TUM DeSal Challenge 2016

The Competition on
Seawater Desalination
June 17 + 18, 2016
At the Campus of TU München
in Garching

YOUNG
SCIENTISTS
COLLOQUIUM

www.desalchallenge.com

Providing Water for the World

TUM DeSal Challenge 2016

Providing Water for the World

Meeting the worldwide demand for energy and water is the biggest challenge of this century. Technical University of Munich is strongly committed to research on technologies providing sustainable solutions. The Institute of Thermodynamics contributes to this research in the areas of Combustion, Thermo Acoustics, Transport Phenomena and Energy as well as Environmental Technologies. 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 as well as Solar Engineering and Desalination.

Among our research projects, we are active in desalination, both thermal and membrane based, also being supported with renewable energy. The TUM DeSal Challenge to date has been a unique competition that was created for drawing attention to the challenge of the worldwide water shortage. This event took place for the first time in 2009. As the competition was very well received by high school students, university students and others, we decided to repeat the Challenge every two to three years.

In 2016, 12 teams from schools and universities were nominated to challenge the global drinking water problem and to develop and build each a small, self-powered plant for seawater desalination.

The competition is accompanied by the TUM DeSal Young Scientists Colloquium, a networking event for young scientists with research focus on water and desalination in Germany.

This new educational approach is focusing on young people to integrate them in the process of solving the problem of water scarcity, which is mainly promoted by research and industry. We want to provide a valuable platform for high schools, universities and industry. In hosting the TUM DeSal Challenge, we look forward to fostering partnerships and networks within the desalination community.

Prof. Dr.-Ing. Thomas Sattelmayer
Ordinarius, Chair of Thermodynamics,
Technical University of Munich

TUM DeSal Challenge 2016

Motivation

“Drought and the expansion of deserts have threatened the existency of over 1 billion people in more than 110 countries of our earth”. With these words, former General Secretary of the UN Kofi Annan had already warned the world in 2001 of the growing and alarming global problem of water scarcity for many of the world’s population.

The United Nations predict that by the year 2025, two-thirds of the world‘s population – which will likely reach 6 billion by then – will lack access to drinking water, a problem that involves a life threatening undersupply to those affected, huge streams of refugees,

growing urban migration and resource allocation conflicts that are already underway.
Progressive global warming is only making the problem worse. Although two-thirds of the surface of the earth is covered with water, only 0.02 % is potable.
One of the many available solutions for tackling this problem, from a technical standpoint the treatment of sea and brackish water, hereafter referred to as sea water desalination, is one of the more promising. Successful large, centralized desalination plants are already in operation today. The use of these large-scale plants, whict can output as many as 1,000 cubic meters of fresh water per day, creates two basic problems:

- The majority of the undersupplied population (roughly 900 million) lives in rural areas with poor infrastructures and without access to fresh water from large plants, which is why a large number of small, decentralized plants are required.
- Desalination requires large amounts of energy, which in large scale systems is usually produced from fossil fuel sources. With respect to the total installed capacity in the world – 40 million cubic meters per day – CO_2 production can be estimated at 200 million tons per year, which equates to one-fourth of the CO_2 emissions in Germany.

In analyzing those regions with insufficient access to the “blue gold”, as drinking water is sometimes called, it becomes immediatly clear that renewable energy sources, especially solar, possess great potential for powering desalination systems. Current systems have yet proven to be economically and technically feasible however.
One genuine solution to the problem is the development of small scale, decentralized desalination plants. Due to the poor infrastructures frequently found in these regions, the plants can be powered through renewable energy sources. Another factor is suitability for developing countries, which requires low investment costs and a ease-of-operation.

This explains the motivation behind the TUM DeSal Challenge. A number of teams from secondary schools and universities have been called on to tackle the world’s drinking water problems by developing a small, energy-independent desalination plant. These plants will be demonstrated during the competition and judged in 6 categories.

What remains is to find out who can produce the largest amount of drinking at the lowest costs, with the least effort and without relying on fossil fuels.

