TECHNICAL SOLUTIONS FOR HEATING SPECIAL GREENHOUSES AT RIBEIRA GRANDE, AZORES

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ABSTRACT

In 1994 a project was presented under the auspices of an EC Program THERMIE in order to optimize a natural resource of high enthalpy using waste heat from a Geothermal power plant (90°C and a flow of 8 l/sec.) for heating a complex of greenhouses in which it is grown different horticulture plants in different cultivation techniques, hydroponics. These greenhouses are adapted to the local specific climate conditions of very strong winds (up to 170 km/hr) and high humidity (up to 90%).

The optimisation of the usage of geothermal energy in heating the complex of greenhouses as well as the introduction of several technical solutions was achieved through another EC program ENERGIA in 1998.

2. INTRODUCTION

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 km^2 and it is the island subject to an intense geothermal site investigation. At depths close to 600 m, a 200°C temperature was encountered. In S. Miguel, 4 deep wells were already drilled and a 3 MW Mitsubishi power plant is operating at Ribeira Grande rift valley (North of S. Miguel).

The discharging geothermal water of the existing power plant used is of 90-95°C and a flow of 8 l/s. The project enables substitution of 415.000 kWh/year heat energy of imported fossil fuels or electricity with local available geothermal energy, and the annual consumption is equivalent to 45.75 toe/year.

The project consists of four 200 m^2 and one 96 m^2 greenhouses covered by Bi-Ondex material with top and lateral ventilation openings.

Two types of heating systems installations connected in cascade is used: “fan jet” forced air heating and soil heating. Fully automatic regulation of the entire greenhouse inside climate parameters is designed in order to reach maintenance of their optimal values and an even distribution in the protected space.

The project is in flow since 1997 and during the 1st phase of the project "scaling" of silica salts and entrance of air inside the pipeline disturbing the work of the pumps were major problems which needed to be solved.

So, in 1998 through the EC program ENERGIA it was possible to optimize all of the systems already installed in the project which were heating environmental control, irrigation and data acquisition systems respectively.

3. IMPLEMENTED SOLUTIONS

The new heating system consists of the installation of a plate heat exchanger and a new pump system, substitution of all PP corrugated tubes for substrate heating and introduction of heated fresh water into the system instead of a direct utilization of the geothermal water.

The optimisation of the environmental control system consists of the transformation of the existing system based on electrical boards with thermostats and relays into a system based on microprocessors controlled by a personal computer. The new system allows total freedom in programming the environmental control based on temperature, relative humidity and solar radiation measured in/outside of the greenhouses as well as it allows the gradual and independent opening and closing of the upward and lateral windows of each greenhouse.

The automation of the irrigation system consists of enlargement and improvement of the existing program AGRONIC 6000 through the inclusion of a connecting interface of the irrigation system into a computer for stored data acquisition and system programming.

The improvement of the data acquisition system includes the definitive installation of the existing system, repairmen or substitution and calibration of all sensors.

4. ENERGETICAL EVALUATION

With all of the optimization solutions explained above it was proven that higher yields could be obtained in geothermal heated greenhouses in comparison with yields taken from non heated greenhouses as well as products of higher quality (Table 1).

Also, 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.

Table 1: Comparison of yields between heated and non heated crops

CROP	Yield (kg/m^2) INOVA	Yield (kg/m^2) TRADITIONAL	*Yield (kg/m^2) INOVA-Heated	Increase of Yield (%)	*Increase of Yield (%)
Capegooseberry	0.58	0.41	0.87	41	112
Melon	7.50	4.00	11.00	88	175

5. CONCLUSIONS

The technical solutions aiming the utilisation of geothermal energy in heating greenhouses is an important challenge because it is a pilot project in Azores using a geothermal effluent of high enthalpy and with appetence to scaling. The most known worldwide geothermal projects are of low enthalpy.

This project proves that it is possible to develop a technology adapted to the characteristics of the available geothermal effluent to heat greenhouses.

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

REFERENCES

1. Ana Catarina Rodrigues; Manual Técnico "Aplicação Directa da Energia Geotérmica na Agricultura"; INOVA, September 20, 2000