*Chapter II*

# *Aim and Scope*

The aim of the present study is focused on trapping toxic metal ions from industrial discharges. In this context, a thorough literature survey was planned. Numerous small and medium metal based industries discharge their metal leachates with improper treatment, thence are categorized under red list by pollution authorities. Novel ecofriendly materials viz., *Prosopis juliflora* Bark, *Tamarindus indica* Hull and Goat Hoofs have been identified, modified to increase the number of active sites and investigated to assess their capacity in the adsorption of Pb(II), Cd(II) and Ni(II) ions, being commonly prevalent in paint industries. The choice of the materials is done on the basis of certain criteria viz., indigenous, cheap, biodegradable, easy and safe to handle as alternates to the reported commercial sorbents.

Physico-chemical properties of the chosen sorbents are determined to examine their nature. Surface characteristic studies are carried out using BET/BJH, SEM, EDAX and FT-IR analyses. The influence of varied operating factors viz., particle sizes, dosages, inital concentrations, contact time, pH, anions, cations, co-ions and temperature of Pb(II), Cd(II), Ni(II) systems are verified experimentally through batch equilibration mode to optimize the sorption characteristics of the modified materials. The relative significance of the sorption parameters with the functional factors of the statistical tools (SPSS software 20) at 95% confidence level is calculated. The adsorption data are correlated using Langmuir, Freundlich, Tempkin, DKR isotherm models. Kinetic studies viz., Pseudo-First Order and Pseudo-Second Order, Elovich and Intraparticle diffusion models are applied to examine the sorption rate of the systems. Thermodynamic feasibility, spontaneity and nature of adsorption process are assessed from the equilibrium data.

Based on the pilot studies, nano-sized materials and their nano-scale magnetic counterparts are synthesized via different techniques and their sorption capacities are experimentally verified for the studied systems. Characterization of nano-sized materials are confirmed using X-ray Diffraction method, Atomic Force Microscope, Vibrating Sample Magnetometer, TGA/ DTA, Zeta- Potential/ Particle Size Analyzers apart from surface analyses as mentioned for modified materials. An indulgent comparison on the sorptive performances of three adsorbent materials and an order of preferential sorption among the three metal ions are made.

Batch results are quantified through conductance of column schemes, so as to explore the sorbents efficiencies on a large scale. Desorption and regeneration studies are designed which details about the reusability and economic viability of the loaded materials. The completely exhausted metal laden sorbents are utilized as manures for growing pulses. Based on these research findings, the scope of the work lies in designing, fabricating and installation of a prototype device in industries pertaining to the discharge of heavy metals under study.