Friday June 17

Schedule
TUM DeSal Challenge 2016

8:00 am – 10:30 am	Building and Start-up of the DeSal Plants		
10:30 am – 11:30 am	Welcome and Opening Ceremony		
11:30 am – 7:00 pm	Competition Plant Operation and Measurements Jury Evaluation	Young Scientists Colloquium Presentations	5:30 pm Announcement Winner DeSal Quiz
7:00 pm – 9:00 pm	DeSal Networking Dinner		
9:00 pm – 12:00 pm	Aftershow Party @ GARNIX Festival at TUM Campus in Garching		

Saturday June 18

Schedule
TUM DeSal Challenge 2016

8:30 am – 9:30 am	**Scientific Breakfast –** **Presentation of Desalination Plant Principles of TUM DeSal Challenge Finalists**	
9:30 am – 11:30 am	**Competition** **Plant Operation and Measurements**	**Young Scientists Colloquium** **9:30 am Guided Tour – Chair of Thermodynamics** **10:30 am Guided Tour – TUM DeSal Challenge**
11:30 am – 12:00 am	**Coffee Break**	
12:00 am – 2:00 pm	**Presentation of the TUM DeSal Challenge Industry Partners** 12:00 Claus **Mertes,** Deutsche MeerwasserEntsalzung (DME) GmbH: DeSal Technologies and Markets 12:50 Christina **Neuhaus,** Deutsche MeerwasserEntsalzung (DME) GmbH: DeSal Technology Trends 13:10 Markus **Wenzel,** memsys GmbH: Membrane Distillation – R&D @ memsys 13:30 Jochen **Kallenberg,** Omya AG: Overview of Omya Group Activities	
2:00 pm – 3:30 pm	**Lunch – Traditional Bavarian**	
3:30 pm – 4:30 pm	**Presentation Ceremony – Awards for Winners of TUM DeSal Challenge and Bottle Challenge, Closing Ceremony**	

The Jury

Claus Mertes is Managing Director of DME (German Seawater Desalination) GmbH working in the field of technology development and improvement. One of his focuses lies on future trends of the desalination market, see e.g. desalfacts.com. As a lecturer at the University of Applied Science in Aachen he is also active in student education.

Claus Mertes

Dr. Joachim Koschikowski

Joachim Koschikowski is head of the Water Treatment and Separation group at Fraunhofer Institute for Solar Energy Systems (ISE). He has been active in the field of solar desalination since 1999 with a focus on the development, design and simulation of membrane distillation (MD) systems.
He is involved in several national and international research projects on solar-driven desalination.

Dr. Markus Forstmeier

Markus Forstmeier is responsible for the development of the business at Electrochaea.
He has been active in the areas of water treatment and renewable energy for more than 15 years in various capacities.

Paul Schausberger is technical manager at UNIHA in Linz, Austria. UNIHA is an EPC contractor for water treatment plants focusing on the production of potable water.

Dr. Paul Schausberger

Oliver Mayer is Principal Scientist at General Electric Global Research. He is responsible for research activities in the field of distributed energy systems and applications at the company's research centre in Garching, Germany. Prof. Mayer has more than 20 years of experience in solar technology, systems technology and solar water treatment.

Prof. Dr. Oliver Mayer

Dr. Bruno Schiebelsberger

Bruno Schiebelsberger is CEO of the Solarenergieförderverein Bayern (Bavarian Association for the Promotion of Solar Energy). He was responsible for several projects related to the development of renewable energies at E.ON Bayern. Dr. Schiebelsberger is involved in additional solar energy competitions.

Nominated Teams for TUM DeSal Challenge 2016

Rank	Points*	Team	Team Leader	Institution
1	95	vAquIon	Johannes Engelsberger	Technical University of Munich, Ludwig-Maximilians-Universität München
2	80	Alavi	Ali Shahnazari	Sari Agricultural Sciences and Natural Resources University
3	79	Chorismós	Florian Kretzler	Thomas-Mann-Gymnasium München
4	77	Membranos	Dr. Marcus Kohnen	Gymnasium Essen-Werden
5	74	WUT Solar Tower	Bernard Swoczyna	Warsaw University of Technology
6	73	SolarPura	Peter Brailovsky	Technical University of Munich
7	70	AgriBox	Jacob Hamar	Technical University of Munich
8	66	Osol1	Andreas Oberbauer	Technical University of Munich
9	64	The Thin Distillery	Stjepan Budimir	University of Split
10	63	Still Waiting	Philip Bonnaire	Technical University of Munich
11	53	Cheap Water	Kilian Heilgemair	Technical University of Munich
12	51	Helios	Moritz Binzer	Technical University of Munich

* Max. 100 points could be achieved with the application. Evaluated are the degree of innovation and the application itself.

