Chapter 2

Scope and Object of the Present Investigation

Clay is an important part of the soil. Most of the soil properties are dependent to a large extent on the nature and quantity of clay minerals present. The clay minerals have received considerable attention in agriculture, ceramic industry, petroleum research, rubber industry and paper technology. Therefore, identification, characterisation and quantification of soil clay minerals have assumed great importance. No single identification procedure, not even X-ray diffraction, gives all the answers on all occasions. The mineralogical analysis of a heterogeneous system like the soil clay usually demands the application of several complementary techniques for obtaining all the desired information. A combination of techniques is, therefore, often employed to confirm an identification and quantification of mineral components. This is particularly the case when one is to deal with mixtures of different clay minerals.

More than one kind of clay minerals are generally present in any soil. The clay mixtures present in soils may be of two types; a combination of discrete particles of the separate mineral or an interstratification of layers of the separate minerals. In mixtures of discrete particles the properties tend to reflect those of the individual components, but in the case of interlayer mixtures the properties of the component clay minerals may or may not be retained. Published works (145) show that the presence of amorphous material in clays may modify or altogether change the characteristics of the crystalline components. The amorphous material occurring as dispersed particle or as an external coating on the layer silicates or by occupying the interlayer spaces of crystalline clay minerals thus give rise to interlayer minerals with changed physicochemical properties.

A general procedure for analysis of the clay grade materials is to concentrate the components involved. Chemical treatments that concentrate or isolate specific minerals are given by many investigators (154-158). Vigorous chemical treatments may damage or seriously modify the component minerals. Physical methods of separation are preferable due to their inappreciable effect to alter the materials.

An approach to the problem of artificial mixtures of clays from different physicochemical standpoints and attempts in separating the component clay minerals from their binary mixtures may bring new facts which are expected to be of profound interest for the prospective worker in the line.

Investigations on mixtures of clay minerals as to whether there is any marked effect on the properties such as electrochemical, base exchange capacity, viscometric, swelling etc. may be informative and useful.

Keeping all these in view, attention has been focussed in the present investigation on the systematic studies of bentonite, kaolinite, alumina and their binary mixtures, from both qualitative and quantitative standpoints.

Organic reactions involving clay minerals have now been well established by many investigators (94-101, 110-112). The formation and stability of organo-clay complexes reveal many points of interest regarding the surface characteristics and crystal structure of the clay minerals. The interaction of organic compounds and different clay minerals and the consequences as regards the stability and electrochemical properties, the volume changes of the clay minerals by the introduction of larger organic cations and other relevant changes in properties are expected to unveil many points of physicochemical interest.

It was pointed out that the quantity of larger cations sorbed by kaolinite is considerably less than that adsorbed by montmorillonite. The development of organophilic characteristics of the organo-clay complexes arises due to the active spots of the clay micelle being covered either wholly or in part by the hydrophobic groups. The resulting complex becomes more or less hydrophobic. It may be expected that the marked interaction of the organic compounds with montmorillonite and other members of

the same group and the pronounced changes in their surface characteristics, such as organophilic and water repellant properties, may be taken advantage in seperating them from other components of the fixed lattice group in view of the insignificant organophilic character developed in the organic derivatives of the latter.