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Characterisation of Clays from South Indian Soils — IV. Viscometric Method *

by

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Synopsis: Eight soil samples representing the four major soil types of South India were studied for their viscosity properties. The data have been graphically represented to study the change of viscosity pattern. From the available data it could be concluded that the black and laterite soils contain montmorillonite and kaolinite as dominant clay minerals, respectively, and the alluvial soil a mixture of clay minerals. The red soil from Semmanguliyur may contain kaolinite as the dominant clay mineral and the red soil from Peelamodu a mixture of clay minerals.

Introduction: Clays and clay minerals are the most active and dynamic constituents of any soil body. The study of clays is important both from the pedological and edaphological points of view. Out of the many methods known for the characterisation and identification of clay minerals the viscometric method is recent and this method is discussed in this paper.

Mukherjee *et al* (1951) found that there was a characteristic change in the viscosity pattern for each type of clay mineral for every addition of alkali. They reported that there was no change in viscosity, apart from a slight initial decrease, on addition of alkali to hydrogen kaolinite. But in the case of hydrogen montmorillonite there was an increase up to 75% neutralisation of the acid given by the inflexion point and then a decrease. Similar results were reported by Chakravarti (1958) and Adhikari (1958). They also studied the behaviour of one clay mineral in a mixture in viscosity pattern.

Materials and Methods: The soil samples collected, their description the method of preparation of hydrogen clays and the titration methods have been presented elsewhere (Manickam and Durairaj, 1963). The viscosity was determined using an Ostwald capillary viscometer. A known quantity of the solution with the alkali added (known milliequivalents) was introduced and the relative viscosity was calculated from the time of flow observed.

Results: The data on the viscometric measurement for the different hydrogen clays with different alkalies are presented in Table and the data have been graphically represented and presented in Figures 1 to 4.

The viscosity was found to increase for both the black soil clays with different alkalies (Table and Fig. 1). The maximum viscosity was found at a point where there was 70 to 80% neutralisation of the acid given by the inflexion point. In the case of the red soil sample from Semmanguliyur and the two laterite samples (Table and Fig. 2 and 4), it was observed that there was no

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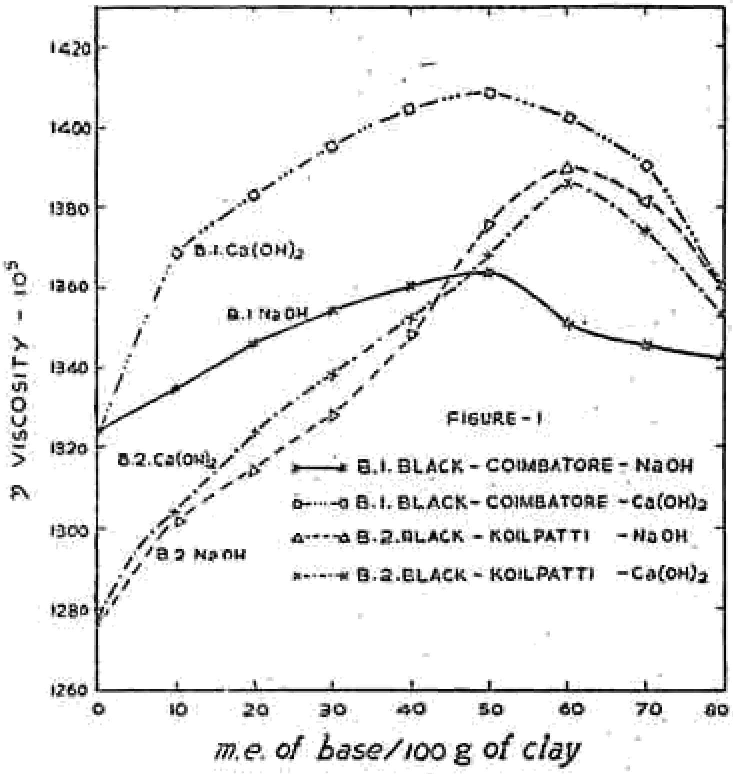
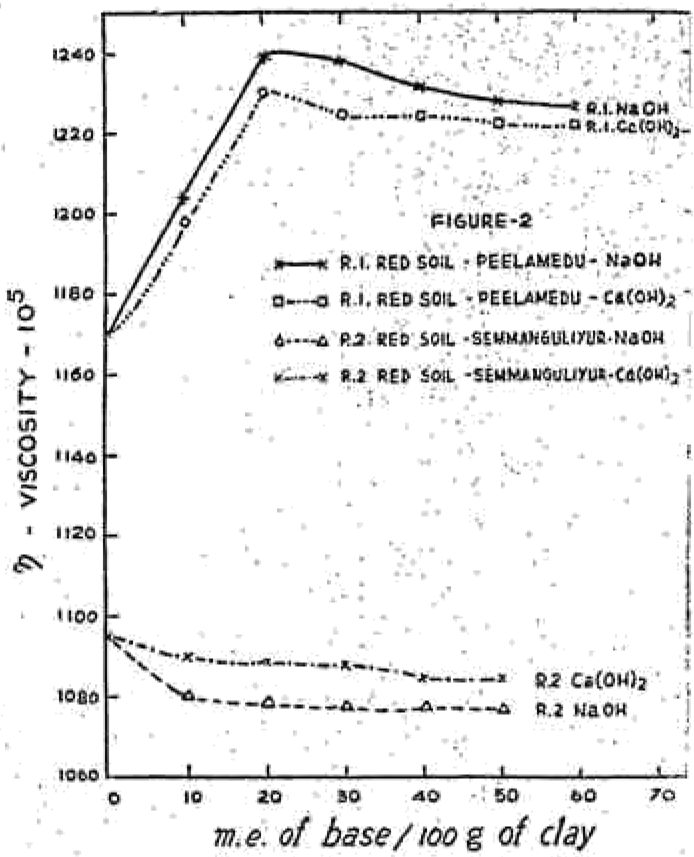
TABLE

