THE ISSUE

The change to a sustainable, resource- and energy-efficient industry represents a significant challenge for the coming years. The efficient supply of energy, the best possible integration of renewable energy sources and the recovery of resources in the sense of a circular economy must go hand in hand. The use of solar process heat represents a large, but so far largely unused, potential in industry. Innovative and concrete solutions are needed for the long-term and successful introduction of solar thermal energy. The integration of solar process heat to supply technologies for wastewater treatment represents a new field of application with excellent technical and economic potential for solar thermal energy. The efficient interaction, the nexus between solar energy, water and industry opens up new and innovative approaches.

OUR WORK

SHC Task 62 is developing and providing the most suitable and accurate information on the technical and economical possibilities for effectively applying solar thermal energy and solar radiation to disinfect, decontaminate and separate industrial process water and wastewater. This Task is supporting specifically the solar energy industry, the water technology sector and the producing industry in identifying new technologies, innovative fields of application and business opportunities.

The main objective of Task 62 is to improve the conditions and increase the applications of solar-driven separation and water purification technologies in industrial applications in order to push the solar water treatment market and to solve water problems at locations with abundant solar energy resources. Innovative results are expected in the field of collector technology and the identification of new applications, such as for municipal and industrial wastewater treatment plants.

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2022 HIGHLIGHTS
Solar Energy in Industrial Water & Wastewater Management

KEY RESULTS IN 2022

Integration Concepts for Solar Water Treatment

As a result of the IEA SHC Task 62, integration concepts are available to create a framework for the optimized combination of wastewater treatment technologies with energy supply. Consideration is given to solar thermal technologies, other renewable energy technologies (e.g., heat pumps), and surplus heat (waste heat) from industrial processes or their hybrid combination (PVT collectors).

The system integration concepts graphically illustrate how energy sources, such as solar thermal, can be integrated in combination with wastewater treatment processes, such as thermal separation processes (an example technology is Membrane Distillation (MD)), to meet the energy demand in a renewable way. The integration concepts are modular and include 3 modules: base modules, auxiliary modules (add-on modules), and integration modules. Each concept has at least one base module for renewable thermal energy supply (energy collection unit), such as solar thermal or heat pumps. There is also the possibility to integrate waste heat. In addition to the basic modules, there are many add-on modules (e.g., charging, storage, discharge, integration). Additional modules allow the integration of renewable process heat modules for heat supply on the process or system level and allow for the adaptation of the concept to the respective requirements. Figure 1 shows an example of the heat supply for MD at the process level. The MD process module changes depending on the requirements, such as batch or continuous operation, as well as realized internal heat recovery and can be replaced by other water treatment processes.

![Figure 1. Integration concept for solar thermal energy in combination with thermal treatment technologies (e.g., Membrane Distillation, MD).](image)

New, Innovative Concepts for Solar Collectors

Conventional solar energy technologies are characterized by the separation of the solar energy generation and the industrial process. Integration takes place, for example, via heat exchangers (e.g., integrated into baths) or a system for energy supply. Concepts for solar reactors represent a process intensification approach, where the integration part is omitted, and the energy generation and processes are combined into one component. The process, therefore, takes place directly in the energy supply unit (e.g., solar collector).

![Figure 2. Approach of solar reactors.](image)
Within the work of the IEA SHC Task 62, new solar reactors for thermal and photon water treatment were collected. For example, the concept of AEE INTEC for a Solar reactor can be mentioned. The design of the solar reactor includes a targeted process intensification approach in which a photo-electrochemical cell (PEC) is integrated into a concentrating solar collector tube with optimized rheology. To concentrate the solar irradiation, the solar collector tube is surrounded by a concave trough mirror. The photo-electrochemical process is used to split water into its components by directly using sunlight to produce alternative fuels such as hydrogen. To increase the process efficiency, wastewater is used in test series since pollutants and waste substances contained in wastewater (e.g., microplastics, pesticides, trace substances) serve as an additional “source” of hydrogen (sacrificial substances). The advantage – at the same time the fuel is produced, there is a significant elimination of pollutants, and thus purification of the wastewater takes place. The reactor is set up in the laboratory of AEE INTEC in Gleisdorf (Austria) and is tested there under natural irradiation conditions.

![Figure 3. Concept of a solar reactor created by AEE INTEC (Austria, Gleisdorf).](image)

**Technology Position Paper**

A Technology Position Paper will be published and posted on the Task webpage in early 2023. This paper includes the current status of solar water treatment and the potential and actions to be taken for increased market penetration.