Department of Mechanical and Materials Engineering

SENIOR DESIGN PROJECT SYNOPSIS – SPRING 2013

MINI AIR COOLING TOWER – HYBRID GEOTHERMAL HEAT PUMP COMPONENT
A PROJECT SPONSORED BY DR. LIN

Team 8: Henry Gutierrez, Miguel Freire, Santiago Paz **Faculty Advisor: Dr. Lin**

The FIU Solar House is connected to a geothermal heat pump with horizontal loops laid 6 ft underground of constant temperature 77°F. This type of pump uses thermal energy to provide cooling during hot weather and heating during cold weather. One problem with this geothermal pump is that during extremely hot and humid days, Miami temperatures reach higher than 90°F and doesn't allow the ground coils to sufficiently remove all of the excess heat.

To solve this issue, an auxiliary heat rejecting device will be designed to work in conjunction with the geothermal heat pump. The pipe that exits the pump has a nominal size of 1 ¼" (polyethylene) and the water flows 8 gal/min. The cooling tower will meet these specifications and operate when it senses that the water temperature leaving the pump is higher than 94°F.

To achieve this, a monthly cooling load analysis was performed using HVAC Explorer to determine the hottest months (June through August) and highest cooling loads (over 26,000 BTU/hr). A heat transfer analysis was also performed to determine the total heat loss of the ground coils (35,350 BTU/hr), the size the heat exchanger (4 ft^2) and fan flow rate (4000 cfm). The appropriate motor to power this fan was one with ¾ HP and a max velocity of 1075 rpm.

To reduce cost, it was decided to replace one large custom radiator with two smaller factory produced ones. This meant a lower priced radiator, less material consumption to build the frame and a more compact design. Several unique features are integrated with the cooling tower such as louvered fin radiators to dissipate heat more effectively, an automatic shut-off valve mechanism to redirect water flow towards the cooling tower, a type-K grounded pipe plug thermocouple to read the water temperatures and a temperature/process controller to read the temperature from the thermocouple.

Overall, a hybrid mini air cooling tower is designed to optimize and balance the annual heating and cooling load, use renewable energy in an efficient and environmentally friendly way, and to possibly become a potential application for residential purposes as opposed to industrial.