European Association for the Development of Renewable Energies, Environment and Power Quality (EA4EPQ)

International Conference on Renewable Energies and Power Quality (ICREPQ'10)
Granada (Spain), 23rd to 25th March, 2010

Geothermal application on an artificial lake powered using photovoltaic energy

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Key words: geothermal , photovoltaic, heat bomb, passive building

Abstract.
This paper describes a geothermal low enthalpy installation mounted in an artificial lake created by recover of an ancient lignite mine. The associated heats bombs will be powered using photovoltaic solar energy with the aims of acclimatise a passive tertiary sector use. The main contribution of the proposed project is a pioneer multi-source renewable energy application with both high social visibility and reproducibility.

Introduction.

In the following, we describe an intervention in a historically highly polluted zone legated to conventional energy production. In fact, the future artificial lake ***, located on As Pontes de García Rodríguez (A Coruña), has born by water filling of the hole created by an opencast lignite mine.

Figure 1 : Google map of the situation.

We propose the use of the man-made lake as geothermal low enthalpy source optimized to provide acclimatisation to public services. Moreover, a solar photovoltaic system will be dimensioned to power the associated heat bomb.

The full installation will be included in a global rehab of the zone containing the creation of a man-made beach, a museum and a sport area.

******* The main characteristics of the lake will be:

- 547.000 million litres of water
- 12 km² extension
- 206 meters maximum deep

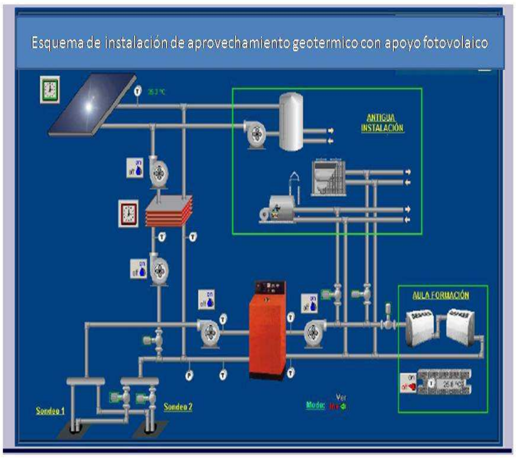
Description.

The project initially raises the installation of 18 200meters deep shafts in the central area of the lake with a *heat utile capacity* of 55MW per year to supply acclimatisation to 700m^2. The heat bombs consume, calculated in 500KW, will be supplied by a *photovoltaic* installation located in one of the islands. This system has been over dimensioned to support a hypothetic *streetlight* during the summer period.

Figure 2 : Esqueme of the proposed geothermal installation.

We estimate the climatization needs in potential values for heating of around 130KW and for cooling of 106KW; the annual working time is

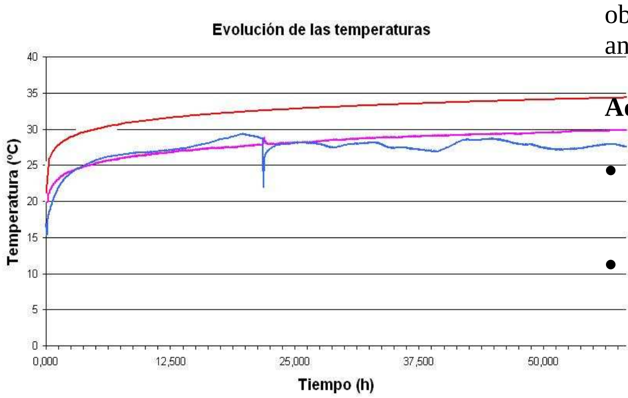
1.100hours and 769 respectively. The thermic conductivity of the area, defined from experimental data obtained by experimental prospections in Santiago de Compostela, raises a media value of 2.2W (mK), which means 18 tests drilling to cover the needs of the building. This offers an extraction ratio of 63W/m for heating and 52 W/m for cooling.
To cover the demand of the geothermal bombs we consider the option to do an island or solar photovoltaic and enclosed garden with thermal support with a scheme similar to the figure:



Figures 3: scheme of installation using thermal support.

