

A broader base for your success

Polymer Dispersions for:

Construction

Architectural Coatings

Adhesives

Fiber Bonding

 **BASF**
The Chemical Company

Micronal[®] PCM

Intelligent Temperature
Management for Buildings

www.micronal.de

Micronal® PCM

Intelligent Temperature Management for Buildings

The Challenge:

The indoor temperature is significantly influenced by the thermal behaviour of a building. In buildings, which because of their construction method lack the required thermal storage mass, inner loads and sun radiation lead to great fluctuations in temperature, losses of comfort and increased need for air conditioning inside buildings.

Nowadays, construction of offices and housing is increasingly carried out using modern lightweight building methods of wood and steel designs with highly insulating wall construction materials and large glass surfaces. The high degree of prefabrication and the avoidance of long drying times lead to quick progress in construction and thus an especially high level of efficiency. In striving to optimise the mass and dematerialisation of the building components, in addition to various practical and economic advantages, one problem, namely a loss of thermal mass and the negative impacts on the indoor climate arises.



Micronal® PCM – Future built in

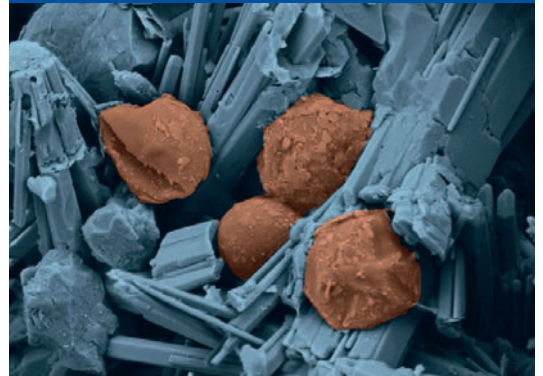
Compliance with the relevant construction guidelines governing climate policy, along with international efforts in building certification in terms of indoor climate, comfort, health, use of resources and energy efficiency, make clear the high demands on architecture, building planning and construction. The consequence – the necessity of developing new, innovative and sustainable approaches for the construction industry, in order to deal with these challenges and to fulfil the exacting demands. With Micronal® PCM BASF has developed an innovative latent heat storage material, which makes the construction industry sustainable in the area of air conditioning in buildings. Micronal® PCM is an innovative, long-term and sustainable solution for a pleasant, healthy indoor climate and more energy efficient air conditioning; for modern architecture with high demands – today and in the future.

The Solution:

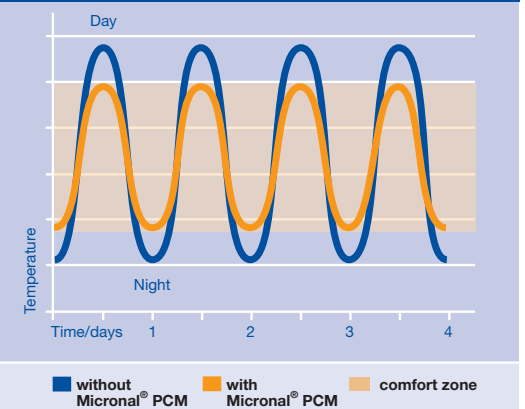
Micronal PCM®, BASF's formaldehyde-free microencapsulated latent heat storer makes it possible to combine the advantages of modern architecture and the efficiency of lightweight construction with the use and compensating effect of thermal storage capacity for a pleasant indoor climate.

Micronal PCM® (Phase Change Material) presents a durable and efficient possibility for isothermal storage of the peak loads, which usually occur during the day, in a defined temperature range, and releasing these again with a time delay (e.g.: in the evening time or at night). Integrated into various kinds of building materials and building systems, Micronal® PCM contributes to an improved indoor climate, more comfortable living conditions and better energy efficiency, using intelligent temperature management.

