

STERIC STABILIZATION: THE EFFECT OF ADSORBED POLYMERS ON SUSPENSION REDISPERSIBILITY

D. A. Rawlins and J. B. Kayes, Pharmaceutics Research Group,
Department of Pharmacy, University of Aston, Birmingham B4 7ET.

It is recognised that in addition to facilitating wetting of particulate matter in aqueous dispersions, surface adsorbed polymers may provide a stabilizing force capable of controlling the aggregation behaviour of such particles. Whilst there have been a number of reports on this 'steric stabilization' of colloidal particles (Ottewill and Walker, 1974), there is little published work on coarse suspension systems which rapidly sediment. Previous work in this area has looked at the measurement of the adsorbed polymer layer thickness at the surface of dispersed particles (Kayes and Rawlins, 1978).

In this investigation the effect of five members of the nonionic surfactant group, nonylphenylethoxylates - NPE (8, 13, 20, 30, 35 ethylene oxide units per molecule) and six fractions of polyvinylalcohol - PVA (molecular weight range 5,000 to 100,000) on the redispersibility of diloxanide furoate suspensions has been evaluated. All suspensions were made in 10^{-2} mol dm^{-3} NaCl. This concentration does not cause salting out of the polymer chains, and the diloxanide furoate particles have a maximum zeta-potential of -7 mV, insufficient to stabilize the particles through electrostatic repulsion. Thus observed changes in suspension stability will be due primarily to the addition of polymer to the systems. Estimates of the re-dispersibility of the suspensions were obtained by revolving the tubes containing the suspensions in a vertical plane about the centre of the tubes and noting the number of revolutions necessary to resuspend.

At very low concentrations of polymer the systems were flocculated with high sedimentation volumes (S.V.) and a low redispersibility value (R.V.). At such concentrations polymer 'bridging' is likely, resulting in the loosely aggregated systems observed; alternatively, aggregation as a result of primary minimum coagulation, due to the absence of a repulsive barrier, may occur. Increasing the concentration of PVA fractions leads to an increase in RV with the attainment of a plateau at higher concentrations. With NPE's, increasing the concentration leads to a maximum in RV after which the value falls and a plateau is reached at higher concentrations. More detailed investigation of the NPE systems showed that the maximum RV occurred between one and two thirds of the maximum surface coverage of the particles by the surfactant, the levelling off in RV coinciding with maximum polymer coverage. At full coverage maximum stability is achieved and the particles will be deflocculated.

The observed maximum in RV may be attributed to partial steric stabilization. At these intermediate surface coverages sufficient repulsion exists for the particles to remain discrete entities, but on sedimentation attraction due to van der Waals forces, and possibly crystal growth, occurs via the 'bare patches' on the partially covered particles leading to a high RV. The absence of a maximum with the PVA systems is a result of the polymer adopting a flattened configuration at the interface so that, even at sub maximal adsorption, few 'bare patches' are available for attraction to occur. Experiments with a polystyrene latex dispersion also indicate that partial steric stabilization is possible at intermediate surface coverage.

Ottewill, R. H. and Walker, T. (1974) J. Chem. Soc. Faraday I 70, 917
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