Description:	*UNISOL project – general presentation*
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Resume

In any solar thermal system, from the absorption, accumulation and distribution sub-systems, accumulation is the one that defines the principles and controls the other two and thus, the overall efficiency of the system. From this assumption, the Unisol project aims to develop an integrated set of R&D activities to design a universal, innovative, independent and intelligent system that manages the accumulation of heat that is capable of using almost any solar collector. This system is intended for pre-heating domestic hot water (DHW) as well as for low-temperature space heating, and also to simplify integrated systems (IS) for the support of individual subsystems in multifamily housing buildings. The project introduces several new peculiarities, such as its unique principles of universality and integration inside and outside of buildings and a reversible heat-exchanger circuit. The main promoter is JPrior - Fábrica de Plásticos Lda, a private Portuguese company, Aveiro University and the National Laboratory of Energy and Geology (LNEG).

Introduction

Almost all forced solar thermal systems available in the Portuguese market have an accumulator tank that is maintained at relatively high temperatures. The solar energy collected by the absorbers is usually transferred to the accumulator through a pressurized solar circuit which includes a copper coil (heat-exchanger) placed inside the tank. It is understood that systems based on these principles have been developed for countries where the danger of freezing is a current concern. However, it is not the freezing but the danger of stagnation with the pressurized absorber filled, the most likely situation to occur in our country. The pressurized solar circuit is more complex, more expensive and less reliable than a non-pressurized circuits. On the other hand, it is clear that keeping heat storage tanks at relatively high temperatures with the aid of other heat sources increases the rate at which materials degrade, increases thermal losses of the system and lowers absorbers efficiency.

The explanation for our market being dominated by forced pressurized systems can perhaps be found in our small dimension and lack of tradition in this area of technology. In this "quasi-tropical climate" only

recently the thermal insulation of houses began to draw real attention and, until the invasion of Iraq in 2003, the energy problem was something that oil could conveniently keep away our worries.

Unlike traditional solar circuits, systems running according to the "drainback" principle are not pressurized and are naturally protected against freezing and over-heating. The solar circuit empties when there is not enough energy in the collector (prevents freezing) and also empties when there is energy in excess (avoids stagnation and slow degradation).

UNISOL is a solar thermal system of forced circulation, working on a "drainback" principle, which is designed primarily for small / medium-sized dwellings (maximum of 3/4 - 6 people), isolated or integrated into buildings, just for DHW or DHW and low-temperature space heating.

Contrary to most developments in this area, which are often targeted at specific components (usually solar thermal collectors), this project is aimed exclusively at the core of the thermal system, using principles and solutions that will optimize, simplify and reduce costs, worrying only with its flexibility and universality in both the application and integration and in the use of third-party components, such as collectors. UNISOL not only allows a better integration of the collectors, solving also the problem of energy distribution in apartment buildings, but also facilitates the integration of the control and the heat storage inside the dwelling. This solar circuit at low pressure and low temperature (up to 80 °C) can be connected to almost all solar collectors, more particularly to a new generation of polymeric collectors, and also to the majority of floor heating systems, forced circulation convectors, etc.

General objectives of the project are the production, optimization and placement on the market an autonomous and intelligent system of distribution and accumulation of thermal energy, operating at low pressures and low temperatures, which can use virtually any type of solar panel thermal (or distribution of collective heat), and be connected to any system for space heating at low temperature.

Experimental setup

This project was divided in 3 phases: i) DHW; ii) DHW and floor heating; iii) integrated system (IS). In the first phase a domestic hot water (DWH) system, with 600 L water storage capacity, containing an immersed cylindrical heat-exchanger with 120 L, was tested for several consumption profiles. The second phase consisted in testing the efficiency of the system, using the same heat store, answering to some floor-heating demands. A special test was performed using a standard gas water heater, consisting in analyzing the efficiency of using this auxiliary heating in maintaining a minimum temperature level in the 600 L accumulator, regardless the type of heating consumption profile. The third phase consisted in connecting several systems of type i) and/or type ii) to an oversized central accumulator, which can be feed mainly by solar collectors and/or other means, ensuring that all the individual 600 L heat stores can have a minimum level of energy available. Figure 1 shows the diagram of UNISOL test assembly, built to evaluate the performance of all three UNISOL phases.

