Summary of the Thesis

In the recent years research on water-soluble polymers has been an area of scientific and commercial interest. This is a reflection of the increasing applications of water-soluble polymers as flocculants, dispersants, stabilizers, emulsifiers, drug delivery devices, modern textile finishes and many other products. It also reflects awareness towards the role of water as a solvent for polymers and other substances. Solubility of water-soluble polymers depends on structural characteristics of the solvated polymer chains. Water-soluble polymers are those that can either dissolve or swell in water to form either solution or hydrogel. The key to water solubility of these polymers lies in incorporating sufficient numbers of hydrophilic functional groups along the backbone or side chain.

With the above mentioned intention in mind the synthesis and characterization of the following were carried out.

- Mono functional β-cyclodextrin
- Difunctional β-cyclodextrin
- Ethylenediamine and urea linked β-cyclodextrin polymers

Selective monofunctionalization at a desired position is a challenging task, the differences in the chemical properties and reactivities among these sites can be exploited to yield a specific product. Monosubstitution of a CD is achieved by using less than one equivalent of the reagent. The presence of a large excess of the electrophilic reagent must be avoided as it often lead to di-, tri or per-functionalization. The most common method for functionalizing at the 6-position of the CDs is nucleophillic attack of a reagent containing the appropriate group on mono-6-tosyl CD (itself a monosubstituted CD). Monosulfates are prepared by reacting one equivalent of *p*-toluenesulfonyl chloride with CD in pyridine or DMF in the presence of a base. Monotosylates have been extensively investigated. An excellent method for the synthesis of monotosyl CD is by the reaction of a CD moiety with *p*-toluene sulfonic anhydride (Ts_2O) in aqueous alkaline medium for a short period of time to obtain the mono-6-tosylate in fairly good yields. These tosylated CDs are important precursors for the synthesis of cyclodextrin dimers.

The three major substitutions (iodo, azido and amino) on the primary side of the cyclodextrin was successfully introduced using bulky disubstituted reagent biphenyl 4,4'-disulphonyl chloride which can react only two specific primary hydroxyl groups of β-cyclodextrin. The synthesized water-soluble β-cyclodextrin based monomers were characterized by conventional spectroscopic techniques. These three major cyclodextrin monomers which have reactive functional groups, enhanced inclusion ability and good water-solubility are further used for the preparation of water-soluble main-chain polymers.

The synthesis of linear highly water-soluble β-cyclodextrin based polymers using short linkers (cyanuric chloride, ethylenediamine, urea and thiourea) to connect the β-cyclodextrins and selectively modified β-cyclodextrins. The water-soluble polymers had β-cyclodextrins in the main-chain. The controlled conditions were used to prevent the crosslinking of monomers. The synthesized polymers were purified by ultrafiltration using MWCO=1K membrane and solid polymers were isolated by freeze-drying. As expected the synthesized β-cyclodextrin based polymers have more aqueous solubility as compared to parent β-cyclodextrin. Thus, such types of polymers are quite useful for the drug delivery applications.

The synthesized water soluble polymers forms inclusion complexation (ICs) with water-insoluble drugs cefpodoxime proxetil and carbamazepine. The inclusion formation of these drugs with β-cyclodextrin and β-cyclodextrin based polymers were characterized by UV-Vis, FTIR and NMR spectroscopic techniques. The formation of 1:1 inclusion complex of these drugs was found from phase solubility diagram.

Aqueous solubilization of [60] fullerene by forming inclusion complex with β-cyclodextrin dimer. β-Cyclodextrin based dimers were prepared by reacting tosylated CDs with ethylenediamine. Interestingly the complex showed supramolecular self-assembly, which was confirmed by TEM analysis. The complex was fully characterized by UV-Vis, FT-IR, and TGA.