DIRECT USE OF GEOTHERMAL ENERGY: MENENGAI DIRECT USE PILOT PROJECTS IN KENYA

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1. INTRODUCTION

- Direct Use of geothermal energy is the utilization of heat energy for industrial, agricultural and leisure applications without converting it into another form.

  - Direct Uses:
    - Heat energy
    - Therapeutic uses
    - Other by-products – (gases, minerals and water)
The possible application depends on the resource temperatures, available flow rate, the chemistry of the geothermal fluid and the distance to the resource.
3. DIRECT USE APPLICATIONS IN KENYA

i. Green house Heating at Oserian

50 ha of rose flower is grown in a geothermal heated greenhouse for export
ii. Pyrethrum Drying at Eburru

- Plant constructed in the 1920s
- Uses heat from a shallow geothermal well
iii. Swimming Pools and Spa

- The Olkaria Spa
Swimming Pools and Spa

- Lake Bogoria Spa Hotel
geothermal heated
swimming pool
iv. Condensate Harvesting in Eburru, Suswa and Paka

Local communities condense steam from fumaroles for domestic uses in Suswa
v. Direct Use Demonstration Projects in Menengai

Four demonstration units have been set up:

- Geothermal powered dairy unit
- Geothermal Heated Aquaculture Ponds
- Geothermal Heated Green house
- Geothermal Powered Laundry Unit
The Demonstration Unit’s Geothermal heating Concept

- Hot fluid (Hot Brine) from Menengai MW-03

- A water bath is constructed and a stainless steel heat exchanger submerged inside the bath. Cold water is heated from 25°C to 85°C through a counter flow movement. This hot water is then used in all the projects.
4. THE MENENGAI PILOT PROJECTS IN KENYA

Schematic Diagram for MW-03 Demonstration Projects
Menengai Pilot projects in Kenya cont’d (1)

MW-03 Geothermal well (heat source)

Water bath heat exchanger
i. Containerized Dairy Unit

- A milk processing unit that uses heat from the geothermal heat exchanger for milk pasteurization.
- Hot water at $80^\circ C$ heats milk to a temperature of $65^\circ C - 67^\circ C$ for a period of 30 minutes.
- Milk is then cooled in two processes; using room temperature water and using ice water to temperatures as low as $4^\circ C$. 

Milk processing container

Inside the milk Processing unit
ii. Heated Aquatic Ponds

- Water in the ponds is geothermal heated to 29°C
- This is the temperature optimal for fish metabolism, leading to:
  - Better feed conversion efficiency
  - Quick maturity
  - More harvests per year leading to More income

- Waste water from the fish ponds is then re-used as fertilizer for crops in the greenhouse
iii. Heated Greenhouse

- Tomato and capsicum crops have been grown inside a greenhouse.
- Geothermal heated water at 50°C is circulated in pipes at night, early morning and during wet seasons to control temperature and relative humidity.
- This reduces fungal infection on the crops scaling down the use of fungicides in the greenhouse, and improving the growth rate, fruiting and quality.
Menengai Pilot projects in Kenya, cont’d (7)

Heated Greenhouse, cont’d (1)

• Other reasons for using geothermal energy
  – Sterilize water for irrigation
  – Supply of Carbon dioxide which improves photosynthesis of the crops
iv. Geothermal Operated Laundromat

- Utilizes geothermal heated water in the washers and dryers. Water for the washer is mixed with cold water to temperatures depending on the type of garments to be washed.
- The dryer has a specially designed fan coil unit that uses hot water to dry the garments.

Washers and dryers in the Laundromat
Menengai Pilot projects in Kenya, cont’d (11)

Geothermal Operated Laundromat (cont’d)
5. Successes and challenges

The direct use pilot projects has had successes and challenges as well as lessons:

• It has successfully demonstrated to students, investors and the local communities that the technology is viable.

• Low value procurements

• There is need to incorporate other disciplines like Agriculturalists, dairy experts, aquaculture experts alongside the geothermal experts.
WAY FORWARD

Data collection is on-going for the projects. Data collected includes:

- Tonnage of brine used to run the projects
- The aquatic pond temperatures
- Amount of water used in the fish ponds
- Temperature and humidity inside the greenhouse
- Weight of crops harvested from the greenhouse
- Weight of fish harvested from the aquatic ponds
- Amount of food fed to the fish
- Crop nutrients added

Analysis of this data will form a base reference during expansion and setting up of industries in the industrial park.
6. CONCLUSION

• Alternative uses of geothermal energy is applicable in Menengai, and can be replicated in other geothermal rich zones.

• Processes that require heat can utilize geothermal energy leading to savings and reducing carbon emissions.

• Heating of water in aquatic ponds and green houses increases yield.
The Menengai Heat Exchanger