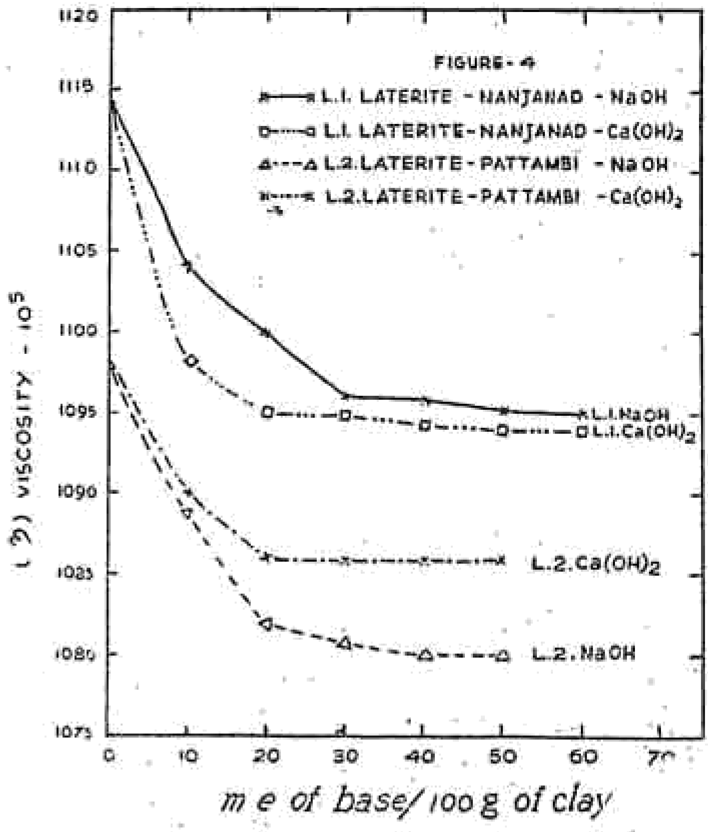
Viscometric Measurements (Eta, poise).

