ABSTRACT

A polymer gel is a crosslinked polymer network swollen in a liquid medium. Gels are found everywhere in nature. In human bodies the cornea, vitreous and connective tissues are gels. They have a wide range of applications.

Hydrogels are a type of gel in which the polymer network is hydrophilic and the liquid component is aqueous. An important class of hydrogels are those known as stimuli-responsive gels. These have potential as sensors, switches, membranes for separations, and are widely employed in the biomedical field. An increasing interest has evoked in developing gels as active materials. By introducing functional groups and by choosing an appropriate polymerization technique, reactive hydrogels can be synthesized.

The thesis describes the studies undertaken in designing catalytic hydrogels for the hydrolysis of esters and amides. These could find applications in controlled release drug delivery systems. Catalytic hydrogels that mimic the catalytic activity of enzymes were investigated. These mimics could replace enzymes in industrial applications.

The work is presented in seven chapters and a brief outline of the studies carried out is as follows :

CHAPTER I : Literature survey

This chapter describes the synthesis, properties and applications of hydrogels in different areas. The literature on the efforts to synthesize polymeric catalysts using different techniques has been reviewed.

CHAPTER II : Objectives and scope of work

The objectives in undertaking the investigation have been summarized.

CHAPTER III : Catalytic Hydrogels as enzyme mimics : Anchimeric effects

This chapter describes the synthesis of catalytic hydrogels by the polymerization of a charge transfer complex between the substrate and the catalyst. The substrate and the catalyst were present on the same chain next to each other. This led to enhanced rate of hydrolysis of the ester by the anchimeric effect of the catalyst in the catalytic hydrogels , compared to the hydrolysis of the ester from the conventional hydrogel.

Chapter IV : Catalytic Hydrogels as enzyme mimics : Molecular imprinting effects

This chapter deals with the synthesis of catalytic hydrogels based on template polymerization and molecular imprinting. The ester and amide substrates were brought in vicinity either by coordination with a metal ion or the substrate was polymerized in preformed cavities prepared by molecular imprinting. These catalytic hydrogels also exhibited enhanced rate of hydrolysis of the ester and amide substrates, compared to the rate in the conventional polymers. The catalytic activity was found to be pH sensitive. These hydrogels could therefore be used for oral controlled drug delivery systems.

CHAPTER V : Catalytic hydrogels exhibiting α-chymotrypsin like activity

This chapter deals with the synthesis of hydrogels that mimic the catalytic activity of α-chymotrypsin. A model mimicing the active site of α-chymotrypsin was prepared using monomers bearing the functional groups present in the active site of the enzyme. The polymer mimic exhibited hydrolytic activity similar to that of the enzyme for phenylalanine ester and amide substrates. Characteristic features of enzyme like activity could also be demonstrated. The approach employed can be used to synthesize 'tailor-made' catalysts for industrial applications.

CHAPTER VI : Summary & conclusions

This chapter summarizes the important findings of the investigations and the conclusions derived.

CHAPTER VII : Suggestions for future work

This chapter describes the possibilities for extending the work further. They include designing pH sensitive, chemically linked controlled release drug delivery systems and synthesizing polymer mimics of other hydrolytic enzymes.