Quantitative Estimation of Particle Orientation of Montmorillonite by Optical And X-Ray Diffraction Techniques*

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Messrs. Sankaran and Venkateshwar Rao are to be congratulated for their interesting study on the fabric of montmorillonite clay. As the authors rightly point out, particle orientation studies on montmorillonite clays is scanty and to that extent the present investigation is a significant contribution.

The particle orientation may be studied by different direct and indirect methods, the most commonly used being electron microscopy, optical microscopy and X-Ray diffraction. Each of these techniques has its advantages and disadvantages. Only with electron microscopy is the actual particle observed but even so no technique for measuring the overall orientation of a group of particles has yet been developed (Tchalenko et al 1971). A recent study by Collins and McGown (1974) using electron microscopy has given a new approach to soil microfabric characterization, but is essentially descriptive. McConnachie (1974) attempted to describe numerically the fabric of kaolin. In contrast, both optical miscroscopy and X-Ray diffraction which measure quantities varying with particle orientation lend themselves to quantifications and number of workers have successfully applied these methods to natural clays. The authors' attempt to adopt both these methods to study particle orientation is commendable.

Regarding the present study, the writer has the following comments to offer:

The writer has serious doubts regarding the validity of the procedure adopted for obtaining samples for carbowax impregnation. The authors state, "After the equilibrium condition for the clay specimen at the desired maximum consolidation pressure in the oedometer is attained, the load was removed immediately and the specimen was not allowed to imbibe water... .....Thereafter, these samples were immersed in the molten carbowax". It is obvious that the sample is not in a state of equilibrium when immersed

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in carbowax, as sufficient time was not allowed. When loads upto 18 kgs/cm^2 were suddenly removed and the montmorillonite sample not allowed to imbibe water, it is possible that the sample may even become unsaturated due to possible cavitation, leading to negative pore water pressures. All these complex phenomena may result in volume changes which may be beyond estimation, when not allowed to be equilibrated. It is difficult to understand how all these could be taken into consideration.

It is a well known fact that there is difficulty in studying the microfabric of montmorillonite clays, not only because of smaller particle sizes but also due to the difficulty in carbowax impregnation. The moment these swelling clays are placed in molten carbowax, the sample more or less crumble into pieces. This of course is partly due to the shrinkage effects, as stated by the authors. Hence in fabric studies dealing with swelling clays, other methods of impregnation could be attempted such as Araldite, Bakelite resin etc. (De, 1972a, 1972b; Singh, 1969).

Further the authors studied the shrinkage behaviour due to carbowan impregnation. But the wavy nature of shrinkage consolidation curves is difficult to be explained. Neither this can be ignored because the percent axial shrinkage is of the order of 40--65 percent and the volumetric shrinkage 20-45 percent.

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