THE APPLICATION OF DYNAMIC MECHANICAL THERMAL ANALYSIS TO STUDY THE PHYSICAL PROPERTIES OF FREE POLYMERIC FILMS

S.V. Lafferty, M.P. Summers, R.Mackey* and J.M. Newton, The School of Pharmacy, University of London. *The Wellcome Foundation, Dartford, Kent.

Differential thermal measurement (DSC, DTA) has traditionally been used to measure physical properties of film coating polymers, but this study reports on evaluation of an alternative technique, dynamic mechanical thermal analysis. Using this technique, a sinusoidal stress is applied to a sample and the resulting strain is measured. For a viscoelastic material the strain will lag behind the stress by an angle δ, known as the loss angle. The response is resolved into the in phase, elastic component E' and the out of phase viscous component E". The sample is scanned over a temperature range at constant frequency; a peak will occur in the tanδ response at a temperature which can be related to the glass transition temperature.

To determine its applicability to the pharmaceutical film-forming system under investigation various ratios of the aqueous polymer suspensions Aquacoat ECD-20 (ethylcellulose) and Eudragit NE 30 D (polyethylmethylmethacrylate) were cast onto PTFE plates to form films which were dried for 48 hours at ambient temperature and stored over silica gel prior to testing. Samples (dimensions 140 x 9 x 0.45 mm) were scanned between -50 and +150°C at a rate of 5°C min^{-1} in a Dynamic Mechanical Thermal Analyser (Polymer Labs MK II) at a frequency of 1Hz operating in the single cantilever mode.

A plot of tan δ v temperature shows two peaks corresponding to the glass transition temperature of each component. The lower peak at about 35°C corresponds to that of Eudragit NE 30D; the higher one, at about 107°C, is due to Aquacoat ECD-20. The height of this Tan δ peak was found to be linearly related to the amount of each component in the mixture (Fig.1). Data can only be presented for those film compositions above 50% Eudragit as other systems were too brittle to be tested.

Fig.2 shows the effect of film composition on the Eudragit Tg. This shows the plasticising effect of one component on the other and although the relationship is non-linear this is not unusual for polymer systems (Kanig 1963). This initial investigation indicates that this method of analysis may be very useful in the evaluation of polymer film forming characteristics and work using this technique is continuing.

Fig.1

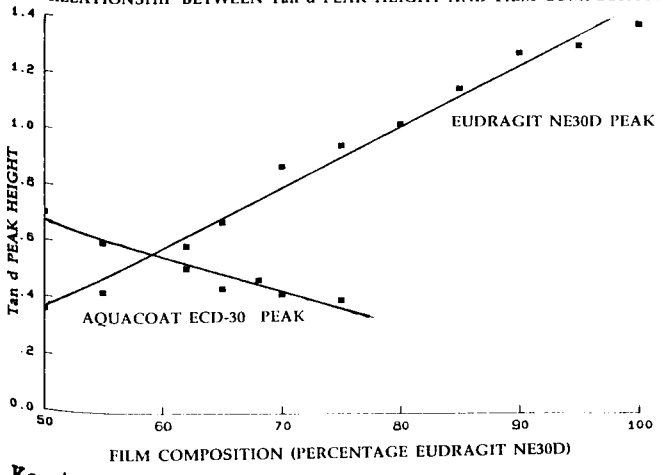
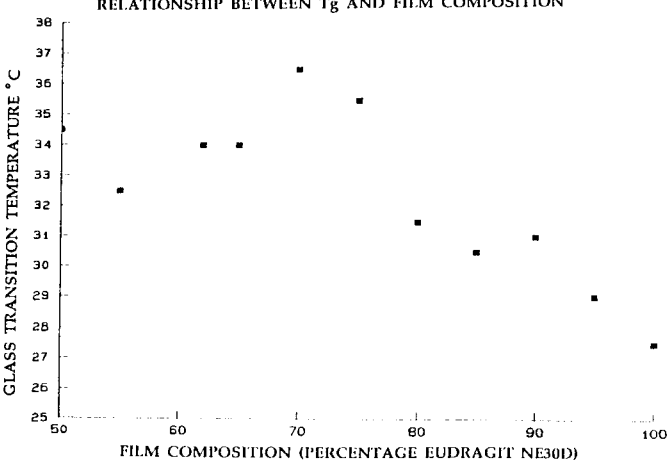


Fig.2



Kanig, G. (1963) Kolloid-Z. Z-Polym., 190: 1 (Royal Aircraft Establishment Library Trans. No. 1135)