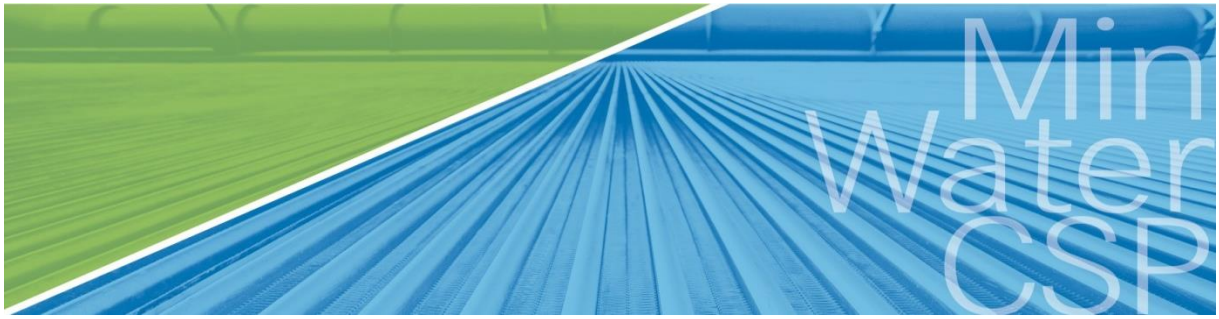

MinWaterCSP Newsletter

Edition: September 2018

Topics

1 Editorial

Dear Reader,

The MinWaterCSP consortium is working on a ***novel hybrid cooling system for CSP plants***, where dry-cooling (cooling with air) and wet-cooling (cooling with water) are combined thus saving water and guaranteeing high performance at the same time. In this context, partners from Germany and South Africa are currently developing a compact wire structure surface area for heat exchangers with reduced material and a higher heat transfer surface. Read more about this technology in the special topic section.

Curious about MinWaterCSP technologies? Then do not miss the project's ***2nd International Conference on the "Reduction of water consumption in CSP plants" in Stellenbosch, South Africa on 7th-8th November 2018***. The conference will conclude our three years of efforts to promote the competitiveness of CSP plants. Discover applicable solutions for mirror cleaning and power plant cooling and meet future business partners to face technology challenges and make CSP technology fit for arid regions! Register now and save your place. You will find more detailed information on this conference and further events in our news and event section. You can also find out more about the recent activities of the MinWaterCSP partners in the blog section.

This newsletter is issued three times per year. It is addressed to all interested stakeholders active in the field of concentrated solar power plants, from power plant developers / operators and technology suppliers to the scientific community as well as governmental bodies.

If you have received this newsletter via a project partner's contact, please feel free to subscribe at our website to have the newsletter automatically forwarded to you in the future.

Enjoy reading!

Falk Mohasseb
Coordinator of MinWaterCSP
Kelvion Holding GmbH

2 Special topic: Performance of Wire Structure Heat Exchangers

MinWaterCSP project partners involved in this activity:

- Fraunhofer Institute for Solar Energy Systems ISE, Germany
- Kelvion Thermal Solutions, South Africa
- ENEXIO Germany GmbH, Germany

The MinWaterCSP project partners designed a first concept of an innovative heat transfer surface area enhancement on the air side of an air-cooled condenser. The concept is based on geometrical and thermodynamic boundary conditions of a CSP plant in Morocco with dry-cooling technology. The concept encompasses the heat transfer enhancement with a **corrugated textile wire fabric** and an adapted flat tube selection. The wire structure is oriented towards the flat tubes in order to ensure **good conductivity** with **low material consumption**.

Figure 1 shows a reference fin, a corrugated expanded metal, and two corrugated wire structures.

The comparison of performance, simulated by computational fluid dynamics (CFD) with the reference air-cooled condenser, shows a strong decrease in material consumption for the wire structure surface area enhancement of the order of 40%-50%. In the simulated design idea, the pressure drop and the heat transfer rate were in the range of the reference condenser. These simulations should be validated with a performance testing of several samples.

