

## THE ADSORPTION OF HYDROPHILIC POLYMERS AT THE LIQUID-SOLID INTERFACE

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The adsorption of hydrophilic polymers at the drug particle-vehicle interface results in suspensions that are either sterically stabilized or flocculated. The properties of the adsorbed film are therefore of paramount importance in determining the bulk properties and may well influence the bioavailability of the suspension.

In a previous study (Najib and others, 1977) the effect of adsorbed polyvinylpyrrolidone (PVP), sodium carboxymethyl-cellulose (SCMC) and gelatins on the electrophoretic mobility of a polystyrene latex and sulphadimidine particles was reported. This work examines the adsorption of the same polymer fractions on the same batch of latex in order to characterize the adsorbed PVP film, an aspect not previously investigated. Mass adsorption isotherms were constructed by centrifuging a latex suspension in equilibrium with the required concentration of polymer at 25° and pH 5.6, and assaying the supernatant for polymer content by differential refractometry. The isotherms obtained in all cases were of the Langmuir type, i.e. exhibited monolayer saturation. The molecular masses of the polymers were determined by osmometry and the monolayer saturation value ( $A_s$ ) was related to the molecular mass ( $M$ ) by the equation

$$A_s = KM^\alpha$$

where  $K$  and  $\alpha$  are constants. The value of  $\alpha$  is indicative of the orientation of the polymer at the interface. For PVP  $\alpha = 0.16$ , indicating that the polymer is adsorbed as random coils, whereas for SCMC  $\alpha = 1.0$  and the molecules are therefore distributed in the adsorbed film as bristles.

For PVP, a nonionic polymer, the amount adsorbed was pH independent for  $pH < 8.5$ . Above 8.5, a slight reduction in  $A_s$  was noted and may be attributed to adsorption of hydroxyl ions by the PVP molecules, thus acquiring a negative charge. SCMC exhibited a pH independence for  $pH > 6.5$  when both the carboxyl groups of the SCMC and the particle surface are ionized. For  $pH < 6.5$ , the degree of ionization decreases and adsorption was found to increase. Acid and alkaline processed gelatins showed extreme dependence on pH, with maximum adsorption coincident with the isoelectric point of the gelatins. For all polymers studied, maximum adsorption occurred under conditions of minimum charge on the polymer and the latex, suggesting hydrophobic interaction. Although the latex surface contains both sulphate and carboxyl groups, the area per ionizable group is  $\approx 8.4 \times 10^{-17} \text{ m}^2$ , hence there is a large uncharged surface area over which hydrophobic bonding could occur.

The thickness of the adsorbed film was measured by U-tube viscometry according to the method described by Saunders (1961). The film thickness was not found to be a continuous function of molecular mass since a transition was found in the region of 40,000.

We attribute this transition to the fact that for fractions below 40,000 film thickness is controlled by the polymer 'tail' lengths, above 40,000 the dominant dimension is that of the polymer 'loops'.

Najib, N., Kellaway, I.W., & Marriott, C., (1977). *J.Pharm.Pharmac.* 29, 43P.

Saunders, F.L., (1961). *J.Coll.Sci.*, 16, 13-22