Investigation of the Intermacromolecular Associations between Hydroxypropyl Cellulose and Maleic Acid-Styrene Alternating Copolymer on Different Domains of Concentration

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In the last decades considerable attention has been paid to the study of inter-macromolecular associations through hydrogen bonding between synthetic complementary polymers like polyacids and polybases. It was found that interpolymer associations were stabilized in many cases by hydrophobic interactions [1]. The interest in this phenomenon is justified by the substantially different physico-chemical properties of the interpolymer complexes (IPC) as compared with the two pure components. IPCs offer another option to obtain new materials with tailored properties for a variety of applications i.e. semipermeable membranes, pigmented fillers etc., but their main field of application is in medicine as biomaterials or in pharmacy as controlled drug delivery systems [2]. So far the complex formation between a synthetic and a natural modified water-soluble polymer has practically not been considered, except for some studies on the poly(acrylic acid) and methyl or hydroxyethyl cellulose [3].

The inter-macromolecular association between hydroxypropyl cellulose (HPC), and a weak polyacid, maleic acid-alt-styrene copolymer (MAC-S) at different total polymer concentrations in the systems and various mixing ratios between components was investigated. It is well known that hydroxypropyl cellulose (HPC) finds applications in coatings, excipients, encapsulations, binding materials, foaming agents, protection colloids, flocculants, etc. for a wide variety of materials [4]. On the other hand maleic acid copolymers are used as flocculants, biomaterials, drug delivery systems [5] etc.

For dilute solutions, the IPCs formation was investigated by capillary viscometry, potentiometry and turbidimetry. The ratio between the experimental and the ideal reduced viscosities (calculated for the lack of specific interactions between the components) of the mixtures as a function of the weight fraction of the maleic acid copolymer shows a negative deviation from the unity with a minimum at a 60 wt% MAC-S copolymer in the mixture. This behavior indicates the formation of the an interpolymer complex with compact structure; the strongest interactions between components manifest at a weight ratio between HPC and MAC-S of 40:60. The potentiometric measurements in “isoionic” condition evidenced a molar unit stoichiometry of HPC:MAC-S ~ 1:2.5. The thermodynamic functions of the intercomplexation reaction were evaluated.

Rheologic measurements in semi-dilute solutions showed a higher dynamic viscosity of the aqueous solution of the mixture as compared with those of the components in a temperature interval between 20-35°C; at higher temperature a phase separation occurring.

At a total polymer concentrations of 10mg/mL a precipitate with a gel-like aspect was observed. The composition of the precipitate and upper phase was investigated by qualitative and quantitative IR spectroscopy measurements. This prepared ICP is a potential carrier for controlled drug delivery.
References


