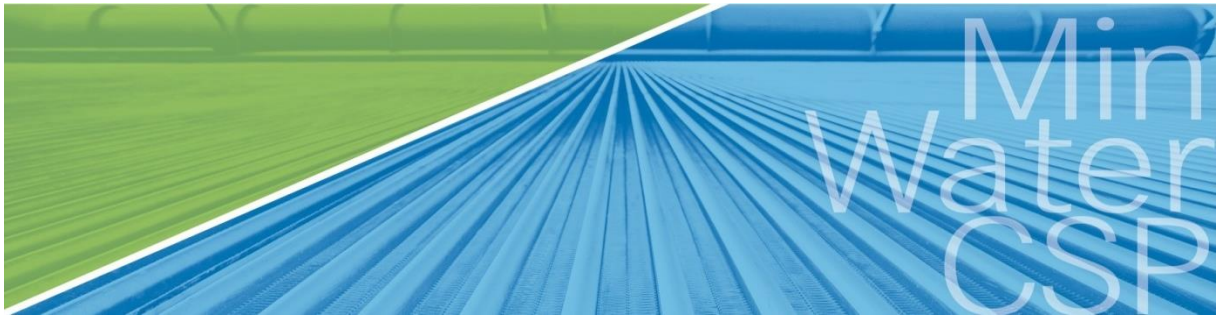

MinWaterCSP Newsletter

Edition: September/October 2017

Topics

1 Editorial

Dear Reader,

CSP plants are typically located in arid regions and subsequently often make use of dry-cooling systems instead of smaller and more effective wet-cooling systems. In MinWaterCSP, overall water management concepts for CSP plants will be designed, covering the whole chain from sourcing via treatment to distribution, with the aim to reduce the overall water consumption. In this fourth edition of the MinWaterCSP newsletter, we would like to introduce the water mangement for CSP plants in more detail. In addition, we will give you an update about the latest blogs on our project website as well as on events where you can meet us and get first-hand information.
This newsletter appears approximately every four months. It is addressed to all interested stakeholders who are active in the field of concentrated solar power plants, from power plant developers / operators and technology suppliers to the scientific communiy 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.

We wish you an inspiring read!

Falk Mohasseb
Coordinator of MinWaterCSP
Kelvion Holding GmbH

2 Special topic: Water Management Concepts for CSP plants

MinWaterCSP project partners involved in this action:

- Fraunhofer ISE, Germany
- Waterleau, Belgium

Introduction:

Minimizing the water consumption of CSP plants is an important issue as this kind of solar energy generation is often found in arid areas where the solar irradiation is high. Any conflict of water use should be avoided to allow high acceptance of the technology in such regions. The step from wet-cooling to dry cooling or to hybrid cooling systems is the most important and efficient measure to save water. But within the water management of a CSP plant, MinWaterCSP wanted to take advantage of more possibilities and additional aspects that can save water, make the operation less complicated, reduce plot place requirements and investment costs and, in the end, contribute to a lower cost of energy (LCOE).

State of the art: Identified benchmark

The two MinWaterCSP partners Waterleau and Fraunhofer ISE analysed in detail the typical water demand for CSP plants. Together, they identified a benchmark by defining a basic scenario based on water management examples of existing CSP plants.

For a typical 50 MW_{el} CSP plant, about 100 m^3/h of water is needed. There are four main water consumers: Cooling system, mirror cleaning, steam cycle and miscellaneous consumers.

The wet-cooling system makes up approximately 93% of the water demand, 4% is used for mirror cleaning, 1% as make-up water for the steam cycle and another 1% for "Miscellaneous Water Consumers", which are quench water, potable water for the staff, fire-fighting water, other smaller closed cooling loops of pumps etc. (see Figure 1). The last percent of the water demand of the consumers is covered through an internal re-use as the boiler-water blow-down is led into the cooling water.

