



European Desalination Society

SPECIAL OFFER

for those attending the EDS
Conference and Exhibition on

Desalination for the Environment

Clean Water and Energy

Barcelona, April 23–26, 2012

Registration Fee for **both events**

	Before March 20	After March 20
EDS members	€2400	€2700
Non-members	€2700	€3000



Desalination with Solar Energy

A 3-day intensive course

April 18–20, 2012, Almería, Spain

Introduction

Desalination of sea and brackish water is a common technique to alleviate the increasing shortage of fresh water in many areas of the world today. Nonetheless, desalination processes require large quantities of energy, so their implementation is jeopardized by a significant environmental impact if fossil fuels are used. In addition, the cost of the different desalination techniques is very closely linked to the costs of energy. Therefore, in a context of continuously rising energy costs and with the impending exhaustion of the conventional energy resources, the development of desalination technologies associated with the use of renewable energies is a very attractive and promising prospect. This is especially true in the case of solar energy, as the regions with greater water shortages tend to be those with higher solar radiation.

Objectives

The general purpose of this 3-day intensive course is to provide experts, professionals and postgraduate students from all around the world with the latest knowledge of the different existing technologies involving the use of solar energy to drive desalination techniques. More specifically, the course will instruct scientists and technicians on the basic principles of desalination using solar energy, the state of the art of the most promising technologies and the experiences acquired so far. Theory lessons will be complemented with visits to the test facilities of Plataforma Solar de Almería operating on solar power production and desalination, which are the most advanced in the Mediterranean area.

Venue

The course will take place at the Hotel Tryp Indalo Almería, and one day will be spent on a technical visit to the operating facilities of Plataforma Solar de Almería (PSA).

This research centre, belonging to the public research institution CIEMAT, is one of the biggest and most complete existing facilities for the research, testing and development of solar technologies and their applications. It is located near the village of Tabernas, about 35 km from Almería city.



The Tryp Indalo Almería is a 4-stars hotel opened in 2004, beautiful yet modern, spacious and comfortable, providing ideal facilities and services for both business and leisure travellers, including the finest hi-tech meeting and congress venue in Almería. The hotel is located on the prestigious Mediterráneo Avenue, only 15 minutes from the beach, near the city centre of Almería.



Hotel Tryp Indalo Almería

Almería is a sun-baked province located in the far Southeast corner of the Iberian peninsula, with the most hours of sunshine and lowest rainfall in Europe. As a result of this climate, much of the province is comprised of semi-arid desert-like landscape and much of the area is a sparsely populated wilderness. Almería's skies, with an annual average of 3,000 hours of sunshine, are also the clearest in Europe. This hot climate and the natural protective barrier of Sierra de Gádor means that Almería is one of the most productive agricultural zones in Europe, with more than 10,000 Ha of land cultivated commercially for fruit, vegetables and flowers. Almería is the location of one of Andalucía's most outstanding wildlife areas and its largest coastal reserve, the Cabo de Gata-Níjar Natural Park. The provincial capital and port of Almería is overlooked by a vast, sprawling Moorish citadel, the Alcazaba. Also well worth exploring is Almería's old town, peppered with interesting monuments, including a cathedral with an impressive Gothic interior, a 300-year-old hospital and great tapas bars. In addition, a large number of very impressive beaches and modern tourist resorts attract the visitors to the province year round.



Syllabus

The course is organized in four modules

A) Introduction

1. Fundamentals of solar energy.
2. Fundamentals of water desalination.
3. Conventional desalination technologies.
4. Research trends in desalination.

B) State of the art of low capacity solar desalination technologies

5. Desalination with photovoltaic energy.
6. Solar ponds and brine management.
7. Low capacity solar thermal distillation systems.
8. Solar powered membrane distillation.

C) State of the art of high capacity solar desalination technologies

9. High capacity solar thermal distillation systems.
10. Coupling of desalination with solar power generation.
11. Economical aspects of desalination using solar energy.

D) Technical visit to PSA installations

12. Technical visit to solar power production installations.
13. Technical visit to solar multi-effect distillation plant.
14. Technical visit to other desalination facilities (membrane distillation, solar-driven ORC, CSP+D test-bed).



