PERMEABILITY ASYMMETRY IN COMPOSITE FILMS OF AN ACRYLATE-METHACRYLATE COPOLYMER

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In composite films comprising individual layers of differing permeability, the total resistance to permeation is given by the sum of the individual resistances of each layer (Barrie & others, 1963). When solute transport is concentration-independent and permeation occurs by a solution-diffusion or partitioning mechanism the overall permeability should be independent of the arrangement of layers in the composite film. However in concentration - or pressure-dependent systems, permeability asymmetry characterises the flow, flux being determined by the layer accepting the permeant (Rogers & others 1957; Kuriyama & others, 1970). Permeability asymmetry has been observed in acrylate-methacrylate copolymer films (Abdel-Aziz & others, 1975).

Acrylate-methacrylate copolymers A and B, Eudragit ERL 100, ERS 100 respectively, (Rohm Pharma, Darmstadt) differing respectively in quaternary ammonium content by 2:1, were used to prepare high and low permeability films by casting on PTFE substrate from acetone solution of polymer (2.5% $^{w}/w$) containing 0.5% $^{w}/w$ glyceryl triacetate as plasticizer. Composite films of A and B were prepared by layering preformed films (20 μm thick) of each type one on the other after exposure of one surface to solvent vapour for 2 h followed by a further 2 h exposure of the composite film. The permeability cell and determination of urea have been described (Abdel-Aziz & others, 1975). Individual films are asymmetric with lower (L) and upper (U) surfaces and composite films were formed in the order LU-LU. Thickness of single and composite films = 40 μm ± 0.7 sem.

Table 1. Urea permeation in single and composite films

		Urea transferred to acceptor compartment, mg				
		h				
		1	2	3	4	5
Single film A		122	355	609	993	1384
B		0	1	3	6	8
Composite film	AB	14	44	84	135	186
	BA	0	1	4	7	10

AB = A exposed to permeant source; BA = B exposed to permeant source. Permeability depends on layer arrangement in the permeant stream, AB having greater permeability than BA and A greater than AB. This asymmetry is attributed to change in layer resistance in the composite film resulting from layer permutation. Resistance to transport of permeant equals the sum of a, interfacial resistance, including steric hindrance, to entry to pores at the fluid-film interface; and b, viscous drag on permeant molecules in the pores. When B (low permeability) in the composite film is adjacent to permeant source resistance a is greater than when A is adjacent because of B's lower permeability generally; but when A is adjacent, entry to B, now distal to permeant source is easier because entry to pores of B is facilitated by the flow momentum established in A and total resistance in AB approximates to b only. Generally, resistance of a layer of a composite film to permeant entry is greater when that layer is in the upstream position.

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