OREGON TRAIL MUSHROOMS

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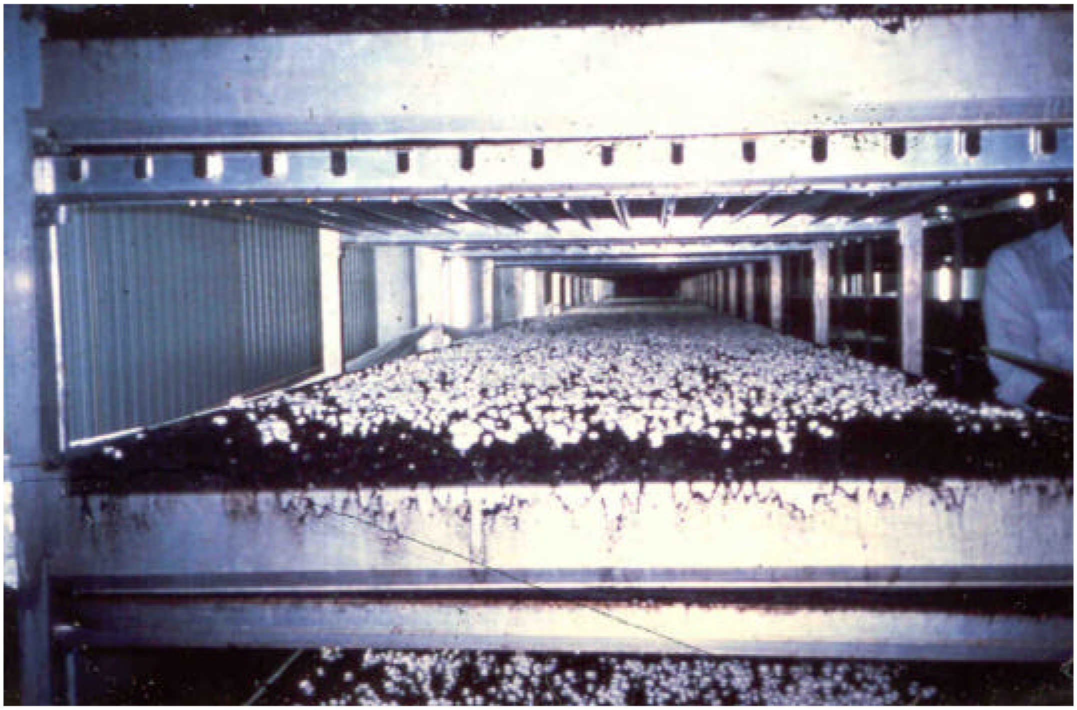


LOCATION

Oregon Trail Mushrooms is located on the east edge of Vale, Oregon, 15 miles west the Oregon-Idaho border. Elevation is about 2,240 ft. Winter temperatures reach -20ºF and summer temperatures 100ºF. The mushroom plant construction was financed through the USDOE Loan Guarantee Program and began production in 1986. Initially, 2,500 tons of white button mushrooms were produced annually. Production now includes other varieties and has increased to 4,000 tons annually. There are 130 employees year round.

RESOURCES

Vale has long been known for its geothermal resources. There are several hot springs in the area. The mushroom plant is on the previous site of hot springs. A geothermally-heated greenhouse, and a slaughter house still utilizes geothermal hot water for cleaning and hog scalding. There was a large geothermal swimming pool and sanatorium just across the highway and several nearby homes also utilize the hot water. Temperature of 198.5ºF with total springs flow of 20 gpm and a 140-ft well were reported by Russell in 1903. Today, wells that more accurately target the resources have temperatures above 220ºF. In the hotter wells, pH ranges from 7.2 to 8.3, TDS is about 1,000 with SiO_2 74 to 113 ppm, Cl about 370 ppm and F 6.1 to 6.6 ppm.

The resource appears to be the result of deep circulating water rising along fractures in completely silicified sandstone and conglomerates along the Willow Creek fault zone. Although there is anomalous heat flow (at least 3 times the surrounding area) in an area about two miles wide and 10 miles long along the fault zone, the only surface manifestations and 29 wells are in an area of about 40 acres between the northern end of Reinhardt Buttes and the Malheur River (Gannett, 1988).

