INTERNATIONAL SUMMER SCHOOL
on Direct Application of Geothermal Energy
Under the auspice of the Division of Earth Sciences UNESCO IGA

EXAMPLE OF A GEOTHERMAL PROJECT FROM AZORES ISLAND

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ABSTRACT

The present project was developed in the biggest island of the Azores archipelago, S.Miguel island under the EC programme THERMIE in 1994. It is a pilot project in the Azores, using a discharging geothermal water from a nearby power station in order to heat a complex of greenhouses for horticulture crops.
The project is still running but some modifications were implemented after the first phase of the project.

Fig.1. General view to the greenhouse complex in Ribeira Grande, Azores

INTRODUCTION

The potential for geothermal energy in Portugal is of two types, a high enthalpy activity confined only to Azores archipelago and a low enthalpy use confined to the mainland .

The Azores Islands are a group of nine volcanic islands of recent geological origin situated in the Atlantic Ocean. S.Miguel is the biggest island occupying an area of 765 Km2 and it is the island subject to an intense geothermal site investigation.

The geothermal energy production in S.Miguel island is supported by two power stations reported by SOGEO- Sociedade Geotérmica dos Açores which main activi-

ty is the production of electricity from geothermal fluids:

CGPV: Central Geotérmica do Pico Vermelho, a Mitsubishi 3 MW power plant operating at Ribeira Grande rift valley (north of S. Miguel) since 1990. It is a reservoir of liquid-dominated type. This CGPV is feed by an exploitation well of 811 m, with a total flow of 120 ton/h at 6 barg; and

CGRG: Central Geotérmica da Ribeira Grande with an output of 5 MW - Phase A supplied by Ormat.

These power stations cover 20% of electricity demand of the island, i.e., 50% of total demand of the archipelago. The total available flow is around 600 ton/hr.

Heating is a major concern to comercial greenhouse producers all over the world. As for the Azorean growers there isn't such big concern because the temperatures year round are not so low compared to other places and crop protection is not significative in this region. The main objective of greenhouse heating is to reach in every moment an environmental temperature near to the one being the optimal for the crop growing.

Even so, in this project we tried to demonstrate, if one heats the greenhouse during the months of lowest temperatures, the yield and the quality would be much higher than in an unheated greenhouse.

Fig.2. Internal view of a greenhouse (drip irrigation system)

DESCRIPTION OF THE PROJECT

The pilot project in question uses the discharging geo water from Central Geotérmica do Pico Vermelho (CGPV), of 90-95Celsius and a flow of 8 li/s. At this moment only 3.2li/s is used to heat 5 greenhouses of 200m2 each at the peak period from October to May.

The hot galvanized steel structure of the greenhouses was specially made for the "sui generis" climatic conditions of S.Miguel, very strong winds up to 120 Km/hr and high relative humidity around 100%. The covering of the greenhouses also was chosen in accordance with these conditions and solar and temperature factors, being Ondex Bio 2, wavy rigid PVC of 90% transparency .

Two types of heating systems installations connected in cascade is used : "fan jet" forced air heating and soil heating. The air heating system consists of a water/air heat exchanger fan for blowing the warm air into the distribution line made of transparent PE sleeve hanged below the greenhouse roof. The substrate heating system consists of corrugated PP black tubes on or below the ground with a water temperature of 35-25Celsius.

A plate heat exchanger is installed in the central station in order to heat the municipal water instead of a direct connection to the water source. Thus it is possible to avoid the scaling problems in the heating system, which was a major problem when the project started running. The small scaling is located in a small and easy place for cleaning.

Fully automatic regulation of the inside climate parameters (temperature, relative humidity) connected to an outside anemometer (wind velocity) which controls the opening and closure of the lateral and roof

windows, is designed, in order to reach maintenance of their optimal values and an even distribution in the protected space.

A Data Logger system is also installed in order to record all the data related to environmental parameters which influence the growth of the crops in the greenhouses.

The crops are grown in a soilless system, "Hydroponic" system using local volcanic substrates, pumice and black "bagacina" respectively.

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"Hydroponics" is the growing of plants in systems isolated from the soil, and fed with total water and nutrients required. Thus, the soil is substituted - in its function to supply nutrients to the plants – by an artificial nutrient solution which is provided to the crop by the irrigation system known as "fertigation". Since in hydroponics the only source of nutrient supply to the roots is virtually the nutrient solution, the latter should contain, in sufficient quantities, all the nutrients which are essential for plant growth and development.

Fig.3. "Fan-jet" geothermal heating system

RESULTS

It was proven that higher yields can be obtained in geothermal heated greenhouses in comparison with yields taken from non heated greenhouses as well as products of higher quality (Table I).

It was shown that traditional crops which are usually not grown in greenhouses may be cultivated in them and that their crop production cycle is shorter, better and of uniform quality. This is the case of papaya crop.

Fig.4. Automatic regulation complete

Also throughout the heating period an increase of +- 5 Celsius was shown in the air temperature of the heated greenhouses compared with an unheated one during the heating season, meaning higher yields and low incidence of plant diseases.

Table I - Comparison of yields between heated and non heated crops.

CROP	Yield (Kg/m2) INOVA	Yield (Kg/m2) TRADITIONAL	*Yield (Kg/m2) INOVA-Heated	Increase of Yield (%)	*Increase of Yield (%)
Capegooseberry	.58	.41	.87	41	112
Melon	7.5	4.0	11	88	175

CONCLUSIONS

INOVA developed the first project using the discharged geo water from CGPV but at this moment other projects are on the way at Parque Industrial da Ribeira Grande. There are a few more other alternatives but the biggest problem is the location of the existing power plants about 20Km from the main city where the industries are located.

Anyway, this project proves that it is possible to develop a technology adapted to the characteristics of the available geothermal effluent to heat greenhouses as well as it is possible to get higher yields than traditional greenhouse production..

However, it is necessary to believe in the project, in its research and undertake the risks.

Fig.5. Examples of excellent quality of fruits grown in geothermally heated greenhouses