The relative permeability of the subsoil, its water transmission capacity, is of primary importance in nearly all hydraulic phases of land planning. The quantitative evaluation of permeability is essential in the design of drainage facilities. A formula developed for calculating tile spacing in the irrigated lands of the Imperial Valley, Calif., utilizes the coefficient of permeability directly (1).³

A 5-year drainage research program in the Imperial Valley revealed the mechanical analysis to be the most effective tool for estimating permeability. This technique satisfies several basic requirements essential to extensive field application. The requirements are: handling a large number of samples in order to obtain accurate representation of highly stratified materials; adapted to use of disturbed samples taken at considerable depth and frequently below the water table and simple technique and equipment.

The proposed indirect measure of permeability applies specifically to the transmission constant or water flow under gravity head differentials, where all noncapillary pores and usually all capillary pores are filled with water. Under field conditions, the major variables influencing this constant rate of movement through the subsoil are changes in hydrostatic head and physical changes in pore characteristics. The latter may be produced by aggregation or dispersion of the fines. This may be caused by a material change in the dissolved solids present in the water associated with the field site (4).

Pore size distribution, in part, is a product of grain size distribution or texture. Pore size rather than total porosity determines the coefficient of permeability of that material. However, sediments containing considerable clay commonly possess structural features which affect pore size more strongly than the grain sizes. It is apparent that methods of estimating permeability by using the mechanical analysis alone must be confined to sediments having a rather low clay content. Further, it should not be used as an index of water movement which does not comply strictly to the fundamental Darcy Law of flow of liquids through porous media.

Measurement of the more permeable sediments were of primary importance in the Imperial Valley drainage study as they provide the major avenues of water movement to a drainage facility. For this reason, this study was restricted to the investigation of the heterogeneous sediments of light textures. As will be illustrated later, even the light-textured sediments are filled by the finer sand particles which determine the permeability by means of mechanical analysis.

Other methods (2, 5, 7) have been proposed for estimating permeability by measure of the pore size distribution with moisture tension methods. These methods probably have merit when applied to specific problem for which they were developed. Study of them revealed that they required time consuming laboratory technique, constant temperatures, or were not adapted to the type of material encountered in the Imperial Valley.

A study conducted by the Punjab Irrigation Research Institute of India (6) approached the problem on the basis of grain size distribution. Similar curves were associated with similar coefficients of permeability. Materials encountered in the Punjab area are in many respects comparable to those of the Imperial Valley. The study, however, gave considerable impetus to a detailed comparison of the mechanical analysis with permeability measurements.

**PROCEDURE**

The first task of the Imperial Valley investigation was to obtain a comprehensive picture of the permeability of the sediments involved in drainage facilities. It was found that the satisfactory function of tile drains depends primarily upon the presence of materials in the subsoil or substrata. Most of these are materials ranging from silt loam with permeability coefficients ranging from 50.0 cc/cm²/ hr. They are, for the most part, dependent upon the grain size distribution for the permeability they possess.

Equipment was designed for measuring the transmission constant of the sediments within the described permeability range. Both undisturbed and disturbed field specimens were obtained. Both undisturbed and disturbed field specimens were obtained. Disturbed or “in-place” samples, 5 cm in diameter by 10 cm in length, were taken normal and parallel to the apparent bedding plane. In nearly all cases, they would be vertical and horizontal to the ground surface. The disturbed samples were first oven dried up to 110 cm in length, were taken normal and parallel to the apparent bedding plane. In nearly all cases, they would be vertical and horizontal to the ground surface. The disturbed samples were first oven dried, then passed through a 20-mesh sieve; then packed in cylinders, 5 cm in diameter by 25 cm in height. Standard compaction was obtained with the samples. A comparison was then made with the disturbed samples. Further, a check was made on measurements of permeability, using a set of sediments from which was pumped a small quantity of water. This technique is described by Wenzel (9).

The mechanical analyses were conducted by using a small well passed through a 20-mesh sieve; then packed in cylinders, 5 cm in diameter by 25 cm in height. Standard compaction was obtained with the samples. A comparison was then made with the disturbed samples. Further, a check was made on measurements of permeability, using a set of sediments from which was pumped a small quantity of water. This technique is described by Wenzel (9).