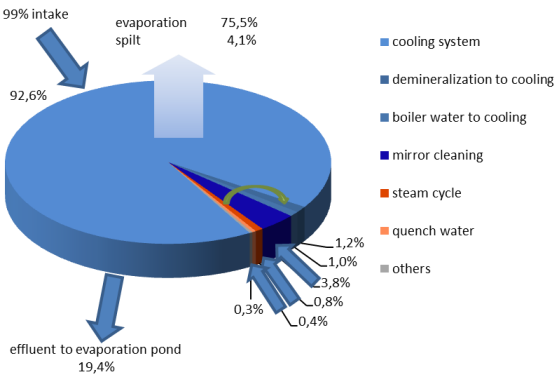

Figure 1: Typical distribution of water to the consumers of a CSP plant with wet-cooling tower.

The raw water can originate from quite a number of different sources like groundwater or surface water (rivers, lakes, dams, reservoirs for seasonal rainwater capture). In a first treatment step, this raw water is purified from particles, turbidity, the TOC and germs are reduced. There are well-known treatment technologies used for this (coagulation and flocculation, sand filter or microfiltration, ozonisation; see also Figure 4). In a second treatment step, the water is demineralized (see Figure 5) to meet the requirements of boiler water make-up and mirror cleaning.

Methods for developing an improved water management concept

Starting from this benchmark, the partners developed improved scenarios for the water management. Simplified flow charts and the mass balance for water and salts were used for this purpose. The final objective of the methodology is to compare and discuss different water management concepts, their savings with regard to withdrawal of raw water from the source and the amount of effluent and its quality.

MinWaterCSP proposal: A Water Management Approach

First of all the proposed MinWaterCSP water management approach substitutes the wet-cooling tower by a hybrid cooling system. This technology makes use of both air-cooling and evaporative cooling to achieve the desired cooling capacity while reducing water consumption by 85% (see Table 1). The next important change is to use the blowdown water from the cooling system and the steam cycle for producing demineralized water. This results in an internal re-use loop which makes up about 36% of the overall water intake. The last important water saving measure is to reduce the amount of losses in mirror cleaning by recollecting water after the mirrors have been wetted for cleaning.

According to the steady state mass balances, these measures result in a saving of 85%, which is mainly achieved through the substitution of the cooling system. The suggested re-use loops account for another 28% savings compared to a system without any re-use (see Table 1 and Figure 3). With regard to the evaporation pond which is usually part of the water treatment in CSP plants, the suggested concept results in a reduction of capacity from ~20 m³/hr to 0.7 m³/hr.

The pie chart (Figure 2) shows the effect of the introduced re-use cycles.

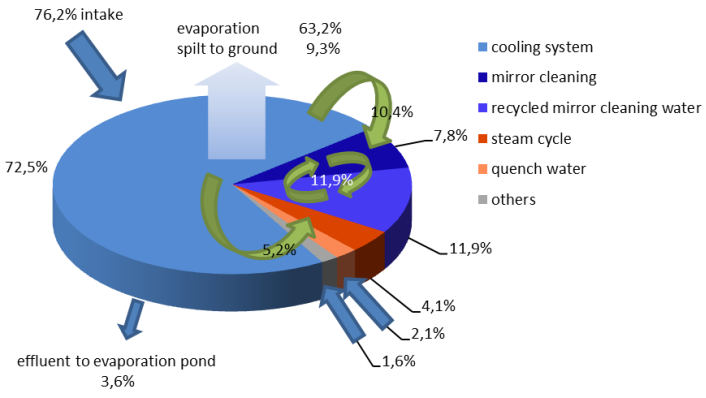

Figure 2: Distribution of water to the consumers in the suggested MinWaterCSP water management concept

	Reference (wet-cooling)	MinWaterCSP 1 (hybrid condenser without any water re-use)	*Savings*	MinWaterCSP 2 (hybrid condenser and water re-use)	*Savings*
net water consumption [m³/hr]	**100**	**20,5**	***79,5%***	**14,7**	***85,3%***
cooling system	94,7	14	*85,2%*	14	*85,2%*
steam cycle	0,8	1,0	*no savings*	0	*100,0%*
mirror cleaning	3,8	4,8	*no savings*	0	*100,0%*
others	0,7	0,7	*0,0%*	0,7	*0,0%*
re-use [m³/hr]	**1**	**0**		**5,3**	
cooling system blowdown	0	0		2	
boiler water blowdown	1	0		1	
cleaning water	0	0		2,3	
evaporation pond [m³/hr]	19,6	4,2		0,7	

Table 1: Comparison of the identified benchmark with the suggested MinWaterCSP water management concept with and without re-use cycles.

