Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 91 (2016) 312 – 316

Energy Procedia

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

Tårs 10000 m² CSP + flat plate solar collector plant - cost-performance optimization of the design

Bengt Perers, Simon Furbo, Zhiyong Tian*, Jörn Egelwisse, Federico Bava, Jianhua Fan

Department of Civil Engineering, Technical University of Denmark,Copenhagen and 2800,Denmark

Abstract

A novel solar heating plant with Concentrating Solar Power (CSP) collectors and Flat Plate (FP) collectors has been put into operation in Tårs since July 2015. To investigate economic performance of the plant, a TRNSYS-Genopt model, including a solar collector field and thermal storage tank, was established. The optimization showed that there was a synergy in combining CSP and FP collectors. Even though the present cost per m² of the CSP collectors is high, the total energy cost is minimized by installing a combination of collectors in such solar heating plant. It was also found that the CSP collectors could raise flexibility in the control strategy of the plant. The TRNSYS-Genopt model is based on individually validated component models and collector parameters from experiments. Optimization of the cost performance of the plant has been conducted in this paper. The simulation model remains to be validated with annual measured data from the plant.

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

Keywords: CSP collectors; FP collectors; Simulation; Cost optimization; Solar District Heating

1. Introduction

Large solar heating plants have gained great success in Denmark. Most of the collectors used in previous large solar heating systems are Flat Plate (FP) collectors. Parabolic trough collectors are the most mature and prominent solar thermal power technology of all the concentrated solar power (CSP) collector technologies [1]. A novel solar

* Corresponding author. Tel.: +45-5278-1629
E-mail address: zhiytia@byg.dtu.dk

Peer-review by the scientific conference committee of SHC 2015 under responsibility of PSE AG
doi:10.1016/j.egypro.2016.06.224

heating plant with CSP and FP collectors was designed and built in Tårs, to investigate the advantages and disadvantages in the application of CSP technology for solar district heating.

The Tårs solar heating plant was put into operation in July 2015. The solar plant consists of a 4039 m^2 CSP collector field and a 5960 m^2 FP collector field respectively. The cost-performance of the combined solar heating plant was optimized and analyzed to investigate the application of CSP collectors for these plants.

2. Method

To investigate the optimum control and plant design principle, a TRNSYS-Genopt model including conventional natural gas heating plant and storage tank was set up [2]. The CSP collector field performance was modelled based on pilot plant experiences in Thisted 2013 [3]. The TRNSYS-Genopt model was then used to investigate the influence of different component parameters and make a cost optimization of the main design parameters, such as collector fields area mix, tilt of FP collectors and azimuth of CSP collectors. As CSP collectors are still in an early market stage, the influence of the cost level was also investigated. The plant will be monitored to validate the simulation model and analyze the operational performance and control strategy. The same measured district heating load is used in the optimization. New reference year climate data for the Northern Jutland area of Denmark was used [4]. The paper presents a cost optimization of the solar district heating plant.

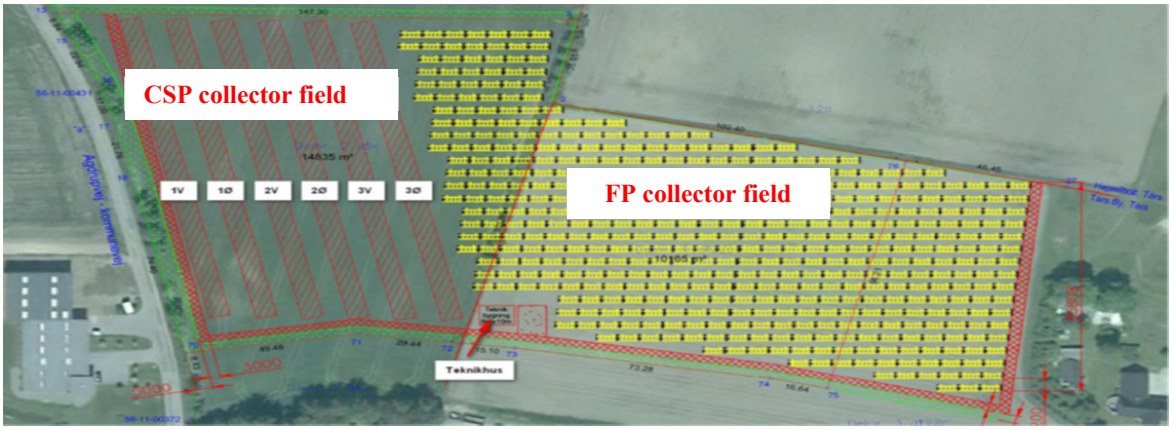

Fig.1. Overview diagram of CSP and FP collector fields.

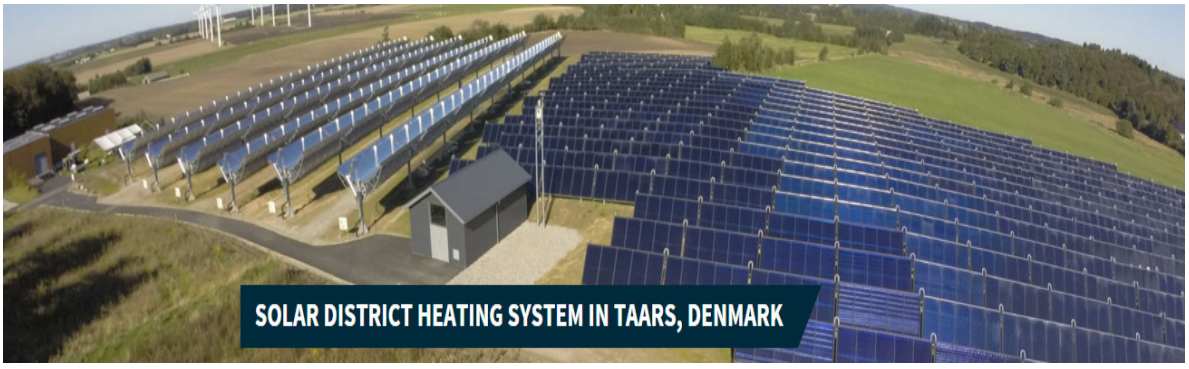

Fig.2. Overview picture of CSP and FP collector fields[5].