Fraunhofer TEG Technologie-Entwicklungsgruppe

PROJECT NO: COOP-CT-2005-017928

DeSol

Low cost low energy technology to desalinate water to potable water

Co-operative Research (Craft)
Horizontal Research Activities Involving SME

Publishable Final Activity Report
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Project coordinator organisation name	Fraunhofer Gesellschaft

Version 01

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Dissemination Level

PU	Public	x
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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1. PROJECT INFORMATION

CONTRACT NO: COOP-CT-2005-017928

TITLE OF PROJECT*: DeSol,*
Low cost low energy technology to desalinate water to potable water

COORDINATOR: Fraunhofer Gesellschaft

SME EXPLOITATION MANAGER: Wattpic

***SME CONTRACTORS*:**

1 Maschinenbau Lohse GmbH

2 Termo-Gen AB

3 Optical Products Ltd.

4 WATTPIC Energia Intelligent S.L

5 Aqua Treatment Ltd.

***OTHER ENTERPRISE / END USER CONTRACTORS*:**

6 Club Mediterranee Sa

RTD PERFORMER CONTRACTORS:

8 Fraunhofer Gesellschaft

9 CRIC Centre de Recerca i Investigacio de Catalunya

2. PROJECT EXECUTION

Motivation

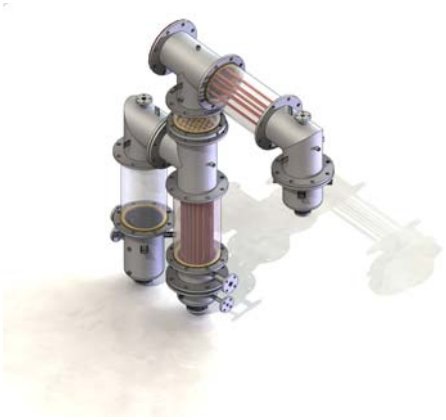
The rising demand of drinking water and climate change has caused a shortage of potable water in many regions of the world. In some coastal areas, such as Southern Europe and the Mediterranean, the groundwater has already been contaminated by the intrusion of seawater. Population growth and increasing tourism will intensify this problem in the future. For these reasons, the production of drinking water from renewable fresh water sources is becoming increasingly difficult. Therefore, desalination of sea or brackish water is necessary to assure a reliable water supply. Most common desalination technologies require large amounts of fossil fuels and thus also have high CO_2 emissions. The costs for standard desalination are continuously rising due to the development of the costs for fossil fuels.

Desiccated soil

Project objectives and achievements

The overall objective of the DeSol project is the development of a low-cost solar thermal water desalination process. The technology is environmental friendly by using the sun as the only energy source. It is independent from fossil fuels and external electricity supply. A high efficiency can be achieved by using temperature at a low level. This becomes possible by applying a vacuum distillation process. The vacuum is produced and maintained, without a vacuum pump, by an innovative process using gravitation for vacuum production. By applying a multi-stage distillation process the energy is re-used internally and the specific heat energy demand is kept on a low level. The control and adjustment of the distillation system is fully automatic without the use of electronic components. Very low maintenance at a long life time is aspired. A modular design enables flexible adaptation to various water production capacities required by customers.

It has been experienced and evaluated by a market survey that the DeSol technology has a high potential to be used for decentralised water production in small and medium sized facilities. Households, campsites, hotels, bungalow resorts or neighbourhoods could have an environmentally friendly, independent and decentralised water supply by this technology. The solar energy source enables independence from grid electricity and fossil fuels. It is also possible to integrate the DeSol technology into renewable energy hybrid systems. Instead of heat from thermal solar collectors, waste heat from e.g. PV panels can be used.

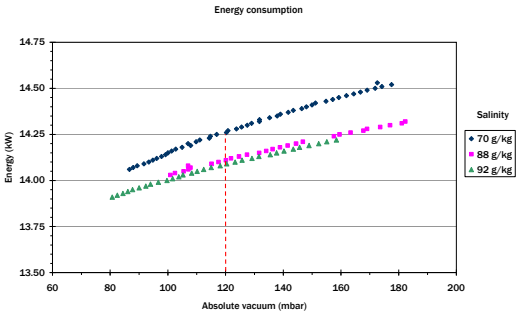


CAD drawing of DeSol Prototype

Work performed

The project started with a detailed scientific characterisation of the technology as the basis for the practical work. The thermodynamics and chemistry of the process has been described and simulated. All sub-systems have been designed, including the interfaces between the sub-systems. Laboratory prototypes for the desalination tank and the vacuum generation system have been set up.

