

Heavy metals have been identified as a common source of water pollution. Because of their toxicity, their detrimental effect on our eco system presents a possible human health risk. The presence of heavy metals like Ni, Co, Cr, Pb, Hg, Cd, Cu, Zn etc., in aqueous streams pose serious threats to the global environment. According to World Health Organization, chromium, lead, copper and nickel are considered to be the most toxic metals. There are lots of metal based and small scale electroplating industries located in and around the city of Coimbatore, India, which are listed under red category by the Pollution Control Board. The heavy metal laden effluents generated by these industries are discharged into the aqueous stream without any treatment intentionally to avoid the high cost of treatment techniques. Amongst all the treatment methods available, adsorption is one of the most popular one, which offers flexibility in design and operation.

The first stage in the design is the development, characterization and the evaluation of the adsorption parameters of economically viable adsorbents. Activated carbon is a preferred adsorbent for the removal of micro pollutants from the aqueous phase, but its wide spread use is restricted due to high associated costs. This has led to the development of novel, low-cost materials like aquatic plant, agricultural, forest wastes which can be used as adsorbents with little processing for water treatment and purification. Abundant availability, renewability, high efficiency, economical and ecofriendly make the agricultural waste materials as a viable option for heavy metal remediation. They prove a potential alternative to the activated carbon in the removal of heavy metal ions effectively.

The low cost adsorbents employed for the removal of heavy metals in this study are two agricultural based by-products namely *Terminalia catappa* nut shell and *Azadirachta indica* nut shell, where least or no work has been reported so far. The husks of both the shells were treated with acid and alkali, modified with phosphate and also nano sized. The applicability of two important indigenous low-cost adsorbents prepared from treated/modified *Terminalia catappa* nut shell and *Azadirachta indica* nut shell, as useful

scavengers are employed to reduce the concentrations of Ni(II), Co(II) and Cr(VI) from aqueous solutions and industrial effluents are studied. Experiments pertaining to the sorption of metal ions by the adsorbents are carried out to assess the sorptive ability. The batch equilibration method for Ni(II), Co(II) and Cr(VI) ions adsorption onto treated, phosphate modified and nano modified adsorbents are discussed in this thesis. Experiments are designed such that, the adsorbent materials are utilized to trap maximum amount of metal ions from the solutions.

The surface characteristics of the treated adsorbents are analyzed using SEM, FT-IR, EDAX, BET and BJH and the Nano modified adsorbent is characterized by AFM. The physical and chemical characteristics of the treated adsorbent materials are studied. Adsorption experiments were carried out using batch equilibration method at ambient temperature, in order to investigate the nature of metal- adsorbent interaction. Optimum conditions favouring maximum adsorption were adopted to produce useful conclusions. The effects of variable parameters like particle size, contact time, dosage, pH, anions, cations, co-ions and temperature on the adsorption systems were studied. Desorption and regeneration studies are carried out to make the sorption process economically viable.

The adsorption equilibrium data are correlated employing two parameter adsorption isotherms such as the Langmuir, Freundlich, Temkin, Dubinin-Kaganer-Radushkevich (DKR) models and are represented graphically. The Pseudo-first-order, Pseudo-second-order, Intraparticle diffusion and Elovich models were used to explain the kinetic data. Thermodynamic parameters are calculated to assess the feasibility of the systems. The efficiencies of the adsorbents on industrial effluent are also investigated pertaining to the efficacy at field level. Based on the experimental results, a judicious comparison among the sorptive behaviour of the treated and modified adsorbent materials toward divalent and hexavalent metal ions are made.