

MOISTURE PERMEATION MECHANISM OF SOME AQUEOUS-BASED FILM COATS

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The sorption-desorption technique (Sacher & Susko 1981) has been used to evaluate the permeation characteristics of water-based free films of hydroxypropyl methylcellulose (HPMC) containing either polyethylene glycol (PEG) 400, PEG 1000 or polyvinyl alcohol (PVA) - degree of hydrolysis 88%. This method provides a deeper insight into permeability mechanisms than the transmission cup method as well as affording practical advantages in avoiding sealing problems and eliminating pore effects.

Films, cast by a pouring technique on the inside of a rotating perspex cylinder maintained at 40 - 42°C, were conditioned for 7 days at 20°C, 58% R.H. before test. The measuring apparatus incorporates an automatic recording microbalance from which the film specimen is hung, and humidity and vacuum lines, placed in a controlled temperature room (20 ± 1°C). The system plus the test film was evacuated at 10⁻⁴mbar overnight, then a steady stream of moist air (75% R.H.) was passed over the film until equilibrium weight was attained. Desorption was carried out under vacuum until a constant weight was reached. The integral diffusion coefficient, D, was calculated employing Boltzmann's solution of Fick's law put forward by Long & Thompson (1955) for concentration dependent diffusion, using the initial linear slopes of plots of Me/Mt against t^{1/2}/l for sorption and desorption. Mt is the amount sorbed or desorbed at time, t, Me the equilibrium moisture concentration and l the film thickness. The permeability coefficient, P, is given by (Crank 1975): P = DS where S is obtained from Henry's law using the expression S = c/p where c is the sorption equilibrium concentration and p is the vapour pressure of the moist air.

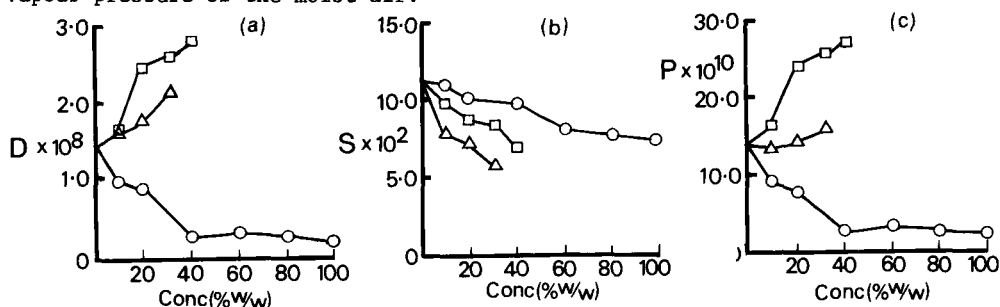


Fig. 1: Showing variation of D ($\text{cm}^2 \text{s}^{-1}$), S [$\text{cm}^3 \text{cm}^{-3} (\text{cmHg})^{-1}$] and P [$\text{cm}^2 \text{s}^{-1} (\text{cmHg})^{-1}$] with concentration of PEG 400 (□), PEG 1000 (Δ) and PVA (○) at 20°C, 75% R.H.

The enhanced segmental mobility of HPMC brought about by the plasticising activity of the PEG's is believed to be responsible for the increase in diffusion coefficient with increase in concentration (Fig 1(a)). PVA, however, causes a decrease in diffusion coefficient, suggesting that it has an anti-plasticising effect. The longer ethylene backbone (and hence lower hydrophilicity) of PEG 1000 makes it a weaker plasticiser than PEG 400. PEG 400 and 1000 (glycols) have twice the number of -OH groups of PVA per molecule forming more hydrogen bonds with HPMC and leaving the film former with fewer bonding sites for permeating moisture. This accounts for the lower value of solubility coefficient (Fig.1(b)). The striking similarity of Figs. 1(a) and (c) indicates that in the film systems evaluated, moisture permeability is influenced more by change in diffusion coefficient than in solubility coefficient.

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