PCM cleverly packed



Temperature management in the defined comfort zone



Advantages of Micronal® PCM at a Glance

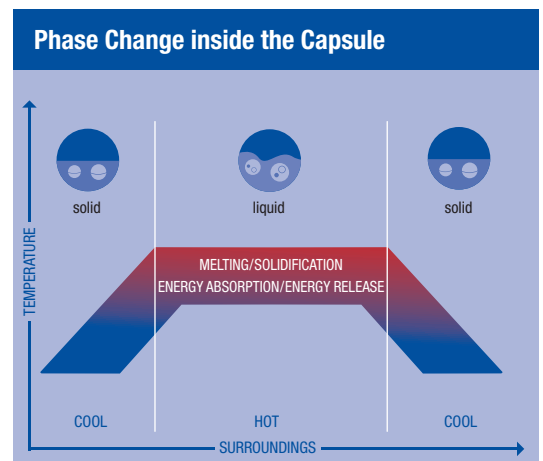
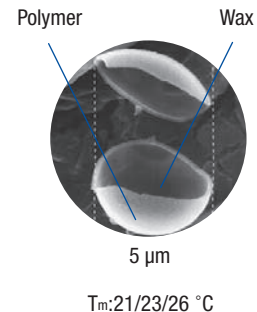
- Optimum indoor climate und consistent temperatures throughout the year
- Working and living in a comfortable and healthy temperature zone, that is between 21°C and 26°C
- A bonus for health: quiet air conditioning without the occurrence of draughts and transference of noise
- Greater energy efficiency through better energy management. Avoidance of excessive energy consumption and better use of sustainable sources of heat and cold
- Your contribution to CO₂ reduction and protection of the environment and climate
- Highly flexible configuration and the simplest processing with respect to conventional building materials – with a new distinctive functionality!
- Cost efficiency. No operating and maintenance costs, independent function
- More thermal mass in the same space, i.e. more useful surface for a given area

Micronal® PCM – High Tech in Microcapsules

Micronal® PCM is a phase change material, which completes a phase change from solid to liquid within the indoor temperature and human comfort range, i.e. at 21°C, 23°C or 26°C and in doing so can store a large quantity of heat. This principle of latent heat storage is comparable to an ice cube, which during its melting process keeps a drink at a constant temperature of 0°C. Micronal® PCM uses this simple physical effect to achieve the objective of stabilising indoor temperature.

Micronal® contains in the core of the microcapsule (size around 5 µm) a latent heat storage material made from a special wax mixture. When there is a rise in temperature above a defined temperature threshold (21°C, 23°C or 26°C), this absorbs the excessive heat energy and stores it in phase change. When the temperature falls below the temperature threshold, the capsule releases this stored heat energy again.¹

Whilst the latent heat is generally stored autonomously above a defined temperature from heat inputs occurring during the day, discharge of the storage material can occur via natural ventilation, mechanical ventilation or also via sustainable or conventional cooling concepts.



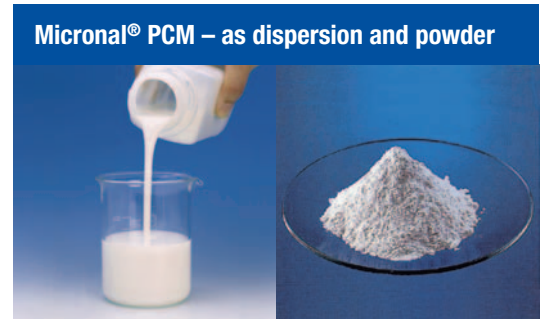
The Advantages of Microencapsulation

- Sealed packaging, the product always stays dry
- The phase change is not visible externally, the change in volume in the melting process occurs in each capsule. PCM building materials therefore remain stable in terms of size.
- Tiny volumes and tiny space requirements with high heat storage capacity.
- "Just in Time". Rapid heat exchange through high surface / volume ratio. 1g Micronal® PCM = 30m² surface
- Can be directly integrated into the building material, i.e. can be used without additional work processes or higher complexity on the construction site
- Mechanically, practically indestructible, high cycle resistance and functions over decades
- Formaldehyde-free

¹ With this process, the aggregate state of the storage material changes: the temperature of the system therefore remains almost constant, as long as the whole concealed = latent heat is absorbed or released.

The Micronal® PCM Product Portfolio

Micronal® PCM can be incorporated into building materials in different forms. For all applications in which a liquid form can be used, BASF offers Micronal® PCM dispersions, in which the microcapsules are dispersed in water. For building applications which require a powder form (such as dry blends like plaster or cement mortar for example), BASF offers a portfolio of redispersible powders.