Program YOUNG SCIENTISTS COLLOQUIUM

Friday June 17

from 8:00	**Arrival and Registration**
10:30	**Opening TUM DeSal Challenge**
11:20	**Opening Young Scientists Colloquium**
	Session 1: High Salinities, Crystallization and Fouling **Chair: Dr. Markus Spinnler**
11:30	**Prof. Dr. Hans-Curt Flemming** University of Duisburg-Essen, Faculty of Chemistry – Biofilm Centre **Why and How Biofilms Cause Biofouling on Membranes – the „Hair-in-Sink-Effect“**
12:30	**Christine Kleffner** Cologne University of Applied Sciences, Institute of Process Engineering and Plant Design **Sustainable Treatment of Brines with High Osmotic Pressures using a Combined Membrane System**
12:50	**Maximilian Waack** University Bremen, Institute of Technical Thermodynamics **Crystallization Fouling and its Mitigation in Multiple-Effect Distillation Plants for Seawater Desalination**
13:10	**Florian Kiefer** Technical University of Munich, Institute of Thermodynamics **Liquid Desiccant Treatment and Zero Liquid Discharge with Vacuum Membrane Distillation**
13:30	**Lunch**
	Session 2: Membrane Desalination – Fundamentals and Materials **Chair: Dr. Heike Glade**
14:30	**Raphael Wagensonner** Deggendorf Institute of Technology **Transport Phenomena in Thermal Membrane Distillation**
14:50	**Alexander Kroiß** Technical University of Munich, Institute of Thermodynamics **Experimental Analysis of Mass Transfer Boundary Layers in Reverse Osmosis**
15:10	**Alexander Präbst** Technical University of Munich, Institute of Thermodynamics **Influence of Dynamic Operation of Osmotic Membrane Systems**
15:30	**Thomas Lippert** Technical University of Munich, Chair of Urban Water Systems Engineering **Computational Fluid Dynamics for Spiral Wound Membrane Modules**
15:50	**Hannah Roth** DWI Leibniz Institute for Interactive Materials e.V. **Single Step Production of Hollow Fiber Nanofiltration Membranes**
16:10	**Coffee Break**
	Session 3: Advanced Technologies – Desalination and Water Treatment **Chair: Prof. Dr. Hans-Curt Flemming**
16:40	**Lukas Arens** Karlsruhe Institute for Technology, Institute for Technical Chemistry and Polymer Chemistry **New Desalination Technique using Charged Hydrogels as Separation Agent**

17:00	**Christoph Pfeifer** Institute for Technical Chemistry and Polymer Chemistry, Karlsruhe Institute for Technology **Synthesis and Characterization of Sulfonated Polystyrene Networks for the Desalination of Seawater**
17:20	**Alexandra Rommerskirchen** DWI Leibniz Institute for Interactive Materials e.V. **Water Desalination by Flow-Electrode Capacitive Deionization**
17:40	**Nils Horstmeyer** Technical University of Munich, Chair of Urban Water Systems Engineering **Alternative Energy-Efficient Treatment Scheme For Water Reuse**
18:00	**Michel Philipp** Technical University of Munich, Chair of Urban Water Systems Engineering **Optimized Decision Making Framework for Advanced Waste-water Treatment using Machine Learning Tools**
18:20	**Discussion**
19:00	**DeSal Networking Dinner**
21:00	**Aftershow Party @ GARNIX Festival at TUM Campus in Garching**

Saturday June 18

8:30	**Scientific Breakfast - Presentation of Desalination Plant Principles of TUM DeSal Challenge Finalists**
9:30	**Guided Tour – Chair of Thermodymacis**
10:30	**Guided Tour – TUM DeSal Challenge**
11:30	**Coffee Break**
12:00	**Presentation DeSal Challenge Industry Partners**
14:00	**Traditional Bavarian Lunch**
15:30 – 16:30	**Awards TUM DeSal Challenge and Closing Ceremony**

Young Scientists Colloquium

The Young Scientists Colloquium is a joint initiative of Deutsche MeerwasserEntsalzung e.V. (DME) and Technical University of Munich (TUM) with the goal to promote young scientists who are active in desalination research in Germany. The event takes place under the umbrella of TUM DeSal Challenge, a desalination competition for students hosted by Institute of Thermodynamics of TUM since 2009.

