REHAU
Unlimited Polymer Solutions

TECHNICAL BULLETIN TB246
GEOTHERMAL MODELING WITH RAUGEO PEXa PIPES

Product: **RAUGEO Ground Loop Heat Exchanger**
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The RAUGEO system of ground loop heat exchangers has several distinct differences from conventional geothermal systems that must be considered when modeling with commercially available geothermal design programs. These differences include:
– Pipe dimensions
– Double U-bend configuration (optional)

Pipe Dimensions
Most conventional geothermal systems use HDPE pipe, which is produced in iron pipe sizes (IPS), with a standard dimensional ratio (SDR) of 11. RAUGEO PEXa pipes, on the other hand, are copper tube size (CTS), with an SDR of 9. Table 1 shows the dimensions of RAUGEO pipe.

Table 1: RAUGEO Pipe Dimensions

Nominal pipe size (in)	Avg. OD (in)	Avg. wall thickness (in)	Avg. ID (in)
3/4	0.875	0.097	0.680
1	1.125	0.125	0.875
1 1/4	1.375	0.153	1.070
1 1/2	1.625	0.181	1.263
2	2.125	0.236	1.653

When modeling with RAUGEO, ensure that the correct pipe size is specified in the software program. In most geothermal design software programs, the type of pipe is selected from a drop down menu. If the drop down menu does not show “PEXa,” “RAUPEX” or “CTS SDR9” dimensions, the dimensions have to be typed in manually.

Note: The difference in thermal conductivity of HDPE and PEXa material is not included here. The variation in the thermal conductivity values produces a negligible effect in geothermal borehole modeling.

Double U-bend Configuration

The double U-bend configuration refers to the number of U-bends, two, in a vertical borehole. This type of pipe configuration is found in most commercially available geothermal design programs, however the description varies. Name variations include:

- Two Vertical U-tubes
- Vertical 2 U-bends
- Double U-tube
- Vertical 2 U-tubes
- Vertical – 2 pipe

The chosen type of U-bend configuration affects the calculated borehole thermal resistivity (BTR). For residential software programs, which often take a more simplistic calculation approach, the BTR is often not displayed. However, more advanced commercial programs not only display the BTR but allow the user to adjust the pipe spacing, grout type and borehole diameter. The BTR is calculated using a simple analytical equation specially developed for the selected U-bend configuration.

In 2011, REHAU teamed up with Bowman Geothermal of Chantilly, VA to create an in-depth numerical model to calculate the exact theoretical BTR of boreholes installed with RAUGEO PEXa double U-bends. The results are listed in Table 2. Because these values were derived directly from the basic principles of heat transfer, they are more accurate than the values calculated by geothermal design programs. If your program allows you to override the computed BTR by manual entry, REHAU recommends the use of these values instead.

Table 2: Borehole Thermal Resistivity (in hr·ft °F/Btu) for various borehole combinations using the RAUGEO Double U-bend

	1 in. PEX 5 in. Borehole		1 in. PEX 6 in. Borehole		1 1/4 in. PEX 6 in. Borehole	
Grout TC	Spacers	No Spacers*	Spacers	No Spacers*	Spacers	No Spacers*
0.44	0.179	0.237	0.245	0.265	0.163	0.234
1.0	0.112	0.141	0.141	0.152	0.105	0.139
1.2	0.103	0.128	0.127	0.136	0.097	0.126

* Average pipe spacing in the borehole assumed