GRTI | GEOTHERMAL RESOURCE TECHNOLOGIES, INC.

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FORMATION THERMAL CONDUCTIVITY TEST AND DATA ANALYSIS

for

Tennessee Valley Authority
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Test location

Meridian Naval Air Station
Air Field Vertical Test Bore
Meridian, Mississippi

June 5, 2000

Test Performed by

Geothermal Resource Technologies, Incorporated

Executive Summary

A formation thermal conductivity test was performed by Geothermal Resource Technologies, Inc., on a test bore located near the Air Field at Meridian Naval Air Station in Meridian, Mississippi. The Formation Thermal Conductivity testing unit was attached to the vertical u-bend assembly on the morning of Tuesday, May 30, 2000. The collected data was analyzed by Geothermal Resource Technologies, Inc. under the supervision of Charles Remund, Ph.D., Director of Engineering.

This report provides a general overview of the test and procedures that were used to perform the thermal conductivity test along with a plot of the data in a form used to calculate the formation thermal conductivity. The following average formation thermal conductivity was found from the data analysis.

⇒ Formation Thermal Conductivity = 1.254 Btu/hr-ft-°F

Test Procedure

The procedure for the formation thermal conductivity test is as follows:

1. Connect the u-bend ground heat exchanger pipe to the portable FTC unit.
2. Connect the data acquisition unit to the wiring harness in the FTC unit.
3. Connect the FTC unit to 240 volt power supply (collected data indicated the average voltage throughout the tests was 250.6 volts).
4. Fill and purge air from the FTC unit.
5. Insulate the exposed u-bend pipes (leading from the well bore surface to the FTC unit).
6. Simultaneously turn on the heating elements and initiate the data acquisition device.
7. Routinely monitor that the power supply remains connected and the water level of the fluid reservoir within the FTC unit stays at an acceptable level.
8. After the test is completed, turn off heating elements, the circulation pump, and the data acquisition device.

Data Analysis

Geothermal Resource Technologies, Inc. uses the "line source" method of data analysis. The line source equation used is not valid for early test times. Also, the line source method assumes an infinitely thin line source of heat in a continuous medium. If a u-bend grouted in a borehole is used to inject heat into the ground at a constant rate in order to determine the average formation thermal conductivity, the test must be run long enough to allow the finite dimensions of the u-bend pipes and the grout to become insignificant.

In order to analyze real data from a formation thermal conductivity test, the average temperature of the water entering and exiting the u-bend heat exchanger is plotted versus the natural log of time. Using the Method of Least Squares, the linear equation coefficients are then calculated that produce a line that fits the data. This procedure is normally repeated for various time intervals to ensure that variations in the power or other effects are not producing erroneous results.

Formation Thermal Conductivity Test Report

Date	May 30 – June 1, 2000
Location	Meridian, MS

Borehole Data

Undisturbed Soil Temperature		Approximately 63°F
Borehole Depth		200 ft.
Borehole Diameter		4 in.
Drill Log	0 – 15'	Clay
	15' – 200'	Sand, Water Table = 30'
U-bend Size		0.75 in. HDPE, Vanguard
U-Bend Length		250'
Grout Type		No Grout – Backfilled with Sand
Grouted Portion		Entire Bore Length
Grout Solids		Not Applicable

Test Data

Average Power	3,256 W
Calculated Circulator Flow Rate	4.55 gpm
Total Heat Input Rate	10,233 Btu/hr

Line Source Data Analysis

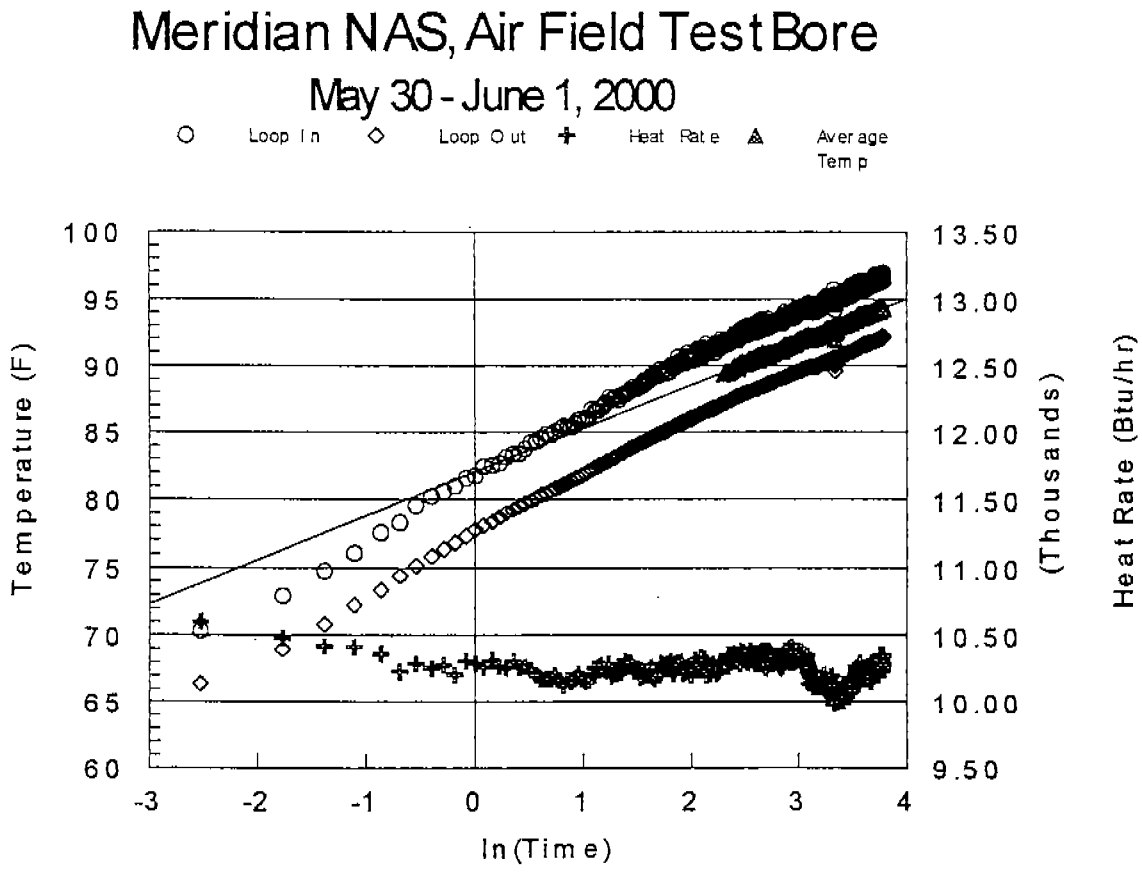

Figure 1: Temperature versus Natural Log of Time

Slope: a_1	Average Heat Input (Btu/hr-ft)	Thermal Conductivity (Btu/hr-ft-°F)
3.246	51.13	1.254

The temperature versus time data was analyzed using the line source analysis for the time period shown above. The slope of the curve (a_1) was found to be 3.246. The resulting thermal conductivity was found to be 1.254 Btu/hr-ft-°F.