CURING BLOCKS AND DRYING FRUIT IN GUATEMALA

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INTRODUCTION

In Guatemala, there are six geothermal fields recognized as potential sources of exploitation and only two have already been utilized. The first two successful uses of geothermal energy in Guatemala have been direct-use applications at the Amatitlan Geothermal site.

Figure 1. Geothermal areas of Guatemala.

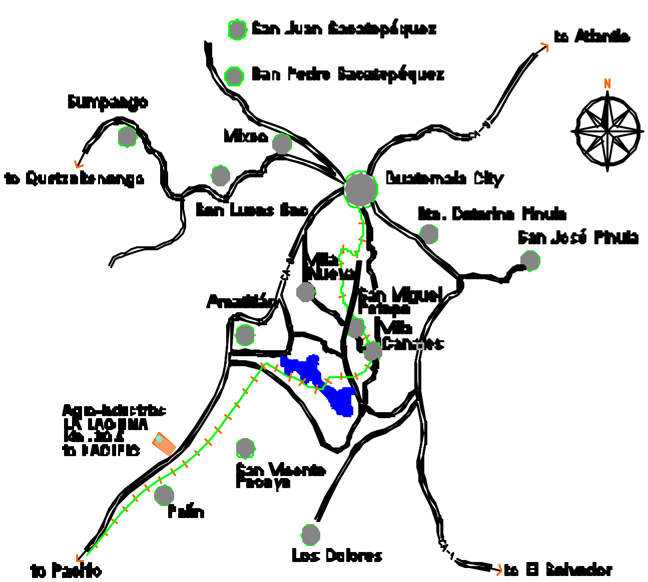

Figure 2. Detailed map of the Amatitlau region.

The first one is Bloteca, a construction block factory established about 20 years ago and that recently started using geothermal steam in the curing process of concrete products. The other one is Agroindustrias La Laguna, a fruit dehydration plant, that was setup as an experimental and demonstration project. While developing this second project the owners decided to bring a product, Eco-Fruit, to the local market using the plant. The product was so successful that it has been in all supermarket chains for the past two and a half years.

BLOTECA

In the 1976 Guatemala earthquake, poor construction materials caused most of the destruction. Most of the houses where built with adobe bricks, and casualties where not really from falling objects, but from collapse and suffocation. From this experience the goverment implemented new building regulations mainly for house construction.

Because of these regulations, a group of investors decided to setup a construction block factory since few existed in the market. Since Amatitlan was just 30 km away from the city it offered a good spot, not only because it reduced transportation costs, but due to the fact that it was located in a volcanic zone where suitable materials are located close by. The materials used are pumice, gravel, limestone, etc., which are very abundant in a volcanic zone; however, it never occurred to use geothermal steam to supply the factory for the curing process of the plant.

Figure 3. Bloteca loading area.

By 1993, the demand on the products from Bloteca was so high that the production could not keep up with the demand and new factories started to come into the market. The need to set up a new production line was obvious. Since the steam supply was one of the biggest problems and having to buy a new boiler, the project was put on hold for some time.

Figure 4.   Well and supply line.

The answer came up while drilling a well to obtain a water supply. The drilling had to stop because the water was too hot. The well actually started flowing steam and water and the geothermal resource was discovered. A few geophysical studies where conducted, like electrical resistivity and electric potential. This showed the most favorable site to drill a production well.

In May 1994, a second well, B-2, was drilled to a depth of 700 feet (213 m) and with a downhole temperature of 185 C. This wells produces enough steam to supply the needs of the plant.

The system consists of two different lines that control the flow of the well, one that goes into a silencer and then into a weir to measure the water before injection, and the other line that goes into a cyclone separator. Since the steam is not needed all the time, it is controlled by regulating the flow that goes into the cyclone separator and then to the distribution lines.

Figure 5.   Cyclone separator.

Although in Bloteca they are concerned on how much steam this well can produce, they are concerned more on how much steam they do not have to produce by burning fuel. A plant with this capacity needs to consume around 16,000 gal (57 tonnes) of diesel fuel a month. The price on Guatemala of diesel fuel in Guatemala is about US$ 1.50/gal ($0.40/liter); so, this come up to a savings of US$ 24,000 a month.

All of the installation including the drilling of the well, cyclone separator and distribution lines came up to around US$ 200,000. So the investment was paid of in less than one year and if we multiply the next three years of operation, we come up to a benefit of US$ 864,000. This is a benefit not just economically for the plant but for Guatemala not having to depend on the import of fuel. It also qualifies Bloteca as a plant with a environmental friendly process.

***Figure 6.   Bloteca process line 2*.**

At present, Bloteca produces 1.5 million units a month and it offers 24 types of blocks and 4 grades of fire resistance blocks.

ECO-FRUIT

Agroindustrias La Laguna was originally just a experimental and demostration project on which it was intended to prove in Guatemala that geothermal energy could be applied in a agroindustrial project. In this case, dehydration was the process selected. The pilot plant was setup and proven and while the investors decided to find a way to make it economically attractive they decided to dry fruit.

