Quantitative Estimation of Particle Orientation of Montmorillonite by Optical and X-ray Diffraction Techniques*

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The authors have given a general conclusion that the X-ray diffraction method is better than the optical microscope method for expressing the average orientation of clay particles quantitatively. The main reason for the disadvantage of the optical microscope method is attributed to the smearing effect noticed in the prepared thin-sections of Carbowax 6000 treated sample blocks, especially for the samples subjected to lower range of consolidation pressures. Quoting Barden and Sides (1971) in their paper, the authors have appreciated that this smearing effect is limited only to a depth of 1μm in the total thickness of a thin-section slide of approximately 30μm. The authors go on to say that this smearing affects the optical microscope observations, while no affect is felt in X-ray diffraction studies. It seems only logical that the percentage vitiation of observations due to the smearing effect should be very small. To appreciate this fully the conclusion of Barden and Sides (1971) is reproduced hereunder fully : "With Carbowax impregnated clay and a gentle grinding process the depth of disturbance is less than 1μm and of this depth only a fraction appears to be completely re-oriented. This will not lead to any significant error in the birefringence ratio values measured in the polarising microscope, since this involves the penetration of a section some 30μm thick." The writer, too, has never found the smearing effect to be of any practical consequence in his different thin-section polarising microscopic studies (Singh 1971, 1975). It may be noted that the authors have also found that the 'R' values obtained by the optical microscope method, based upon two-dimensional theory are close to those obtained by the X-ray diffraction analysis.

If a softer grade of Carbowax is used or a mixture of different molecular weight carbowax is used, the smearing affect will be considerably enhanced so as to affect the observations. The authors may check whether such has been the case. The writer has also faced the difficulty of getting pure Carbowax 6000 for soil sample impregnation work. It is suggested that commercially available Carbowax 6000 be chemically tested before its use as a routine procedure.

It is now well appreciated that all the three main microfabric observation techniques, viz., thin-section polarising microscopy, X-ray diffraction,

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and electron microscopy have their own special advantages (e.g., Yong, 1971). It is best to put all the three techniques to work to solve completely a soil microfabric problem, depending, of course, on the resources and facilities available.

References

BARDEN, L. and SIDES, G. (1971), "Sample Disturbance in the Investigation of Clay Structure," *Geotechnique*, 21 : 3 : 211-222.

SINGH, R.B. (1971), "Microstructural Changes in Swelling of Compacted Clays," *Indian Geotechnical Journal*, 1:4:384-406.

SINGH, R.B. and PRASAD, K. (1975): "Shear Response of a Silt and its Silt-Clay Matrices," *Proc. Fifth Asian Regional Conf. on soil Mechanics and Foundation Engineering, Bangalore*, Vol. 1 :19-21.

YONG, R.N. (1971), General Report on "Soil Technology and Stabilization", *Proc. Fourth Asian Regional Conf. on Soil Mechanics and Foundation Engineering*, Bangkok, Vol 2 : 111-124.