Erickson buried 320 barrels filled with water to store heat from greenhouse.

Heat is transported from the greenhouse to the buried barrels by 2,600 ft. of 4-in. dia. pvc.

By Jim Ruen, Contributing Editor

"Earth Pack" Energy System Heats, Cools Farm Buildings

Norm Erickson's earth pack energy storage system provides heating and cooling at a minimal cost. It keeps his large root cellar cool, his greenhouse warm, and provides radiant floor heat and hot water for an office and a large-scale food dehydrator.

Retired from IBM, Erickson has more than 4,500 hazelnut bushes and is doing research with them for both food and fuel production. "We built a greenhouse to start the hazelnut plants and a root cellar to store bare root dormant plants until spring. We also plan to raise winter vegetables in the greenhouse and use the root cellar for storage," he adds.

Erickson's earth-bermed greenhouse acts as a heat collector throughout the year for his heating and cooling system. Hot air collected in the 60 by 28-ft. glazed portion of the building is forced down into a 15-in. dia., double-walled pvc culvert that functions as a manifold. From the manifold, it is distributed through more than 2,600 ft. of 4-in. pvc drainage pipe that lays over the top of 320 high-density poly 55-gal. drums filled with water, sealed and buried in rows. Warm air is transferred from the pipes to the water in the barrels.

At the ends of the 75-ft. long block of barrels, the pipes make a U-turn down under the barrels, carrying the now cooler air back beneath the same storage barrels, to another 15-in. culvert-manifold buried below the floor of the greenhouse. A dozen under-floor pipes distribute the return air along the front edge of the greenhouse to be reheated.

Heat is held in the barrels - and in the dirt around them – by a double-walled umbrella of foam insulation and moisture barrier laid over and under the barrels. The insulation umbrella extends across an additional 12 ft. of earth in front of the greenhouse, allowing heat to also be stored in the packed soil.

To help the soil between the barrels retain heat, it was packed with a air hammer as fill was shoveled in between the barrels. But it is the barrels of water that are key to the plan.

"Water has about 2 1/2 times the energy storage capacity of soil, plus it has the advantage of convective flow to move energy to or from the ventilation heat exchange piping," explains Erickson. "The idea was that when we blow the air out of the hot greenhouse, the heat will be transferred into the water and then disperse into the soil. When we blow in cold air, the reverse occurs."

The goal with the greenhouse is to keep it warm enough overnight so that plants will survive, even in the coldest January.

"It will be in the 80 to 90 degree range on a sunny day in the winter, but at night we will let the temperature in the greenhouse drop to 40 degrees," says Erickson. "When the greenhouse reaches that point, we blow cold air from the greenhouse down through the storage system where it will be warmed and then returned to the greenhouse as needed through the night."

On an early August day when FARM SHOW visited the site, air left the greenhouse at 98 degrees F and returned at 74 degrees. The day before, Erickson said the air temperature going into the pipes was 106 degrees and 76 degrees coming out.

The Root Cellar

Erickson's 15 by 18-ft. root cellar has an 8-ft. ceiling and was constructed with poured concrete, set into a hillside. A double door maintains the inside temperature when entering and exiting.

It's insulated with alternating layers of plastic and foam insulation, two of each. Several feet of soil were then added over the top layer of plastic.

The temperature in the root cellar is dropped by exhausting warm air and bringing in cold air through a pair of duct pipes. A thermostat controls a blower to maintain the temperature needed. The goal for the root cellar is to keep it cool, but not below freezing. It's designed to stay below 60 degrees for most of the summer.

A Second Heating System

Erickson built a second heating system using a solar thermal panel to capture heat and store it in 100 55-gal. poly barrels. This energy bank is also covered with an insulation umbrella but instead of pvc air pipes, a network of 500 ft. of 3/4-in. PEX heat tubing carries heated liquid from the solar panels under the barrels to transfer heat to the water in the barrels.

"Temperatures in those barrels will reach 180 to 190 degrees," says Erickson.

Another 500 ft. of tubing is laid across the top of the barrels to carry heat away from the energy bank and back into the floor of Erickson's office, where it provides radiant floor heat and hot water for a shower and sinks. Erickson is also adapting it to power a food dehydrator.

"We expect to be able to raise hazelnut seedlings about 8 months of the year, storing them in the root cellar as they come out of the greenhouse until shipping them out for planting in mid-April," explains Erickson.

Erickson admits that the system has become a major investment for him. He is learning as he goes and has installed temperature sensors throughout the various energy storage banks.

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A manifold made out of 15-in. dia. plastic culvert distributes heat to the pvc heat pipe.

Double layers of insulation were laid over and under heat storage barrels before they were covered with a thick layer of dirt.

Erickson poses by greenhouse building. Glass front extends up to building's peak.

Cool air is brought back to front side of greenhouse through pvc pipes. After the air is reheated it's recirculated back underground.