

Preface

Scope and Object of the Work

Polyelectrolytes are an important class of polymers which are both conductive and viscous. Since the emergence of polymer science, polyelectrolytes owing to their unique nature have been the subject of extensive investigation. These still continue to be a very active area of research in a variety of fields *e.g.*, chemistry, physics, biology, medicine, materials science and nanotechnology. The widespread interest in polyelectrolytes stems from the scientific curiosity in understanding their behaviour as well as from their immense potential in commercial applications. Polyelectrolytes have been utilized to assemble nanostructured materials with desired properties. Potential applications in medicine and biomedical engineering are also being pursued extensively. Complexes of polyelectrolytes with conjugated polymers *e.g.*, polyelectrolyte-polythiophenes and polyelectrolyte-polyanilines are being used commercially as conducting coatings. These are extensively used in industry as surface-active agents for water treatment and oil-spill treatment. These also find applications in the industrial production of personal care products, cosmetics, pharmaceuticals, biosensors, surfactants, absorbents, ion exchange resins, stabilizers, adhesives, paints, papers etc. A very promising and emerging area of application of polyelectrolytes is in the assembly of thin films of novel materials.

Physicochemical properties of polyelectrolyte solutions have been studied for several decades, but several of them have not yet found a satisfactory theoretical interpretation. In many cases although a qualitative understanding is available, a quantitative understanding is still awaited. For others, the origin of the phenomena observed remains partly obscure, indicating that the current treatment of the polyelectrolyte behaviour is incomplete and that more fundamental new views are required to gain a full understanding. Keeping in view of widening fields of applications based on the specific properties of the polyelectrolytes, it, thus, appears that the present situation in polyelectrolyte chemistry is far from satisfactory.

In recent years, there has been an upsurge of interest in the study of polyelectrolytes stimulated by the availability of sophisticated experimental techniques and the introduction of new theoretical approaches. Although new insight has been gained, no real breakthrough has been realized so far and much more remains to be done.

The study of polyelectrolyte solutions has been conducted very extensively in aqueous solutions.¹⁻⁷ This is partly because many polyelectrolytes, usually with high charge densities, are difficult to dissolve in solvents other than water. Moreover, because of the great interest in the naturally occurring polyelectrolytes such as proteins, nucleic acids, and polysaccharides in aqueous medium, the behaviour of these species in aqueous solutions has become the main subject of study.⁷⁻¹⁰

The principal factors that govern the dissolved state of polyelectrolytes in solutions are firstly, the electro-repulsive forces operative between the ionic sites in the polymer chain and secondly, the interactions between the polyions and counterions surrounding the polyion chains. The first factor is intimately related to the expansibility of the polymer chains, whereas the second is not only manifested in counterion binding but also in the extent of solvation and the solvent structure in the neighbourhood of polyelectrolyte molecules. Both of these factors are, in turn, related to the relative permittivity of the solvent media. Use of a series of mixed solvents corresponds to a systematic variation in the relative permittivity of the media and hence provides us an opportunity to study the behaviour of polyelectrolyte solutions from a more general point of view.

The present dissertation, therefore, aims at elucidating the behaviour of a selected polyelectrolyte (sodium carboxymethylcellulose) in methanol-water mixed solvent media using three different experimental techniques namely, electrical conductometry, viscometry and volumetry.

References

1. S. A. Rice and N. Nagasawa, *Polyelectrolyte Solutions*, Academic Press, New York (1961).
2. F. Oosawa, *Polyelectrolytes*, Marcel Dekker, New York (1971).
3. E. Selegny (Ed.), *Polyelectrolytes*, D. Reidel, Dordrecht, The Netherlands (1974).
4. M. Mandel, *Polyelectrolytes*, In *Encyclopedia of Polymer Science and Engineering*, H. F. Mark, N.M. Bikales, C.G. Overberger and G. Menges, (Eds.), 2nd ed., Wiley, New York (1988).
5. S. Förster and M. Schmidt, *Adv. Polym. Sci.*, **120**, 51 (1995).
6. H. Dautzenberg, W. Jager, J. Kötz, B. Philipp, C. Seidel and D. Stcherbina, *Polyelectrolytes: Formation, Characterization and Application*, Hanser Publishers, Munich (1994).
7. S. K. Tripathy, J. Kumar and H. Nalwa (Eds.), Vol. 2, *Handbook of Polyelectrolytes and Their Applications*, American Scientific Publishers, Stevenson Ranch (2002).
8. H. Eisenberg, *Biological Macromolecules and Polyelectrolytes in Solution*, Clarendon Press, Oxford (1976).
9. A. Veis (Ed.), *Biological Polyelectrolytes*, Marcel Dekker, New York (1970).
10. V. Bloomfield and I. L. Carpenter, *Biological Polyelectrolytes*, In *Polyelectrolytes: Science and Technology*, M. Hara (Ed.), Marcel Dekker, New York (1993).