

CHAPTER - 2

SCOPE AND OBJECT.

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Scope and object of the present investigation.

Though present in small quantity, humic matter plays an important role in the formation of fertile soils. Because of its high exchange capacity, it retains a number of trace elements like Co, Ni, Zn, Mn etc. known as "micronutrients" along with some major elements e.g., Fe, Al, Na, K, Ca, Mg etc. These minerals are taken up by plants through the ion exchange process as the plant tissues contain some acid groups capable of binding and exchanging cations. In this context, the studies on the exchange behaviour of the humic acid fractions may prove rewarding for the better understanding of the exchange characteristics of soil organic matter as also of the soil as a whole.

While the exchange behaviour of some metal ions, chiefly the trace element cations, have been studied in detail by some workers, much less is known in this respect about the trivalent metal ions and least about the complex cations in particular. Moreover, such studies when conducted at high pH, the results are more often than not robbed of their exact significances by the probable formation of metal hydroxides whereas at low pH, again, only a fraction of the total exchange sites in the exchanger substrates is likely to be utilised by the metal ions because of the competition

between these ions and the high concentration of H^+ .

The present thesis primarily aims at the systematic study on the exchange characteristics of humic acid fractions. To this effect, in view of the above limitations in particular, a complex inorganic cation, namely, $[Coen_3^{3+}]^*$ has been chosen for interaction with the exchanger phase. From the structural consideration, the stability of $Coen_3Cl_3$ is well known. Unlike ferric or aluminium compounds, it is far less prone to hydrolysis over a wide range of pH. Beside the concentration of $Coen_3^{3+}$, even in presence of humic acid components, can easily be determined polarographically, for it yields a well-defined wave under diverse conditions. It may be noted, pH is found to have little effect on the diffusion current of this complex ion at least in the pH range studied. Here, the exchanger substrates include humic, hymatomelanic and fulvic acids from soil and peat as well as the synthetic model humic and hymatomelanic acids, selected for comparative purposes.

The interaction between the above noted complex cation and the exchangers have been extensively studied under different conditions. A number of alkali and alkaline earth metal cations as well as organic cations have been incorporated as counter ions to provide information about the nature of interacting sites in the exchanger, and their relative affinities for the exchanger substrates have been

* Triethylenediamine Cobaltic ion

determined. Attempts have also been made to fit the results of the exchange reactions in the well known models and formulations so as to have an insight into the nature of such interactions. During these studies, it has also been kept in mind to detect peculiarities, if any, which might help in identifying the humic acid fractions. This apart, the aid of infrared spectroscopy has been resorted to for ascertaining the nature of bonding between Coen_3^{3+} and the exchanger phases.

Incidentally, the published results on similar exchange reactions involving Coen_3^{3+} with the clay minerals afford a comparison with those of the present study. This comparison should, in fact, be enlightening about the contribution individually made by different humic acid fractions as well as by clay minerals to the over-all exchange properties of the soil.

However, prior to going in for the exchange studies, an all-out attempt should be made to characterise the humic acid fractions. On this count, potentiometry, viscometry, polarography, visible spectroscopy and I.R. spectroscopy have been taken advantage of.

To sum up, the present investigation may be divided into the following heads:

(i) Characterisation of the humic acid fractions from different origins.

(ii) Exchange behaviour of Coen_3^{3+} in the above noted polyfunctional exchangers.