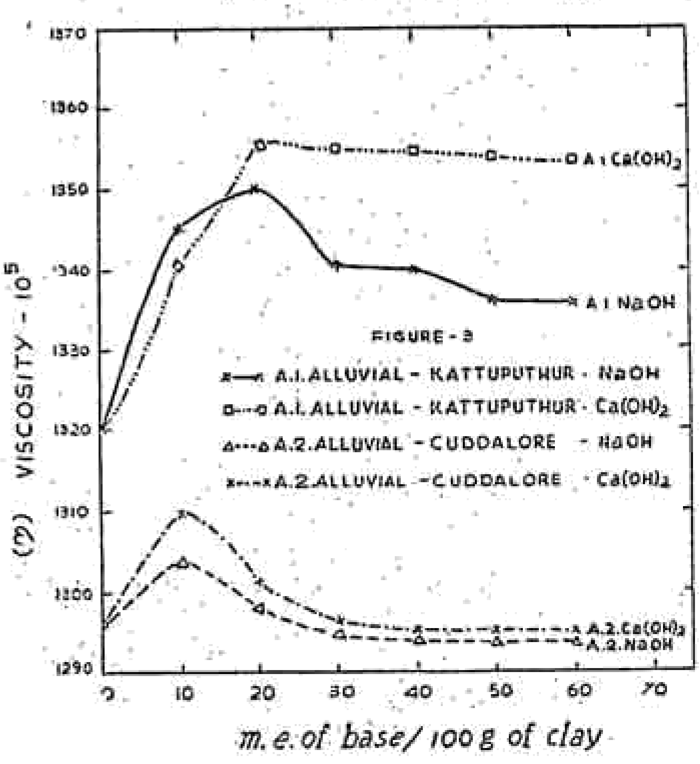
Milliequivalents of base/100 gram of clay	Sodium hydroxide	Potassium hydroxide	Calcium hydroxide	Sodium hydroxide	Potassium hydroxide	Calcium hydroxide
I Black Soil Clay		Coimbatore			Koilpatti	
0·0	0·01324	0·01324	0·01324	0·01276	0·01276	0·01276
10·0	0·01334	0·01344	0·01368	0·01302	0·01285	0·01304
20·0	0·01346	0·01350	0·01383	0·01315	0·01298	0·01324
30·0	0·01354	0·01358	0·01394	0·01328	0·01306	0·01338
40·0	0·01360	0·01364	0·01404	0·01349	0·01314	0·01352
50·0	0·01364	0·01366	0·01408	0·01376	0·01324	0·01368
60·0	0·01350	0·01358	0·01402	0·01390	0·01332	0·01386
70·0	0·01346	0·01356	0·01390	0·01382	0·01326	0·01374
80·0	0·01342	0·01355	0·01360	0·01360	0·01320	0·01352
90·0	...	...	...	0·01357	0·01316	0·01346
100·0	...	...	...	0·01356	0·01314	0·01340
II Red Soil Clay		Peelamedu			Semmanguliyur	
0·0	0·01170	0·01170	0·01170	0·01094	0·01094	0·01094
10·0	0·01204	0·01182	0·01194	0·01080	0·01082	0·01090
20·0	0·01240	0·01200	0·01230	0·01078	0·01080	0·01089
30·0	0·01238	0·01198	0·01224	0·01078	0·01078	0·01088
40·0	0·01232	0·01198	0·01224	0·01077	0·01078	0·01084
50·0	0·01228	0·01197	0·01222	0·01076	0·01078	0·01082
60·0	0·01228	0·01197	0·01222	...	...	...
III Alluvial Soil Clay		Kattuputhur			Cuddalore	
0·0	0·01320	0·01320	0·01320	0·01296	0·01296	0·01296
10·0	0·01345	0·01348	0·01340	0·01304	0·01311	0·01310
20·0	0·01350	0·01359	0·01356	0·01298	0·01304	0·01301
30·0	0·01340	0·01350	0·01355	0·01295	0·01298	0·01296
40·0	0·01340	0·01344	0·01355	0·01294	0·01298	0·01295
50·0	0·01336	0·01344	0·01354	0·01294	0·01298	0·01295
60·0	0·01336	0·01344	0·01354	0·01294	0·01298	0·01295
IV Laterite Soil Clay		Nanjanad			Pattambi	
0·0	0·01114	0·01114	0·01114	0·01098	0·01098	0·01098
10·0	0·01104	0·01106	0·01098	0·01089	0·01080	0·01090
20·0	0·01100	0·01102	0·01095	0·01082	0·01078	0·01088
30·0	0·01096	0·01100	0·01095	0·01081	0·01078	0·01087
40·0	0·01096	0·01100	0·01094	0·01080	0·01077	0·01087
50·0	0·01095	0·01100	0·01094	0·01080	0·01076	0·01088
60·0	0·01095	0·01100	0·01094	...	...	...
70·0	0·01078	0·01100	...	...	...	...

change in viscosity for all the alkalies apart from an initial decrease. But variations were observed for the different alkalies used. In the case of alluvial sample of Kattuputhur and Cuddalore it was observed that there was a slight initial increase in the viscosity and then a gradual decrease to constant values. This was observed for all the alkalies for both the samples though there were variations in the trend of change.









Discussion: In the case of black soil clays of Koilpatti and Coimbatore the viscosity was found to increase up to 70 to 80 per cent base saturation and then decreased. Mukherjee *et at* (1951) attributed the above features to the mineral montmorillonite and hence it may be concluded that the two black soil clays contain montmorillonite as the major mineral. This was found to be supported by the results of other methods. For the red soil sample of Semmanguliyur and the two laterite samples, there was no change in viscosity apart from an initial decrease. Similar results were reported for the presence of kaolinite and these soils may contain kaolinite as the predominant clay mineral. For the red soil clay from Peelamedu, the viscosity was found to increase at the initial stages and then attain a constant value, which is not a kaolinite character. Adhikari (1957) attributed similar results to the presence of illite and hence it may be concluded that the clay may contain illite as a constituent mixed with kaolinite and other minerals. For the two alluvial soil samples the viscosity was found to increase at the initial stages to attain a constant value afterwards. Chakravarti (1958) reported similar results for a mixture of clay minerals. Since these two soils are of alluvial origin, there is every possibility of mixing up of various soil types, resulting in a mixture of clay minerals in the soil.

Summary and Conclusion: Eight clay samples from four types of soils were studied by viscometric method. The viscosity was determined using a capillary viscometer. The viscosity was found to increase up to 80 per cent neutralisation of the acid given by the inflexion points in the case of black soil clays. No change in viscosity apart from an initial decrease was noticed for laterite and red soil clay of Semmanguliyur. Others were found to increase in the initial stages.

Hence, it may be concluded that the black soil clays studied contain montmorillonite, red soil clay of Peelamedu probably a mixture of kaolinite and illite, alluvial clays a mixture of minerals and other samples kaolinite as the major mineral. This was found to be supported by the results, obtained by other methods, reported in previous papers of the series.

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