Polymer Adsorption on Silica Particles: Relation Between Kinks on Adsorption Isotherms and Bulk Phase Behavior

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Adsorption isotherms of polymers on solid particle as silica beads, from aqueous solutions, are known to present, in some cases, vertical jumps or kinks [1, 2]. These are generally identified as the signs of surface demixings but little is known about the causes of such behaviour. An extended study of the physico-chemical properties of PEG 400 solutions in water versus temperature and concentration shows several different behaviours according to variable zones. At very low temperatures, as shown by DSC, solid-liquid equilibria appear around a 50-50 eutectic point. Close to room temperature, in liquid mixtures, as shown by surface tension measurements, micellization occurs, but disappears at higher or lower temperatures. The molecular rearrangements suggested by these data are confirmed by NMR analysis. Surface behaviour following the adsorption of PEG 400 onto silica beads highly depends on bulk behaviour. In temperature and concentration zones in which micelles exist, obvious kinks are observed on the adsorption isotherms. Organized as surface phase diagrams, they suggest a solid-like or liquid-like organisation according to the surface quantities. Out of the micelles zone, kinks disappear, but isotherms take an oscillatory shape which suggest surface organisation changes in which water exchanges between bulk and surface play an important role. This study gives important hints on the inter-correlation between bulk and surface behaviours of PEG and on the role of temperature. They are of importance in the view of composite material elaboration.

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