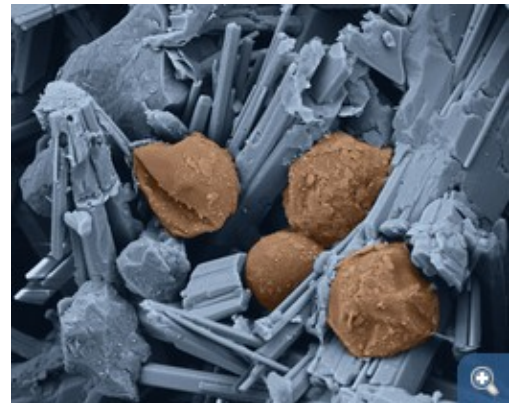


# Climate-active heat storage in construction materials




Construction systems with integrated phase-change materials (PCM) can store a high degree of heat at room temperature. If this heat is transported by means of water-carrying systems, it is possible to regulate room temperatures in an energy-efficient manner. This research project focused on the ongoing development of materials, components and systems with paraffins, the identification of promising applications, the performance of system tests and the development of a planning tool.



Electron microscopy: PCM in gypsum plaster  
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## Technology summary

<b>Formal project title</b>	Climate-active heat storage in construction materials
<b>Term of project</b>	09/2004 - 09/2008
<b>Technology status</b>	 Market Launch
<b>Key aspects</b>	Regenerative + passive cooling, Thermo-active building element systems, Heat / cold storage

## Project description

When using large surface areas to regulate the room temperature, the heating and cooling temperature may be very close to the room temperature. On the one hand this promotes comfort, whilst also allowing the utilisation of previously unused heat sources or heat sinks. Examples are the temperature differences between day and night, or outside and inside. The ground can also serve as a heat source or heat sink.

The heat absorption capability of typical construction materials such as plaster, plasterboard sheets, panels, screeds and fillers can be significantly increased by mixing in microscopically sized encapsulated phase-change materials (PCM). The PCM can be activated using water-carrying systems, which usually include capillary tube mats or tube heat exchangers. This means that significantly less energy is required to regulate building temperatures.

Fraunhofer ISE and BTU Cottbus are involved on the research side of this project. BASF develops the PCM, whereas construction material manufacturers maxit and daw develop the construction material systems and Valentin Energiesoftware implements the findings in a user-friendly planning tool.

### Focus

Passive systems based on construction materials with integrated phase change materials (PCM) developed in previous projects and partly available on the market are now being further developed into active cooling systems; these systems have been characterised and tested. A tool for simulating these new building systems has also been developed.

In this project, BASF developed latent heat storage micro capsules for active heat storage systems integrated in construction materials. Suitable latent heat storage micro capsules are planned to be manufactured for water-activated heat and cold storage systems and adapted to the requirements of construction materials used by partners. BASF supplies large sample batches to project partners from the construction sector. Materials intended for use in buildings are investigated in detail and assessed using energy-related, ecological and economic criteria.

Construction material manufacturer maxit has developed plasters and screeds for active heat storage systems, which are suitable for use with water-carrying systems. Measurements for production systems concerning floors, walls and ceilings are performed under controlled conditions on a pilot plan scale.

Deutschen Amphibolin-Werke (DAW, Caparol) develops indoor plasters and fillers in this project, suitable for active heat storage areas with water-carrying systems. The fillers were developed, tested and optimised in the lab on a pilot plan scale as well as in practical tests.

The department for applied physics / thermophysics at BTU Cottbus developed a measurement procedure for determining the load factor of PCM heat storage systems. This new procedure is tested on PCM-filled sandwich

panels. Investigative tests are also carried out in the PASSYS test cell under realistic climatic and solar irradiation conditions.

Valentin Energiesoftware developed a Windows PC software based on the mathematic models for component-integrated PCM heat storage systems developed by Fraunhofer ISE. This also includes an associated building model. By modifying and providing interfaces to existing system programmes, it is possible to simulate the resulting thermal effects and make economic assessments. It is planned to market this programme as part of an existing software suite.

The Fraunhofer Institute for Solar Energy Systems coordinates the research project as a whole and directly contributes in the areas of system modelling, simulation models, processor core development, design optimisation and system tests. Furthermore, the developed simulation tool is validated using measurement data from various test rooms. A completely new test room in accordance with DIN4715-1 and EN 14240:2004 has also been built at Fraunhofer ISE. This allows surface heating and cooling systems to be measured under controlled and reproducible ambient conditions. The temperature of the test room environment with a floor area of 4x4 m<sup>2</sup> and a height of 3.1 m can be fully regulated. A removable south wall also allows measurement tests which are subject to external influences.

### **Success**

The functional principle of the PCM cooling ceiling was proven using measurements in the test rooms and on prototype walls. Overall, a regulated PCM solution reduces temperature peaks as compared to unconditioned rooms and lowers energy consumption as compared to conventional cooling ceilings.

A new micro-encapsulated product PCM base product (Micronal DS5029) has been developed, the melting point of which has been optimised for use with water (active) flow-through systems.

The first demonstration buildings have now been equipped with products developed within the scope of this project.

### **Milestones**

Over the next few months, at least one cooling ceiling using this new type of PCM material will be measured in the new test room. Several cooling ceiling regulation strategies will be developed depending on the connected heat sink. At the same time, two demonstration projects will be fitted with a PCM cooling ceiling and tested under real conditions during the summer of 2007.

The design tool is scheduled to be available by the end of the year. The final implementation and detailed validation using measurement data still need to be completed.

### **Application**

The first PCM construction materials are already available on the market:

BASF manufactures a PCM raw material in micro-encapsulated form for the construction materials industry: Micronal® PCM.

Link: [http://www.micronal.de/portal/basf/ide/dt.jsp?setCursor=1\\_290226](http://www.micronal.de/portal/basf/ide/dt.jsp?setCursor=1_290226)

Other industry partners manufacture various PCM construction materials or construction products based on PCM raw materials made by BASF:

H+H Celcon produces porous concrete blocks with added latent heat storage: CelBloc Plus.

Links: <http://www.hhcelcon.de>, <http://www.human-healthy.de/waermespeicher.htm>

maxit Germany sells a PCM gypsum plaster which may be used as a single-coat interior plaster for regulating the indoor temperature: maxit clima (PCM gypsum plaster)

Link: [www.maxit.de](http://www.maxit.de), <http://www.maxit.de/775/pagetype/1/url/977>


Knauf manufactures special boards sold by BTC Speciality Chemical Distribution GmbH: SmartBoard™.


Link: [http://www.micronal.de/portal/basf/ide/dt.jsp?setCursor=1\\_290227](http://www.micronal.de/portal/basf/ide/dt.jsp?setCursor=1_290227)


Ilkazell Isoliertechnik is the first company to offer a thermally activated system. This is a SmartBoard variant. An integrated capillary system allows the heat storage system to be filled with water or emptied: Ilkatherm active – this can be employed in ceiling radiant cooling panels, ceiling slabs or wall panels.

Links: <http://www.ilkazell.de>, [http://www.ilkazell.de/pdf/prospekt\\_ilkatherm.pdf](http://www.ilkazell.de/pdf/prospekt_ilkatherm.pdf)

A commercial software tool for designing PCM heat storage in construction materials is also being planned

 **Fraunhofer ISE**

 **manufacturers website**

 **material from the project-portal**

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