Participants TUM DeSal Challenge 2016

Team	vAqulon
Team leader	Johannes Englsberger
Members	Rainer Szalata, Catharina „Nina“ Gieck
Institution	Technical University of Munich, Ludwig-Maximilians-Universität München
Desalination technology	Electro-static steam-compression powered by photovoltaics

We are a team of researchers, engineers and students, but most of all we are friends! Our goal in this competition is to contribute to the developments in the field of environment-friendly desalination.

Our desalination system is based on the same principle as Mechanical Vapor Compression. The main difference is that our compressor unit is based on another physical principle (details cannot be published yet due to intellectual property reasons).

The plant‘s design will be very compact. Major expected advantages as compared to other desalination methods include low requirements for feed-water purity, high energy efficiency and low noise levels.

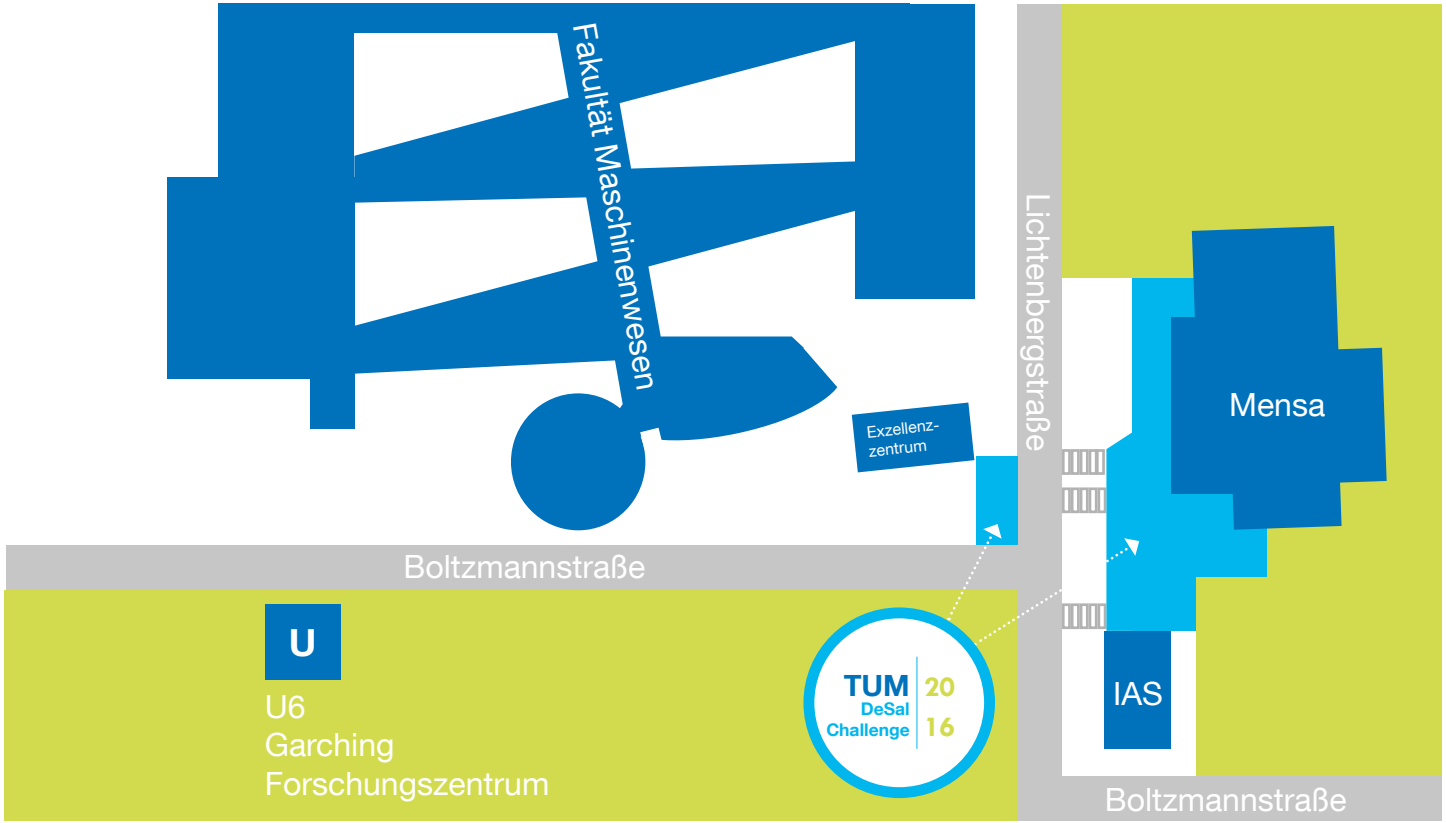
Participants TUM DeSal Challenge 2016

Team	**Alavi**
Team leader	Prof. Dr. Ali Shahnazari
Members	Raheb Mahforouzi, Keyghobad Rostami Rigcheshme, Shaghayegh Emamdoust, Pouneh Fard
Institution	Sari Agricultural Sciences and Natural Resources University
Desalination technology	Ultra sonic evaporation powered by photovoltaics

Our team supervisor, Dr. Ali Shahnazari, is associate professor of Department of Water Engineering and works on deficit irrigation and the use of saline water. Raheb Mahforouzi is a Ph.D. student of irrigation and drainage, and studies the reuse of drainage water, runoff and wastewater relying on the host reservoirs bioremediation abilities. Keyghobad Rostami Rigcheshme and Shaghayegh Emamdoust are first year M.Sc. students, in the fields of irrigation and drainage, and water resources engineering, respectively. Pouneh Fard is graduate student of food industry engineering. All team members are from Sari Agricultural Sciences and Natural Resources University, IR Iran.

We live with this problem and deeply familiar with it. Caspi Desalion is of simple structure and its operation and maintenance requires low skilled labor. It is made from ordinary cheap materials. Due to use of solar powered ultrasonic low temperature evaporator, system‘s total energy consumption is low. So electrical energy can be store during the day to run the Caspi Desalion plant after sunset. Ordinary cheap materials and low energy consuming would result to low cost desalination.

