PREFACE

The natural resources such as air, water, soil, plant and animal life constitute the natural capital on which man depends on to satisfy his needs to achieve his aspiration for development. The water pollution is becoming the most challenging threat to the human beings as a result of rapid industrialization and growth of population throughout the world.

Arsenic contamination in natural water is a worldwide problem and has become a challenge for the world scientists. It has been reported in recent years from several parts of the world, like USA, China, Chile, Bangladesh, Taiwan, Mexico, Argentina, Poland, Canada, Hungary, Japan, and India. Jain and Ali (2000) have reviewed the international perspective and treatment strategies on the problem of arsenic contamination in ground water.

The treatment of polluted water through conventional treatment methods such as precipitation, coagulation, oxidation, bio-technical (Sayed et al., 1996) and adsorption (Gumbo, 1985) methods have been employed. Among these methods, the adsorption is most attractive because it is a well-established and economical technique for treating domestic and pilot plant at low cost.

Important factors to be considered for a water source to be used for drinking purposes are bacteriology quality and presence of certain inorganic constituent like metal, fluoride and arsenic are commonly occurring toxic element in eco-system (Voutsas, 1994. Arsenic enters the aquatic system in the dissolved form through industrial discharge such as metallurgical, glass and ceramic, pesticide manufacturing and petroleum refining industries etc.

Arsenic chemistry in aquatic system is quite complicated as the element can be stable in four oxidation states (+5), (+3), (0) and (-3) under different redox condition, out in ground water only two valance states As (+3) and (+5) are common (Stumm, 1992). The toxicity of arsenic varies greatly with its oxidation state as As (+3) is much more toxic and mobile than As(+5). However, biologically, As(III) is considered more toxic than As(V). Data on the differences in toxicity between As(III) and As(V) on human beings are very limited. Trivalent arsenic is about 60 times more toxic than oxidized pentavalent state. Inorganic arsenic compounds are about 100 times more toxic than organic arsenic compounds (DMMA and MMAA) (Jain and Ali, 2000). The toxicity of different arsenic species varies in the order:
Arsenite > Arsenate > Mono-methylarsinate (MMA) > Dimethylarsinate (DMA)

However, in groundwater the arsenate (H$_3$AsO$_4$, H$_2$AsO$_4^{-1}$, H$_2$AsO$_4^{-2}$) and arsenite (H$_3$AsO$_3$, H$_2$AsO$_3^{-1}$, HAsO$_3^{-2}$) species are more predominant (Chakravarty et al., 2002).

Besides being proven carcinogenic, inorganic arsenic can lead to gastrointestinal, cardiovascular, skin and respiratory disorders as it gets deposited on or bound to tissues. The human exposed from As(V) and As(III) in mixed form in following way-

$$\text{As(V) and As(III) + Active Chemicals in Tissue + RSH} \rightarrow \text{RS - HS}$$

It produce biological alterations and reduced repair efficiency and biological consequences such as Tumor Promotions, Later Stage Carcinogenesis, Enhance Mutations and Genomic Problems.

Occurrence of arsenic in groundwater is reported worldwide. As per the new EPA standards, the drinking water limit for arsenic is being reduced to 5ppb and is expected to go into effect by the end of 2005. Presently (WHO, 1998; EPA, 1999) has set the uppermost safety limit of arsenic as 0.05 mg/l.

A variety of methods have been used in the past for arsenic removal from drinking water. Existing methods of arsenic removal include precipitation adsorption, ion exchange, ultrafiltration (Pal et al., 1998). Chemical precipitation with lime and ferric salt has proved to be effective. However, it yields large quantities of sludge, which is difficult to treat further or dispose of directly. The other methods have their limitations and are expensive. Activated alumina has shown promising results for the removal of various inorganic impurities from water (Su, 2001). The objective of the present work is to investigate the effectiveness of indigenous grades of coated sand for the removal of arsenic from drinking water. Keeping above view in mind, the present investigations are oriented towards the removal of arsenic from drinking water by adsorption technique using various low cost adsorbents Arsenic have been used as contaminant and Iron coated sand, Iron coated alumina, Iron coated red sand, MnO$_2$ coated sand, MnO$_2$ coated red sand, MnO$_2$ coated alumina etc. were used as adsorbents.

In order to understand the mechanism of adsorption process and interaction solid-solution interface various relevant parameters like effect of concentration, temperature and pH of adsorptive solution and de-sorption of pre-adsorbed species have been studied. The matter presented in this thesis has been divided into five chapters:
CHAPTER – I

The important theories and concepts of adsorption. A brief introduction of the environmental pollution. The importance of adsorption and use of low cost adsorbent for the arsenic removal.

CHAPTER – II

Various methods used for drinking water treatment and literature review related to this have been cited and object of the present study.

CHAPTER – III

The list is briefly the preparation of adsorbents and their characterization by chemical surface analysis, Fourier Transform Infra-red, X-ray diffraction and SEM-EDX photographs occurs.

CHAPTER – IV

It consists of the studies related to the removal of arsenic from drinking water at different parameters. The effects of concentration, contact time, particle size of the adsorbent, adsorbent dose, agitation speed, isotherm studies, temperature, pH, rate constant, intra particle diffusion, de-sorption, safety evaluation and validation study have also been discussed.

CHAPTER – V

It describe the result and discussion of all suitable adsorbents.