The geothermal industry was a featured track at the World Energy Engineering Congress (WEEC), held October 24-26 in the Georgia World Congress Center in Atlanta, Georgia. WEEC is an opportunity to get cutting edge information about innovations in the energy industry. At the 24th annual conference, 3,019 attendees listened to speakers, attended workshops, and browsed exhibits, speaking with 960 exhibitors. The conference featured a geothermal track, with speakers promoting and discussing the geothermal industry. The exhibit hall also featured an area for exhibitors in the geothermal industry.

IGSHPA staff exhibited at the conference to promote geothermal technology and the Certified GeoExchange Designer (CGD) course. This intense course is targeted at experienced architects or engineers who want specific information about ground source heat pump design.

Prior to the WEEC Conference, IGSHPA conducted a Certified GeoExchange Designer course at the Georgia World Congress Center. Sixteen students enrolled in the CGD course, with three of the students being engineers from Korea. Students spent time in the classroom with industry experts and took an examination at the end of the course.

WEEC was a great opportunity for IGSHPA to promote the ground source heat pump industry and to educate attendees about the benefits of this efficient technology. To find out more information or to enroll in an IGSHPA course or workshop, call 800-626-4747.

A New Look for The Source?

What's up with The Source this month? Has St. Patrick's Day come early?

No! The Source has temporarily turned green in eager anticipation of next year's Green Book!

So what is The Green Book? The Green Book will replace the IGSHPA Membership Directory as the industry resource for professional contacts. Like the Membership Directory, it will feature IGSHPA members by type of business, geographic area and alphabetically.

The Green Book will be printed in a compact size (6 x 9 inches) making it a convenient, portable reference. All members will receive one free copy, with additional copies available for a nominal fee.

The Green Book will also be sold to non-members through the IGSHPA website and at industry trade shows.

For more information on The Green Book and advertising opportunities call 1-800-626-4747.
The Internet is a powerful tool in today's fast-paced, high tech society. The world is at your fingertips. One can check on everything from stock prices to information regarding geothermal technology. The question is, where to start?

- A quick search located the U.S. Department of Energy's, Energy Efficiency and Renewable Energy Network (EREN) page at www.eren.doe.gov. This site links to many renewable energy resource pages. The geothermal link allows one to find information regarding heat pumps as well as advanced technologies and environmental advantages. The greatest value to this site may be the contacts. The opportunity to discuss technology and research with professionals around the world is just a click away.

- Another site of interest is Demarco Energy Systems at www.demarcoenergy.com/home.cfm. This is a site for a company specializing in geothermal heat pumps. Here, one can read case studies, news and press releases. Demarco also offers online subscription to news and press releases. This page is interesting because it shows how geothermal technology is being used and marketed in the real world.

This brief overview of Internet sites is just that—brief. It is a starting point for finding more information and contacting with others interested in this work. Many other sites are available. The Internet may not replace hands on research but it is a valuable tool. A quick search can lead to vast amount of information.
Experimental Observations of Pond and Hydrant Flowing Water Temperatures
by Marvin Smith, Ph.D., P.E.
Oklahoma State University

Introduction
Recent experiences with an architect showed a need for more information regarding pond water temperatures. The plan was to use a ducted air system through pipes in a pond. A fan would return the air to an air space under the floor, around the walls and the ceiling to cool the building at night during the summer. A ground source heat pump (GSHP) would be used during day. Unfortunately, the water in a pond fed by rainwater run-off in the southern half of the United States is often too warm to approach cooling with this method. Water sources from ponds and municipal water sources are being explored in an attempt to reduce the high-energy costs in cooling buildings. Before designs can be implemented it is necessary to know the temperature ranges expected from these water sources.

Background: Test System
A 3.5-acre pond constructed at Oklahoma State University (OSU) is used to investigate cooling and heating applications associated with bodies of water. The pond is 17-feet-deep in areas. A test bridge constructed over a portion of this pond is equipped with a ground source heat system. The bridge deck is 20-feet-wide and 60-feet-long. E-PexB pipe loops imbedded in the bridge connect to a ten-ton water-to-water heat pump. This system heats the bridge, preventing the buildup of ice and snow, thus increasing bridge safety while decreasing maintenance. The energy sources feeding the heat pump are a vertical borehole field of six boreholes, and a set of three, four-ton flat plate “Slim Jim” heat exchangers mounted in a submerged vault. Both, pond and hydrant water are used to supply vault water. Hydrant water is carried through a six-foot-deep supply line to ensure temperature stability. Pond water comes from a two-foot vertical intake submerged in nine-feet of water. Each method may be used simultaneously.