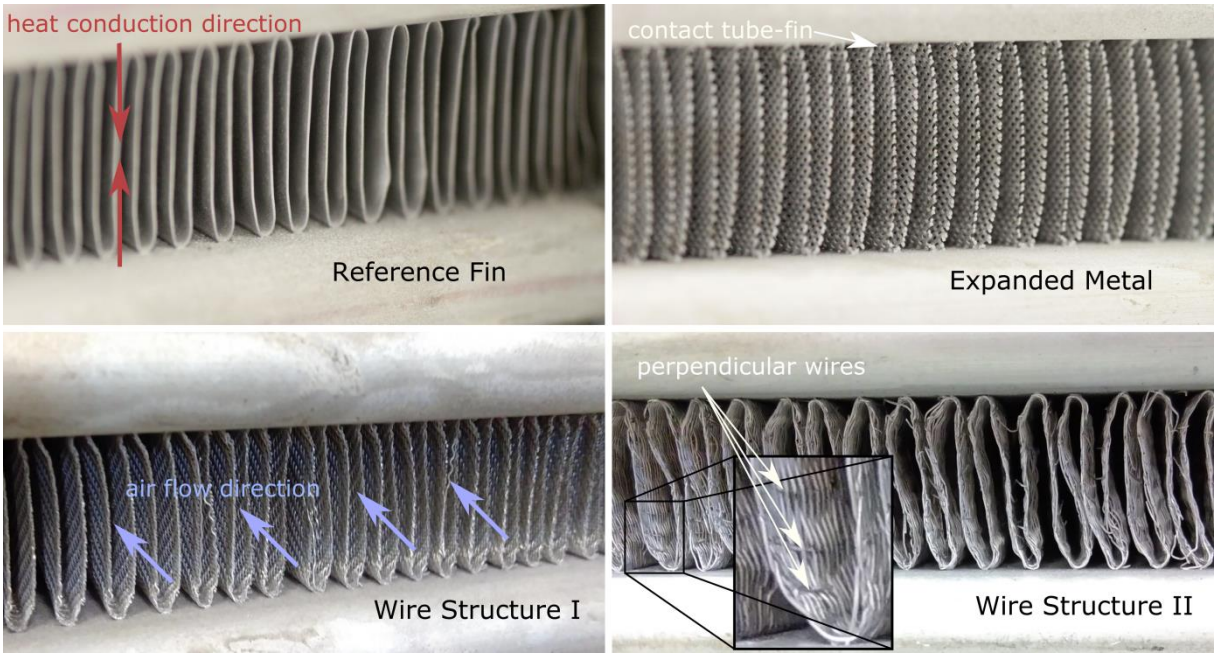

Figure 1: Different surface area enhancement contacted between flat tubes (Figure: Hannes Fugmann, Fraunhofer ISE)

Figure 2 shows the concept and one manufactured sample with a flow cross section of 200 mm x 200 mm. Different metal textiles and an expanded metal have been tested for manufacturability; concentrating on material, mechanical stability, and wire arrangement. Firstly, the very thin wires (180 to 250 µm diameter) allow for high heat transfer coefficients with the drawback of a fast deformation under mechanical stress. Secondly, the textile fabric consists of hundreds of parallel wires from tube to tube, and additional perpendicular wires for mechanical stability. The parallel wires transport heat

by conduction; the perpendicular wires impede the fluid flow, but are needed for mechanical stability. Finding a good balance between both requirements was challenging.