Map of the TUM DeSal Challenge 2016




Mensa
Osol1
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Still
Waiting
The Thin
Distillery
DeSal
Hot Spot
Choris-
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IAS
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TUM
DeSal
Challenge
2016
Alavi
Cheap
Water
Lichtenbergstraße
Helios
Solar
pura
WUT
Solar
Tower
Boltzmannstraße

Participants TUM DeSal Challenge 2016

Team	**Chorismós**
Team leader	OStR Florian Kretzler (Teacher)
Members	Veronica Della Mura, Johannes Bundschuh
Institution	Thomas-Mann-Gymnasium München
Desalination technology	Electrodialysis powered by photovoltaics

Veronica Della Mura and Johannes Bundschuh are attending the secondary school “Thomas-Mann-Gymnasium” in Munich, Germany. Florian Kretzler is their biology and chemistry teacher. Johannes Bundschuh took part in the 2016 pupils’ and students science fair “Jugend forscht” with a presentation of his empirical data about the “effects of direct-current on salt water”.

The two pupils are designing a small scale electrodialysis device based on Johannes’ results. The completely energy self-sufficient outdoor gear is either powered by a foldable 50 W solar panel or a hand-operated dynamo.

Energy self-sufficient, low cost and lightweight, with a capacity of a minimum of 6 l a day, the Chorismós desalination device is the ideal equipment wherever drinking water is needed.

Participants TUM DeSal Challenge 2016

Team	**Membranos**
Team leader	Dr. Marcus Kohnen (Teacher)
Members	Kirsten Groß, Jonas Hellrung, Marcel Hohlmann, Katharina Mersmann, Lukas Miederer, Jan-Marc Kartenbender, Wolfgang Scherbaum, Thorben Stromberg, Tobias Welling
Institution	Gymnasium Essen-Werden
Desalination technology	Reverse osmosis powered by static forces

We are the advanced chemistry course of the Gymnasium Essen-Werden, being a small creative group who coincidentally found this competition. We previously participated in other competitions. We are excited about the competition's topic because it combines a chemical challenge with an engineering one.

Our project relies on the general concept of reverse osmosis, which purifies water by forcing it through a semipermeable membrane to remove the salts. We produce the required pressure in a pipe using both the water's own weight besides an additional weight. The water column is fed by a reservoir to ensure sustained filtration.