UTILIZATION

250 gpm of geothermal fluid at 220ºF is pumped from one 250-ft deep well by an oil- lubricated vertical lineshaft 20-hp pump. A similar well with a 10-hp pump is available as standby. Geothermal fluid flows through two plate-and-frame titanium heat exchangers in series, which supply 213ºF hot water to a 400-ton lithium bromide chiller and growing room where fan coil units are supplied with 191ºF hot and 40ºF chilled water via a 4-pipe system. The geothermal effluent is also provided to five homes for space and domestic hot water heating, a swimming pool located about one mile away in the city and to a corn dryer (in season), and/or injected into two injection wells.

The growing medium, a mixture of wheat straw, chicken manure, gypsum, alfalfa seed screenings and urea is composted off site and trucked to the plant. The compost is then moved by conveyor to one of three pasteurizing rooms; where, it is held for a 7-day controlled heating and cooling schedule. Maximum pasteurizing temperature is 140ºF. Air is forced through the compost via tunnels and grated floors. After pasteurization, the compost is moved to the growing rooms by conveyor. There are 42 growing rooms, each 20 ft wide, 85 ft long and 12 ft high with removable ends to facilitate conveying compost in and out. Compost is loaded into six shelves on either side of a corridor providing a growing area of 4,320 ft^2 per room. Spawn is added and the room is held at 80°F and 94% relative humidity for 35 days when the first crop is harvested. Rooms are held at 64°F and 94% relative humidity for a 21-day growing period during which three crops are harvested. Harvesting is done by hand. Temperature and humidity are closely controlled by a central computer system. After harvesting, mushrooms are sent to chill rooms for sorting, packaging and storage awaiting shipment. Chill and storage areas are cooled by centrifugal (electric) chillers.

The geothermal system provides about 5×10^6 Btu/hr (1.47 MWt) (depending on outdoor air conditions) and replaces about 430,000 therms of natural gas annually to the mushroom facility; plus provides heat for the homes, pool and corn drier.

OPERATING COSTS

Operating costs for the geothermal system are minimal. Geothermal fluids are limited to the two heat exchangers and a small amount of piping. There have been no problems with the piping, but one set of pump bowls have been replaced since plant startup. Stainless steel plates in the heat exchangers were replaced with titanium and there has been no problems, not even cleaning since then. Maintenance personnel stated that it cost less than $500 per month to operate the chiller including maintenance and pumping, and that a chiller of equal duty would cost at least $500 per week.

REGULATORY/ENVIRONMENTAL ISSUES

None after obtaining production and injection well permits.

PROBLEMS AND SOLUTIONS

Shortly after plant startup, it was noted that wells supplying the five homes, the corn drier and a slaughter house were declining in both water levels and temperatures. Oregon Trail Mushrooms obtained the water rights for the five home wells in exchange for a guaranteed supply of effluent water sufficient to meet their needs. They no longer have pumping nor pump and well maintenance costs. The corn drier owner maintains his rights, but agreed not to pump so long as he is supplied with sufficient effluent. All effluent ultimately is injected into Oregon Trail's injections wells. Since the homes and drier wells are not used, the slaughter house well has stabilized and the owner continues on his original system. The remainder of the 29 wells in the immediate area are not used.

As noted above, there were problems with the stainless steel heat exchangers leaking at the gaskets. Converting to titanium has solved the problem.

At plant startup, the temperature at the production wells was 228°F. This has dropped to 220°F, probably due to lower water levels allowing cool water intrusion from the river, the injection wells, or the other side of the fault where wells were historically cooler by 20 - 40°F. The temperature drop caused a decrease in the capacity of the lithium bromide chiller. This was somewhat offset by running chilled water through the heating coils when cooling the grow rooms. Also, when a few of the coils needed replacing, higher capacity coils were installed. Now they plan to add more grow rooms–hence, the recent installation of a booster boiler in the closed chiller circuit. It has not yet been operated except for testing. Also planned are modifications to the piping to handle additional load and changing fan coils to increase efficiency.