Fruit is abundant in Guatemala and a lot of the harvest does not go into export since it does not comply with international standards of shape, color and form. All of the reject fruit stays in the country and goes to waste, which is available in the market at a very low price. The intention of the project was to give the exporters a service on which they could give an added value to the fruit they do not export and make it attractive to the export market.

This project was undertaken in order to start making some profit by extending the market of a local product and selling it in small stores as a natural product with a environmental friendly process. The product was so successful that it has been in all the supermarket chains for more than two years. The products produced are: pineapple, mango, banana, apple and pears.

Figure 7. Samples of the dried fruit.

The project started with the idea to use a downhole heat exchanger to extract the heat. A well was drilled with a 12" diameter all the way down. A downhole heat exchanger was installed and tested. The performance decreased after a few hours of operation so some tests where conducted. A temperature profile was taken and it did not give very good result. (see Fig. 10 - no enhancer).

To increase the performance of the downhole heat exchanger an enhancer tube was used. This is a 4-in. diameter pipe with perforation at the two bottom tube segment, solid in the middle and perforated again at two tube lengths at almost the top of the pipe. This creates a convention cell that causes the temperature profile to be almost linear all the way down (see Fig. 10 - enhancer installed).

After setting up the enhancer, the performance of the downhole heat exchanger increased more than enough to supply the heat load of the dehydration plant.

The concept of the system is very simple. The resource is only used as a heat source and does not supply the system with any amount of fluid. Water is pumped from a process water tank through the heat exchanger where it gains temperature. This water is then pumped through a finned tube heat exchanger (radiator coil, three step) where the airstream, that dries the fruit, is heated. The air dries the fruit that is set

Figure 8. Setting up the DHE.

Figure 9. Setting up the enhancer.

up in trays and tray-trucks inside a tunnel drier. The fruit stays inside the tunnel drier until its water content is reduced to 4%.

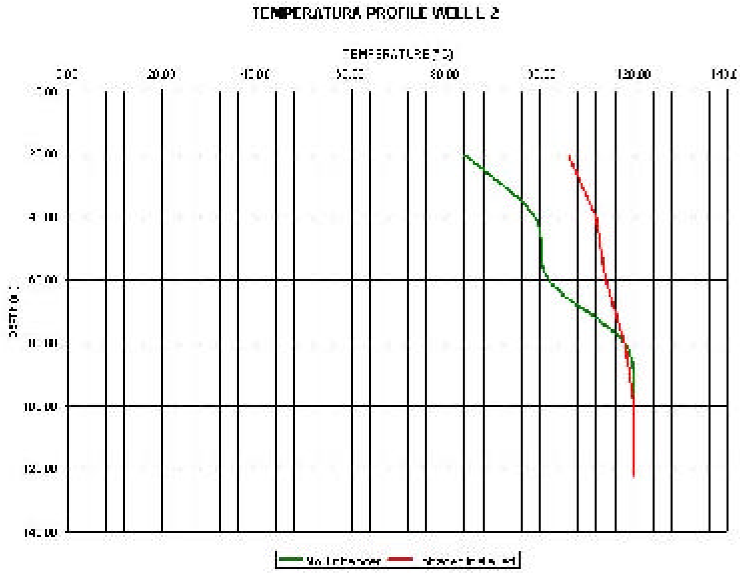

Figure 10. ***Temperature profile of well L-2.***

At the moment, the capacity of the plant varies depending on the fruit it handles and the way the fruit is set up. Either slices or cubes yield a different capacity for the plant, the average is:

Fruit	Capacity Pounds (kg)	Drying Time (hours)
Banana	1800 (816)	22
Mango	1600 (726)	16
Pineapple	1800 (816)	18
Pear	1500 (680)	12
Apple	1500 (680)	12

A. Weighing the fruit. B. Slicing.

C. Setting up in trays. D. Tray trucks.

Figure 11. Steps in processing the fruit.

CONCLUSIONS

I believe that, although direct-use projects are generally smaller in scale that power generation, they have a greater economical benefit in countries like Guatemala. You have to build something around the use of the geothermal energy use. You keep more people involved at all times so in the long run they will create a larger development in a country like Guatemala.

REFERENCES

Lienau, P., 1999. "Industrial Applications," Geothermal Direct-Use Engineering and Design Guidebook. Geo-Heat Center, Klamath Falls, OR.

Merida, L., 1994. Fruit Dehydration Thesis. Geothermal Institute, University of Auckland, New Zealand.

Popovski, K., 1994. "Direct Application in Agriculture." Geothermal Institute, University of Auckland, New Zealand.

Rafferty, K. and G. Culver, 1991. "Heat Exchangers," Geothermal Direct-Use Engineering and Design Guidebook. Geo-Heat Center, Klamath Falls, OR.