The first thing that must do is a Test of Thermal Response (TRT) of the subsoil that is directed to determine the following parameters:

a) Stable temperature of the Subsoil (K)
b) Thermal Conductivity of the subsoil I object of study W/mK
c) Thermal Resistance of the well of exchange mK/W



Figures 4: Graphical example of a TRT

Measured of a system:

a) Promotes in the field of captation:

Pe = [PC * (COP - 1) / COP

b) Length of the well:

L = Pe/C

c) Wealths

Cinv = Qinv / dTinv
Cver = Qver / dTver
Parameters:

Pe = Promotes evaporating (Kw)
L = Length of the well (m)
C = thermal Conductivity of the subsoil (w/m)
Cinv = Wealth needed for the captation in winter
dTinv = thermal jump in winter.
Cver = wealth needed for the captation in summer.
dTver = thermal jump in sum.

*** Formulae based on the directive 4640 of the norm VDI.

Considerations:

The COP of the bomb must be higher than 4 and for a bigger efficiency the recirculating bombs must be of changeable speed.
In the moment of the start it's advisable that is connected to network, because it is where the major higher point of consumption takes place(is produced) and is a take-off in three-phase. From the take-off and depending on the value of the characteristics of the bomb, the energy can be given across the garden or photovoltaic island, and the thermal punctual support optimized the energetic consumption obtaining thus the best saving both energetic and economic

Advantages Expected

- ***High efficiency*** because the COP is expected between 4 and 6 (compared with the 2 of the air-air heat bomb).
- ***Important energy savings***. Around 25% of the total heating and 50 % of the cooling needs. Figure 3 shows the expected saving with respect to the most common used combustibles.

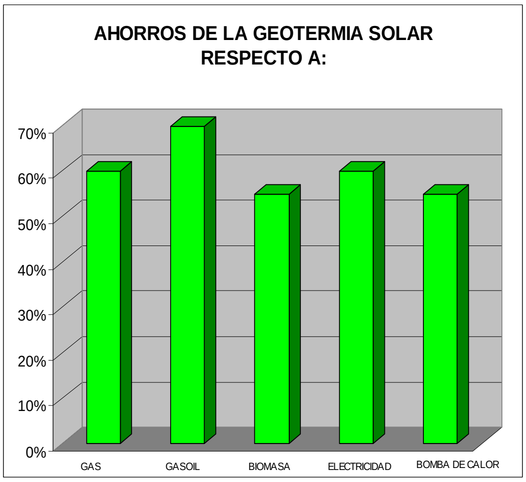


Figure 5 :Expected Energy saving

- ***Fast investment recovery*** estimated between 5 and 10 years.
- ***Passive installation (zero energy)*** ensured with the solar photovoltaic power covering the GHP needs.
- ***Decrease of the CO2 emission***s because conventional combustibles are avoided (see figure 4).

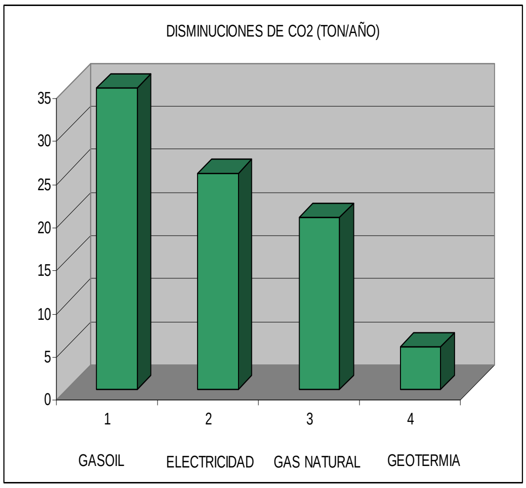


Figura 6 : Expected decrease of CO2 emisions compared with other habitual combustible in Tons per years.

- ***Decrease of the noise contamination*** level because no external condensed unit is need.

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