

Economic Analysis of Vertical Ground-Coupled Heat Pump Systems with Pipe Spacers

1. System parameters for simulation

- Gross floor area : 22604.21 ft²
- Annual Heating/cooling load : 88.9 MWh / 70.5 MWh
- HDPE pipes diameter: 32 mm
- Software: GAIA Ground Loop Design.
- Mean thermal conduction of soil 2.7 w/m²x k
- Mean heat volume 2130KJ/m³.k
- Borehole depth 328 ft,
- Borehole distance 16.4 ft

Table 1:

Software Simulation comparing single, double, and single with pipe spacers U-tube GCHP system

Items	Single U-bend system	Single U-bend with Pipe Spacers
Number of boreholes	22	17
Total borehole length (feet)	7218	5577
Pipe length (feet)	14436	11155
Landscape area (ft ²)	4706	3631
Antifreeze volume (l)	4118	3183
Grout volume (l)	33974	26252
EZ-Snaps quantity	0	558

Benefits and drawbacks of single U-bend with Pipe Spacers

Benefits

- ✓ 22.7% less boreholes, pipes, grout
- ✓ 22.7% less landscape and antifreeze
- ✓ Less installation time and electricity

Drawbacks

- Pipe spacers cost

2. Price parameters for comparison

- Drilling: 11\$/ft
- Pipes and grout: 4.50\$/ft
- Landscape cost: 5\$/ft²
- Antifreeze cost 1.25\$/litre
- Grout cost 1.5 RMB/litre
- EZ-Snaps cost 4\$/ea.

Table 2:

Cost Analysis of Single, Double and Single with Spacers U-bend Systems

Items cost (Canadian dollar)	Single U-bend system	Single U-bend with Pipe Spacers
Boreholes drilling	79,398	61,347
Loop and grout	32,481	25,095
Landscape	20,380	18,155
Antifreeze	5147	3,978
Pipe Spacers	N/A	2,232
Total cost	137,406	110,807

Conclusion

Compared to the double U-tube system, the single u-tube with Pipe Spacers system offers a 19.36% reduction in installation costs. In this project, it amounts to savings of almost 27,000\$. Even though it is not mentioned, it also reduces total installation time and pumping electricity consumption.

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