Some Suggested Laboratory Standards of Subsoil Permeability

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Subsoil permeability is recognized as one of the most important characters which distinguish the various soil types. Many systematic groupings of soils, therefore, are based in part upon the field man’s estimate of what this permeability may be. There is little doubt that an experienced field man can often place most soils of an area in their approximate relative order of profile permeability, but it is obvious that a reliable measurement would offer definite advantages. Even if the field man’s judgment were practically infallible, it would still be desirable to be able to attach certain indices to the ratings of permeability. These afford an easier reference and a better understanding by people less skilled in the science in field observation. Moreover it is to be expected that any reliable measurement would help to confirm or disprove the rating by field men in cases of doubt or disagreement. Instances would doubtless occur in which the measurement would lead to a revision of field ideas because of some erroneous concept or faulty reasoning.

No attempt seems necessary here to review the record of laboratory methods of measuring soil permeability that have been used or proposed because such reviews are already available (1, 2, 3, 11). The aim of this paper is to point out certain requirements which must be met in making laboratory permeability measurements; also, to propose certain tentative standards obtained by a method which satisfies these requirements but is not arbitrary or empirical and that can readily be adapted or varied in detail to fit specific needs.

Requirements for Establishing Laboratory Standards of Permeability

In the humid region there seems to be general agreement that a laboratory measurement of permeability must be made on samples with natural structure. Under arid conditions a proper measurement on artificially packed material may afford valuable information, where texture rather than structure dominates in determining deep subsoil permeability (3, 6). But the importance of structure in humid soil areas leads to the first requirement in measuring permeability, as follows:

1. The sample must be collected, transported, and preserved in such a way that the natural structure remains undisturbed. As far as laboratory standards are concerned this is the only basic requirement as to method of sampling. The size, shape, or nature of the core, lump, or other type of sample need not be specified, other than that it must be a truly representative sample (4, 11). Our experiences indicate that no one method is always best for certain soils and conditions a core 3 inches in diameter with removable sleeve has been quite satisfactory. However, for many subsoils the most satisfactory method has been to dig out the natural profile and seal in cylinders with paraffine for permeability measurement as described elsewhere (11).

2. The measurement must be made with a known viscosity which has the same effect as the physical properties of the soil as does water. A viscous fluid to meet these requirements is water itself. Since impurities would, in certain cases, complicate the measurement, distilled water should be the fluid of choice, but in many cases ordinary tap waters would pose no significant difference. Since the viscosity of water varies with temperature, a rigid standardization requires a specification of temperature (5), say at 25°C. However, in practice, the measurement of permeability need not consider variations in viscosity within the normal range of room temperature, because such precision is not important in ordinary permeability measurements.

3. The effect of trapped air must be eliminated. This can be done to a satisfactory degree by deflation of sample prior to wetting in the laboratory (2, 8).

4. Some provision must be made for eliminating the influence of worm and root holes, channels and all leaks or cracks. In the case of soils, under West Virginia conditions, this is accomplished by a pre-permeability testing which consists of applying the water pressure from below: serving the exposed upper surface carefully to see where the water is coming through. If cracks or definite channels are present the sample is discarded. Measurements are recorded only where the water flows through which the permeability is accountable for through natural structural openings.

This is consistent with dictionary definitions of the words commonly used to describe such measurements. To percolate means to filter through; and to permeate means to pass mingling with. Both of these concepts are in harmony with our requirement for eliminating free-flowing channels from percolation measurements.

It is recognized that worm and root holes are important in the field, but it is to be expected that any reliable measurement would help to confirm or disprove the rating by field men in cases of doubt or disagreement. Instances would doubtless occur in which the measurement would lead to a revision of field ideas because of some erroneous concept or faulty reasoning.