SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

# 2021 HIGHLIGHTS

# Task 62 – Solar Energy in Industrial Water & Wastewater Managment

## 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.

**Participating Countries**

*Australia*
*Austria*
*Denmark*
*France*
*Germany*
*Italy*
*Netherlands*
*Portugal*
*Spain*
*Sweden*
*UK*


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# KEY RESULTS IN 2021

## Overcoming Barriers for Up-scaling New Decontamination and Disinfection Systems

In 2021, Task participants surveyed experts on their opinions about the techno-economic and political challenges facing new/integrated water treatment for upscaling applications in industrial wastewater management and the actions needed to tackle challenges, such as water-energy nexus issues and improving water resilience in industry.

Experts' opinion on technological barriers to the market implementation of new/integrated technologies in treating industrial wastewater clearly states **cost-related issues are the main barrier**. Traditionally, advanced oxidation technologies for the remediation of specifically persistent industrial wastewater are characterized by their elevated costs. Such treatments include ozonation, high doses of UV, electrocatalysis, wet oxidation, reverse osmosis, etc.


Overview technological barriers

The main economic barrier identified by SHC Task 62 experts for implementing new industrial wastewater treatment technologies is an **investment**. Independent from public investment instruments already available, not only at European or national levels, there is a clear and prevailing lack of investment by the private sector to develop and implement new and/or integrated technologies.


Overview economic barriers

**Political and legal aspects** must always be taken into account in the introduction of new technologies into a specific market. In the case of industrial wastewater treatment, experts have established the most important political barriers in the "**conflict of interest" and "legislation**." It is clear that new regulations and legislation focused on forcing more stringent water quality parameters, not only before discharging to the sewerage but even more so when recycling wastewater for activities such as crop irrigation and some industrial processes, are necessary. In addition, in the specific case of industrial wastewater, there is always a part related to conflicting interests that could arise for the implementation of a sustainable circular economy vision. Nevertheless, it must be considered that time by time, industry is more conscious and focused on trying to reduce its water footprint.


Overview political barriers

## Future R&D Demand for Membrane Distillation

To further develop and attract Membrane Distillation (MD), SHC Task 62 focused on identifying technological challenges and hurdles and specification of related **R&D demand,** including basic research, component development, system technology, and control strategy for integrating MD in industrial processes. Key components of MD systems and associated R&D activities include **a) membranes and materials, b) module design,** and **c) system design.**

**Table 1. Overview of important R&D topics for integrating Membrane Distillation based on results from Subtask A.**

| Topic | Key properties |
|---|---|
| **Membranes and materials** | • Scaling and fouling<br>• Long-term hydrophobicity |
| | • Temperature resistance<br>• Mechanical resistance |
| | • Selective membranes<br>• Enhancing transmembrane flux<br>• Cost reduction |
| **Module design** | • Heat recovery<br>• Thermal efficiency<br>• Flux enhancement through innovative/new designs (e.g., vacuum)<br>• Mechanical strength (e.g., under vacuum) |
| | • Maintenance (Scaling, fouling, cleaning reduction) |
| | • End of life recycling |
| | • Cost improvement |
| **System design** | • Renewable heat and cooling supply ( e.g., waste heat, heat pump, solar thermal) |
| | • System control |
| | • Integrated systems (new concepts, combining technologies) |

## Membrane Distillation for Ammonia Recovery

**AEE INTEC** has successfully operated a MD pilot plant (14 m$^2$) to remove ammonia and produce fertilizer during a 24/7 operation at the municipal wastewater treatment plant in Gleisdorf, Austria. The results were produced jointly with the Austrian flagship project Thermaflex (https://thermaflex.greenenergylab.at/) and within the IEA IETS Task 17. Solar Spring, together with Fraunhofer ISE, University of Stuttgart, and Abwasserzweckverband Breisgauer Bucht, successfully finalized a research project on ammonia recovery from wastewater by Osmotic Membrane Distillation (OMD). The project was funded by Deutsch Bundesstiftung Umwelt. A demonstration system was designed, constructed, and operated in a municipal wastewater treatment plant near Freiburg, Germany, and included a full Life Cycle Assessment and economic evaluation. The economic analysis shows that OMD technology can be economically sustainable if there is a corresponding demand for the ammonium sulfate product produced, and corresponding prices can be achieved as a result. In practice, this will strongly depend on the respective wastewater treatment plant for which the application is intended and the local supply and demand situation for fertilizers. It is expected that about 47 ct/kg ammonia sulfate would be necessary to fully cover the costs.

**MD pilot plant at a WWTP in Gleisdorf, Austria operated by AEE INTEC.**

## SHC Task 62 Webinar

The Task's Solar Academy webinar highlighted the project's ongoing work. Christoph Brunner discussed the importance of the Nexus between energy and water followed by presentations on specific applications – Sacha Sineux of newHeat presented on the effective combination potential in applying solar energy for thermal energy supply in the mining industry. And Isabel Oller of CIEMAT showed how solar decontamination and advanced disinfection processes could play an essential role in reducing industrial water footprints. The webinar highlighted the importance of finding the most suitable and accurate information on the technical and economic possibilities for effectively applying solar thermal energy and solar radiation to disinfect, decontaminate and separate industrial process water and wastewater. More information and the recording are available at https://www.iea-shc.org/solar-academy/webinar/solar-energy-in-industrial-water-wastewater-management.