Participants TUM DeSal Challenge 2016

Team	**WUT Solar Tower**
Team leader	Bernard Swoczyna
Members	Michał Tadejko, Jan Dubiński, Wojciech Konicki, Jan Połeć, Aleksandra Michałkiewicz, Roman Lajkosz
Institution	Warsaw University of Technology
Desalination technology	Multi effect distillation powered by solar thermal power

WUT Solar Tower is a group of students and young engineers united by their passion for unconventional energy sources. We decided to take part in the TUM DeSal Challenge to prove ourselves in the pursuit for an effective and environmentally sound way to produce clean water.

We are well aware of the financial and logistical problems in most developing countries with water scarcity, therefore we come up with a desalination plant, that can be built almost entirely from locally made, or recycled materials. We want to prove, that a high-capacity desalination plant can be built by a local population with limited resources, and operated safely by virtually everyone.

We combine the advantages of a very big parabolic mirror and a unique, highly efficient heat recycle system to make a desalination plant, that is supreme in efficiency, affordability, resilience and versatility.

Participants TUM DeSal Challenge 2016

Team	**Solar Pura**
Team leader	Peter Brailovsky Signoret
Members	Kevin Lemmer, Felipe Díaz Bórquez, Ismael Leitmannstetter
Institution	Technical University of Munich
Desalination technology	Humidification-dehumidification powered by solar thermal power and biomass

We are a team of international Masters students of Sustainable Resource Management at TUM, coming from Mexico, Chile, the USA and Germany.
We share the vision of creating an affordable and simple solution to provide isolated communities in water scarce costal regions with a self-sufficient, potable water source. More specifically, we are building a humidification-dehumidification (HDH) unit that could be made out of low-cost, local resources with high availability that can be integrated into households and community kitchens, ensuring safe water supply to those in need.

The unique characteristic of our plant is the composition of the energy input, using both solar energy and waste heat from domestic wood-burning stoves, commonly used for cooking in rural areas. The aim is to develop a system that is easy to build, simple to maintain and provides high quality, low-cost potable water.

Participants TUM DeSal Challenge 2016

Team	AgriBox
Team leader	Jacob Hamar
Institution	Technical University of Munich
Desalination technology	Greenhouse humidification-dehumidification powered by solar thermal power and photovoltaics

The purpose of the proposed system is two-tier. The main goal is to provide the daily water requirement for a four person household. Additionally, the AgriBox will provide water requirements for 6 m^2 of crops which the family can consume or sell. Based on these requirements the target output for the system is 50 l/d.

This standard HDD system is composed of a humidifier, condenser, parabolic trough concentrator, and a solar powered pump.

The greenhouse provides an efficient crop growing environment that also reduces the amount of water required per unit output. The HDD system helps to maintain a suitable temperature inside the greenhouse. Furthermore, the greenhouse will collect any additional condensate on the walls and roof.

Participants TUM DeSal Challenge 2016

Team	**Osol1**
Team leader	Andreas Oberbauer
Members	
Institution	Technical University of Munich
Desalination technology	Single stage evaporation powered by solar thermal power

Osol1 will be a convection driven system, relying on humidification and dehumidification. The main goal is to find a design, which enables as many people as possible to build up and drive a low cost, yet effective desalination system. Therefore it will be characterized by the following three points:

First, the choice of materials: Osol1 will try to use mostly wood and plastics which are abundant and cheap. Furthermore, neither advanced tools nor special skills are needed to process them.

Secondly, the functionality will be simple and intuitive.
To archieve this goal, only concentrated solar power, gravitation and muscle power will drive the system. In particular there will be no electrical elements or parts which are sensible to mistreatment or environmental conditions.

Finally a low price per liter distillate and day which means Osol1 will try to archieve the maximum output regarding the materials used, and also that additional parts will only be added, if they are expected to decrease the price per liter and day.

Participants TUM DeSal Challenge 2016

Team	The Thin Distillery
Team leader	Stjepan Budimir
Members	Thomas Ronnberg
Institution	University of Split
Desalination technology	Vaccum distillation powered by solar thermal power and photovoltaics

We are group of friends who went together to high school and now we are studying or graduating in different fields, IT, math and marine biology. Our desalination system is based on the simple concept for desalinisation – the distillation, the most simple way to get pure water. To make water evaporate from water to gas we need to increase temperature and/or reduce pressure. To increase the temperature we will use concentrated solar power, and reducing the pressure using vacuum pumps.

