E	95.89	90.40	81.84	98.19	95.23	90.21
71.3% A 28.7% E	95.82	90.84	83.51	97.92	94.76	89.55
52.5% A 47.5% E	95.83	91.22	83.91	97.56	94.62	90.12
29.3% A 70.7% E	95.83	92.36	86.24	97.21	94.46	90.15
100% Emcompress	95.76	92.39	87.09	96.70	93.97	90.45

The relationship between relaxation and concentration for Aspirin - Emcompress mixtures compressed at 162.5MPa exhibited a maximum at long relaxation times whereas the data for brittle materials reported by Sheikh-Salem et al. (1984) showed a minimum. Similar differences were shown by mixtures of other materials suggesting that the relaxation of mixtures is more complex than an additive function of the properties of the individual components.

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