spacings has little meaning (12). Therefore, in their second step expansion the protein cations might be in preferred orientations depending on their quantity, charge density, polarity, polarizability, compressibility, and other properties (6) without any interstratification at any level of adsorption of protein. This is supported by the fact that Armstrong and Chesters (ref. 2, Table 2, Fig. 4) measured d(001) spacings at many randomly selected adsorption levels of lysozyme but could not observe any interstratification. Moreover, in swollen systems, Ensminger and Gieseking (4) observed large d(001) spacings with gelatin also. There acetic acid might have acted as a swelling agent. McLaren et al. (11) reported that maximum adsorption for gelatin is about 1.8 g protein/g of clay. What was the d(001) spacings?

Received 1 July 1976.

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Literature Cited


Calculated vs. Measured In Situ Hydraulic Conductivities

Recently, Matzdorf et al. (1975) compared theoretical and in situ hydraulic conductivities, K(θ), for a silt loam soil at several depths. They concluded that "further research is needed to evaluate theoretical conductivities and their use in predicting actual field conductivites." Their Fig. 3 presents theoretical estimates of hydraulic conductivity utilizing water retention characteristics of undisturbed cores. The Green and Corey (1971) method for calculation of K(θ) was employed with the modification that the matching factor is taken from the midpoint of the measured θ range. Unfortunately, there are two major difficulties in a general application of this method:

1) Matching of Data. The matching of K(θ) data at the midpoint of the θ range for each depth, particularly when the θ range is small, may cause the match to look fortuitously good (see their Fig. 3). However, the K(θ) values diverge considerably at the lower measured water contents. It appears from their data that at water contents lower than reported, produced by further drainage or evapotranspiration, the theoretical estimates would considerably underestimate the actual K(θ) values. Kunze et al. (1968) have indicated that better calculated K(θ) values are obtained when more information on the water retention characteristics is available (i.e., a much wider range of θ). In addition to these concerns, Gardner (1974), in a recent review of methods for calculating hydraulic conductivities, states, "There is, as yet, no discernible pattern to the matching factors, so one is totally in the dark in the absence of a known conductivity value." Therefore, for predictive purposes, the requirement of a known conductivity severely limits the utility of this approach. It is a particularly stringent requirement when unsaturated K(θ) values are required.

2) Water Retention Data. Laboratory analysis of undisturbed cores for water retention with subsequent analysis for hydraulic conductivity has been popularized by Nielsen et al. (1973). However, indiscriminate application of this technique should not be encouraged for the following reasons:

a) Excessive equilibrium times. Drainage from large core samples can take excessive time, particularly if they contain appreciable clay. A 7.6-cm-high soil sample drains over 50 times slower than a 1-cm-high sample. Therefore, special precaution in obtaining the water retention data is required. Analysis similar to that employed by Stol (1965) may be required for core samples of this size. The error of overestimating the water retention would tend to cause the calculated K(θ) values to be lower than the true values.

b) Swelling soils and dispersive soils. Dispersion and subsequent reduction of hydraulic conductivity can occur in samples with high exchangeable sodium and also in swelling clay soils. It is not uncommon to have both high levels of exchangeable sodium (> 12%) and swelling clays in the upper 150 cm of the surface in many western soils. As an example, over 2.8 x 10⁶ ha (7 x 10⁶ acres) of land in southwestern North Dakota contains 12% or more exchangeable Na in the root zone (Omord et al., 1975). Many of these soils are high in montmorillonitic clays. Water retention measurements of swelling clays are difficult to obtain. Overburden pressures would have to be simulated in the laboratory to obtain an accurate estimate of a swelling soil water characteristic.

Perhaps a more realistic approach would be to conduct a drainage study similar to that described but measure water content

Response to Letter by Dr. Laura

Here Dr. Laura continues with a polemic begun in Soil Science. We still feel comfortable with our response [his ref. (10)] and any meaningful questions posed by Dr. Laura had best be answered by additional experiments. Ergo, we invoked Occam's razor.

Until we can agree on data, opinions can scarcely be considered helpful.

Received 23 Aug. 1976.

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Published November, 1976