Underground heat, picked up by a water/methanol solution circulating through buried pipes, heats the Clark home in winter. The same system cools the house all summer.

"CLOSED LOOP" HEAT PUMP USES UNDERGROUND TEMP TO HEAT, COOL HOUSE

By Eric Lyttle

"Earth Pipe" Heats This Ohio Farm Home

Bruce Clark, a lineman with Butler Rural Electric, Camden, Ohio, lives with his wife, Wendy, and three children in an all-electric rural home. Like many other homeowners, Clark's heating bills had become greater than his mortgage payments. The idea of retrofitting a water source heat pump to his existing furnace promised a dramatic reduction in heating bills. However, the local water wells in his area are generally low yield. For this reason, Clark began working with Butler REC to develop a "closed loop" earth pipe heat pump heating and cooling system.

To make the most of available space and to reduce trenching costs, the horizontal system chosen uses two parallel circuits of 900 ft. each. Each circuit is laid at a six-foot depth in a 450-ft. double-U shaped trench and then backfilled with 2 ft. of wet sand. After backfilling, the polyethylene pipe is doubled over itself at a 4 ft. depth and follows the trench back to the home. By using this doubling-over technique, the length of the trench and the trenching costs were dramatically reduced. It is through this double-running pipeline that the water/antifreeze solution will flow, extracting heat from (or, in summer, being cooled by) the moist soil surrounding it.

A soaker pipe was then laid on top of the double-running, 1½-in. tubing in the loop bed. This corrugated 3-in. pipe is attached to the downspouting on the house. Water from the downspout will run into the perforated pipe, where it will trickle into the loop bed. This should assure that the soil around the tubing is kept moist so it will provide a better medium for heat transfer. It is more difficult to extract heat from dry soil.

Also buried into portions of the loop are a number of thermocouple sensors. Twenty temperature readings and six moisture readings will be taken at given intervals along various points in the trench. This information will be relayed to a data logger in the basement of the Clark home. A direct telephone line from researchers monitoring the experimental system to the data logger's answering modem allows the data to be retrieved at any desired time. If, by chance, there is ever a malfunction in the closed loop system, the monitoring equipment will be able to detect it.

The Clark system is designed to circulate a 20% methanol/water solution through the 1,800 ft. of buried pipe. The solution will circulate at a rate of about 12 to 16 gpm. The temperature of the fluid should range from 60° in the summer to 35° in the winter. The polyethylene pipe is manufactured to withstand stress much greater than the pressure actually generated within the working closed loop heat pump. Provided there are no initial leaks in the pipeline, it is unlikely that any will occur in the future.

Heats And Cools

Once in operation, Clark's system is expected to provide for all of the home's heating and cooling needs, as well as reduce the cost of the family's hot water supply.

In the cooling mode, the system eliminates the need for an expensive-to-run compressor, which most conventional air conditioning units use. Instead, the earth-cooled fluid from the closed loop circulates through a large finned water coil. The blower draws warm air from the household across this water coil. The air is then cooled as it transfers its heat to the colder water/methanol solution. The amount of cooling is adjusted by regulating the flow of water through the coil and the column of air delivered by the blower unit.

Overall, the consumption of electricity in a closed loop, earth-coupled heat pump system is greatly reduced. Three Grundfos pumps are used in the Clark system. Each one (heating, cooling and hot water circulation) has a 1/12 hp., 185-watt capacity, which translates to little more than a bright lightbulb's electrical usage. An electric blower unit is also needed, and in the heating mode a compressor is driven electrically. Opposed to conventional heating/cooling/hot water methods, the system utilized by the Butler REC in the Clark home results in estimated savings of 50 to 70% for existing similar installations.

According to Jeff Parsons of TETCO, the company that makes the closed loop system, the average cost of an installed closed loop system is between $8,000 and $12,000. For an average 2,400-sq. ft. home, a payback period of five to six years can be expected from a closed loop heat pump versus conventional oil, propane or electric heating and cooling systems.

Another form of closed loop, earth-coupled heat pump system is the vertical loop. It differs from the horizontal type in that, instead of digging a long 6-ft. deep trench across the property, contractors make a vertical bore straight down into the ground.

A vertical loop installation is much less site specific because it needs very little ground cover area.

As far as cost is concerned, the vertical and horizontal systems are nearly the same, Amsterdam said. The vertical loop may have a slight edge in efficiency for two reasons. In the summer, the earth surrounding a horizontally laid pipeline may not accept as much heat as the vertical loop because the earth is cooler at, say, 100 ft. than it is at 6 ft. Secondly, according to Amsterdam, the ambient working fluid temperature is higher the farther down into the earth it travels.

For more information, contact: FARM SHOW Followup, Jeff Parsons, TETCO, 378 N. Owen Tangy St., Drawer C, Powell, Ohio 43065 (ph 614 889-6654).

For more information on vertical loop systems, contact: FARM SHOW Followup, National Geothermal, 6220 Sawmill Road, Dublin, Ohio 43017 (ph 614 889-0300).

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