SUMMARY

 Ion exchange is a standard analytical tool and is widely used in separation science. In laboratories ion exchangers are being used as an important tool to solve new problems, such as rapid and accurate determination of the constituents of a sample, contaminants of alloys, biological substances etc. Ion exchange has also been established as a powerful technique in the field of soil analysis thus proving its worth in soil pollution control.

 Soil provides us a place to live and is a reservoir of minerals but with accelerating growth of the world's population and rapid urbanisation tremendous pressure has been created on it. Dumping of industrial wastes containing poisonous chemicals and spraying of pesticides aiding agricultural production and health protection leads to large scale soil pollution. When the soil comes in contact with these chemicals its physico-chemical and biotic properties are affected leading to its degradation and pollution.

 The work embodied in this thesis comprises of five chapters. Chapter I is general introduction covering the background of the work presented in this thesis.
Ion exchange is a widespread phenomenon and ion exchange processes are useful in separation, removal and recovery of various kinds of species. Looking towards the growing interest in the chemistry of the ion exchange process emphasis has been given to the adsorption studies on an ion exchanger and its thermodynamics. To understand the nature of adsorption, in the most convenient way adsorption isotherms are plotted.

The second chapter deals with the equilibrium studies for the sorption of cobalt(II) on two types of soils, performed at 30°C and 50°C by batch technique. The sorption data are analyzed in terms of sorption isotherms, the Langmuir equation and the distribution coefficient Kd. Various thermodynamic parameters, such as thermodynamic equilibrium constant ($K_o$), standard free energy ($\Delta G^o$) changes, standard enthalpy ($\Delta H^o$) changes and standard entropy ($\Delta S^o$) changes are evaluated. The adsorption data are in close agreement with the Langmuir equation at both temperatures. Sorption of cobalt(II) is higher in Bhopal soil than in Tehri soil and adsorption is lower at higher temperature in both soils.
The third chapter deals with the adsorption studies of pesticide, endosulphan on uncontaminated sandy loam (Mukteshwar) and silt clay loam (Bhopal) soils in acetone-water and methanol-water mixtures, at different volume fractions of cosolvents, performed by batch technique. Higher adsorption of endosulphan was observed on sandy loam (Mukteshwar) soil than silt clay loam (Bhopal) soil and was anticipated with Freundlich constant $K$ values and partition coefficient $K_D$ values. The $K$ and $K_D$ values also confirm that adsorption of endosulphan was higher in acetone-water mixtures than methanol-water mixtures and adsorption decreases with increase in volume fraction of cosolvents (acetone, methanol). The data obtained were used to evaluate the cosolvent theory for describing adsorption of endosulphan in acetone water and methanol-water mixtures. The aqueous phase partition coefficient $K_{DW}$ (mol/g) normalised on fraction of organic carbon of respective soils ($f_{OC}$), for endosulphan was evaluated by extrapolating $f_S = 0$.

The fourth chapter deals with the effects of exchangeable ions, $H^+$ and $Na^+$, organic matter, non-ionic and anionic surfactants and temperature on the adsorption of endosulphan on two different soils. Adsorption studies were performed by batch technique
and adsorption isotherms were in close agreement with the Freundlich equation. The amount of endosulphan adsorbed in all cases was higher in sandy loam (Mukteshwar) soil than in silt clay loam (Bhopal) soil. The adsorption on both the soils followed the order – Hydrogen saturated soil > Sodium saturated soil > Natural soil at 10°C > Natural soil at 20°C > Soil with 0.1% non-ionic surfactant > soil from which organic matter was removed > Soil with 0.1% anionic surfactant > Natural soil at 40°C and was in accordance with Freundlich constant K values and distribution coefficient Kd values. The adsorptive capacity of endosulphan for organic matter and clay content for both soils (natural form) was also evaluated by calculating $K_{om}$ and $K_c$ values. Various thermodynamic parameters such as the thermodynamic equilibrium constant ($K_o$), standard free energy ($\Delta G^o$) changes, standard enthalpy ($\Delta H^o$) changes and standard entropy ($\Delta S^o$) changes were calculated in order to predict the nature of isotherms.

The fifth chapter deals with the movement of selected pesticides in different soils and their different forms. Movement of pesticides has been estimated by using thin layer chromatographic technique
and has been expressed in terms of $R_f$ values. The $R_f$ values for different pesticides keeping the same solvent system on the different soils follow the order - Mukteshwar < Doiwala < Tehri < Aligarh < Jhansi < Pilibhit. The difference in the movement of pesticides is because of the nature and properties of the pesticides and on certain soil properties such as organic matter content, clay content, texture and structure of the soil, porosity, pH and cation exchange capacity of the soil.