Environmental Pollution is now an important problem in the whole world and a number of pollutants are causing havoc, owing to increased industrialization and population overflow, and much effort is directed towards its control. The pollutants are generally introduced into the environment as sewage, waste, accidental discharge or as a by-product of manufacturing processes. The pollutants may be broadly classified as inorganic and organic pollutants. They are found in all three states, viz. solid, liquid and gas. These pollutants are summarized in Chapter 1 and listed in table 1.1 and 1.2.

The presence of toxic heavy metals in industrial effluents such as zinc, cadmium, copper, chromium, nickel, lead, antimony, mercury, arsenic etc. has become a matter of environmental concern. Mining, tannery, jewelry, chemical, metallurgical, electrical and electronics large scale industries in industrial nations, and also arts and crafts in developing countries are the main sources causing heavy metal pollution. Use of different adsorbents, namely, sawdust, activated carbon, fly ash etc. is of current interest in the removal of heavy metals from water and wastewater. In recent years the use of adsorption technique for the removal of heavy metals from wastewater has received global attention and different substances have been employed as adsorbents.
The work described in the thesis deals with the studies on the adsorption behaviour of some heavy metals and their removal and documented in the following chapters:

Chapter-I- General introduction

Chapter-II- Sorption studies for the removal of Zn(II) and Cd(II) ions on treated sawdust of sissoo wood

Chapter-III- Adsorption dynamics and equilibrium studies of heavy metal ions onto mango sawdust

Chapter-IV- Comparative studies on the removal of Cu(II) ions from aqueous solutions by using different adsorbents

Chapter- V- Removal of As(III) from aqueous solutions through adsorption on activated carbon

Chapter I includes the literature survey on environmental pollution in general and water pollution in particular. It has a detailed literature on the latest work of different researchers on water pollutants, effect of water pollutants, heavy metal pollution and adsorption. The literature survey also includes the studies conducted by different workers on the adsorption properties of sawdust under the following headings:

- Adsorption of heavy metal ions
- Adsorption of phenolic compounds and alcohols
- Adsorption of hydrocarbons
• Adsorption of fats and oils
• Adsorption of dyes

Chapter II contains brief introduction on adsorption of Zn(II) and Cd(II) ions on sawdust of sissoo wood treated with formaldehyde. The effects of time of equilibrium, pH, temperatures and dosage of the adsorbent on the removal of Zn(II) and Cd(II) ions have been studied. The equilibrium nature of Zn(II) and Cd(II) ions adsorption at different temperature (25-60°C) has been studied. The percent adsorption of Zn(II) and Cd(II) ions increased with an increase in pH, temperature and dosage of treated sawdust. The adsorption followed Langmuir isotherms. The adsorption of Zn(II) and Cd(II) ions takes place in the order of Cd(II) > Zn(II). The applicability of Langmuir isotherm suggests the formation of monolayer coverage by Zn(II) and Cd(II) ions at the surface of the adsorbent. The thermodynamic parameters like free energy, enthalpy and entropy changes for the adsorption of Zn(II) and Cd(II) ions have also been computed and discussed. The heat of adsorption \[ \Delta H_{Zn} = 17.706 \text{ kJ mole}^{-1} \text{ and } \Delta H_{Cd} = 16.949 \text{ kJ mole}^{-1} \] implied that the adsorption process was endothermic in nature.

Chapter III describes the use of mango sawdust in the removal of Cu(II), Cr(III), Ni(II) and Pb(II) ions from aqueous solutions. The results obtained in this study demonstrated the potential use of mango sawdust for the removal of these metal ions from aqueous solutions. The kinetic studies indicated that equilibrium in the adsorption of Cu(II), Cr(III), Ni(II) and Pb(II) ions on sawdust was reached
within 120 minutes of contact between the sawdust and the solution. The different kinetics models viz. first-order reaction, a pseudo first-order and second-order reaction were simulated to fit the observed adsorption data. The second-order was found to be the best fit for these studies. Further the adsorption dynamic studies indicated that the rate of controlling step is mainly intraparticle diffusion but is not the only rate-limiting step for the metal ions. Batch adsorption studies shown that sawdust was able to adsorb Cu(II), Cr(III), Ni(II) and Pb(II) from aqueous solutions in the concentration range 100-1000 mgL⁻¹. The parameters studied include equilibrium time, temperature, and initial metal concentration of the adsorbate and dosage of adsorbent. The percent adsorption of Cu(II), Cr(III), Ni(II) and Pb(II) increase with increase in concentration of adsorbate, dosage of adsorbent. The reaction rate for the adsorption of Cu(II), Cr(III), Ni(II) and Pb(II) ions increased with an increase in temperature. It was also observed that the adsorption process obeyed the Langmuir adsorption isotherms.

Chapter IV describe the adsorption technique using sissoo sawdust for the removal of Cu(II) ions from aqueous solutions. The results have also been compared with those of activated carbon and fly ash. The results showed that with in a contact time of 90 minutes about 82-86% of Cu(II) ions adsorbed in case of activated carbon and sawdust but in case of fly ash only 30% Cu(II) was adsorbed from solution in 120 minutes. The amount of Cu(II) ions adsorbed onto the different adsorbents increased with an increase in concentration and temperature.
The optimum pH corresponding to the maximum adsorption was found to lie at 6. The uptake capacity of the adsorbents was found in the order:

activated carbon > sissoo sawdust > fly ash

The optimum conditions for the removal have been worked out and the mechanism of the process is also discussed. Adsorption isotherm can be described by the Langmuir as well as Freundlich equations. The related parameters of Langmuir and Freundlich constants are listed in Table 4.2.

Chapter V describes the use of activated carbon as an adsorbent for the removal of arsenic(III) from aqueous solutions. The adsorption isotherms were analyzed to explain the sorption process of this system. The extent of adsorption increased along with an increase of activated carbon dosage. The Langmuir adsorption models appears to be the best fitted one. The equilibrium nature of arsenic(III) adsorption at different temperature (25°-60°C) has been described by the Langmuir isotherms and a tentative mechanism has been proposed. The related parameters for Langmuir constants are listed in Table 5.3. The thermodynamic parameter like free energy, entropy and enthalpy changes for the adsorption of arsenic(III) have also been computed and discussed and the values are listed in Table 5.4. The heat of adsorption [$\Delta H = -2.0316 \text{ kJ mole}^{-1}$ for Langmuir adsorption and $\Delta H = -9.575 \text{ kJ mole}^{-1}$ for Freundlich adsorption] implied that the adsorption was exothermic in nature.