SOWADIS – Solar Water Disinfection

Analysis of a SoWaDis plant

Graduate

Martin Widmer

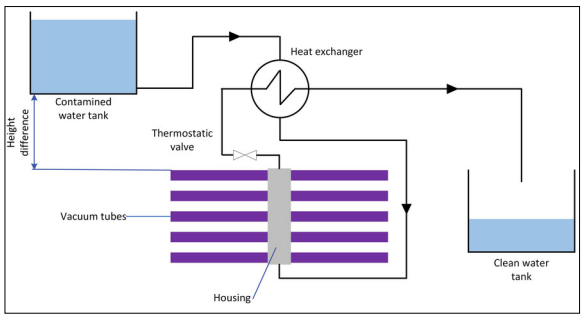
Introduction: According to the 2023 report of the UN, about 2 billion people worldwide did not have any access to safe drinking water. The Waterkiosk Foundation is a Swiss based Foundation that supports access to safe drinking water in Tanzania by installing two types of systems: SoWaDis (“solar water disinfection”) and SuMeWa (“sun meets water”). SoWaDis water treatment technology is based on thermal disinfection. Water is disinfected by heating it to 80 °C using solar energy.

Definition of Task: The first part of the project was focused on assessing SoWaDis performance at laboratory scale, at SPF Institute for Solar Technology in Rapperswil SG. The daily clean water production and the working disinfection temperature were evaluated. The plant was then optimized by adding new reflectors under the vacuum tubes and the same measurements were repeated. After that, a similar procedure was applied for SoWaDis plants installed in different institutions in Mbeya, Tanzania. In addition, interviews with the plants’ responsible people were performed and microbiological plausibility tests were done on site.

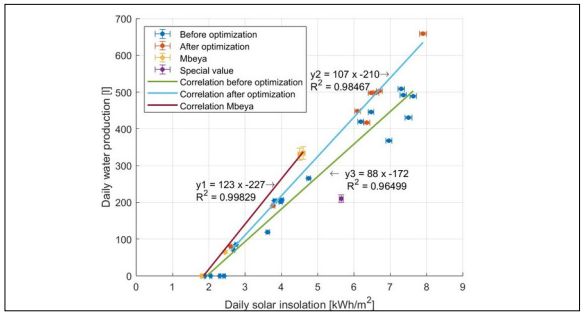
Result: The measurements carried out in Rapperswil SG demonstrated that the disinfection temperature is always above 79 °C. The daily water production depends on the global irradiation level and reached a maximum of 509
L/d at optimal weather conditions (7.3 kWh/m2 solar insolation) before the optimization was done. The optimized plant could produce 100 L/d more water in good weather conditions (7.5 kWh/m2 solar insolation),
thus about 600 L/d. With optimal weather conditions, large fluctuations for the water production were noticed even though the solar insolation values were similar. This is due to different energy losses that can be explained by stratification and streams inside the collector mixing the warm and cold water. The measured disinfection temperature of all tested SoWaDis plants in Mbeya was around 100 °C. The thermostatic valves were clogged due to the formation of carbonates and thus did not open at the right temperature. As a result, the volume of produced water was about 80% less than the expected volume for the same solar insolation. The microbiological plausibility tests carried out in Mbeya indicated that the clean water tanks were subject to pathogen contamination. All treated water tested presented bacteria after a 72-hour incubation. The concentrations varied between 3 and 86 CFU/100 mL. According to the user interviews conducted in Mbeya, all SoWaDis plants are well accepted by the local population. The SoWaDis systems also allow the population to save money that is no longer spent buying bottled water. The interviewees noticed as well that the pupils were no longer sick due to the drinking water. Based on the results obtained, suggestions for improvements were made. To avoid streams inside the collector, an inlet plate could be installed. Additional reflectors could also be
installed under the vacuum tubes, to increase the daily water production. The thermostatic valves should be regularly controlled, so the clogged valves could be replaced quickly. To reduce the risk of clean tanks contaminations, the chlorine disinfection performed during the maintenance could be conducted more frequently.

SoWaDis system at St. Clara's primary school in Mbeya, Tanzania
Own presentment

Process flow diagram of the SoWaDis system
Own presentment



Comparison of the performance measurements of the different SoWaDis systems
Own presentment



Advisor
Prof. Dr. Andreas Häberle

Co-Examiner
Christopher Wellauer, Waterkiosk Foundation, Zürich, ZH

Subject Area
Solar thermal technology, Water treatment