Water Treatment and Desalination at the Lehrstuhl für Thermodynamik, TUM

Burkhard Seifert, Alexander Kroiss, Dr.-Ing. Markus Spinnler, Prof. Dr.-Ing. Thomas Sattelmayer
Lehrstuhl für Thermodynamik, Boltzmannstr. 15, 85748 Garching. Email: spinnler@td.mw.tum.de

Meeting the worldwide demand for energy and water is the biggest challenge of this century. The Technische Universität München is strongly committed to research on technologies that provide sustainable solutions. The Lehrstuhl für Thermodynamik contributes to this research in the areas of Combustion, Thermo Acoustics, Transport Phenomena and Energy & Environmental Technologie.

The Energy & Environmental Technology Group covers four areas of activities:

Teaching: To provide the educational basis required for research in the energy and water sector, we offer lectures including Thermodynamics, Heat- and Mass-Transfer, Multi-Phase-Flow or Solar Engineering. The lecture Solar Engineering includes an overview of solar powered desalination systems.

The new lecture “Desalination”, planned to start in WS2012, will provide the insight into thermal and membrane desalination technologies. Guest speakers from the industry will share their knowledge on the growing demand for desalination.

Water Research: Within the water research activities, we focus on two topics: the treatement of industrial waste waters (e.g. high salinity) and desalination:

The disposal of waste waters involes with high costs. A cost effective solution is the concentration of liquids which requires efficient and robust technologies. At the Lehrstuhl für Thermodynamik, several research projects have covered that topic and several pilot plants were developed and tested.

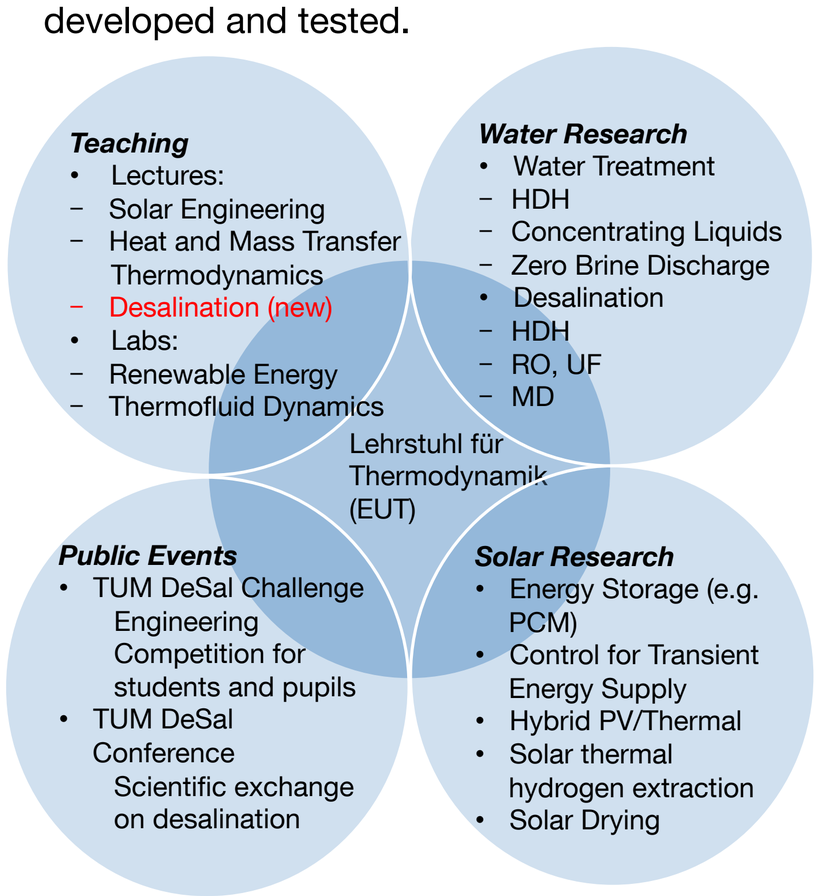

Fig. 1: Lehrstuhl für Thermodynamik, Energy and Environmental Technologies (EUT): The Four Areas of Activities

Solar Research: Due to limited resources of fossil fuels and the crucial reduction of the emission of green-house gases, the chair contributes efforts to the world’s sustainability challenges with its research in the field of solar applications. A Solar Research Center is affiliated to it. Research topics deal with energy storage, hybrid PV / Thermal systems and solar drying.