Preliminary tests of the flat plate heat exchangers provided the data concerning hydrant source and pond source temperatures. Flow rates from the hydrant and pond water sources were each around 20 gpm. The two-inch diameter distribution pipe used for each source enters a buried concrete control room.

Flat Plate Heat Exchanger System
In the foreground of Figure 1 (page 4) you will see the heat exchanger vault. Baffles near the wall of the heat exchanger vault guide the exiting water. Three flat plate heat exchangers are spaced between the

(continued on page 4)
baffles. The vault is eight-feet high and five-feet wide. The heat exchangers are six-feet by four-feet by 3/8 inch. Each is rated at a four-ton capacity with 12-gpm flow rate.

The control vault for the heat exchanger is also pictured in the middle of Figure 1. Water from the pond enters the control room on the left. Hydrant water enters on the right. A portion of the bridge deck, pond and the bridge control building are seen in the background of this view.

Figure 2 (page 6) shows the front of the control vault after the lid on the heat exchanger has been installed and backfilling has taken place. The manhole containing the control valves for the heat pump connection to the vertical borehole field is in front of the control vault. The borehole field is left of the manhole, and the flat plate heat exchangers. Lines run from the manhole to the heat exchanger field. Two conduits contain instrumentation, control wires, and electric service wires. Heat pump supply and return lines also run from the manhole to the control vault.

A 50-foot-long trench running from the front corner of the control vault to the pond contains a two-inch HDPE suction. This suction line extends 75-feet into the pond and is submerged in nine-feet of water. A piece of pipe connected by a 90° ell to the main line pumps water from a depth of seven-feet. A device attached to the end keeps it facing up when submerged into the pond. A coarse screen placed over the end keeps debris and fish out of the line. Another trench extends from the opposite corner of the control vault to the pond. Water is discharged from the vault using a screened three-inch PVC line laid in this trench. Inside the control vault are the control valve, a pump, thermistors, a flow meter, back flow preventor and strainer. Motorized control valves allow for computer control.

There are also thermistors in the heat exchanger vault and two outside the vault buried in soil. The sensors are connected to the computer in the bridge control building.

**Temperature Profiles**

Tests ran in July and August 2001 partially fulfilled the requirements for the OSU Smart Bridge research project funded by the US Department of Transportation. Pond hydrant water temperatures were obtained as a part of the overall project. This information is pertinent to the design of systems using water from either of these sources for building cooling systems. (continued on page 6)
Calendar of Events

December 7-9, 2001
2001 Ground Water Expo
National Ground Water Association
Nashville, TN
www.ngwa.org/convention/national.html
800-551-7379

February 8-11, 2002
International Home Builders Show
National Association of Home Builders
Atlanta, GA
www.buildersshow.com/2002/02welcome.shtml
800-368-5242

February 27-March 2, 2002
ACCA 34th Annual Conference
Air Conditioning Contractors of America
Kissimmee, FL
www.accaconference.com
703-575-4477

March 11-15, 2002
Train-the-Trainer Workshop
International Ground Source Heat Pump Association
Stillwater, OK
www.igshpa.okstate.edu
800-626-4747

March 13-15, 2002
IGSHPA Installation Workshop
International Ground Source Heat Pump Association
Stillwater, OK
www.igshpa.okstate.edu
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Mark Your Calendar!
The first test in the series began on July 12, 2001. The data obtained during this testing is shown in figure 3. For the initial test the hydrant water line provided all the water to the vault heat exchanger. The air temperature was about 104°F, the six-foot soil temperature was around 79°F, and the hydrant water flowing temperature was 79°F. Fluctuations in air temperature occurred. The hydrant water temperature fluctuated at a delayed and dampened rate. The response of the soil temperature was more pronounced than the hydrant water flow. A high-density layer of rock running toward the pond above the thermistor caused the soil temperature to change at a faster rate. The heat transferred through the rock alone at a faster rate than it would through both soil and rock. The combination of heat from the sun, and ambient conditions allowed for a much a faster temperature response.

