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-01	Updated to WP4C	DDH	11/12/10
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Dimensions: 8.5 inch wide, 11 inch tall

Material: Paper, 92 Bright White or better, 75g/m² or heavier

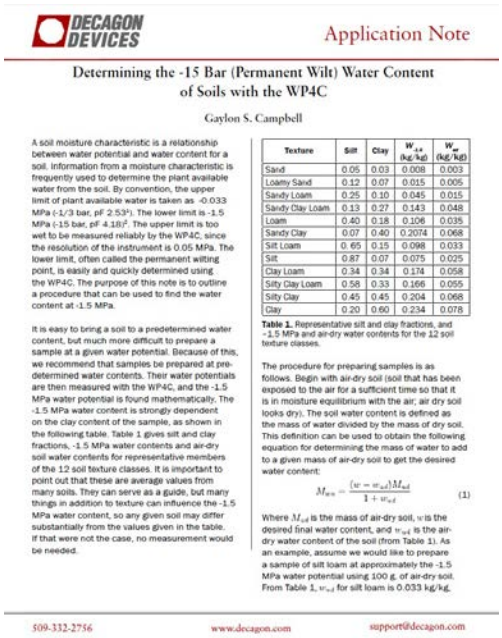
Colors: Color Print on White

Printer: HP Color LaserJet 5550

Finish: None

Adhesive: None

Special Notes: Illustrations are Ref Only ** Not to Scale ** (Shown page 1 of 5)



DECAGON DEVICES Application Note

Determining the -15 Bar (Permanent Wilt) Water Content of Soils with the WP4C

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A soil moisture characteristic is a relationship between water potential and water content for a soil. Information from a moisture characteristic is frequently used to determine the plant available water from the soil. By convention, the upper limit of plant available water is taken as -0.033 MPa (-1/3 bar, pF 2.53[1]). The lower limit is -1.5 MPa (-15 bar, pF 4.18)[2]. The upper limit is too wet to be measured reliably by the WP4C, since the resolution of the instrument is 0.05 MPa. The lower limit, often called the permanent wilting point, is easily and quickly determined using the WP4C. The purpose of this note is to outline a procedure that can be used to find the water content at -1.5 MPa.

It is easy to bring a soil to a predetermined water content, but much more difficult to prepare a sample at a given water potential. Because of this, we recommend that samples be prepared at pre-determined water contents. Their water potentials are then measured with the WP4C, and the -1.5 MPa water potential is found mathematically. The -1.5 MPa water content is strongly dependent on the clay content of the sample, as shown in the following table. Table 1 gives silt and clay fractions, -1.5 MPa water contents and air-dry soil water contents for representative members of the 12 soil texture classes. It is important to point out that these are average values from many soils. They can serve as a guide, but many things in addition to texture can influence the -1.5 MPa water content, so any given soil may differ substantially from the values given in the table. If that were not the case, no measurement would be needed.

Texture	Silt	Clay	$W_{-1.5}$ (kg/kg)	W_{ar} (kg/kg)
Sand	0.05	0.03	0.008	0.003
Loamy Sand	0.12	0.07	0.015	0.005
Sandy Loam	0.25	0.10	0.045	0.015
Sandy Clay Loam	0.13	0.27	0.143	0.048
Loam	0.40	0.18	0.106	0.035
Sandy Clay	0.07	0.40	0.2074	0.068
Silt Loam	0.65	0.15	0.098	0.033
Silt	0.87	0.07	0.075	0.025
Clay Loam	0.34	0.34	0.174	0.058
Silty Clay Loam	0.58	0.33	0.166	0.055
Silty Clay	0.45	0.45	0.204	0.068
Clay	0.20	0.60	0.234	0.078

Table 1. Representative silt and clay fractions, and -1.5 MPa and air-dry water contents for the 12 soil texture classes.

The procedure for preparing samples is as follows. Begin with air-dry soil (soil that has been exposed to the air for a sufficient time so that it is in moisture equilibrium with the air, air dry soil looks dry). The soil water content is defined as the mass of water divided by the mass of dry soil. This definition can be used to obtain the following equation for determining the mass of water to add to a given mass of air-dry soil to get the desired water content:

$$M_{ww} = \frac{(w - w_{ad})M_{ad}}{1 + w_{ad}} \quad (1)$$

Where M_{ad} is the mass of air-dry soil, w is the desired final water content, and w_{ad} is the air-dry water content of the soil (from Table 1). As an example, assume we would like to prepare a sample of silt loam at approximately the -1.5 MPa water potential using 100 g. of air-dry soil. From Table 1, w_{ad} for silt loam is 0.033 kg/kg.

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