Public Events: The objective of TUM DeSal Challenge is to create awareness in the general public for the growing issues of drinking water scarcity in the world.

The competition should identify ways of how to solve this problem with the power of innovativeness in European research and technology. This event is organized by our institute and is held biannually since 2009.

Held for the first time in 2011, TUM DeSal Conference offers a platform for scientific exchange on desalination systems completely or partially supported with renewable energies.

Waste Water Treatment: Humidification – Dehumidification (HDH) plants consist of three main components: the humidifier, the dehumidifier and external heating. Water is initially preheated in the dehumidifier and is then heated to the Top Brine Temperature using an external heat source.

Water is spread throughout the humidifier, which consists of filling or packing material. Cool air from the dehumidifier enters the humidifier and is heated by the counter current water flow that absorbs the water vapour. The air circulates due to density differences and flows in the dehumidifier where fresh-water is condensed at the surface of the heat exchanger.

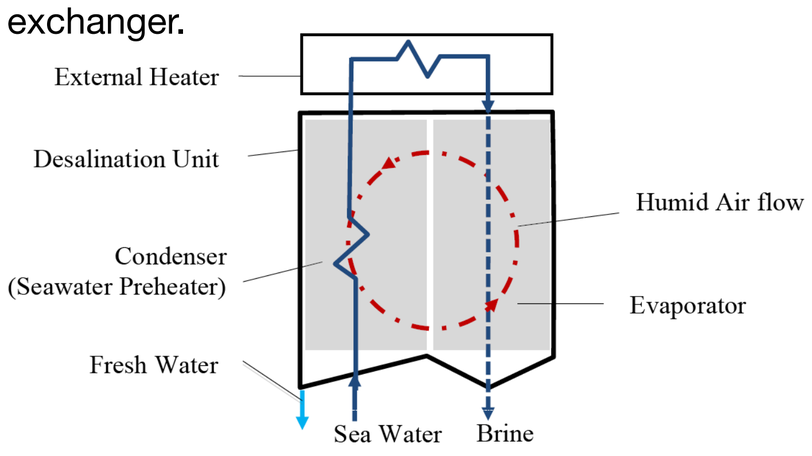

Fig. 2: Humidification-Dehumidification System for Waste Water Treatment and Desalination Applications

This technology is suitable for treatment of high saline waters (>100.000 ppm) or other waste water. Concentration of liquids is a growing industrial requirement and requires robust and scalable solutions aiming for zero brine discharge. This technology can also be used for desalination applications (<10 m^3/d).

Several fully operational prototypes with different features have been tested, also with solar energy usage e.g. in Greece and Dubai.

Desalination: Reverse Osmosis (RO) belongs to the membrane based desalination technologies. Compared to thermal desalination processes like HDH this desalination type needs electrical energy supply.

In a research project, the RO system is coupled with a hybrid Photovoltaic/thermal (PV/T) solar energy system. PV/T systems produce both electrical and thermal energy. The main objective of this work is to improve the energy efficiency of a solar powered RO desalination and, simultaneously, to provide technical solutions for the challenge of the transient power supply.

Summary:
The institute has gained experience within the last 6 years on HDH and other water treatment technologies. We believe HDH has great promise in the field of liquid concentration and small scale desalination for the developing world. The experience gained within the thermal water treatment systems is now applied to membrane systems for both water treatment and desalination. Also, the know-how within the area of solar applications allows us to contribute towards innovative solutions for transient power supply, such as PV/T - Reverse Osmosis systems.