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ScienceDirect

Energy Procedia 91 (2016) 190 – 196

Energy Procedia

SHC 2015, International Conference on Solar Heating and Cooling for Buildings and Industry

Retrofit of a solar system in sport center in Mallorca

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Abstract

The building was built in the late 90s, had a solar installation of 200 m^2 with 4 tanks of DHW and the support of diesel boilers and district heating. After 16 years 25% of the solar collectors are damaged, and some of the storage tanks have rust and lime with leaking. A new design and retrofit is needed to improve the existing installation. New advanced systems are being designed in different phases. The first phase consists of installing new collectors and combisystems tanks. If we add the pool to the system, it is further possible to improve the water management of the building. During this first phase 25% of the solar field will be added with higher efficiency collectors. The estimated energy savings are 14% and the cost savings will be near to 30%.

Peer-review by the scientific conference committee of SHC 2015 under responsibility of PSE AG

Keywords: Solar Thermal; Heat Pump; Solar Tank; Combisystems; Heat recovery

Nomenclature

CHP	Combined Heat and Power
COP	Coefficient Operating Performance
DH&C	District Heating and Cooling
DHW	Domestic Hot Water
ST	Solar Thermal

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Peer-review by the scientific conference committee of SHC 2015 under responsibility of PSE AG
doi:10.1016/j.egypro.2016.06.201

1. Introduction

The building is situated on the campus of the University of the Balearic Islands (UIB) in Palma de Mallorca. It was built in the late 90s. It has an acclimatized Olympic swimming pool, gymnasium and some sports fields (football, badminton, tennis, basketball etc.). Initially, a solar installation of 200 m^2 with 2 tanks of DHW with 8 m^3 in serial and 2 tanks of 5 m^3 with the support of diesel boilers was designed. Nevertheless, during the following decade this system was modified. A heat exchanger that is connected to a District Heating (DH) system from Technological park "Parc Bit" (from a CHP with solar and Biomass) was added. This utility is comprised of a tri-generation plant of 2,9 MW electrical power and a thermal production of 6210 kW from the generators. The utility consist of; two Diesel engines, a solar thermal installation with low temperature collectors of 864 m^2 and two lithium bromide absorption chillers, one of 1.318 MW with a COP=0,64 and the other of 436 kW with a COP=0,64, both of them of simple effect. The thermal energy is distributed by district heating and cooling networks to the buildings around the plant and to the UIB. A big amount of the energy of this DH&C is free of CO_2 emission [8]. This DH provides 78% of the thermal energy demand of the sport center, the rest is coming from the old diesel boilers and the solar collectors. Sports and pool centers have high thermal energy demands [2]. In our case 20% are due to DHW and the rest is for space heating (sport hall, reception, fitness,…) and pool heating.

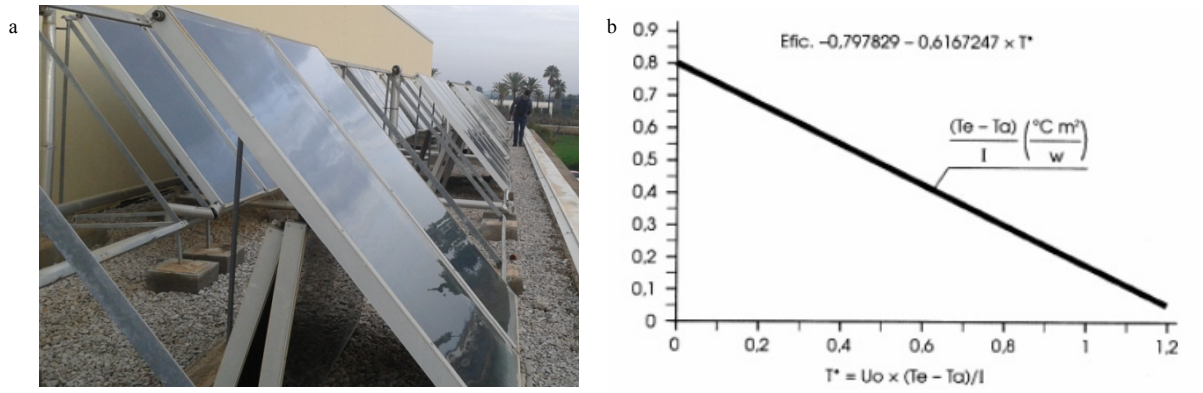

Fig. 1. Existing panels (a) and efficiency curve of the panel (b).

The solar collectors are 16 years old. Now 25% (50 m^2) are damaged which is mainly due to: aging, rust, thermal shock (they are full with normal water) and some accidental/environmental influences. The storage tank has become older, and two of them are leaking. In addition, the design of the initial project wasn't optimal. Self-shadowing between the two collector rows could be observed during winter time. To avoid shadowing, one collector row will be relocated. The field size of 200 m^2 was originally designed for 400 people, however, more than 1000 people visit the gymnasium every day - more surface is therefore needed. The solar fraction is less than 40% of the DHW demand. A higher fraction (up to 60%) would be desirable from the technical, environment and economical point of view. This way, the project could also benefit more from national subsidies (70% for DHW and 60% for the pool) [7].

A new design and retrofit is needed to improve the current installation and have high energy conservation [2]. New advanced systems [2] are being designed in different phases. The first one will be described in this paper.

2. New storage

The four tanks for DHW are very old and with an old design. It employs 4 pumps and 2 heat exchangers. The new proposed system is simpler. Different combinations and different sizes and models have been simulated before installation. The storage tank has to be sized determined depending on the respective requirements [5]. Only DHW was taken into account. Finally, it was decided to install two new storage systems, integrating the solar storage with the auxiliary storage in the same tanks without secondary loop and thereby reducing pumping and heat exchanger