CONCLUSIONS

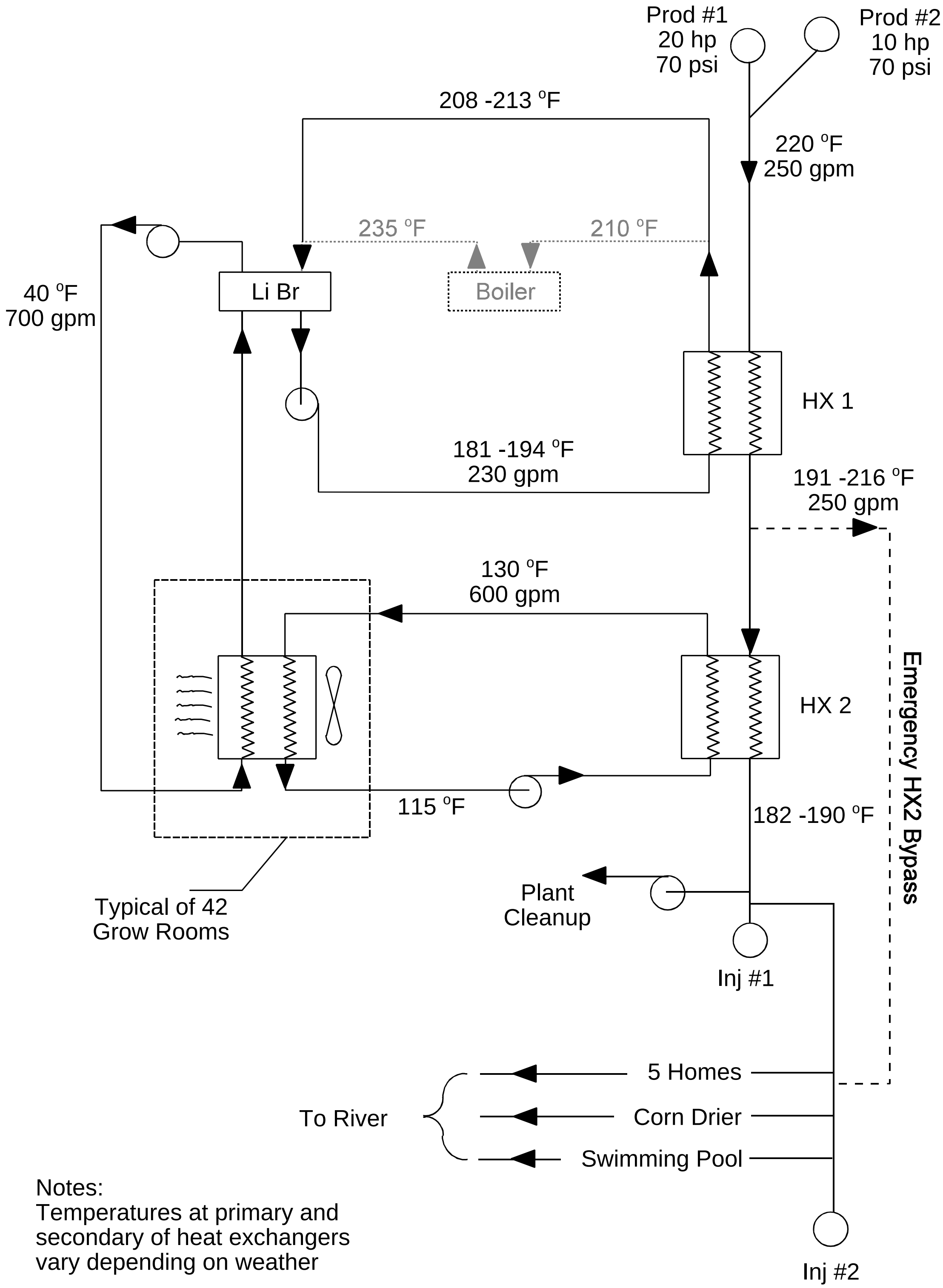
This is a very successful project that is the result of the USDOE Loan Guarantee Program. The plant has expanded and increased production since startup and continues to expand.

Lithium bromide chillers, while not common in geothermal applications, are economical where temperatures of 220°F are available.

Where there is interference between wells of a number of owners and uses, reasonable people can probably reach an agreement that is beneficial to all.

REFERENCES

Gannett, Marshall W., 1988. "Hydrogeologic Assessment of the Developed Aquifer Near Vale, Oregon." State of Oregon Water Resources Department. Open-File Report No. 88-04.



Notes:
Temperatures at primary and
secondary of heat exchangers
vary depending on weather