HLWYM HEmails

From: Ronald Green
Sent: Thursday, May 05, 2005 9:38 AM
To: rfedors@cnwra.swri.edu; Osvaldo Pensado; Budhi Sagar; Goodluck Ofoegbu
Cc: Sitakanta Mohanty
Subject: RE: thermal conductivity

The DOE is not clear on how their thermal properties for crushed tuff (Table IV-9 in MSTHM AMR2004) were derived. Unless I am proven otherwise, I believe these are calculations (not measurements) based on estimates of partitioning and the thermal values for the matrix and fracture continua. I base this on past DOE practices that were better documented than the AMR and the following citations from the AMR: From pg 6-52

"The bulk density and bulk thermal conductivity of the host-rock rubble are partitioned between the fracture and matrix continuum in the exactly same fashion, and for the same reasons, as is done for the crushed-tuff invert material (see Appendix IV). Thus, 99 percent of the bulk density and bulk thermal conductivity are partitioned to the matrix continuum and 1 percent is partitioned to the fracture continuum. This partitioning is done because the majority of the thermal mass in the rubble resides in the matrix continuum."

and again on IV-3:

"The invert properties for the matrix continuum (i.e., the intragranular porosity) are obtained from DTN: LB0208UZDSCPMI.002 [DIRS 161243] and for the fracture continuum (i.e., the intergranular porosity) are from Appendix X. Section 5.3.1.8 discusses the assumption about the intergranular permeability of the crushed-tuff invert material. The van Genuchten alpha for the fracture continuum from Table X-7 of Appendix X is 624 bar-1, which converted to SI units, is equal to 6.24 × 10−3 Pa−1. The input parameters that require hand calculations are: (1) intragranular porosity (φm), (2) the thermal conductivity for the fracture and matrix continuum, and (3) the grain density of the matrix and of the fracture continuum. The thermal properties of the crushed-tuff invert are given in Tables IV-8 and IV-9."

(sorry for the font, caused by copying from the pdf)

and again on IV-3

"**Invert Thermal Conductivity**

The bulk thermal conductivity of the crushed-tuff invert material is partitioned 99 percent to the matrix continuum and 1 percent to the fracture continuum, as follows:

$$K_{th,f} = K_{th}\,(0.01)$$

$$K_{th,m} = K_{th}\,(0.99)$$

This partitioning is done because the majority of the thermal mass in the invert resides in the matrix continuum."

The only published thermal conductivity measurements of the Tptpll by DOE I am aware of are those in two documents by Brodsky et al. (11th IHLRWM). Please provide any information you may have that adds to my understanding.

-----Original Message-----
From: Randall Fedors [mailto:rfedors@cnwra.swri.edu]
Sent: Wednesday, May 04, 2005 4:30 PM
To: opensado@cnwra.swri.edu; 'Ron Green'; 'Budhi Sagar'; 'Goodluck Ofoegbu'

Cc: 'Sitakanta Mohanty'
Subject: RE: thermal conductivity

The DOE measured (MSTHM AMR 2004) the thermal conductivity of an aggregate derived from the lower lithophysal unit (Tptpll). Contrary to Ron's email below, it is not "crushed invert," which I think he took as crushed cement??? The design invert is now a crushed aggregate of the rock removed during the tunneling process. The average of about half a dozen DOE measurements was 0.15 W/m-K for the Tptpll aggregate, which should be taken as the dry thermal conductivity. The thermal conductivity of intact lower lithophysal, excluding the lithophysae, ranges from a dry value of 1.4 W/m-K to 2.1 W/m-K. These values are consistent with expected general trends for intact tuff versus tuff ground up into fragments. Of course the nature of the fragments play an important role in determining the thermal conductivity. With small fragments, or poorly sorted fragments, small average pore sizes, the effective thermal conductivity will be small (dominated by conduction). With large fragments (and large pore spaces), the effective thermal conductivity will be larger because of the combined effect of conduction, convection, and radiation. Unfortunately, the fragment sizes and distribution are poorly constrained. Ron Green's measurements were judged to be the best available, though in situ measurements in a scoria field (Connor et al.) supported lower estimates. Ron's measurements have been taken to represent mean values for the effective thermal conductivity of the rubble.

I have not seen how the value 0.23 W/m-K was derived in the Analysis for UCDF Waste Packages (May 2000) document.

Goodluck's argument is valid. I thought that spatial variability (and general uncertainty) could be mapped to different Monte Carlo realizations. However, it seems the suggestion is that average values for the repository should be sampled instead. Thus, removing both ends of the distribution would be required (the argument goes: remove low end of distribution because all of the repository for one realization should not use a low value that may only occur in 5 or 10 % of the repository; ditto for the high end).

--Randy

> -----Original Message-----
> **From:** Osvaldo Pensado [mailto:opensado@cnwra.swri.edu]
> **Sent:** Wednesday, May 04, 2005 4:37 PM
> **To:** 'Ron Green'; 'Budhi Sagar'; 'Goodluck Ofoegbu'
> **Cc:** Sitakanta Mohanty; Randall Fedors
> **Subject:** RE: thermal conductivity
>
> Then, the lower bound proposed for the TPA computations (0.12 W/m-K) may not be representative of the drift rock.
>
> Goodluck provided a valid criticism to my approach of removing the low end of the thermal conductivity distribution. He said I do not have a valid reason to remove the low end of the distribution while keeping the upper end (1 W/m-k). Why do I believe one end more than the other?
>
> We should use a low value applicable to drift rock. Looking at the Design Analysis for UCDF Waste Packages (May 2000), thermal conductivities are as low as 0.23 W/m-k. Thermal conductivities of the rock exceed 1.5 in multiple instances.
>
> Now, what do we do?
>
> > -----Original Message-----
> > **From:** Ron Green [mailto:rgreen@cnwra.swri.edu]
> > **Sent:** Wednesday, May 04, 2005 4:17 PM
> > **To:** Budhi Sagar; Osvaldo Pensado; Goodluck Ofoegbu
> > **Subject:** thermal conductivity

FYI from our lunchtime discussion. I spoke with Randy. The 0.12 W/m-K is for crushed invert material, not rock from the repository horizon (i.e., Tptpll).

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From: Ronald Green

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Tracking Status: None
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