UNISOL – solar combistore evaluation and optimization **INFO** Sheet B18

Description:	*Characterization of UNISOL combistore according to tests using EN 12977-3:2012 and EN 12977-4:2012.*
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Introduction

UNISOL is a national project aiming at the development of an innovative, autonomous and intelligent universal system for management and accumulation of solar heat that can practically use any solar collector in the market. The system will simultaneously pre-heat domestic water (DHW) and space heating (SH). The main component is a combistore which includes a two-way heat exchanger [1].

In Figure 1 a schematic presentation of the combistore is shown. This figure also shows the flow direction for each port and the used ports. In order to study the configuration of the inner storage tank, used for DHW pre-heating or as back-up of the space heating, tests according to EN 12977-3:2012 [2] were performed. Tests according to EN 12977-4:2012 [2] were also performed for characterization of the complete combistore.

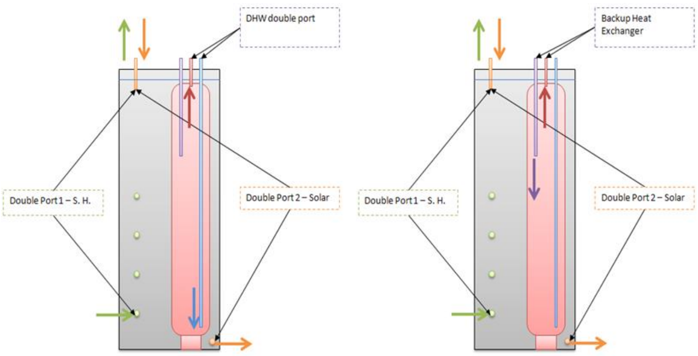

Figure 1: Schematic representation of the combistore of the type tank in tank where the tank inside works as preheat for DHW preparation (Left) or back-up for SH (right).

Numerical simulations were performed in the software TRNSYS [3] in order to test the selected numeric model Type 340 [6] and optimization algorithm available in GENOPT [4] according to EN 12977-3:2012 [2], respectively, Annex A and C. Parameters were identified based on the tests performed according to EN 12977-3:2012 [2] and EN 12977-4 [2]. A new deck was created in TRNSYS [3] to calculate the long-term performance energies. This deck has 4 circuits, the solar collector loop, auxiliary loop, space heating loop and DHW consumption. The best results of the identification parameters process are used in Type 340 [4] to perform the long-term performance.

Results and discussions

In reference to UNISOL – solar combistore evaluation and optimization [6] the identified parameters for both prototypes are listed. Results for long-term performance are also presented in the same reference.

Conclusions

Two combistore prototypes were tested according to EN12977-3:2012 [2] and EN12977-4:2012 [2]. Although prototype 2 reduces the solar energy delivered to the system and also imposes higher losses, it makes more energy available to the space heating. The controller set-point also influences the performance of the combisystem. Lower set-points reduce the energy lost and the interference with the solar loop.

Prototype 2, when tested according to EN 12977-3:2012 [2] better fulfilled the energy demanded for space heating. It was then tested as combistore according to EN 12977-4:2012 [2]. Since the prototype has imperfections in the way the insulation is applied to the store walls, it shows high heat losses coefficients (top, bottom and side losses). Simulations using TRNSYS [3] were performed, for a system using this combistore and a solar field of 10 m^2 and delivering energy to space heating and preheating DHW. The performance indicator used is f_{sav} (fractional energy savings) and the results for Davos and Würzburg show values of f_{sav}, respectively, of 18.6% and 6.3%. Simulations using lower heat losses coefficients, considering a heat conduction value for the insulation of 0.04 W/mC, showed large improvement in the f_{sav} values, 39.3% and 25.3%, respectively. These results show that the performance of the combisystem increases substantially with a better insulation.

References

[1] Patent INPI n. 105061 - Circuito Auxiliar para Aquecimento de Acumuladores Térmicos.
[2] EN 12977-3 and 4 :2012 (Ed. 2) - Thermal solar systems and components. Custom built systems. Part 3: Performance test methods for solar water heater stores. and Part 4: Performance test methods for solar combistores.
[3] TRNSYS, A Transient System Simulation Program, version 17.00.0019, Solar Energy laboratory, Univ. Of Wisconsin-Madison.
[4] Harald Drück, MULTIPORT Store – Model for TRNSYS Stratified fluid storage tank with four internal heat exchangers,ten connections for direct charge and discharge and an internal electrical heater, Type 340, Version 1.99F, March 2006
[5] GENOPT®, Generic Optimization Program, version 3.1.0, Lawrence Berkeley National Laboratory
[6] Ricardo Amorim, Jorge Facão, João C. Rodrigues, Maria João Carvalho, UNISOL – solar combistore evaluation and optimization, Energy Procedia 48 (2014) 264 – 27 .

Acknowledgements

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