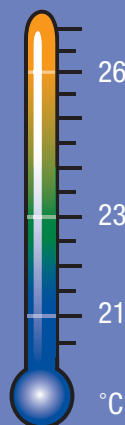
Product designation	Product type	Melting point approx.	Application	Integration range	Overall storage capacity approx.	Latent heat capacity approx.	Solid content	Density	Apparent density	Viscosity
DS 5000	Dispersion	26°C	Summertime excessive heating protection	10–30°C	59 kJ/kg	45 kJ/kg	Approx 42%	Approx 0,98		Approx 200–600 mPas
DS 5007	Dispersion	23°C	Stabilisation of the indoor temperature in the comfort zone Passive and active application	10–30°C	55 kJ/kg	41 kJ/kg	Approx 42%	Approx 0,98		Approx 200–600 mPas
DS 5030	Dispersion	21°C	Surface cooling systems	10–30°C	51 kJ/kg	37 kJ/kg	Approx 42%	Approx 0,98		Approx 200–600 mPas
DS 5001	Pulver	26°C	Summertime excessive heating protection	10–30°C	145 kJ/kg	110 kJ/kg	In powder form		Approx 250–350 kg/m³	
DS 5008	Pulver	23°C	Stabilisation of the indoor temperature in the comfort zone Passive and active application	10–30°C	135 kJ/kg	100 kJ/kg	In powder form		Approx 250–350 kg/m³	
DS 5029	Pulver	21°C	Surface cooling systems	10–30°C	125 kJ/kg	90 kJ/kg	In powder form		Approx 250–350 kg/m³	

Best results can be achieved with Micronal® PCM latent heat storers with regard to passive overheating protection, stabilisation of indoor temperatures and efficient use of surface cooling systems, as a component part of a functional building concept.

The Right Choice of Melting Point

Did you know:

30 kg of Micronal® PCM gives around 1 kWh of storage performance. This corresponds to the quantity of heat from a 1,000 W hairdryer running for 1 hour.

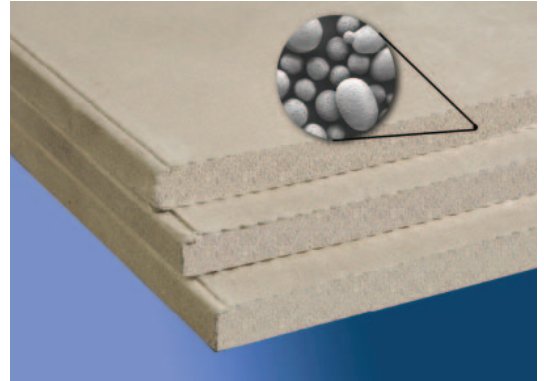


- 26°C for summertime excessive heating protection (e.g.: in lofts or for passive application in warm regions)
- 23°C for stabilisation of the indoor temperature in the comfort zone, thus frequent use of the PCM effect. Most important product for cases of active and passive applications.
- 21°C for use in surface cooling systems

Construction Applications and Systems with Micronal® PCM

Knauf Gips KG's PCM SmartBoard®

In the form of the gypsum wallboard, Knauf PCM SmartBoard®, Micronal® PCM can be quickly and simply integrated into innovative building concepts in dry construction. Every square meter of this building material contains three kilograms of the Micronal® PCM latent heat storer. The heat capacity of a wall construction, twice equipped with 15mm PCM SmartBoard®, is thus comparable to a 14 cm thick concrete wall or a 36,5 cm thick brick wall.



Ilkazzell Isoliertechnik GmbH's Ilkatherm® System

Derived from sandwich technology (metal surface, PUR rigid foam core, metal surface), highly efficient radiant ceiling panels with Micronal® PCM were developed, which can be linked to existing cooling water circuits via a simple Plug and Play process. Water cooling is achieved through capillary tube mats, which are located on the reverse of the PCM layer facing into the room. This system solution makes renewable cooling and buffering of peak loads possible.



