THE INFLUENCE OF PHASE TRANSITIONS ON THE SORPTION OF BENZOCAINE BY POLYAMIDE MEMBRANES

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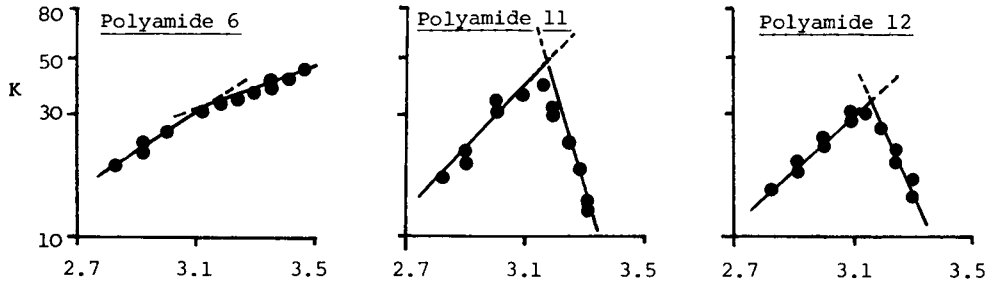
Previous studies have shown that discontinuities occur in the Arrhenius plots for the permeability of benzocaine through polyamide (nylon) 6 membranes, and that these are probably associated with phase transitions in the polymer (Uyokpeyi & others, 1975). Further, it has been demonstrated that these changes in permeability are reflected by changes in the sorption of the drug over the same temperature range. Since 'odd' and 'even' number polyamides have been reported to exhibit different thermal patterns indicating different types of transition (Lord, 1974), it is likely that drug-polyamide interactions will also be influenced by the polymer number. Consequently the sorption of benzocaine by non-oriented polyamide 6, 11 and 12 membranes has been studied as a function of temperature over the range 10 - 80°. For each membrane linear sorption isotherms were obtained from solutions in pH6 phosphate buffer over the drug concentration ranges 0.3 to 6.0×10^{-4}M (10-25°) and 0.3 to 6.0×10^{-3}M (30-80°). The isotherms could, therefore, be characterised by their slopes or sorption coefficients (K). Plotting the data according to the Van't Hoff equation gives the profiles shown in the Figure.



For polyamide 6 the sorption process is exothermic throughout the temperature range studied, although there is a discontinuity at about 45°. For polyamides 11 and 12 however, the Van't Hoff plots exhibit maxima at about 42°, the sorption process being endothermic below, and exothermic above, this temperature.

Polyamide	Δ H sorp. (kJ $mole^{-1}$) Low Temp.	High Temp.	Sorption Discontinuity	d.s.c. transition
6	- 8.67 ± 1.25	-13.35 ± 0.35	~45°	61°
11	+60.62 ± 11.45	-20.60 ± 2.82	~42°	40°
12	+68.09 ± 5.39	-20.35 ± 1.04	~42°	40°

Differential scanning calorimetry (d.s.c.) studies performed on the dry membranes showed that each exhibited phase transitions which, for polyamides 11 and 12, were in good agreement with the maxima on the Van't Hoff plots; for polyamide 6 the d.s.c. transition was about 16° below the sorption discontinuity. This difference can probably be attributed to the presence of water in the sorption studies which can be expected to plasticize, and hence lower the transition temperature of, the more hydrophilic polyamide 6, whereas the more hydrophobic polyamides 11 and 12 are unaffected by water. Orientation of the membranes has no influence on the transition temperature since mono- and bi-axially oriented polyamide 6 membranes exhibited a d.s.c. transition at 60°.

Lord, F.W. (1974). Polymer, 15, 42-48.
Uyokpeyi, I.V., Padfield, J.M. & Meakin, B.J. (1975). J.Pharm.Pharmac., 27 Suppl., 8P