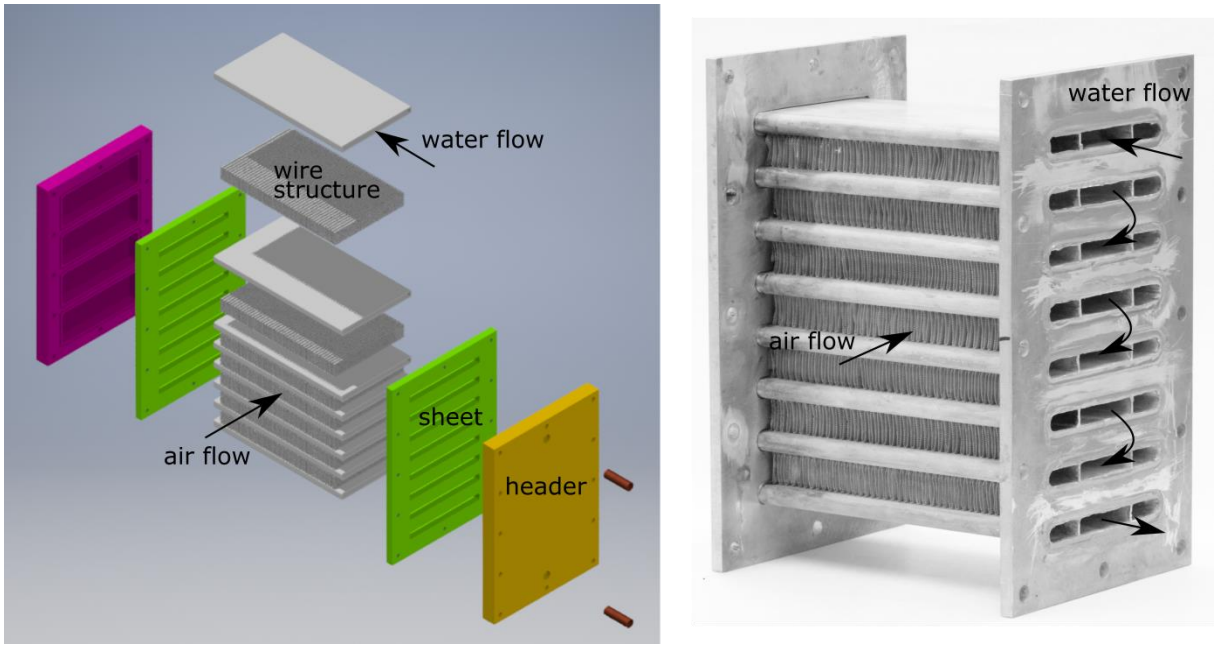

Figure 2: Heat exchanger sample; left: CAD drawing; right: manufactured heat exchanger (Figure: Hannes Fugmann, Fraunhofer ISE)

The test samples are characterised for heat transfer and fluid dynamics at a Fraunhofer ISE test laboratory. For characterising the heat exchangers, air and water are used as fluids. However, the results are transferable to air-cooled condensers with air and steam as fluids. The measurements allow for determining the effective heat transfer coefficient (conduction and convection) on the air side $U_{\mathrm{air,eff}}$, the heat transfer surface area A_{HTS}, and the pressure drop Δp_{air} through the structure. The results in Figure 3 show a very high heat transfer of the wires for high air velocities. For lower velocities, however, the reference and wire structure heat transfer are similar. Further, the pressure drop through the wire structure is much higher than the reference and the result expected from the CFD simulation. A more precise arrangement of wires will reduce the pressure drop and several approaches are currently under examination to achieve this. However, to control the geometry in such a way that pressure drops are reasonably small is the main challenge for compact enhancement development in general. The degree of freedom to change further geometrical boundary conditions (e.g. size of air inlet area) must be kept open. The benefit of material reduction could be verified in this concept phase. The heat transfer related to the material mass for fins was three times higher for the wire structure, compared to the reference fins.