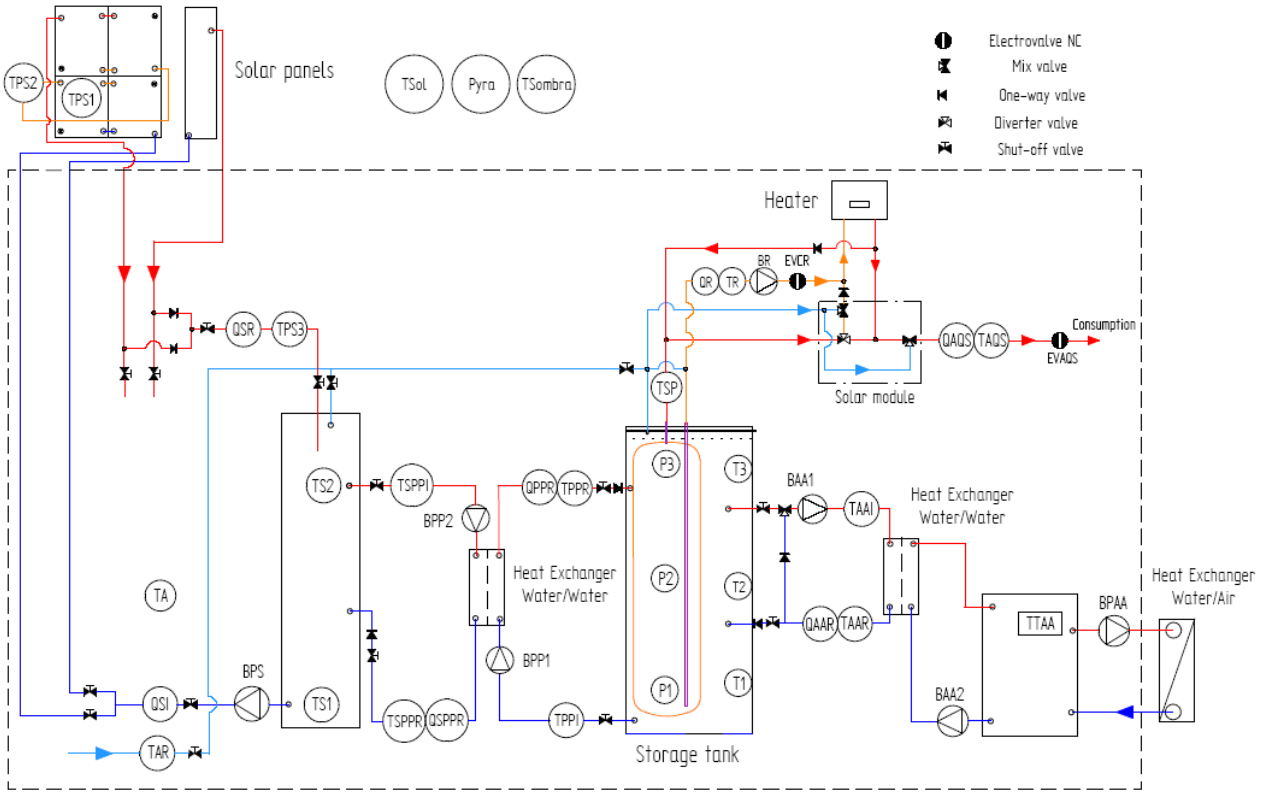

Figure 1: Schematic representation of the experimental setup assembled in JPrior facilities.

A specific electronic circuit to actuate the pumps, valves and signal acquisition of all temperature and flow sensors was developed. This electronic circuit is the basis for the construction of a controller prototype. The software for the acquisition, control and communication system has been developed in collaboration with the Aventa AS. Presently some control algorithms are being tested.

It is expected the presentation of a final UNISOL prototype, base to evaluate serial fabrication, in the end of 2014.

References

[1] European Patent 1172328.2 – WO 2011/133058 – AUXILIARY CIRCUIT FOR HEATING HEAT STORAGE TANKS

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