We were not aiming to ´´reinvent the wheel´´, distillation is a process known for a long time so we took the road of perfecting it, making it more efficient.

Initial inspiration for this design, but without vacuum component, has came from the systems used in traditional alcohol distilleries, producing hard liqueur called ´´rakija´´.

Participants TUM DeSal Challenge 2016

Team	**Still Waiting**
Team leader	Philip Bonnaire
Members of the team	Michael Stark, Benjamin Vogg, Christian Piotrowski, Valentin Scharl
Institution	Technical University of Munich
Desalination technology	Solar still with external condenser

The basic principle of a Solar Still will be revised by adding an external condenser. However this desalination technology is still able to run just by solar power.

The huge benefit of the system is its simplicity, hence there‘s no great knowledge needed to handle it. Especially the property to produce potable water after a short initial period is another plus. Therefore, a felt textile is installed, which is moistened with the feed.

The separation of evaporation and condensation results in the possibility to use heat recuperation which increases the performance. With access to brackish water, cleaning the plant to guarantee the long term use won‘t be a problem.

Due to its robustness and convenience, the plant is tailored for the application in areas where potable water is a scarce resource and on account of this urgently needed: in regions with high solar irradiation and economic as well as social backwardness.

Participants TUM DeSal Challenge 2016

Team	**Cheap Water**
Team leader	Kilian Heilgemair
Members	
Institution	Technical University of Munich
Desalination technology	Solar still

The idea is the construction of a simple and cheap water purification system made of locally available PET bottles which supplies constant clean and disinfected drinking water for the family.

Two different large PET bottles are needed per cascade for the water treatment plant. The bottoms of the large bottles are cut off so that they can stick to each other. The distillate is collected from the underside of the large bottles. The small bottles, in which the dirty water flows, are cut lengthwise. The system is mounted on the roof and filled with dirty water once a day. Each channel of the corrugated metal roof a cascade can be inserted. The water treatment system covers the entire roof.

The main goal is the production of sufficient water for a family, what can be achieved through the production of drinking and service water. On the one hand absolutely clean drinking water is produced on the other hand, sufficient amounts of disinfected service water.

Participants TUM DeSal Challenge 2016

Team	**Helios**
Team leader	Moritz Binzer
Members of the team	Christoph Glaser, Marc Kaufeld, Maximilian Strutz, Stefan Waldherr
Institution	Technical University of Munich
Desalination technology	Solar evaporation with a parabolic trough collector

All team members are students from the Technical University of Munich in their first semester. What we can't reach through experience we compensate through motivation and effort. Our desalination plant is specialised for the use in warm developing countries as it works with the power of the sun and is easy to handle. Through a well-balanced relation between expenses and effects we try to make our construction as affordable as possible, so less wealthy costumers still can get access to it.

The system of our desalination plant is based on condensation through solar energy. To increase the temperature of the water we use circular mirrors to concentrate the sunlight . To cool the water-steam the incoming sea water is used as coolant. By a smart placement of all components we try to make it as efficient as possible.

Our Partners

Technische Universität München

www.tum.de

Lehrstuhl für Thermodynamik – TUM

www.td.mw.tum.de

Deutsche Meerwasserentsalzung e. V.

www.dme-ev.de

Krones AG

www.krones.com

KSB STIFTUNG

KSB Stiftung

www.ksb.com

Omya AG

www.omya.com

Solarenergieförderverein Bayern e. V.

www.sev-bayern.de

TUM DeSal Challenge 2016

About us

The idea of the TUM DeSal Challenge was born in January 2009. It resulted in the first final in July 2009 and has been further developed to a great extent.

While the host of this competition is the Institute of Thermodynamics of Technical University of Munich (TUM), the main part is organized on a voluntary basis by averagely ten TUM students.

Organisation TUM DeSal Challenge

Technische Universität München
Lehrstuhl für Thermodynamik

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Fabian Flade (fabian.flade@fp-werbung.com)

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TUM | Lehrstuhl für THERMODYNAMIK | DME | KRONES | KSB STIFTUNG | OMYA | Solarenergieförderverein Bayern e.V. Bavarian Association for the Promotion of Solar Energy