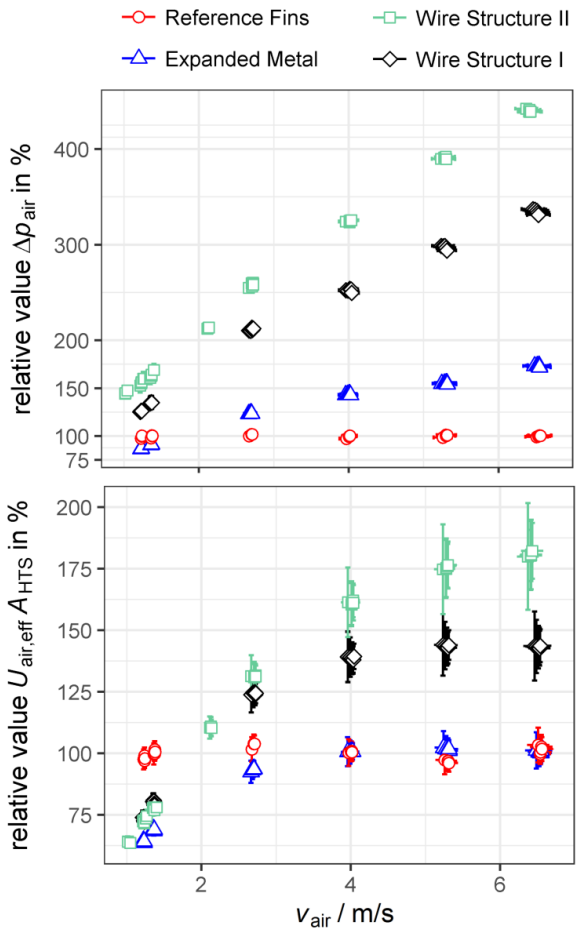

Figure 3: Performance of tested heat exchanger samples relative to the reference performance (Figure: Hannes Fugmann, Fraunhofer ISE)

Further work in MinWaterCSP will concentrate on an economic analysis of the wire structures and on the system level effects of integrating more compact surface area enhancements in air-cooled condensers.

Author: Hannes Fugmann, Fraunhofer ISE, Germany

3 News

- **Full scale testing in Stellenbosch, South Africa**

Two main concerns exist within industrial forced draft air-cooled condensers (ACCs) in relation to concentrated solar power (CSP) plant performance. The concerns being that of excessive auxiliary power consumption and underperformance during adverse atmospheric conditions. Within MinWaterCSP, an attempt is made to provide a cost and water effective solution to address both these concerns through custom designed high efficiency axial flow fans as well as the design and demonstration of a so-called directly integrated deluge cooled condenser cell. Although numerous analytical, numerical and lab-scale experimental analyses have been conducted for these technologies in the past, many questions on full scale system effects remain unanswered. With this in mind, the full scale test facility at Stellenbosch University was purposely designed for testing 24 ft axial flow fans as well as for demonstration of the novel deluge condenser concept. The facility is presently undergoing final installations and commissioning, where after it would be "all systems go" for the final testing leg of the project. Read more in our blog #29.

Photo: Full scale test facility nearly completed. Visible is the fan casing at the bottom as well as the deluge test section (opening at the top) (© ENEXIO Management GmbH, Kelvion Thermal Solutions (Pty) Ltd, Stellenbosch University).

- **MinWaterCSP blogs published monthly**

Project partners are publishing monthly blogs on experiences, technological developments, events they are organising or have attended and activities they want to share on the MinWaterCSP website. Visit our website to find out more information in the 29 blogs published to date.

Click on any of these links to view our latest blogs and articles:

- Blog #29 – Full scale testing in Stellenbosch, South Africa
- Blog #28 – Hybrid cooling system for CSP applications
- Blog #27 – Cleaning robots successfully tested on Linear Fresnel collectors
- Blog #26 – ENEXIO presents innovative cooling technology at North Africa Renewable Energy Summit in Casablanca
- Blog #25 – First International MinWaterCSP Conference in Marrakech showed new approaches to reduce water consumption in CSP plants

Stay tuned! - *http://www.minwatercsp.eu/news/blogs/*

- **Saving water when the sun shines!**
  Join us on 7th - 8th November 2018 for the Second MinWaterCSP Conference

Reduction of water consumption in CSP plants

2nd International Conference by the Horizon 2020 project MinWaterCSP

Date: 7th - 8th November 2018
Stellenbosch, South Africa
The two-day conference will present current challenges and technological solutions for CSP plants:

- Water Management Challenges in CSP plants: Managing Strategies of Water, Simulation-based Analysis of Water Consumption in CSP plants
- Water and Soiling Challenges linked to Cleaning Activities and Systems for Heliostats, Parabolic Troughs and Linear Fresnel
- Novel cooling system technologies for CSP plants

The conference programme will be accompanied by an exhibition where industrial stakeholders will inform about their products and services.

In addition to the presentations on the second day, a site visit to the full-scale fan test facility and ACC integrated Deluge Cooling functional testing facility at Stellenbosch University will be organised. Meet future business partners to face technology challenges and make CSP technology fit for arid regions!

