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## Solar thermal collectors for medium temperature applications: a comprehensive review and updated database

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### Abstract

Although the technology of solar thermal collectors for medium temperature applications is not new, few collectors and commercial installations were available worldwide. Presently the sector is growing rapidly, new technologies have been developed and real installations using these technologies are already being built all around the world for different applications, especially for the generation of heat required by industrial applications.

Considering the increasing number of available products and the importance of disseminating this information among system designers and end-users, a database of the available solar collectors for medium temperature applications is under development. The information has been gathered from the different collector manufacturers and suppliers and the available technical information published on the different collector models. Aiming a thorough insight into these new commercially available solutions, the database includes the most relevant technical information of the different existing collectors.

This work is being done within the framework of the European project STAGE-STE (Scientific and Technological Alliance for Guaranteeing the European Excellence in Concentrating Solar Thermal Energy) (<http://www.stage-ste.eu/>). The information gathered will also be used within the Task 49, the working group for Solar Heat Integration in Industrial Process (SHIP) of the Solar Heating and Cooling program (SHC) by the International Energy Agency (IEA) (<http://task49.iea-shc.org/>).

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## 1. Introduction

Solar energy is widely used worldwide to supply thermal needs [1]. Medium temperature solar collectors represent an interesting solution to cover specific demands. According to the definition proposed within Task 49 [2], medium temperature solar thermal collectors refer to collectors whose power output exceeds  $300 \text{ W/m}^2$  (referred to gross collector area) for the following conditions:  $1000 \text{ W/m}^2$  hemispherical irradiance, 15 % diffuse fraction and  $20^\circ\text{C}$  ambient temperature at an operating temperature above  $100^\circ\text{C}$ .

Although the development of medium temperature collector technologies technology started more or less at the same time as the Concentrating Solar Power (CSP) systems (some examples are available from the seventies and eighties of last century [3]), until now their market development has not been as relevant as in CSP, due more to the lack of financial support than to the technology itself. Currently these technologies are developing very fast. Possible uses of these collectors are mainly solar process heat but also solar cooling, desalination, electricity generation using Organic Rankine cycle (ORC), pumping irrigation water, water heating for high consumptions, etc. In Task 49, a database for applications of solar heat integration in industrial processes was created (<http://ship-plants.info/>).

Existing collectors are based on different technologies (Parabolic-Trough Collectors PTC, Linear Fresnel Collectors LFC, parabolic dishes, ultra-high vacuum flat plate collectors, fixed mirror solar concentrator FMSC, etc...), different designs, concepts, sizes and materials, etc. Therefore, no standardized designs of collector-components are still available. The database herein presented will serve as a reference survey of available products in the medium temperature solar thermal collectors market.

## 2. Methodology

The methodology followed for developing the medium temperature solar thermal collectors database was accomplished in three main steps:

- The first one consisted on defining the most important technical parameters of the collectors to be gathered, such as the main materials, collector designs, certifications (if any) and geometrical, optical and thermal behavior information. The selected parameters are the following: manufacturing information, collector type, component materials and dimensions, optical properties, tracking system information and other specifications. For a clearer understanding of the parameters selected to be included in the database, details are presented in section 3.1.
- Secondly, the existing information on solar thermal collectors was collected and the defined technical information was extracted. It was noted that the information on different existing collectors varies depending on the sources. In addition, it should be mentioned that the different suppliers have different collector models and their products are continuously evolving.
- Finally, the different suppliers were contacted to check the validity of the available information. With all the information collected a statistical analysis was performed to achieve important conclusions such as market distribution among the different collector types, specific relevant parameters that are not typically reported, component materials typically used, etc.

Aiming a permanent update of the gathered information, a public online form was created. Following the same format and data parameters of the original database, such form will enable the introduction of information on new collector technologies by manufacturers. Such information will then be screened by the core database technical commission and, upon approval, will be made available to the general public online.

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