

Phenolic copolymer/polyelectrolyte/non-ionic homopolymer interactions: thermodynamic and electrochemical studies in dimethylformamide/water mixtures

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SUMMARY:

p-Aminobenzoic acid/*p*-hydroxybenzoic acid/formaldehyde copolymer (**I**) was prepared and characterized. An interpolymer complex of copolymer (**I**) was prepared by adding stoichiometric amounts of a polyelectrolyte [poly(methacrylic acid)] and non-ionic homopolymers [poly(*N*-vinyl-2-pyrrolidone) and poly(ethylene oxide)]. The stability constant and related thermodynamic parameters (ΔH^0 and ΔS^0) were determined in DMF-H₂O mixtures of different compositions using Osada's method. The stepwise degradation of the complex is explained on the basis of the relative stability of various interacting forces, particularly in media of varying dielectric constant. Electrochemical studies in the media substantiate the observations from thermodynamic studies.

Introduction

Studies of polymer-polymer interactions and formation of interpolymer complexes have aroused considerable interest in the field of polymer science in view of the unique properties of such complexes^{1,2}. These products have found wide applications in the field of medicine and in industries^{1,2}. Though considerable work has been done during the last decade on polyelectrolyte³ and hydrogen bonding complexes^{4–6} involving non-ionic homopolymers, very little information is available in the literature regarding the use of phenolic copolymers as one of the components in such complexes^{7–9}. The unique properties of phenolic polymers are attributed to the presence of intramolecular hydrogen bonding^{10,11}. Since the mode of formation of interpolymer complexes is mainly through hydrogen bonding^{1,2}, phenolic copolymers may provide an excellent component for making such complexes. Apart from electrostatic forces, ion-dipole interactions, and hydrogen bonding involved in such complex formation, other forces like hydrophobic interactions also play an important role in stabilizing such complexes in aqueous medium. In organic solvents, one could expect considerable weakening of hydrophobic interactions, and hence stability constant (*K*) and related thermodynamic parameters (ΔH^0 and ΔS^0) of the interpolymer complexes are most likely to be affected in such media¹².

Though considerable data are available in the literature regarding the role of solvent on interpolymer complex formation, there seems to be very little information regarding the use of mixed solvents^{1,2}. For the present investigation, interactions of *p*-aminobenzoic acid/*p*-hydroxybenzoic acid/formaldehyde copolymer (PAB-PHB) with poly(methacrylic acid) (PMA), poly(*N*-vinyl-2-pyrrolidone) (PVP) and poly(ethylene oxide) (PEO) have been studied in mixtures of DMF and water of different