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Quality assurance and support measures for solar cooling on system level

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Abstract

Within the IEA SHC Task 48 "Quality assurance and support measures for Solar Cooling" the analysis and evaluation of the systems has been one of the four main focuses. Here the activities are including the lab- and field-based characterization of the systems, the definition and application of performance figures, a guideline for a reliable monitoring procedure including methods for automated error detection and an updated overview on worldwide installed DEC systems including hints and good practice examples. They are furthermore leading to three different easy-to-use tools for solar cooling systems: The LCA tool considers environmental and energetic values for the evaluation, the PISTACHE tool offers a fast pre-sizing of the systems giving support for the planner in advance and finally an Excel tool allows a complete system evaluation using long term monitoring data.

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Keywords: system characterization, desiccant evaporative cooling, LCA, design tool, system monitoring, performance figures

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1. Introduction

While the overall aim of the IEA SHC Task 48 were quality assurance and support measures for solar cooling systems in general, ranging from activities on component level over system level to market support and policy advice this paper is focusing on the consideration of the system level.

It has been the aim to develop tools and deliverables to show the level of quality of solar cooling and heating systems to contribute to the effort of making these systems efficient, reliable and cost competitive. Therefore this subtask had been realized in two steps: first, the development of a procedure to extend the quality characteristics from component level to system level and second, to extend the procedure from characterization of single stationary states to a performance evaluation for whole year operation.

The activities within this subtask had been covering a broad spectrum with the following topics:

- System/Subsystem characterization and performance assessment
- Good practice for DEC design and installation
- Life cycle analysis at system level
- Simplified design tool used as a reference calculation tool: design facilitator
- Self-detection on monitoring procedure
- Quantitative quality and cost competitiveness criteria for system

2. System/Subsystem characterization and performance assessment

This activity comprised at first a review of laboratory test standards suitable for performance analysis of single components such as heat pumps, storages and solar thermal collectors of systems related to the European and US markets. Furthermore, different non-regulated methods have been assessed suitable for whole system characterization, e.g. the Bin-method, the CTSS, and the SCSPT/CCT methods.

The Bin Method is based on the EN 14825 and EN 12309: at present it is well suited for testing single components with boundary conditions that can be decided depending on the location. The component performance is obtained by stationary testing at full and partial load. The integration of the single components performance into a system calculation over a range of different boundary conditions gives the seasonal behavior.

The CTSS method is a combination of performance results from component laboratory tests with a numerical simulation. The components' test validates the numerical models that are used in the system simulation to determine the standardized annual energy use.

The SCSPT/CCT methods finally test the entire system in the lab, including pipelines, actuators and control strategy by emulating the boundary conditions, which the system is subject to. A short test sequence lasting few days is used to extrapolate the annual system performance.

In any of the cases described, the components, actuators and boundary conditions included in the calculations deeply influence the results. To support a general and comparable system evaluation a methodological approach has been adapted considering the system main components, the energy flows among each, the auxiliary units and the system boundaries (dashed line in fig. 1) indicating what elements are considered in the computation and what are disregarded. This work has had a strong link to the certification effort for solar cooling systems, which are handled within the activity of Task 48 on market support measures.