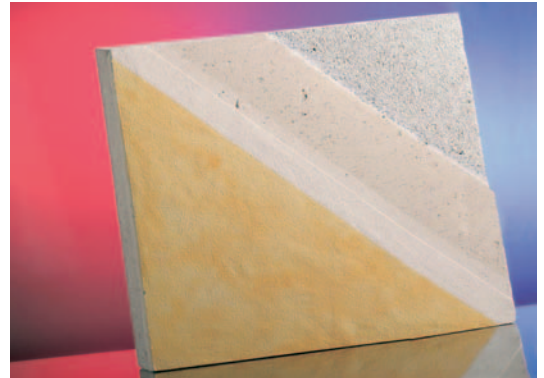
© Ilkazzell Isoliertechnik GmbH

Passive or Active Application

With Micronal® PCM, modified building materials can be used in “passive application”, i.e. without simultaneous use of mechanical cooling, but also as a component of an “activated” system in building concepts. An activated system describes the combination of various components, which enable recooling or active charging or discharging of the storage material. The heat transfer medium for this can for example be air or water.

Maxit clima® machine-applied plaster from maxit Deutschland GmbH

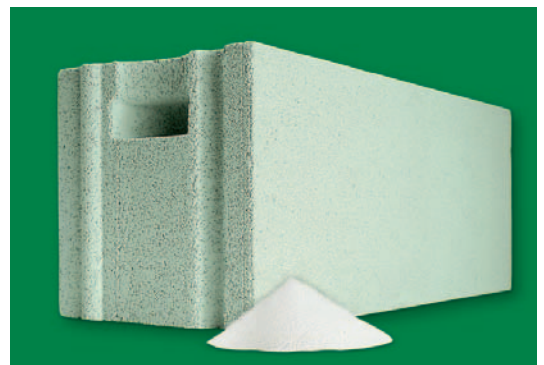
Maxit clima is a PCM machine-applied plaster for making single-layer interior plaster with a temperature regulating effect. Through varying the thickness of the layer, the quantity of Micronal® PCM latent heat storer can be controlled according to requirements. Maxit clima® is available fully formulated (for direct processing on the construction site) as a dry mortar.



H+H Deutschland GmbH's CelBloc Plus®

The green aerated concrete CelBloc Plus offers the capability for latent heat storage in addition to good heat, fire and sound insulation characteristics and positive environmentally compatible characteristics for adjusting air humidity.

The migration of the heat front through the outer wall is slowed down by the active PCM component. The result is a highly insulating stone that shows smaller temperature fluctuations on the inner wall surface for the same U-value. This leads to more constant indoor temperatures.



© H+H Deutschland GmbH

Further product developments on request.

Tips for Planners



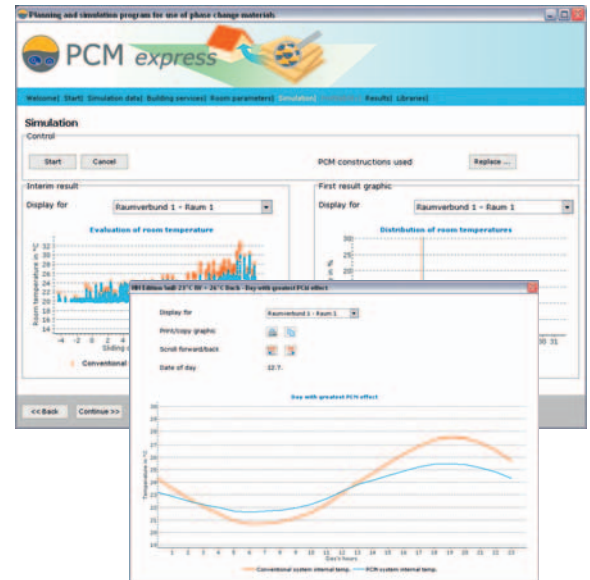
Micronal® PCM has demonstrated its performance in accordance with the criteria of the RAL quality control association, Gütegemeinschaft PCM e.V, in comprehensive test series. Micronal® PCM has passed all tests, both as a raw material and also in PCM SmartBoard® dry wall-boards, and has had the RAL quality mark since 22 August 2008. Thus invitations to tender according to RAL-GZ 896 for building products based on Micronal® PCM correspond to good professional practice and the recognised technological rules.

Details can be found at www.pcm-ral.de

Micronal® PCM – High Performance in Intelligent Building Concepts

The PCMexpress Simulation Software

The PCMexpress program was developed within the framework of a research project in co-operation with the Fraunhofer Institute for Solar Energy Technology (ISE) in Freiburg, the Valentin Energiesoftware Company and other industrial partners. PCMexpress is a planning and simulation program for buildings with phase change materials (PCM). It is designed to support architects and planners in the evaluation of the effect of PCM in concrete buildings, by enabling secure decision making for the sizing of the overall system. As a concluding presentation, amongst other things, project reports were offered to customers and planners, as well as meaningful graphs for comparing the systems.



