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Title of the Thesis : **Assessment and Adsorption of Heavy Metal Ions and Organic Pollutants from Waste Water and Other Samples Using New Adsorbents**

ABSTRACT

One of the most serious environmental problems is the existence of toxic and hazardous pollutants in water bodies and the food materials, as both are directly linked to the survival and physiological necessities of human beings and other living creatures. Research and development therefore focuses on sector specific methods and technologies to remove pollutants from different waste streams. The research work in the thesis was mainly aimed to investigate new adsorbents for the treatment of heavy metal and organic pollutants by adsorption method, because of its simplicity, universal nature, inexpensiveness, ease of operation and convenience.

First chapter describes general introduction about the pollution, sources of pollution, toxicity and treatment processes for the removal of the pollutants. It also describes about the advantages of adsorption methods over the conventional methods. Adsorption mechanism, factors affecting adsorption and types of adsorbent are elaborately discussed.

S**econd chapter** discusses about the literature survey and material & methods applied in the present study.

Third chapter deals with the efficiency of activated *Parthenium hysterophorous* as an adsorbent for removing pesticide mixture from water has been studied. Batch mode adsorption experiments have been conducted by varying pH, concentration, adsorbent dose and contact time. Pesticide removal was pH-dependent and found maximum at pH 2.0. The maximum removal of pesticides was achieved within 100 min after the start of every experiment. Experimental results showed that the Langmuir isotherm model best describes for the adsorption of endrin and o,p DDT. The kinetics data for the adsorption process obeyed pseudo second-order rate equation. The adsorbent was also characterized using FTIR spectroscopy to detect vibration frequency changes and BET to measure surface area, pore volume and pore radius of the adsorbent.

Fourth chapter describes the potential applicability of chemically treated Parthenium hysterophorous leaf powder (PHLP) for removing pesticide (aldrin and dialdrin) from aqueous solution. The pesticides' determination was carried out by Gas Chromatography. Pesticides' removal was found pH dependent and the maximum removal was found to be at pH 2.0. The maximum removal of pesticides was achieved within 100 min after the start of every experiment. The adsorption data were fitted to Langmuir, Freundlich, Temkin and Dubnin- Radushkevich (D-R) adsorption isotherm models to evaluate the model's parameter. Experimental results showed that the Freundlich isotherm model best describes for the adsorption of aldrin, dialdrin. Pseudo-first order, pseudo-second order and Weber-Morris equations were applied to fit the kinetic results. aldrin and dialdrin fitted well in pseudo-first order model and Intra-particle diffusion was found to be the rate controlling steps in the adsorption process.

Fifth chapter deals with the "Influence of operating conditions on the removal of Pb ions from aqueous solution by adsorption on fly ash", Fly ash was used to study the influence of operating conditions on the adsorption of Pb ions from aqueous solution within various experimental conditions. The influence of several parameters such as concentration of Pb ions solution, adsorbent dose, pH and contact time was evaluated by batch experiments. The batch experiments were carried out using metal concentrations in the solution raging from 5-50 mg/l at room temperature. Pb ions removal was

effected by pH and the maximum Pb ions removal was found to be at pH 5.0. The percentage of metal removal decreases at lower pH values. The equilibrium for removal of Pb ions was attained within 120 min of contact time for every experiment. The adsorption of Pb ions was found to increase with increasing fly ash dose and decreased with the increase in initial metal concentration. The equilibrium adsorption data were correlated with Langmuir and Freundlich adsorption isotherm models to evaluate the model's parameter. Experimental results indicate that the Freundlich isotherm model was best fitted for the adsorption of Pb ions than Langmuir isotherm model. Thermodynamic parameters were also evaluated, which showed that the adsorption process was endothermic in nature and was more favourable at higher temperature.

Sixth chapter discusses about the removal efficiency of Nickel ions from aqueous solution on chemically treated *Parthenium hysterophorous* leaf powder (PHLP) has been investigated. The adsorbent was characterized by SEM images and FTIR spectra analysis. The effect of several parameters such as pH, adsorbent dose, concentration of Ni ion solution and contact time was evaluated using batch experiments. Nickel ions removal was pH dependent and the maximum removal was found to be at pH 7. The maximum removal of Ni ions was achieved within 100 min after the start of every experiment. The equilibrium adsorption data were fitted to Langmuir, Freundlich, Temkin and Dubnin- Radushkevich (D-R) adsorption isotherm models to evaluate the models parameter. Experimental results showed that the Langmuir isotherm model best describes for the adsorption of metal than Freundlich isotherm model. Adsorption data were processed according to various kinetic models. Pseudo-first order and pseudo-second order were applied to fit the kinetic results. Pseudo-first order model was less applicable than pseudo-second order. Thermodynamic studies showed spontaneous and exothermic nature in the adsorption of Ni (II) onto PHLP.

Seventh chapter discusses about Fly ash, discarded from the thermal power plant as waste, characterized by FTIR and SEM studies, and was used as an adsorbent for the removal of chlorpyrifos. Adsorption isotherm and kinetics of chlorpyrifos on fly ash was determined from batch tests. The effects of contact time, initial chlorpyrifos concentration, fly ash dose and pH of the solution were investigated. The adsorption equilibrium data were processed in accordance with the three most widely used adsorption isotherms: Langmuir, Freundlich and Temkin isotherm models. The correlation coefficient values obtained from the isotherm models indicate that the adsorption pattern for chlorpyrifos on fly ash followed the Freundlich > Temkin > Langmuir model. The kinetic data were also examined for the pseudo-first-order and pseudo-second-order models, and it was observed that pseudo-second-order kinetic model closely followed.

Eighth chapter discusses about "Adsorptive studies of spiked Ni (II) removal from orange juice by Ashoka leaf powder and its quantitative determination by titration", The foreign matter and impurities in the fruit juice contaminate the fruits by their origin, storage conditions and processing and thus pose health problems to humans,. Special attention is therefore required for maintaining the safety and quality of juice by the manufacturer. Ashoka leaf powder was used to remove nickel ions from orange juice. Orange juice was spiked with nickel ions (2-10 $mmoll^{-1}$) and then treated with Ashoka leaf powder (ALP). The residual concentration of nickel ions was quantitatively determined by titration after digestion. The batch experiments were studied for analysing the effects of pH, contact time, adsorbent dose and nickel ion concentration. The uptake percentage of nickel (II) ions at pH2 was observed as 17 % while at pH8 it increased to 79%. The increase of ALP dose from 0.25 gm to 1.25 gm, increased nickel (II) ions uptakes from orange juice from 52 % to 86 % respectively and the equilibrium was attained after 100 minute. The spectral changes in the FTIR studies showed possible interaction of functional groups present in the ALP with nickel ions and SEM micrographs also supports the adsorption phenomenon. Heterogeneous coverage of nickel (II) ions on the surface of ALP suggested Freundlich isotherm as the correlation coefficient was observed maximum for Freundlich isotherm. Kinetic results suggest that pseudo- second-order kinetic model were best suited to experimental data.