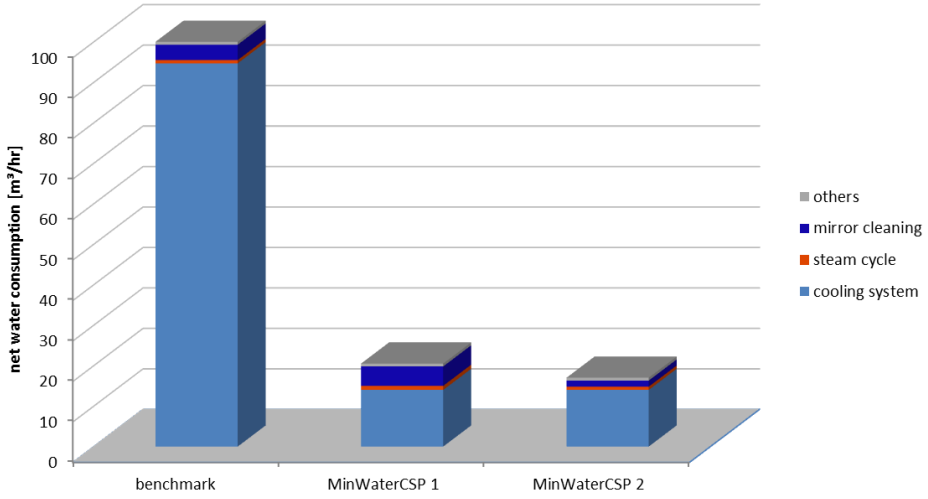

Figure 3: Comparison of the identified benchmark with the suggested MinWaterCSP water management concepts with and without re-use cycles.

Future steps to follow

Waterleau started to develop water treatment technology trains to meet the requirements of CSP plants with unitized, cost-effective solutions. The design of the water management concept serves as a basis for this kind of new modular treatment system.

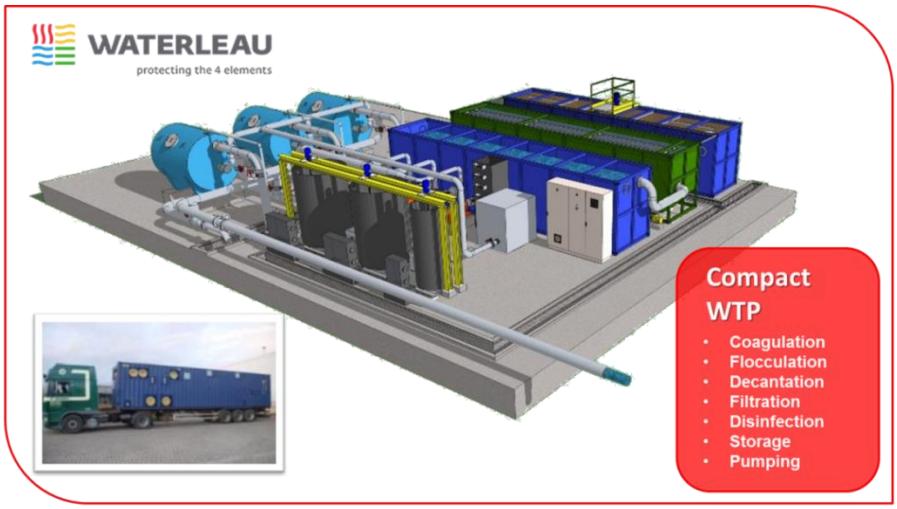

Figure 4: Compact modular treatment system for the MinWaterCSP water management for the first treatment step proposed by Waterleau.