The second test series was conducted with both the pond pump and the hydrant valve open simultaneously. Water supplied to the heat exchangers was discharged into the pond at a higher total rate. Air temperatures remained high between the first and second test periods. Soil and water temperatures continued to increase due to the heat. When the test began on July 23, 2001 the air temperature was above 102°F and the six-foot soil temperature was above 78°F.

The hydrant water temperature was 80°F and increasing. The pond water flowing temperature was 85°F and increasing at approximately the same rate.

On July 28, 2001 Oklahoma Mesonet data showed that it rained 1.97 inches in Stillwater. The high temperature was 100°F and the low temperature was 71°F. See figure 3 for details of these variables. Rain and cooler air temperatures had more influence on the pond flow temperature than on the hydrant temperature. There was an abrupt decrease in pond water flowing temperature following the rain and cooler weather. The hydrant water temperature did not change as drastically.

The hydrant valve was closed on July 30, 2001. This testing period would determine how well pond water alone would handle the temperature changes. During this test the pond water flow temperatures increased due to increased air temperatures. On August 2, 2001 it rained 0.38 inches, resulting in a lower pond temperature. Air temperature did not decrease significantly so the primary cooling was caused by the rain and run-off from the surrounding area.

Figure 2.
The manhole pictured to the left allows access to control valves for the vertical borehole field’s heat pump connection. Trenches are dug to hold lines running between the manhole and the control vault. Inside the control vault are the control valve, pump, thermistors, flow meter, back flow preventor and strainer.
A debugging test took place on August 16, 2001 showing a decrease in the general temperature trend. Another test was conducted on August 22, 2001 using the hydrant water flow. The trend followed the air temperature, as it was cooler than in previous tests.

In general, the water temperature followed the air temperature at a delayed rate. It was anticipated that the flowing hydrant water temperature would be less than the six-foot soil temperature. Tests were run on several hydrants in the region. They were all similar temperatures. Water from a hydrant 650 feet from the control vault measured within 0.2°F of the hydrant flow temperature in the control vault. This line feeds directly into the system. Thus, the source of higher temperature is upstream from local hydrants. Lakes supply the water for Stillwater and OSU.

### Applications and Comments on Water Sources

If the application were to duct air through the pond so that the heat would be rejected to the pond from the building, the building temperature would only be cooled to temperatures in the range of 2°F to 6°F higher than the pond temperatures. Figure 3. shows that 87°F source temperature would be the maximum expected for this particular year. It is clear to see that this method was not effective.

A maximum entering water temperature for a GSHP is typically set at 90°F. The entering water temperature is determined by loop length. With the given pond temperatures one is able to operate with an open or a closed loop system. Using an open loop system the temperature would provide an entering water temperature no higher than 87°F. This temperature can be maintained even during extreme summer heat. When using a closed loop system the entering water temperature would be dependent upon the loop lengths and the loop material. This system comes closer to obtaining the 90°F design value. An example is the Bridge Control House. It is heated and cooled with a one-ton heat pump and 60-feet of copper coil in the pond. The coil is in a 12 to 14 foot portion of the pond with an entering water temperature of 84.4°F. At the same time the pond water flowing temperature is about 85°F.

A news release reports that WaterFurnace International, Inc. in Fort Wayne, Indiana, is forming a joint venture with Hardin Geotechnologies in Indianapolis, Indiana. Water Furnace will market a technology that delivers water from the local water company to any home or commercial building as a free source of heating and cooling. The joint venture is known as water+Æ. It is an independent operation available to all heating, air conditioning and refrigeration manufacturers making geothermal and water source units. Water supply systems will be used more and more frequently as research improves. It is important that the application design is dependent upon the water source temperature. As demonstrated by the test data, temperatures in the low 80’s could be expected. In comparison with some other alternatives this provides favorable entering water temperatures.

### Conclusions

This article provides only examples of temperature profiles of some water sources viable for geothermal heat pump applications. It dispels perceptions that the temperature of pond and municipal water supplies are often in the 60’s. In some areas of the United States these temperatures are cooler and data needs to be assembled to determine the local temperature profiles for design purposes.

The trend in hydrant and pond temperature profiles is highly dependent upon the ambient temperature history. At the same time hydrant and pond temperature profiles depend on the water source.

Even in the hot weather of Oklahoma, pond and hydrant water sources are good potential energy and cost saving sources when coupled with ground/water source heat pumps. Reliable designs are based upon reliable data. Further studies are needed to produce models for predicting good design temperature values.

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