GEOTHERMAL HEATING OF HORTICULTURAL GLASSHOUSE AT LAMAZERE

C. BOISSAVY
GEOTHERMA
Centre d'Affaires Paris-Nod
93153 Le Blanc-Mesnil Cedex
France

W. OFFRINGA
Serres de Lamazère
32300 Lamazère

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ABSTRACT

The horticultural zone of Lamazère has been created in an agricultural region with the aim of developing a well integrated economical activity.

The excellent productivity of geothermal reservoir has allowed the production of enough hot water to heat 8 hectares of glasshouses.

Technical projet carried out in 1982 was based on standard equipment which are still in operation in 1994 without failure and running problems.

Greenhouse exploitation took place from 1982 to 1987 and restarted in 1991 with a new owner. Annual energy savings to heat 36000 m^2 of greenhouses is estimated at about 1300 TOE/year

AIM OF THE PROJECT

The "Departement" of Gers is lightly populated and the predominant activity there is traditional agriculture. As it is off the beaten track it has always suffered from a lack of diversified activities.This has hampered the creation of jobs and the maintenance of productive dynamism. It is against this specific socio-economic background that the Compagnie d'Aménagement des Coteaux de Gascogne took steps to carry out this project in line with the regional development responsibilities assigned to it by the Central Government.

The CACG supported and caried out this project in response to a local request. It was attractive for the following reasons :
- it develops high gross yield agricultural production which fits in well with the socio-economic background and also creates jobs (65 in the long term) ;
- it is a project enabling the production of crops currently in short supply, to be expanded, i.e. out-of season vegetables, horticultural plants ;
- it is a project enabling substantial public energy savings to be made (more than 3500 TOE per year in the long term). This includes the producers, who may thereby lower their production costs ;
- it would concentrate the horticultural producers in one area, thus making it easier to organize production and marketing.

TECHNICAL PRINCIPLES

The basic technical principle involved is the maximum economic use of the geothermal energy available. Three techniques have been harnessed in order to achieve this :
- regulation of the heat supply (storage by day, use when normal power requirements are exceeded at night) ;
- combination of geothermal energy with another heat source (LPG) to cut heat demand peaks ;
- use of appropriate heat exchanger systems in the greenhouses enabling the geothermal energy extracted to be use at the lowest temperatures.

BRIEF TECHNICAL DESCRIPTION

Public installations

Geothermal borehole sunk by the national owned Elf Aquitaine Company in 1981, tapping the water from the Eocenian Lussagnet sands (or inframolassic sands), were limited by a very important molassic bed, - Oligomiocenian clay formation between 10 m and 1622 m - and by a sandstone between 1700 and 1750 m. The reservoir was reached between 1622 and 1697 m. The formation is made up of 6 m thick clays of sandy origin.

The accumulated height of sandstone is 38 m with a porosity of 17 to 25 %.

The completion including a 15" gravel pack is situated in the zones presenting the best porosity between 1630 to 1671 m. The upper layer of sandstone containing nummulites (1707 to 1743 m) which have a net pay of 6,5 m and a porosity of 23-25 % was not completed although its potential is substantial. The results obtained are proving to be in line with an average exploitation of the resource :
- net pay of aquifer 38 m, transmissivity 30 D.m. ;
- temperature = 57°C ;
- flow-rate : 150 m^3/h minimum ;
- static level : - 20 m in relation to the level of the ground ;
- very high physico-chemical quality : 0.4 g of salt per litre ;
- drawdown : between 180 and 250 m at 200 m^3/h