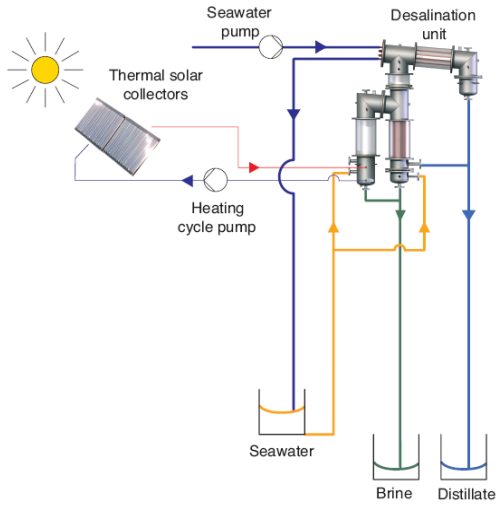
Laboratory set-up



Test results

In the following experiments the laboratory prototypes were tested and continuously improved. It was possible to show that the DeSol technology can desalinate sea water or brackish water with a high energy efficiency. At lab experiments (without insulation or energy recovery), it was already possible to achieve an efficiency of 80% - 85%. The vacuum generation by gravitation was possible down to very low pressures that enables the usage of low temperatures for evaporation (<50°C).

In parallel to the tests of the distillation tank and the vacuum generation principle a number of sub-systems were designed and independently tested. Besides the solar pump system and the measures against fouling and scaling the focus was on the automatic control and adjustment system. The objective was a self-adjusting system without using electronic components as actuators or sensors. Finally the result was a 100% mechanical / thermo-mechanical control and adjustment system that reacts flexible to changing conditions of the distillation process (fluctuating heat supply, pressure changes, weather, etc.).



Principle of 2-stage test installation

In the second phase of the project the DeSol system was extended to a 2-stage distillation system to decrease the energy demand and to prove that a multi stage process is possible. The 2-stage system was tested at changing locations with different objectives:

Tests at Fraunhofer TEG Stuttgart, Germany

- Commissioning and optimisation of 2-stage system
- Test trials under controlled laboratory conditions (electrical heating and vacuum pump)
- Test and evaluation of different design variations
- Test of sub-systems for control and adjustment of process

Tests at the technology centre of CRIC in Terrassa, Spain

- Integration of sub-systems in complete system (Thermal solar collectors, control and adjustment, pump system,…)
- Commissioning and (qualitative) test of system and interactions of sub-systems

Tests and demonstration at Hotel facility of Club Med, France

- Tests under real conditions to evaluate the performance of the system and to identify the potential for further optimisation
- Variation of process parameters and investigation of the impact on the systems performance

Set-up at ClubMed with explanation sign

The project ended with successful demonstration activities at ClubMed. These activities continue beyond the project duration.

Progress compared to the State-of-the-Art

The difference of the system to the current state of the art is that the technology is a low cost and low energy consuming technology. It is designed to provide water for single households up to small and medium sized SME companies.

Current desalination technologies are usually realised as large units. A reliable energy source and high capital investment are required for establishing and operating them. With the target of minimizing the potable water production costs, desalination plants have an unavoidable enormous size to balance the operating expense and throughput. As such, the inherited problem of the desalination industry, the high capital investment results in unattractiveness for SMEs and the private sector to obtain such a system.

The DeSol technology enables a decentralised water supply with small and medium sized units and a regenerative energy supply. The technological innovations are especially in the vacuum generation and the self adjustment without a complicated control system. It is no system known that produces the vacuum in a similar way. By this vacuum pump systems are not needed and electricity can be saved. The self-adjustment by mechanical or thermo-mechanical components is also unique and makes the system affordable for small to medium scale applications.

3. DISSEMINATION AND USE

Exploitable knowledge and its use

Within the project knowledge was created that is going to be used after the project for the benefit of the SME partners. The most important aspects are summarised below.

DeSol System

The overall focus is on the exploitation of the complete DeSol desalination technology including a number of sub-systems. This technology will be suitable to desalinate sea or brackish water effectively with low costs and low maintenance efforts. The system runs by solar energy and enables an autarkic water supply, independent from a public infrastructure.

The partners form a strong supply chain that gives the capability to offer the system to the customers. A patent application by the SME partners is planned for January 2009.

Vacuum generation without vacuum pump

The generation of a vacuum by gravitation without a vacuum pump is an innovative technology that is not yet realised in the market. It represents on of the main sub-systems of the DeSol technology. Besides the usage as an integrated part of a DeSol system, a wide range of other applications are possible. This knowledge can be used for many vacuum processes in the industry. Because of its simplicity it could perfectly be used in applications where no complex measurement and control are possible and the maintenance efforts needs to be very low (e.g. technologies for households, decentralised applications, technologies for developing countries,….)

Enhanced tank system for combined evaporation and condensation

In the distillation tank system the evaporation and condensation of water (or other liquids) takes place. In the DeSol project a multi-stage process was developed. The design enables an effective and reliable distillation and condensation with a high efficiency. The knowledge about the tank system developed in the DeSol project is, besides the application as a sub system of the DeSol technology, also suitable for other markets like water purification and chemical industry. This knowledge enables the SMEs involved to strength their market position and to enter new markets.

Dissemination of knowledge

During the project a high number of dissemination activities took place. Besides published leaflets and articles the technology was also presented on trade fairs and congresses (IFAT 2008 & Solar 2008). At the end of the project the system was demonstrated at ClubMed facilities in France.
The dissemination activities will go on after the project. A presentation will be held at the Sustainable Energy Week 2009 in Brussels. Further participation at seminars and congresses are planned for summer 2009.