

Document Title: 14538-01 LIT, Modeling Soil Thermal Properties Compaction, Moisture, Temperature, Composition and Stability		Part # 14538-01	
		Release Date: 8/14/12	
Rev.	Description	Revision By	Date

Production Filename: 14538-01 LIT, Modeling Soil Thermal Properties Compaction, Moisture, Temperature, Composition and Stability

Path to Working Files: DecaDoc\Video Transcriptions\Master\Thermal Properties\14538-01 LIT, Modeling Soil Thermal Properties Compaction, Moisture, Temperature, Composition and Stability

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 **



DECA GON THERMAL
BY DECA GON DEVICES, INC.

Video Transcript

2012 International Thermal Property Workshop

Modeling Soil Thermal Properties:
Compaction, Moisture, Temperature, Composition and Stability

Caylen S. Campbell

Outline

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Modeling Soil Thermal Properties

So it's a mixture of the solids of the soil minerals, organic matter, liquid which is mostly water, and that and gases. The thermal properties of the soil will depend on how much of each of those things we have and to some extent how they are mixed together, what the geometry of the phase factors are that are associated with those.

Thermal Properties of "Dry" Soil Constituents

The soil constituents and their thermal properties are listed here. You see some things that kind of jump out at you. The thermal conductivity of air is actually lower than that of the thermal conductivity of anything else here out to the more and we have in the soil that, more important is in. The thermal conductivity of organic matter is also pretty low but for soil that's high in organic matter will have a low thermal conductivity or a high reactivity, there is a little bit higher but

not nearly as high as the minerals and finally, the amount of air we have in the soil that is high in quartz we would expect to be a good conductor of heat. As for specific heat goes we can see that a lot of things work on a similar basis but water has the ultra-high specific heat and air, of course, has a very low specific heat.

Volumetric Specific Heat

To model the specific heat of the soil is pretty straightforward. The volumetric specific heat is just the weighted sum of each of the constituents, so there's 3 are the volume fractions of each of the constituents of the minerals, the water and the air and then there's 3 is the volumetric specific heat of each of those constituents, off of that table that we had before in the volume fractions have to add up to one. What that makes it really simple to model it and that the relationship between the water content and specific heat is going to be linear. You can see for this kind of response here a sort of typical mid texture soil that the specific heat will be about one for dry soil and it will be about three for wet soil. That makes it pretty easy to know how to predict that. In fact, it's probably a much easier, easier and more accurate to predict than to try to measure it. Predicted meaning to measure the water content from the density of the soil and then calculate it from that.

Calculation of Volumetric Specific Heat

So just to go through a quick example here, here a 50% more covered in the soil, 50% soil moisture, 25% air, let's say, and 25% water. So kind of like that field property but we know about this morning and we just go through and add down each of those and we get a function like 2.2 MJ per cubic meter. You can see that it wouldn't have made any significant difference to this calculation to have left the air part out of that, we

www.decagothermal.com

509-333-5800

support@decagothermal.com