GEOTHERMAL HEATING OF A LARGE COMMERCIAL GREENHOUSE

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Masson Geothermal Greenhouse, Radium Springs, New Mexico
Radium Springs
15 miles north
Las Cruces

South-central
New Mexico
(Rio Grande Rift)

4,000 ft Elevation

3,400 Degree
Heating Days

1,450 Degree
Cooling Days

Mean Annual
Temperature
15.5° C (60° F)
PURPOSE

THE PRIMARY OBJECT OF GEOTHERMAL USE IN A GREENHOUSE IS TO GROW THE BEST QUALITY PRODUCT SAFELY AND PROFITABLY WITH ENERGY SAVINGS

Masson Geothermal Greenhouse, Radium Springs, New Mexico
GEOTHERMAL GREENHOUSE HEATING

- CENTRAL HOT WATER SYSTEM
- GEOTHERMAL WELLS AND HEAT EXCHANGERS REPLACE CONVENTIONAL FOSSIL FUEL BOILER

GEOTHERMAL INFRASTRUCTURE

- PRODUCTION WELLS
- INJECTION WELLS
- HEAT EXCHANGERS
- PIPE LINES

Geothermal Heating Distribution Manifold, Masson Geothermal Greenhouse, Radium Springs, New Mexico
SITE ATTRIBUTES

- Geothermal and fresh water supplies co-located
- Shallow reservoir and deep reservoir  
  - Injection  
  - Production
- Private surface
- Level land
GEOLOGY

LEGEND
Qal Recent Quaternary alluvium
Qws Recent windblown sand
Qcr Quaternary Comp Rice Fm
Tr Oligocene Rhyolite (intrusive)
Tpp Eocene Palm Park Fm
Fault (bar on downthrown block)

Production well
Injection well

Geology modified from Seager, 1975
PRODUCTION AND INJECTION WELLS

PROBLEMS
• Production temperature decreases
• Injection wells not taking full production

SOLUTIONS
• Site production wells further from injection wells
• Add production from the deep parent reservoir
• Eliminate open hole completions for injection wells and add liners
• Use larger diameter injection wells
PRODUCTION WELL
RADIUM SPRINGS

- Isothermal in Paleozoic carbonate reservoir
- Conductive across Tertiary Palm Park Aquitard
CORROSION

PROBLEMS

- Pitting of stainless steel heat exchangers
- Corroded well casing adjacent fluctuating water level

SOLUTIONS

- Titanium steel heat exchangers
- High temperature fiberglass casing

FLUID CHEMISTRY

TDS – 3,600 to 3,700 mg/L
Cl – 1,500 to 1,700 mg/L

Original plate and frame heat exchanger, Masson Geothermal Greenhouse, Radium Springs, New Mexico

Plate and frame heat exchanger dismantled for cleaning

Williamson, NREL

NMSU
HOT WATER STORAGE

PROBLEMS

• Slow heating response to rapid temperature/weather changes
• Continue optimal heating if one of the well pumps fails on a winter night

SOLUTIONS

• Use large 167,000 gallon insulated hot water storage tank to buffer heating system
• Use radiant floor heating
RADIANT FLOOR HEATING

ADVANTAGES

• Provides thermal mass and stabilized heating system
• Decreases geothermal well production
• Places uniform heat at plant roots
• Allows for flood irrigation

Construction of new 2-acre greenhouse range with radiant floor heating, Masson Geothermal Greenhouse, Radium Springs, New Mexico

Williamson, NREL
FLOOD IRRIGATION

PROBLEM
• Irrigation water is treated with reverse osmosis (RO) to remove undesirable minerals and nutrients are added (important cost factors)

SOLUTION
• Flood irrigation conserves water by recycling excess water and nutrients and decreases costs and disposal needs

Completed 2-acre greenhouse range with radiant floor heating and flood irrigation, Masson Geothermal Greenhouse, Radium Springs, New Mexico
ECONOMICS

ANNUAL SALES (wholesale)
$325,000 to $850,000 per acre

EMPLOYMENT
4 to 8 employees per acre

ENERGY SAVINGS
$43,861/yr per acre
4,200 MMbtu/yr/acre at less than $1.50/MMbtu
Natural gas $12.50/MMbtu (boiler inefficiency included)

Masson Geothermal
Greenhouse, Radium Springs,
New Mexico
SUMMARY

- 3rd largest geothermal greenhouse in US (18 acres)
- Installed heating capacity 30 x 10^6 Btu/hr (8.8 MWt)
- Estimated capacity factor 30 percent
- Average annual energy use 79 x 10^9 Btu
- Deep Production (800 ft max)
  - Winter - 195° F at 750 gpm
- Shallow Production (325 ft max)
  - Winter - 165° F at 720 gpm
  - Summer - 165° F at 430 gpm
- Started at 4 acres in 1987 with plans to grow to 40 acres in future
- Resource has potential to add binary-cycle power for on-site use before greenhouse heating