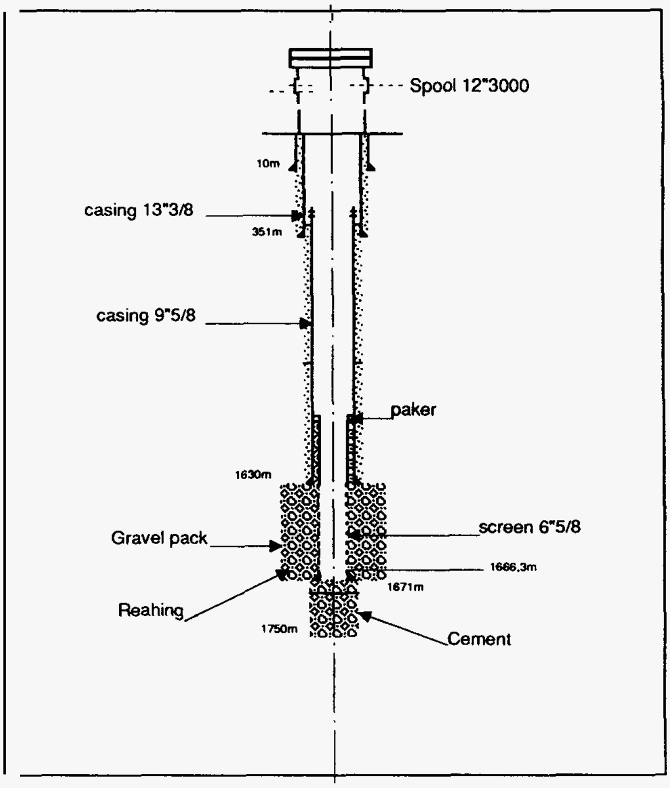

Fig. 1 - Technical section of the well

In the geothermal water is driven through a regulating tank, which permits :

- adaptation of the flow-rate to meet the need of glasshouses ;
- assurance of the good functioning of the well installations ;
- the pumping of only the amount of water required.

Till the beginning of the work, this tank, integrated with the pumping-station, will have a capacity of 15 m^3. In the future, the same tank will be extended to include a compensation pool of 1500 m^3 which will permit the distribution of 240 m^3/h during 15 hours and assure good daily regulation for 8 hectares of greenhouses.

The water is distributed to the glasshouses at an average of 4 bar pressure through a variable speed (electromagnetic tuner) pumping-unit and an insulated piping network of cast and ductile steel. The overall temperature difference does not exceed 1°C under continuous operating conditions.

Heat from the geothermal water is transferred to the glasshouses though stainless steel plate heat exchangers (1 per glasshouse).

Measuring instruments and safety devices are centralized within the pumping station. These mainly permit the control, on a permanent basis, of the different production parameters of the hot water : temperature, pressure and drawdown.

Moreover, each glasshouse is equipped with a LPG-fired independent boiler which provides back-up and emergency heating facilities. These boilers can operate under all circumstances since a collective generating set placed in the station, allows the replacement of the EDG grid if necessary.

Private installations - glasshouses

It was beyond the traditional heating system's capacity (heating radiant pipes for a water at 90-70°C) to satisgy the needs of the plants with cooling water, *so* that the latest heat-exchange processes had to be applied.

The earden glasshouses consits of several parts each one is 6.40 m long, oriented NW-SE and grouped into two bigger section of 10 000 m^2. They are equipped with heat screens possesing a combined spray and dropwise fertilizing imgation system. The heating is camed out by way of radiant pipes through which the hot water is circulated at the desired temperature (these pipes connected with flexible ones, could be raised, and hooked onto the gutters, so that the soil may also easily be cultivated). The water is then used in the radiant system (tubular sheath of EPDM) which contacts the ground here and there across the rows of the plants (cultivation).

This device for using the hot water in different stages and the regulation systems, give the opportunity for more rational utilization of the water ; in fact the temperature difference obtained between the inlet and the oulet of the water from the glasshouse could reach 33°C (55-22°C).

The horticultural elasshouse of 10000 m^2 consists of 8 parts, each one 16 m long. The essential characteristic of this glasshouse is the high performance regarding heating and productivity.

The heat is supplied by the radiant pipes, which are below the agricultural slabs and in some case, above the slabs in the open air. The essential thermal contributions is however made in the slabs themselves : the body of the slabs being traversed by a serpentine alveolar PVC piping having a large heat exchange surface. There again, local heating combined with a heating screen presents a remarkable performance regarding heating. This glasshouse gives a very high performance thanks to the maximum utilization of space (rolling and hanging slabs) and to computerized control of the climate. The serviceable materials moreover, give an opportunity for the rational and economic organization of the personnel.

Organization of the horticultural area

The glasshouses owners in Lamazkre have formed a cooperative, in which the client is involved. The Compagnie d'Aménagement des Coteaux de Gascogne, which has had the status of client conferred upon it and was also the principal contractor who launched the project and raised the necessary investment. As soon as the horticultural area has been completed and all of the equipment has been sold back to the cooperative (ASA - Association Syndicale Autorisée. "Les scrres géothermiques de Lamazkre").

