Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 91 (2016) 630 – 637

Energy Procedia

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

IEA/SHC T49 activities on process heat collectors: available technologies, technical-economic comparison tools, operation and standardization recommendations

Pedro Horta[a]*, Christoph Brunner[b], Korbinian Kramer[a], Elimar Frank[c]

[a]*Fraunhofer Institut für Solare Energiesysteme ISE, Heidenhofstrasse 2, 79110 Freiburg, Germany*
[b]*AEE-INTEC, Feldgasse 19, 8200 Gleisdorf, Austria*
[c] *Institut für Solartechnik SPF, Hochschule für Technik HSR, Oberseestrasse 10, CH-8640 Rapperswil-Jona, Switzerland*

Abstract

Process temperatures found in industrial processes are manifold, ranging from low (T<100ºC), medium (100ºC < T < 250ºC) to high (T > 250ºC) operating temperatures. Whereas low temperature applications are already suited by well-established stationary collector technologies, the approach to medium temperature applications rely on a growing range of stationary and tracking collector technologies, all of them presenting products already in pre-commercial or commercial stage (TRLs 8 and 9).
Considering the technical and economic challenges raised by a growing range of technologies suiting process heat application requirements, IEA/SHC Task 49 "Solar Heat Integration in Industrial Process" activities on Sub Task A "Process Heat Collectors" aim at further development, improvement and testing of collectors, collector components and collector loop components by: providing a comprehensive overview of available solar collector technologies and collector enhancement strategies; providing a basis for the technical-economic comparison of collectors and giving comprehensive recommendations for standardized testing procedures fitting the whole range of collector technologies suitable to Process Heat applications.
The present article presents an overview of the activities developed in this scope and provides an insight into the most relevant results on available solar collector technologies for process heat applications, technical-economic comparison tools, operation and standardization recommendations.

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

* Corresponding author. Tel.: +49-761-4588-2126; fax: +49-761-4588-9000.
E-mail address: pedro.horta@ise.fraunhofer.de

Peer-review by the scientific conference committee of SHC 2015 under responsibility of PSE AG
doi:10.1016/j.egypro.2016.06.217

Keywords: solar collectors; process heat; recommendations

1. Introduction

Process temperatures found in industrial processes are manifold, ranging from low (T<100ºC), medium (100ºC < T < 250ºC) to high (T > 250ºC) operating temperatures: low and medium temperature processes presenting a high share of heat demands on the mining, food & beverage, tobacco, pulp & paper, machinery and transport equipment manufacturing sectors; high temperatures presenting a high share of heat demand on the chemical, non-metallic minerals and basic metals production sectors [1].

This wide range of temperatures is addressed by a growing number of solar collector technologies, whose development, assessment and comparison raises challenges at both technical and economic levels. In the framework of IEA/SHC Task 49 "Solar Heat Integration in Industrial Process" [2], activities on Sub Task A "Process Heat Collectors" aim at further development, improvement and testing of these technologies.

Considering the range of topics addressed, Subtask A is divided in three different actions:

- A1: Improvement of solar process heat collectors and collector loop component – action aiming the support to the development and improvement of cost effective, well-performing and reliable process heat collectors, including the identification of the most relevant requirements and parameters to be considered regarding the reliability of the systems with a special focus on overheating/stagnation prevention strategies;
- A2: Comparison of collectors with respect to technical and economic conditions – considering the specificity of each of the different solar collector technologies suitable for process heat applications and the importance of comparison terms enabling a due technology selection, this action aims at identifying simplified calculation and assessment methodologies and key figures enabling a technology independent comparison of technical and economic performance results in the framework of a preliminary collector selection, prior to detailed system design;
- A3: Comprehensive recommendations for standardized testing procedures: considering the appearance of different technological concepts, namely those resulting from the adoption of solar concentrating systems in the development of medium/high temperature collectors, adaptation of the current solar collector testing standards is required, complying e.g. with the specificities of line-focus technologies from the optical, thermal, HTF or module dimension points of view.

Sub-Task A received contributions from more than 30 institutions (Universities, R&D institutes, Collector manufacturers, Engineering or Consulting companies) from Europe, Asia, Africa and America.

2. Sub Task A actions: collector development, comparison and testing

Considering the potential use of higher operation temperatures, tracking collectors and high temperature and pressure conditions in process heat applications, Sub task A actions focused on three different aspects: collector technology developments, collector comparison methodologies and collector testing procedures.

A1: Improvement of solar process heat collectors and collector loop components

Aiming the support to the development of cost-effective and reliable process heat collectors, A1 activities included the exchange of information on new collector and component developments as well as solar field measurements and monitoring data, aiming at the analysis of collector performance, overheating and stagnation or dusting effects.

As there is no clear distinction between a "conventional" solar thermal collector and a process heat collector as the heat delivered by any solar thermal collector may be used for industrial heat applications, a definition of Process Heat Collector was based around the definition of operating temperature ranges (related to process temperatures