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Summary

The present thesis involves three main chapters:

Chapter (1) (Introduction):

Represents a scientific and a historical review concerned with soil characteristics and the effect of soil properties such as pH, CEC, and CaCO₃ percent on the chemistry of zinc, manganese and cobalt as minor elements in soil.

Chapter (2) (Experimental):

This part represents the experimental and techniques that are used for characterization of soil samples and studying the adsorption behaviour of zinc, manganese and cobalt in soil.

Chapter (3) (Results and discussion):

The results can be summarized as follows:

Six soil samples were selected as adsorbents for studying the physico-chemical behaviour of adsorption of zinc, manganese and cobalt ions on soil. Four soil samples were referred as S1, S2, S3 and S4 and were classified as salt-affected soils. It was found that as salinity increases, the adsorption capacity of zinc, manganese and cobalt ions decreases. Adsorption studies on washed sample of highly saline sample indicated that decreasing salinity improved adsorption of zinc, manganese and cobalt ions on the sample. In addition, adsorption of a specific metal ion was inhibited or depressed by the presence of another metal ions as shown from adsorption studies of binary mixtures of metal ions on S1.

S1, S5 and S6 were soil samples different in aluminosilicate content. Adsorption isotherms of zinc manganese and cobalt ions on these samples showed that adsorption capacity of the metal ions increases with increasing

the aluminosilicate content of the soil. Adsorption capacity of zinc, manganese and cobalt ions was strongly affected by the cation exchange capacity of the soil since it is an indication for aluminosilicate content in soil sample. Silicates were found to play a lesser role in adsorption of metal ions on soil since the soil sample of highest silicate content showed the smallest adsorption capacity for zinc manganese or cobalt.

Amounts adsorbed of zinc, manganese and cobalt ions on soil were found to be distributed between different particle size fractions. Fine fractions (small particle size) that include silt and clay fractions adsorbed much greater amounts of zinc, manganese and cobalt ions than coarse fraction, which was the sand fraction. This was indicated by adsorption-desorption studies of zinc, manganese and cobalt on sand, silt and clay fractions.

Data of the mentioned summary led to the following conclusion: The salinity of solution of adsorbents was found to affect its adsorption capacity towards metal ions. The salinity effect on adsorption may be due to the competition of soluble ions with metal ions for adsorption sites. At low salinity levels which mean low concentration of soluble ions in solution, the adsorption of metal ions was better than adsorption at high salinity levels. According to the studies of first order kinetics, the adsorption of zinc, manganese and cobalt ions on soil was mainly surface adsorption. Free energy change values indicated that adsorption of zinc, manganese and cobalt ions on soil was physical adsorption. Values of K and b obtained by fitting the adsorption data to Langmuir isotherms revealed better adsorption in absence of competing metal ions in solution. A portion of adsorbed metal ions may react with organic matter involved in soil composition through complexation.

The cation exchange capacity of soil appeared to be an important property, which affect its adsorption capacity when the main adsorption

mechanism is surface ion exchange or surface reaction. As the CEC increases the adsorption capacity of metal ions on adsorbent increases and the reverse is true. Fine fractions showed greater CEC and higher adsorption capacity of minor elements than coarse fractions. This is due to the high content of aluminosilicates and consequently high density of negatively charged adsorption sites in fine fractions.