The partners consider the proposed water management concept as a basis for more detailed evaluations. Within MinWaterCSP, Fraunhofer ISE and Waterleau will run simulations of the overall CSP plant operation, including the water consumers to determine the actual water demand profiles. The actual water demand is the most important parameter for dimensioning a treatment plant. Of course, the partners are highly interested to save costs in the end. Therefore, they want to evaluate the concept more precisely with the simulation results. The partners will carefully compare the auxiliary power demand for the more energy-intensive demineralization step and finally analyse the expected costs for investment and operation of the suggested water management concept.

Figure 5: Example of a possible technology train for the demineralisation step in the MinWaterCSP water management.

Author: Joachim Went, Fraunhofer ISE, Germany

3 News

- **Euronews TV shooting at IRESEN's demo-site Green Energy Park**

On 18th September, a team of Euronews TV visited IRESEN's Green Energy Park to produce vidoes of the containerized fouling test rig, consisting of four small cooling towers. The cooling towers will enable multiple accelerated investigations to determine the effect of fouling for different water compositions and various tube materials. Kelvion Thermal Solutions carried out the concept design in cooperation with ENEXIO Germany and managed the manufacturing; shipment to Morocco and the subsequent commissioning. The test rig was manufactured by TF Design of Stellenbosch, South Africa. In Morocco at Green Energy Park, IRESEN is running the fouling test program. Broadcasting of the recently produced video footage is planned for 8th October 2017 on the Euronews channel.

Photo 1 and 2: IRESEN team explaining the fouling test rig.
© Pictures made by Kelvion Holding

- **MinWaterCSP leaflet on technologies published**

  The second leaflet of the MinWaterCSP project has been published. It highlights the benefits of the technologies under deveopment.

  Download the leaflet at:
  http://www.minwatercsp.eu/wp-content/uploads/2017/06/MinWaterCSP_project-leaflet-technologies.pdf

- **Joint activities with other H2020 CSP projects (CAPTure, MOSAIC, WASCOP)**

  MinWaterCSP continued the collaboration with other H2020 CSP projects:

  - The 1st edition of a **joint newsletter** providing information on H2020 funded CSP project progress has been published in June 2017. A 2nd edition of the joint newsletter will be published soon.
    Follow us by subscribing to the joint newsletter: http://eepurl.com/cOtWvj
  - A joint **"H2020 CSP projects"** group on LinkedIN has been created. Here you receive news linked to CSP and to our projects. Follow the four projects via the joint LinkedIN Group: *https://www.linkedin.com/groups/13519618*

- **MinWaterCSP blogs published monthly**

Project partner are publishing monthly blogs on key 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 17 blogs published to date.

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

- Blog #17- Joint activities of Low Carbon Energy Projects funded under Horizon 2020
- Blog #16 - MinWaterCSP Consortium meets as University of Sapienza in Rome
- Blog #15 - The MinWaterCSP coordination team visits the IRESEN Demonstration site in Morocco where the deluge cooling fouling test rig has been installed

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

4 Events – Meet us at…

- **SDEWES 2017, 12th conference on sustainable development of energy, water and environment systems,** 4th - 8th October 2017 in Dubrovnik, Croatia; http://www.dubrovnik2017.sdewes.org/
- **IEA SHC 2017** – Conference with ISES Solar World Congress 2017, 29th October - 2nd November 2017 in Abu Dhabi, United Arab Emirates; http://www.shc2017.org/
- **Africagua 2017. International business meeting under the theme of water and renewable energy,** 6th - 7th November 2017, in Fuerteventura – Canary Islands, Spain; https://africagua.com/es/
- **11th International Concentrated Solar Power Summit (CSP Seville 2017),** 21st - 22nd November 2017 in Seville, Spain; http://events.newenergyupdate.com/csp/
- **5th International Women4Energy Conference** – in Stuttgart, Germany; 6th December 2017; http://www.women4energy.eu/; MinWaterCSP represented by S2i

5 Stay in contact with us

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 654443