Content of Soil by the Microwave Oven Method

3. Terminology

3.1 *Definitions:*

3.1.1 Definitions shall be in accordance with Terminology D 653.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 Descriptions of terms shall be in accordance with Ref (2).

4. Summary of Guide

4.1 *Test Methods for Measuring Saturated Hydraulic Conductivity Above the Water Table*—There are several test methods available for determining the field saturated hydraulic conductivity of unsaturated materials above the water table. Most of these methods involve measurement of the infiltration rate of water into the soil from an infiltrometer or permeameter device. Infiltrometers typically measure conductivity at the soil surface, whereas permeameters may be used to determine conductivity at different depths within the soil profile. A representative list of the most commonly used equipment includes the following: infiltrometers (single and double-ring infiltrometers), double-tube method, air-entry permeameter, and borehole permeameter methods (constant and multiple head methods).

4.1.1 *Infiltrometer Test Method:*

4.1.1.1 Infiltrometer test methods measure the rate of infiltration at the soil surface (see Test Method D 2434) that is influenced both by saturated hydraulic conductivity as well as capillary effects of soil (4). Capillary effect refers to the ability of dry soil to pull or wick water away from a zone of saturation faster than would occur if soil were uniformly saturated. The magnitude of the capillary effect is determined by initial moisture content at the time of testing, the pore size, soil physical characteristics (texture, structure), and a number of other factors. By waiting until steady-state infiltration is reached, the capillary effects are minimized.

4.1.1.2 Most infiltrometers generally employ the use of a metal cylinder placed at shallow depths into the soil, and include the single-ring infiltrometer, the double-ring infiltrometer, and the infiltration gradient method. Various adaptations to the design and implementation of these methods have been employed to determine the field-saturated hydraulic conductivity of material within the unsaturated zone (5). The principles of operation of these methods are similar in that the steady volumetric flux of water infiltrating into the soil enclosed within the infiltrometer ring is measured. Saturated hydraulic conductivity is derived directly from solution of Darcy's Equation for saturated flow. Primary assumptions are that the volume of soil being tested is field saturated and that the saturated hydraulic conductivity is a function of the flow rate and the applied hydraulic gradient across the soil volume.

4.1.1.3 Additional assumptions common to infiltrometer tests are as follows:

(a) The movement of water into the soil profile is one-dimensional downward.

(b) Equipment compliance effects are minimal and may be disregarded or easily accounted for.

(c) The pressure of soil gas does not offer any impedance to the downward movement of the wetting front.

(d) The wetting front is distinct and easily determined.

(e) Dispersion of clays in the surface layer of finer soils is insignificant.

(f) The soil is non-swelling, or the effects of swelling can easily be accounted for.

4.1.2 *Single-Ring Infiltrometer*:

4.1.2.1 The single-ring infiltrometer typically consists of a cylindrical ring 30 cm or larger in diameter that is driven several centimetres into the soil. Water is ponded within the ring above the soil surface. The upper surface of the ring is often covered to prevent evaporation. The volumetric rate of water added to the ring sufficient to maintain a constant head within the ring is measured. Alternatively, if the head of water within the ring is relatively large, a falling head type test may be used wherein the flow rate, as measured by the rate of decline of the water level within the ring, and the head for the later portion of the test are used in the calculations. Infiltration is terminated after the flow rate has approximately stabilized. The infiltrometer is removed immediately after termination of infiltration, and the depth to the wetting front is determined either visually, with a penetrometer-type probe, or by moisture content determination for soil samples (see Test Method D 4643).

4.1.2.2 A special type of single-ring infiltrometer is the ponded infiltration basin. This type of test is conducted by ponding water within a generally rectangular basin that may be as large as several metres on a side. The flow rate required to maintain a constant head of water within the pond is measured. If the depth of ponding is negligible compared to the depth of the wetting front, the steady state flux of water across the soil surface within the basin is presumed to be equal to the saturated hydraulic conductivity of the soil.

4.1.2.3 Another variant of the single-ring infiltrometer is the air-entry permeameter (see Fig. 1). The air-entry permeameter is discussed in 4.1.4.

4.1.3 *Double-Ring Infiltrometer*:

4.1.3.1 The underlying principles and method of operation of the double-ring infiltrometer are similar to the single-ring

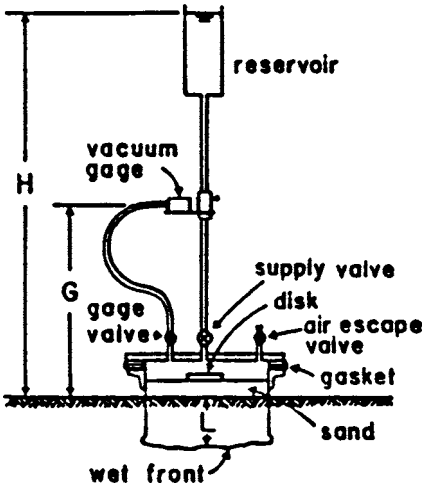

FIG. 1 Diagram of the Equipment for the Air-Entry Permeameter Technique (from Klute, 1986)