INDUSTRIAL USES OF GEOTHERMAL ENERGY IN THE USA

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INTRODUCTION

- Industrial applications & agricultural drying
- Few in number in the U.S.
- Large scale operations dominate
  - Gold ore heap leaching
  - Onion dehydration
- Many small scale operations:
  - Milk pasteurization, laundry, beer production, alcohol production and mushroom growing.
ENERGY USE

- Installed capacity = 38 MWt
- Annual energy use = 500 TJ (140 GWh)
- Mainly due to agricultural drying
- Enhanced petroleum recovery using injected geothermal water – NE Wyoming and adjacent states estimated at 8,600 TJ/yr (2,390 GWh) and approx. 250 MWt
  - However, no reliable data available
KLAMATH FALLS GEOTHERMAL BREWERY
KLAMATH BASIN BREWING CO.

- Replaced the Crater Lake Creamery in 2005
- Now known for making great craft beer.
- The brewery is connected to the city geothermal district heating system
  - Hot water is provided through a heat exchanger for use of hot water in the brewing process, for space heating and for snow melting on the sidewalk
- The brewery uses about 1,700 therms (179 GJ) of geothermal energy a month at a cost of $1,360, saving $1,190 over fossil fuel (peak month usage) – and 430 therms (45 GJ) at a cost of $344, savings of $300 (off peak month).
A small community cooperative in northern California (I’SOT) retrofitted gas-fired 55-lb (25 kg) industrial laundry driers to use geothermal water supplied at 150°F (66°C). A plenum was mounted over a larger air-flow vent with a geothermal hot water coil. The retrofit average about $1,800 per drier including the coil, plenum, control valve, fitting and copper supply and return lines. Simple payback was under 3 years.
Geothermal heat used in laundry machines – Canby, California
Used in gold recovery from Nevada mines
Process consists of dripping a dilute sodium cyanide solution over a crushed ore pile or heap
The gold, in solution, drains from the heap and extracted by a charcoal process producing a bar of impure gold (doré).
The cyanide solution is then recycled
Operation can recover up to 95% of gold

Also, used for silver extraction

Under normal circumstances – in Nevada – operation takes place mid-March to late-October (min. production temp. = 4°C - 40°F)

Using geothermal energy
- Recovered enhanced by 5 to 17% by accelerating the chemical reaction
- Year-around operation possible
Heap leaching flow diagram with geothermal
Two mines in Nevada have used geothermal

Round Mountain

- 86,000 tonnes (95,000 tons) of ore/day
- 1g/tonne (0.035 oz/ton) = 21,000 kg (46,000 lbs) of gold in 2001
- Geothermal @ 82°C and 69 L/s (180°F and 1,100 gpm)
- 14.1 MWt and 208 TJ/yr (57 GWh)
A large geothermal onion and garlic dehydrator is located in NW Nevada.

This unit can each process 4.5 to 6.8 tonnes (10,000 to 15,000 lbs) of wet onions/hr – drying them from 80% to 5% moisture (output = 0.9 to 1.4 tonnes/hr – 2,000 to 3,000 lbs/hr).

35 MJ/kg used (15,000 Btu/dry lb) = 208 TJ/yr (58 GWh) (100 billion Btu/yr) over 150 days period.

Product used in soups, baked goods, salt, & seasoning as powders to slices.
(assumed outside temperature is 4°C)
AGRICULTURAL DRYING 2

- Single-line, continuous-belt dryer use
  - 3.8 m (12.5 ft.) wide
  - 58 to 65 m (190 to 215 ft.) long
  - 3 to 4 sections (A to D) – 96 to 74°C (205 to 165°F)
  - Processing 4.5 to 6.8 tonnes/hr (10,000 to 15,000 lbs/hr) of wet onions
  - Using 2,450 m³/hr (86,500 ft³) of air
  - 42 GJ/hr (4.3 million Btu/hr)
  - Onions 5 cm to 2 m (2 in. to 6 ft.) deep
  - Bryair desiccation unit required in final stage
MILK PASTEURIZATION 1

- Medo-Bel Creamery in Klamath Falls, Oregon used geothermal heat in milk pasteurization for about 50 years.
- 233-m (765 ft.) deep well @ 87°C @ 6.3 L/s (189°F and 100 gpm).
- Used a 3-section plate heat exchanger.
- Minimum temperature needed: 78°C (172°F) for 15 seconds in short term pasteurizer.
Medo-Bel pasteurization flow diagram
Medo-Bel Creamery with plate heat exchanger
SUMMARY

- Industrial use dominated by large facilities (onion dehydration, and heap leaching)
- Small industrial uses include: laundries, beer production, mushroom growing, mineral water processing, and an industrial park in Hawaii (experimental work)
- Enhanced petroleum recovery in NE Wyoming using injected geothermal water – no reliable data
- Total as high as 100 MWt and 2,000 TJ/yr (555 GWh) + 250 MWt and 8,600 TJ/yr (2,390 GWh)
- Today 38 MWt and 500 TJ/yr (140 GWh)
THANK YOU