THE SOLAR ROOF OF ENERCOM, AS AN INTEGRATED ENERGY SOLUTION FOR THERMAL CONDITIONING OF BUILDINGS.

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ABSTRACT

Actually and in the near future, due to the necessity of refrigeration, the need of thermal energy dissipation systems will be increased. One of the best element, is the cooling tower, but it has one mean inconvenient, what is the use of a fan. The use of the fan has the following misfortunes: waste of energy, noise, vibration and dissemination of Legionella, if it is present. To overcome these misfortunes, we present a energetic solution, highly efficiently, The Solar Roof of Enercom, because the draught of the air, is by natural driving, this element has the following advantages: No electric energy wasted, no noise, no vibration and dramatic reduction of Legionella dissemination in the air. Integrated in an air conditioning system, the solar roof works in different ways according to the needs of the conditioned building, in summer as a heat sink and in winter as a source of heat.

KEYWORDS

Cooling, tower, solar, roof, thermal, conditioning.

ELEMENTAL DESCRIPTION OF THE SOLAR ROOF

This new element provides to the thermal conditioning systems, the suitability to eliminate the cooling tower to reject the heat from the condenser of the cooling machines. New operation ways to take profit of the solar radiation not only in summer, but also in winter, is envisage. The solar roof not only act as dynamic element, when the hydraulic pumps is in operation but at the same time act as an static element.

Solar roof erected at the Scholl of Engineers in the Polytechnic University of Cartagena (Spain)

Dynamic behaviour

Heat rejection, to use, for example, for thermal conditioning of buildings

Summer:

Adiabatic evaporation: in summer, during the sunny days, the absorbent plates of the system are heated. An air vertical flow is produced by natural convection inside the channel that forms the plates (solar chimney) and then a water flow is sprayed crosscurrent. A little part of the water is evaporated and the rest is cooled.

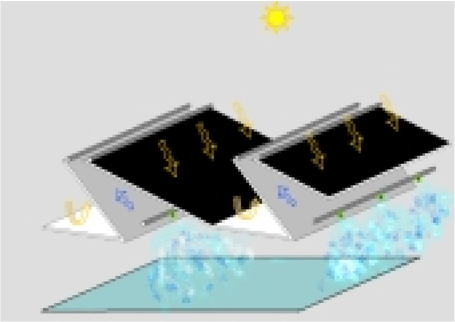

Fig. 1: Solar roof performance in summer (during the daytime)

Night radiation: in summer, during the night, water is slipped over the upper plates. Basing on the fact that the sky temperature is lower than the temperature of the plates, an amount of energy is radiated to the sky and the temperature of the water decreases.

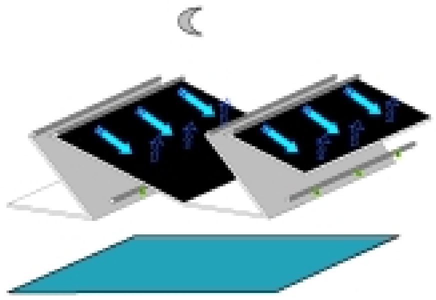

Fig. 2: Solar roof performance in summer (at night)

Energy recovery

The solar roof can move air from the external or from the exhaust of the building, in which is located. In the last case, as the enthalpy of the inner air is lower than the external air, we can remove part of this energy, not only the latent heat content but the sensible one too.

Heat collection: for example, for hot water production

Winter:

<u>Solar absorption</u>: In winter, during the sunny days, an amount of water is dropped over the inside face of the lower plate of the channel. The sun is radiating on this plate and the water takes a very important part of that energy to increase its temperature.

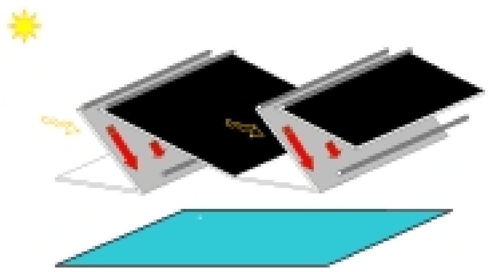

Fig. 3: Solar roof performance in winter (during the daytime)

Of course in winter, the solar roof can reject heat, nevertheless, in general the use will be to heat collection.

Static behaviour

All year round the solar roof protect the building against water inclemencies, for example, in summer the cover of the building, due to the solar roof, is at shadow, so the heat load of the building is reduced. In winter, during the night protect the cover from the infrared radiation, so less heat demand is needed.

SYSTEM INTEGRATION

Integrated in an air conditioning system, the solar roof works in different ways according to the needs of the conditioned building. In summer, the solar roof is used to reduce the temperature of the service water that acts as heat drain of refrigerant condensers, making the thermal conditioning economically profitable. In winter time, solar energy is collected by the solar roof to assist the conditioning system in heating the building and producing domestic hot water.