© Dr. Valentin EnergieSoftware GmbH

Reference Items with Micronal® PCM

In the past few years Micronal® PCM has been sampled and tested several times in real reference items. Three examples follow from the areas of commercial construction, school construction and housing construction.

PCM evaluation made easy

More about the free simulation software PCMexpress along with the download link can be found at www.micronal.de

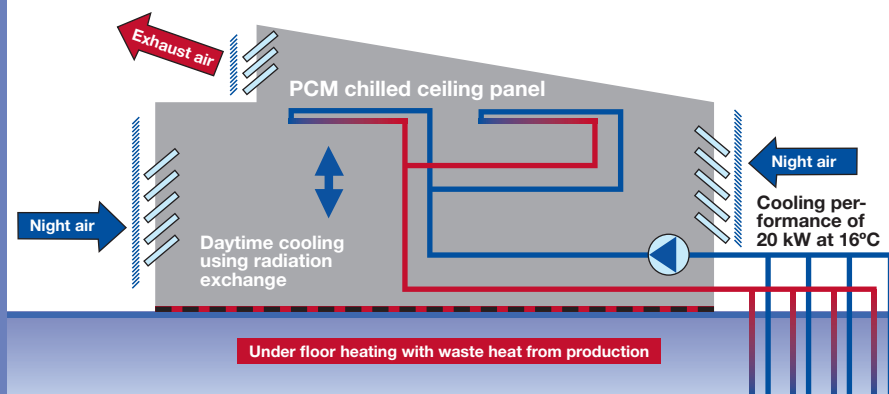
Reference Item 1: Commercial Construction

Objective: Optimised energy concept with excellent indoor climate conditions for staff

- Construction item: Office construction for Engelhardt & Bauer in Karlsruhe
- Application: active cooling ceiling elements with renewable cooling sources (geothermal probes)
- Product: Ilkazell's Ilkatherm chilled ceiling panel
- Concept and monitoring: Fraunhofer Institute for Solar Energy Technology (ISE) in Freiburg
- Result: Geothermal probes as renewable cool sources constantly provide cold energy for the Ilkatherm cooling ceiling. In addition, automatic window opening controls night ventilation to discharge the building at night. Micronal® PCM acts as a temporary storer for the peak loads occurring during the usage time in the day and thus homogenises the "just-in-time" cooling requirement.

Reference Item: Engelhardt & Bauer

- Small geothermal probes are the cooling sources
- Energy efficient solution based on sustainable cooling concept
- No heat exchange between the cooling source and the chilled ceiling panel
- Minimal technical effort expended, small operating and investment costs



Reference Item 2: Housing Construction

Objective: Most constant indoor temperature possible at 23°C, autarkic supply via photovoltaics

- Construction item: German contribution to the Solar Decathlon Competition of the DOE in Washington D.C. 2008
- Concept: Professor Hegger, Darmstadt Technical University
- Application: passive temperature management at 23°C on walls and active cooling ceilings
- Products: Knauf PCM SmartBoard® and Ilkatherm cooling ceiling panels
- Construction methods: wood-framed lightweight construction, partly with vacuum insulation, interior fittings dry construction
- Implementation: student work group with Professor Hegger, Darmstadt Technical University
- Website: www.solardecathlon.de

Reference Item: Solar Decathlon House



Reference Item 3: School Construction

Objective: Good thermal comfort in container lightweight construction without active cooling.

- Construction item: new school building for the state of Luxembourg, town of Diekirch
- Concept: Public Buildings Administration, new buildings division, Luxembourg
- Application: purely passive temperature management at 23°C on walls and ceilings
- Product: Knauf PCM SmartBoard®
- Construction methods: structural work steel container construction, interior work dry construction and PCM grid ceilings
- Implementation: ALHO Systembau GmbH, Morsbach
- Monitoring: Fraunhofer Institute for Solar Energy Technology (ISE) in Freiburg

Reference Item: School Building Diekirch

Further reference items are to be found at www.micronal.de

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