CHAPTER 4
CONCLUSIONS

The presence of strongly adsorbing hydrophilic and hydrophobic contaminants in deeper aquifer system has prompted researchers to investigate and understand the transport mechanism of these contaminants in natural environments. As the indulgence of colloids on the transport of these contaminants is suspected, investigating the properties of colloids, thoroughly isolated from sediments, has been taken up in this study. Since the vadose or subsurface zone extends up to ~100m depth from the ground surface, the collection of soil samples would prove difficult or tedious as it requires digging of cores. Thus to get a clear understanding of the properties of colloidal particles in terms of size, electrical conductivity and concentration, sediment samples were collected from the type section of Mahi river at particular depth intervals. The investigations carried out to determine the size of the colloidal particles showed the presence of colloids of varying size in every sample except few with monodispersity. The long term soil formation process by various weathering mechanisms has contributed to the difference in the size distribution of colloids in particular single section and among the different sections. The idea involving the size measurement of colloidal particles is justified, as they would improve our understanding of particles in subsurface environments. The small particles tend to move in pore water much faster than the larger one, because the large particles may settle down due to gravitational forces acting on it.

The electrical conductivity analysis proves the existence of charge on the colloids. Though the electrical conductivity of distilled water is ~ 1μS/cm, the EC of colloidal suspensions exceeded 2 mS/cm indicating the presence of charge on it. The concentration of colloids in suspensions correlate well the EC and the EC decreases with decrease in colloidal concentration. The colloids were found to be made up of quartz, calcite in major proportions with less amount of kaolinite.

Colloid mobilization experiments conducted in columns packed with sediments showed the release of colloidal particles with distilled water, and the colloid concentration in the effluent increased initially followed by decrease to low concentration. This trend in breakthrough curves has been obtained for all samples. Further more, these colloid mobilization experiments prove the possibility of colloid release scenario during the rainfall events.

The experimental investigations involving the adsorption of alizarin red and methylene blue dyes on colloids from aqueous solution show that the colloids have good adsorption capacity for the dye. The adsorption capacity of soil colloids for alizarin red and methylene blue dyes is much higher than other adsorbents reported earlier. Though the quantity of colloid taken for adsorption experiments is less, the adsorbed amount of dye on colloid is high indicating surface adsorption and intraparticle diffusion processes occurring in the adsorption experiments. The contaminant must adsorb strongly on colloids for the facilitated transport to occur. The variation in the adsorption capacity of colloids isolated from single type section of sediments for dyes was insignificant.

Batch experiments show that the native colloids have good adsorption capacity for Pb(II), Ni(II), Cu(II) and Cr(VI). Adsorption of chromium was found to be low at high pH values and increased significantly at low pH values. Adsorption on soil followed linear isotherm that resulted in peak shift of effluent concentration- time plots with increase in soil layer height.

The profound influence of low ionic strength enhanced the transport of dye through the sediment column and the release rate. The significant increase in the transport of dye with increasing pH implies that the colloid-associated dye transport is sensitive to pH also. Though industrial effluents in general cannot be expected to be greater than pH 10, improper treatment would have a major effect and the results presented here show the transport behavior of dye in response to effluent pH in natural environments. These studies can be extended to other contaminants to understand their transport through the heterogeneous soil environments in the vadoze zone. The results presented in this study prove the potential role of soil colloids on the adsorption and transport of contaminants in the laboratory columns, and thus can be used in field studies for the effective remediation of contaminated subsurface environments.

The adsorption experiments with humic acid suggest their potential for the removal of dyes and Cr(VI) from aqueous solution and thus can be used as an effective adsorbent in the color removal process and remediation of water.