COMPETITIVE SORPTION BEHAVIOUR IN NYLON 6

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The study of drug-plastics interactions is of importance in the design and development of pharmaceutical containers and polymeric controlled release devices. Generally, such interactions have been studied for single solute systems but in practice, solutions in contact with the plastic may be more complex containing more than one solute. We have investigated the interaction of four model compounds with Nylon 6 powder from single solute and binary solute solutions to assess possible competitive sorption effects. The model compounds selected (4-nitrophenol, phenol, 4-methoxybenzoic acid and benzocaine) possess functional groups common to many drugs. Previous reports have shown that the sorption of aromatic weak electrolytes by Nylons increases proportionately as the concentration of drug in the unionised form increases (Richardson and Meakin 1974). Sorption isotherms were therefore determined at a pH which optimised the concentration of unionised species present. The sorption of all four compounds gave rise to linear C_1 type sorption isotherms (Giles 1974) which may be characterised by their slopes (K values). At higher concentrations, the isotherm for 4-nitrophenol showed a plateau (C_2 type isotherm) indicating that the solute is saturating the available sorption sites. No competitive sorption effects were observed from mixtures of 4-methoxybenzoic acid and benzocaine (table 1). The sorption of 4-nitrophenol by Nylon 6 powder, from phenol/4-nitrophenol mixtures, decreases as the amount of phenol present increases (figure 1). At higher concentrations of total phenols the isotherm for 4-nitrophenol changed from C_1 type to Z type (figure 1) with an associated plasticization of the polymer matrix which can be observed visually. The extent of sorption of phenol is unaffected by the presence of 4-nitrophenol until at higher concentrations the system again becomes plasticised, suggesting that phenol has a higher affinity for the polymer matrix. This difference in sorption behaviour may be due to the phenolic compounds forming strong hydrogen bonds with amide groups in the polymer whereas the non-phenolic compounds may interact by non-specific Van der Waals forces. Thermodynamic parameters calculated from K values determined over the range 7° - 60° also support the concept of a dual binding mechanism. ΔH° interaction values for phenol and 4-methoxybenzoic acid were - 0.47 and + 16.98 K.J mol^{-1} respectively and ΔG° interaction ($323^{\circ}K$) values were - 5.90 and + 5.36 K.J mol^{-1} respectively.

Solute System	K value	(S.D)
Benzocaine	21.8	(0.6)
Benzocaine + 4-methoxybenzoic acid	22.6	(0.6)
4-methoxybenzoic acid	28.1	(0.8)
4-methoxybenzoic acid + benzocaine	28.9	(0.6)

Table 1: K values for the sorption of benzocaine and 4-methoxybenzoic acid by Nylon 6 from single and binary equimolar solutions.

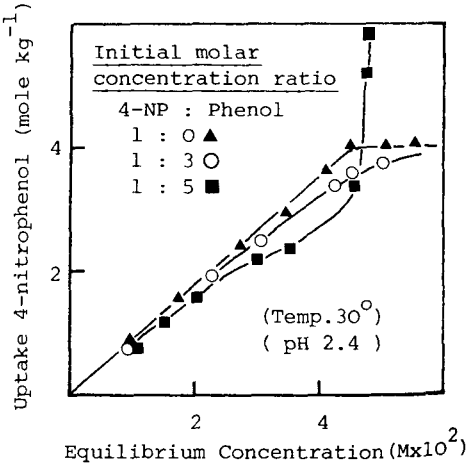

Fig.1: Sorption of 4-nitrophenol by Nylon 6 from 4-nitrophenol/phenol mixed solutions.

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