- **Registration is open until 24th October 2018. Register now!**
- **Conference website: https://www.minwatercsp.eu/overview-conference-stellenbosch-november-2018/**
- **Conference programme: https://www.minwatercsp.eu/programme-stellenbosch-conference/**

News from other projects

SHIP2FAIR - Launch of H2020 project on Solar Power to boost energy efficiency in industrial processes

The SHIP2FAIR project (Solar Heat for Industrial Process towards Food and Agro Industries Commitment in Renewables) involves fifteen institutions working to minimise the dependence from fossil fuels in most representative processes of the agro-food industry. Through the integration of solar heat, the project will optimise the global operation of these industrial processes, reducing energy consumption, while increasing their production.

Solar Heat Industrial Processes (SHIP) deployment is currently very low due to economic competitiveness, low prices of fossil fuels charged to industries, and also due to the complexity of their integration in existing industrial processes. SHIP2FAIR team has found the solution for SHIP progress thanks to competitive and environmentally friendly solar technologies, innovative business lines and a user-friendly approach.

The Spanish research centre, CIRCE, leads SHIP2FAIR team, with a perfect balance of main partners from the Agro-food sector and key partners in solar technologies.

Read more…

Follow on Twitter @SHIP2FAIR #SHIP2FAIR & Subscribe to stay informed on SHIP2FAIR News

- **Joint activities with other H2020 CSP projects**

  MinWaterCSP continued the collaboration with other H2020 CSP projects:

  - On 26th June 2018, the Innovation and Networks Executive Agency (INEA) hosted the second **H2020 Coordinators' Day Workshop on Concentrated Solar Power.** The aim of the workshop was to investigate potential synergies between projects in the area of Concentrated Solar Power with ongoing RIA, IA and CSA projects. Representatives of 16 projects introduced their approaches and upcoming activities to enable the identification of synergies.


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  - **Meet us at WASCOP Event in the frame of SolarPACES 2018:**
    On 3rd October 2018, WASCOP will organise a session on ***"Water Consumption Management in CSP Plants"*** in the frame of the **SolarPACES Conference 2018 in Casablanca, Morocco.** MinWaterCSP partners Fraunhofer ISE and IRESEN will contribute to this event by presenting the following MinWaterCSP solutions:

    - *Modelling and Simulation of Water Use and Treatment in CSP Plants (Fraunhofer ISE)*
    - *Strategies for Water Saving and Influence of Water Treatment Concepts in CSP-Plants (Fraunhofer ISE)*
    - *Solar mirrors Soiling detection using night time image processing method (IRESEN)*

    Registration: http://wascop.eu/wcmincsp/

  - **Joint LinkedIn Group** "**H2020 CSP projects**":
    Interested in the latest news linked to CSP and the projects CAPTure, MOSAIC, WASCOP and MinWaterCSP? Follow the four projects via the joint LinkedIn Group **"H2020 CSP projects"**: *https://www.linkedin.com/groups/13519618*

4 Events – Meet us at…

- **Energy4u: Connecte Ideas2Business 2018,** 27th September 2018, Karlsruhe, Germany, https://www.connectideas2business.org/
  MinWaterCSP partner at this event: Steinbeis 2i GmbH
- **SolarPACES2018 – Solar Power & Chemical Energy Systems,** 2nd – 5th October 2018 in Casablanca, Morocco, http://www.solarpaces-conference.org
  MinWaterCSP partners at this event: Fraunhofer ISE, Waterleau and IRESEN
  Also join the side event on 3rd October on Water Consumption Management in CSP Plants organised by WASCOP project
  Registration: http://wascop.eu/wcmincsp/
- **Reduction of water consumption in CSP plants, 2nd International Conference hosted by the Horizon 2020 project MinWaterCSP,** 7th - 8th November 2018 in Stellenbosch, South Africa, https://www.minwatercsp.eu/overview-conference-stellenbosch-november-2018/
  MinWaterCSP partners at this event: whole consortium
  Registration: https://minwatercsp-stellenbosch.eventbrite.de
- **6th International Women4Energy Conference**, 7th December 2018 in Stuttgart, Germany, https://www.women4energy.eu/
  MinWaterCSP partner at this event: Steinbeis 2i GmbH

Visit the event section on our MinWaterCSP website for further events and information.

5 Stay in contact with us

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