AQUASOL solar multi-effect distillation plant at PSA

Lecturers:

The course will be given by researchers and scientists from Plataforma Solar de Almería (CIEMAT-PSA):

- **Dr. Ing. Julián Blanco** Course director. Head of Environmental Applications of Solar Energy unit of CIEMAT and Operating Agent of SolarPACES Task VI (Solar Energy and Water Processes and Applications). Large experience in the coordination and development of international R&D projects. Author of 7 books, 18 chapters and more than 60 SCI publications.
- **Dr. Diego-César Alarcón-Padilla** Researcher with extensive experience in European R&D Projects related with the combination of solar thermal energy with desalination processes. He has published more than sixteen scientific papers in the field of solar energy and water treatment, co-author of two books in the field of solar desalination.
- **Dr. Guillermo Zaragoza** Researcher with extensive working experience in the application of renewable energy to desalination, including solar distillation and projects that combine it with greenhouse agriculture and architecture. He has participated in European R&D Projects and published over ten scientific papers in the field.



Plataforma Solar de Almería (PSA) in Tabernas, Almería (Spain)

Course Programme

DAY 1 Introduction to Solar Energy and Desalination

- 09:00 – 09:15 Opening and Introduction to the course
- 09:15 – 10:15 Fundamentals of Solar Energy I
Solar radiation
Low temperature solar collectors (Flat plate collectors; CPC collectors; Evacuated tube collectors)
- 10:15 – 11:15 Fundamentals of Solar Energy II
Medium and high temperature solar thermal collectors (Central receivers; Parabolic troughs; Fresnel collectors; Parabolic dishes)
Photovoltaics
Energy storage in solar plants
- 11:15 – 11:30 *Coffee break*
- 11:30 – 12:30 Fundamentals of water desalination
Historic background
Definitions and fundamental parameters
Classification of desalination processes
Current world outlook
- 12:30 – 13:30 Conventional desalination technologies
Thermal processes (Multi-stage flash evaporation; Multi-effect distillation; Multi-effect distillation with thermo-compression; Mechanical vapor compression)
Membrane processes (Reverse osmosis; Electrodialysis)
Research trends in desalination
- 13:30 – 15:00 *Lunch*
- 15:00 – 16:00 Desalination with photovoltaic energy
- 16:00 – 17:00 Brine management and Solar Ponds

DAY 2 Technologies of Solar Desalination

- 09:00 – 10:00 Low capacity solar thermal distillation systems I
Solar stills
Technologies of Humidification-Dehumidification
- 10:00 – 11:00 Low capacity solar thermal distillation systems II
Solar powered membrane distillation
- 11:00 – 11:15 *Coffee break*

- 11:15 – 12:15 High capacity solar thermal distillation systems I
Multi-stage flash evaporation
Multi-effect distillation
Multi-effect distillation with thermo-compression
- 12:15 – 13:15 High capacity solar thermal distillation systems II
Practical case of MED plant coupled to a parabolic trough solar field
- 13:30 – 15:00 *Lunch*
- 15:00 – 16:00 Coupling of desalination with solar power generation
- 16:00 – 17:00 Economical aspects of desalination using solar energy
Conventional seawater desalination costs
Estimation of solar energy desalination costs

DAY 3 Practical Work at Plataforma Solar de Almería

- 09:00 – 10:00 Global water and energy problems and the role of renewables
- 10:00 – 11:00 *Trip to Plataforma Solar de Almería*
- 11:00 - 12:00 Technical visit to solar power production facilities at PSA (central receiver and parabolic trough)
- 12:00 – 13:00 Technical visit to MED plant at PSA
- 13:00 – 15:00 *Lunch*
- 15:00 – 16:00 Technical visit to other PSA desalination facilities (solar membrane distillation plant, solar-driven ORC, CSP+D test-bed)
- 16:00 – 17:00 *Return to hotel*



AQUASOL solar distillation plant at PSA

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Lecturers Dr. Julián Blanco, Dr. Diego-César Alarcón-Padilla, Dr. Guillermo Zaragoza

REGISTRATION FORM

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EDS member	<input type="checkbox"/> € 2400	<input type="checkbox"/> € 2700
Non-member	<input type="checkbox"/> € 2700	<input type="checkbox"/> € 3000

Registration fee for those attending the **course only**:

EDS member € 2150 Non-member € 2350

The fee includes 4 nights accommodation, lunches, coffee, dinners, course Workbook and CD.

Payment can be made by:

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