

Document Title: Description, AN, Measuring Spec. Surface of Soil with WP4		Part # and Rev. 13389	
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Rev.	Description	Revision By	Date

Production Filename: 13389 (In Product Library)

Path to Working Files: DecaDoc\Application Notes\Master

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 8550-PS

Finish: None

Adhesive: None

Special Notes: Illustrations are Ref Only ** Not to Scale ** (Shown page 1 of 2)



Application Note

Measuring Specific Surface of Soil with the WP4

The specific surface area of a soil sample is the total surface area contained in a unit mass of soil. Soils with high specific surface areas have high water holding capacities, more adsorption of contaminants, and greater swell potentials.

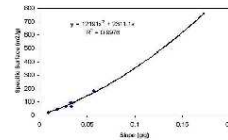
Specific surface is therefore an important parameter. Specific surface is closely tied to particle size distribution. This can be seen with a simple thought experiment. A cube, 1 cm on a side, with a density of 1 g/cm³ has a surface area of 6 cm²/g. If the cube were divided into smaller cubes 1 mm on a side, the resulting 1000 cubes would have the same mass of material, but a surface area ten times that of the single cube, or 60 cm²/g. If the cube were divided into 10¹² cubes 1 μm on a side, the surface area would be 6 x 10⁴ cm²/g. Thus, the smaller the particles, the greater the surface area per unit mass of soil.

Various approaches have been used to measure specific surface area, including adsorption of nitrogen and other gases on the soil. The most commonly method at present uses the adsorption of ethylene glycol monoethyl ether (EGME). This involves saturating prepared soil samples, equilibrating them in a vacuum over a CaCl₂-EGME solvate, and weighing to find the point when equilibrium is reached. The specific surface is then determined from the mass of retained EGME in comparison to the amount retained by pure montmorillonite clay, which is assumed to have a surface area of 810 m²/g (Carter et al. 1986). The measurement typically takes around 2 days to complete.

Soil is typically in a hydrated state, and surface area measurements should apply to that state. It would therefore be ideal if water could be used

as the probe to determine the specific surface area. Quirk (1955) reviewed such measurements and concluded that water clusters around cation sites, and can therefore lead to errors in the measurements. Recent work, however, using more modern methods for measuring the energy state of the water in the soil, show promise as simple methods for determining specific surface of soil samples. Campbell and Shiozawa (1992) correlated specific surface of six soils with measurements of the slope of a moisture release curve and found excellent correlation.

Figure 1 shows the data for the six soils, along with an additional point for Ca-montmorillonite. The slope (x axis value) is equal to the water content of the sample at a water potential of -123 MPa, and is the inverse of the slope used by McKeen (1992) to quantify expansive soils, so it is clear that all these properties are closely linked.



A recent paper by Tuller and Or (2005) obtained the following equation relating surface area and the moisture characteristic:

$$w = \left[\frac{k}{6.01(p_w w)} \right]^{1/2} p_w S$$