Project update

Cooler homes from solar-powered mini-chillers

Project details

Project title	Solar cooling for private housing – development of a compact, thermally-driven absorption chiller for domestic air conditioning using membrane and nanotechnology
Participant	Fraunhofer Institute for Environmental, Safety and Energy Technology, Germany
Start date	2008

Key aims

- Development of efficient air conditioning and cooling units using solar power
- Reduce the high level of consumption of fossil-fuel energy in buildings
- A cooling system technology with no potential to cause ozone depletion or global warming.

Project summary

A new type of residential cooling system that is scaled down with nanotechnology and powered by solar energy is receiving funding from E.ON's International Research Initiative.

Compact units, which can also provide heating and hot water, will adapt the efficiency and versatility of absorption chillers, whose size and weight have previously prevented their use in homes.

Nano-scale innovation will be applied to develop the advanced heat transfer and cooling technologies.

The use of solar power maximizes the role of renewable resources. As the demand for cooling and ventilation rises in line with the availability of solar energy, this could reduce summer time peak loads on fossil-fuel generating plant.

This project comes from the Fraunhofer Institute for Environmental, Safety and Energy Technology in Oberhausen. It was put forward by Dr Christian Dötsch, Leader of the Energy Systems Department, and Peter Schwerdt, a member of the department.

The concept is to utilize the principles behind absorption chillers which are widely used for cooling in hospitals and universities. This brings the challenges of reducing the sizes of both the heat absorbers and the cooling towers which use water.

The project could make a particular contribution to meeting the need for air conditioning where demand is outstripping generating capacity in some parts of the world and has caused a reversal in the peak demand period from winter to summer.

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Research is moving forward on several fronts with the aim of unlocking the main scientific challenges in this project.

The initial phase of the work was to ensure that accurate, comprehensive, knowledge of the technology being developed was obtained.

This involved compiling published information and market data in four areas:

- Small-scale thermally-driven chillers
- Membrane absorption technologies
- Surface technologies
- Self-cleaning structures.

The focus then moved on to laboratory activities which included the modification of a module for testing absorber membranes, and the design and construction of a new version.

One of the project aims is to apply nanotechnology to scale down large conventional chillers which operate with falling film heat and mass exchangers. The team is developing a compact stack absorber using membranes with nano-scale pores and hydrophobic coatings to achieve a high efficiency heat and mass transfer.

To support this work, investigations were made to find suitable membranes for the liquid/vapor interface in the absorption process. Samples for testing were obtained from manufacturers.

Nanotechnology is also being used in the development of the advanced cooler technologies which the new chillers will require.

The cooling tower arrangements in existing chillers will be replaced by a small dry cooler. This will function as a hybrid unit with the ability to switch to a wet 'spray' cycle when a high level of cooling is required.

Special nano-coatings are being used to make this a viable solution which can operate trouble-free in the long term. The coatings will allow the heat exchanger surfaces to be made self-cleaning, which should overcome the common problems of wet cycles causing fouling and blockages, and requiring costly water treatment.

Development work on this hybrid cooler requires an experimental wind tunnel and the project team is modifying an existing facility to meet these needs.

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IRI08/u3 11/2009