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1 *Demonstration plant.*
2 *Brine storage tanks.*
3 *Plant controls.*

WATER EXTRACTION FROM AIR MOISTURE USING AN INNOVATIVE SORPTION METHOD

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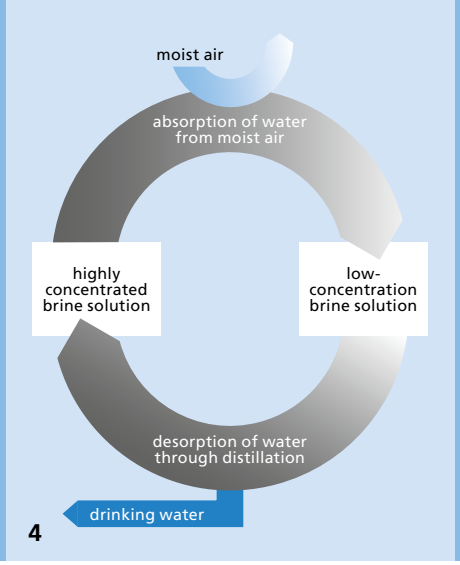
Exploiting new drinking water resources

Safeguarding a drinking water supply for a growing world population is one of the most important tasks facing the generations of today and tomorrow. Already, in several regions of the world, there is no reliable supply of drinking water and increasingly climate change is making the situation worse, particularly in arid and semi-arid areas. Above all in regions where there is no access to surface water or groundwater that is sustainably usable, the water contained in the ambient air as moisture can, essentially, provide a virtually inexhaustible source of water. The latest technology, however, has so far provided only a few systems available on the market, for example by condensation of humidity by cooling of air down to the dew point. Their disadvantage is a very high specific energy consumption and high operating and plant costs. In addition, cooling condensation only works under certain climatic conditions.

Innovative sorptive method for the extraction of water from air moisture

The approach taken by a new method developed at the Fraunhofer IGB is the extraction of water from air moisture using a combined absorption/desorption process. To achieve this, the absorption of air moisture by a liquid absorbent material, a highly concentrated brine, is combined with desorption by means of vacuum evaporator technology (Fig. 4). The aim of a project funded by the state of Baden-Württemberg and the EU was to demonstrate, together with development partners from industry, the feasibility of an energy-self-sufficient, mobile facility for the decentralized extraction of water from air.



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From the laboratory to field trials

The first step was the elaboration of the technical and scientific principles, the parameterization of the system and a series of preliminary trials. On the basis of these, the subcomponents were designed and built. After manufacture of the components, the individual systems were comprehensively tested. Following amalgamation and integration of the whole facility into containers, a series of practical trials was carried out for the purposes of evaluation of performance and demonstration of the technology as a whole.

With the demonstration plant we were able, together with our development partners, to implement the technology for water extraction from air moisture on an application-oriented scale and in a quality that meets the requirements of industry. The plant consists of three containers which, alongside the absorption and desorption modules, contain all the required auxiliary units, a brine reservoir and an energy store (Figs. 1–3, 5 and 6).

Successful start-up and test phase

In a test phase lasting several weeks in autumn 2013 we were able to show that the subprocesses and the facility overall work well and that water can also be extracted from air moisture under real conditions. It was possible, even under what in some cases were very unfavorable environmental conditions regarding moisture content and temperature, to absorb water from the air and to separate it from the sorbent as usable drinking water.

Thus the method represents an alternative to the established facilities that use cooling condensation. An advantage of the new technology is the use of thermal energy as a main source of energy for the most energy-intensive subprocess of desorption; this can be obtained from waste heat or through solar thermal energy. Even the electric energy required for the smaller loads such as the pumps and controls can be obtained from renewable sources, via photovoltaics or wind, allowing the plant to be used in an energy-self-sufficient way. The overall design is sustainable and CO_2-neutral thanks to the use of renewable energies. In addition, no waste products are produced and all working materials are fed back into the cycle.

Outlook

It is intended that the successfully implemented demonstration plant be tried out at different locations in the future and the technology be optimized. It is planned to realize additional pilot plants together with partners, and to further develop the technology so that it is ready for the market. The method for water extraction from air moisture could in many regions make a contribution towards supplying drinking water, in particular in the Middle East, parts of South-East Asia, the extended Mediterranean region and Africa where a safe supply of drinking water is of vital significance to the population living there. Also conceivable is a transfer of the technology to applications in overcrowded areas, for example for decentralized drinking water production in megacities.

4 *Principle of sorptive water extraction from air moisture.*
5 *Photovoltaic unit and tower of the demonstration plant.*
6 *Row of valves.*

Project partners

Maschinenbau Lohse GmbH, Heidenheim

Michelberger Energietechnik GmbH, Bodnegg

Melotec Kunststoffverarbeitungs-GmbH, Ulm

University of Stuttgart
Institute of Interfacial Process Engineering and Plasma Technology

IGVP, University of Stuttgart

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