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Remediation of Soil and Water Contaminated by Cadmium and Lead using Humic Acid

A Thesis submitted by

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ABSTRACT

The distribution and fate of heavy metal pollutants in soil and aqueous solution is strongly influenced by the presence of natural organic material. They are present in aqueous systems and can exist either in solution or as a precipitate mixed with sediments. Important characteristics of humic acid form water-insoluble complexes with metal ions and sediments or suspended particulates.

The aim of this study remediation of soil and water contaminated cadmium and lead ion by using humic acid.

The extract of the humic acid was achieved from compost sample. The obtained humic acid was characterized using Fourier transform infrared (FTIR), Scanning electron microscopy and the elemental analysis(C, H, N, S and O %). Adsorption capacities of humic acid towards the different concentration of $Cd^{2+}$and Pb^{2+}. The effect of pH, metal concentration and ionic strength was evaluated and discussed. The obtained data go well with previous work. The concentration of metal ions was followed by using the atomic absorption Spectrophotometer (AAS) technique.

The ash content of the humic acid was measured by muffle furnace at $500C^{o}$ for two hour 0.1 6%. Remediation of water at pH = 6 is greater than pH= 4. The high adsorption ratio for Cd^{2+} and Pb^{2+} at pH= 6 are 92.25% and 99.02% respectively, Meanwhile at pH=4 for are 63.49% and 84.93% respectively.The hydrated humic acid appears to be significantly more reactive than the dried humic acid, Pb^{2+} bond strongly to humic acid more than Cd^{2+}. With the application of adsorption equations for Frindlich, Langmiur and Temkin.Langmiur's model was better for adsorption of Cd^{2+} on HA. Freundlich's model was better for adsorption of Pb^{2+} to HA. Study of the effect of ionic

strength on the adsorption of Cd^{2+} or Pb^{2+} on HA was found that the rate of adsorption decreased with increasing ionic strength.

Remediation of contaminated soil samples with Cd^{2+} or Pb^{2+}:

The highest efficiency of bonding of Cd^{2+} or Pb^{2+} was on loam clay soils, calcareous loamy sand soil and loamy sand soil and when applying the adsorption models, Langmiur model was the best with the three soil samples. When soil samples were treated with dissolved humic acid in potassium hydroxide, the highest treatment was in loamy sand, then calcareous loamy sand and then clay loam.

These results indicate that soil properties (pH, organic matter, calcium carbonate) have a significant impact on the treatment process.

- The metal ions Cd^{2+} or Pb^{2+} had very similar kinetic adsorption.
- The rate law for a pesudosecond- order kinetic model best described the experimental data with the correlation coefficients (R^2) of being over 0.995. Successful fitting of the data with the second – order kinetic model suggests that chemisorption was the rate – controlling step and $Pb^{2+} > Cd^{2+}$ according to the initial adsorption rate. The very fast sorption kinetics observed on humic acid and soil.