Geothermal exploitation

The exploitation of geothermal energy started at the end of 1982 without problem. The only difficulty to be mentionned is linked to a failure of the electrical submersible pumps unit, changed in 1984 because of elecmcal breakdown. The pumping unit still working in 1994, has been running during 10 years without trouble.

Principal energetical results

Of the expected 8 hectares to be constructed only 3,6 has been realized.The exploitation began in November 1982 and the geothermal water production much lower than expected because of the small needs of the greenhouses.

The following table gives the energetical results of the first phase of exploitation (Table 1).

Table 1

	1984	1985	1986	1987	TOTAL
Electricity Consumption (MWh)	630	700	350	520	2200
GPL Consumption (MWh)	1200	90	65	130	1485
Geothermal Energy (MWh)	10300	10300	5200	8100	33900
Net savings (MWh)	9700	9600	4800	7600	31700
Net savings TOE/Y	830	820	410	650	2710

The exploitation had been stopped between 1987 and end of 1990.At that time the horticultural exploitants were obliged to stop the production because of economical and financial problems not connected to the geothermal plant itself. The price of the energy sold by CACG was based on a fixed term 1150 Ecu/m^3/year and variable term of 0,08 Ecu/m^3 consumed.which correspond to price of 7.6 Ecu/MWh for a 5000 h heating per year and a temperature discharge of the geothermal water after use of 22°C.

Since the end of 1990, a new operator bought the plant and used the 3.6 ha to grow greenplants and flowers.

The average exploitation flowrate is 180 m^3/h for the heating period from 15 September to 15 April.The well is used between 10 to 14 hours per day. Production temperature at 57°C and discharge temperature of 22°C give an instantaneous thermal power of 7.3 W.

Total production of geothermal water is between 350 000 to 400 000 m^3/year giving a total energy production of 15 260 MWh/y corresponding to annual energy savings of about 1300 TOE.

Financial and Economics characteristics

Total investment costs in 1982 was 16 271 000 FF, 23.9 % up compared to the previous costs established in 1980 (Table 2).

Unit 1000 FF	Previsional costs (1980)	Final costs (1982)	Difference
Drilling	7016	9242	+ 31.8 %
Surface installations	3601		
Heating station	1811	6605	+ 14.7 %
Civil Works	345		
Engineering	345	420	+ 18.3 %
TOTAL	13128	16271	+ 23.9 %

The difference between previsional and final costs is due to :
- high inflation rate during the 2 years
- geological problems with over costs of drilling operations.

The project was financed by European Commission (8 %), AFME : French Agency for Energy Management (3,5 %), Ministry of Agriculture (18 %), Region Midi-Pyrénées (4 %) and the rest by loans.

For the period 1984-1987 estimated cost of the heat delivered to the horticultural greenhouses was estimated at 12 Ecu/MWh. In 1994, the cost of heating including investments, amortization and maintenance costs correspond to 4,15 Ecu/m^2 to be compared with the 8 Ecu/m^2 usually taken into account in a conventional plant using natural gas.

THE ADVANTAGESOFTHEPROJECT

Nationaly

Even with a stop of the installation between 1987 and 1990, the project has served more than 7 000 TOE. Considering the extra cost due to the exploitation of a geothermal resources (10 000 000 FF) the pay back period can be calculated at 5-6 years.

It will also help to restore the national trade balance by producing competitives priced horticultural products which at the moment *are* largely imported.

The horticultural area fits in well with the local socio-economic background and creates new activities yielding a high gross value.

It **also** creates a large number of new jobs **(35)** in a region in great need of them. The actual owner plans to construct in 1995 four additional hectares of greenhouses providing **30** more jobs.

The principal advantage lies of course in the savings made on heating (about 50 %). This substantial saving also has the attraction of being fully under the control of the producers themselves owing to the legal structure provided.

CONCLUSIONS

The Lamazère horticultural area was intended as a demonstration. It incorporated a lot of relatively new techniques and know-how. The combination of which provided its originality.

The project thus illustrates above all else, the conditions under which the use of geothermal energy in glasshouses can create efficient, competitive businesses by reducing their heating costs.

Moreover, the use of new heating techniques (local supply, water at low temperature) and of glasshouses modified for efficiency provides full-scale proof of current advances in glasshouse climate control. It should possible to extend further operations of the type into the long term, since they provide a solution to one of horticulture's problems : containig energy costs.