Figure 4, shows a simple scheme of the solar roof integration into a conventional air conditioning system working in summer:

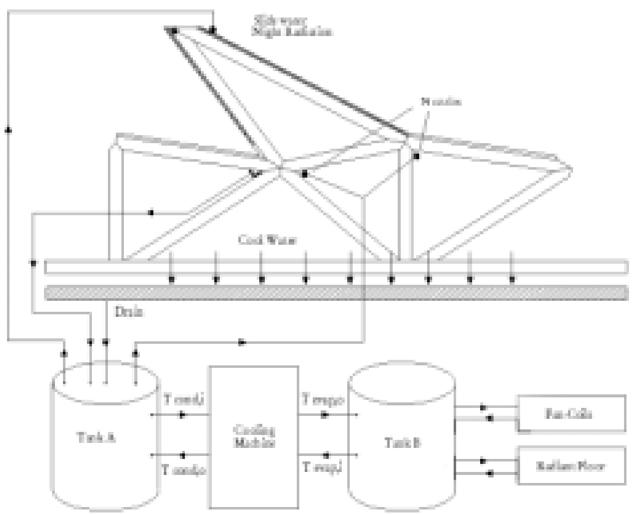

Fig. 4: Solar roof working beside an air conditioning system in summer

To maintain a steady temperature inside the building, heat loads have to be evacuated. Two systems to evacuate heat from buildings have been installed: fan-coil and radiant floor. Both systems take cool water from the tank B and return it hotter. The water of the tank B maintains its temperature because the cooling machine is working to cool it.

The water is pumped from the tank B to the evaporator of the cooling machine and there is cooled. Cooling machines operate between two thermal levels: high level, condensation temperature (tank A), and low level, evaporating temperature (tank B). The energy removed from the tank B and the mechanical energy dissipated by the machine go to the tank A.

The function of the solar roof is to reduce the temperature of the tank as much as possible. The less temperature of the tank A is, the more mechanical energy savings in the cooling machine is earned.

Figure 5, shows a simple scheme of the solar roof integration into a conventional air conditioning system working in winter:

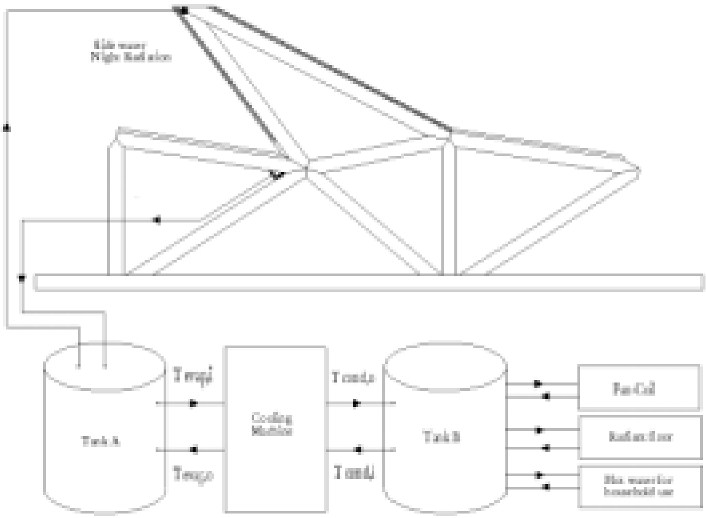

Fig. 5: Solar roof working beside an air conditioning system in winter

In winter, to maintain a suitable temperature inside the building, heat losses have to be compensated with an external heat flux. The same systems that are used in summer, fan-coils and radiant floor, can be used again. Both systems take hot water from the tank B and return it cooler. The water of the tank B maintains its temperature because the cooling machine is working to heat it.
The water is pumped from the tank B to the condenser of the cooling machine and there is heated. In this case, tank A is cooled due to its connection with the evaporator of the cooling machine. The function of the solar roof is to increase the temperature of the tank A as much as possible.

Conclusions:

A new energetic element has been introducing, that have the following advantages, compared to a cooling tower:

- Do not need fans, this means energy saved and suppression of aerial noise and vibrations.
- The lost of water is reduced.
- Aesthetical integration on buildings
- Reduction about 20% of the cooling load, due his position over the roof, because the roof is at shadow.

Future work.

At present we are designing a new University building with a solar roof, and with radiant flooring and with ventilation for displacement to inner conditioning.

The main figures are:

A building of 2400 m2 of area to conditioning and 900 inhabitants, located at south of Spain
A solar roof of 170 m^2
A cooling power of 200 kW
An electric supply of 90 kW

Energy saved, aprox: 75%
Recovery of capital, aprox: 2 years

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