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RESEARCH NEWS

BAU 2017: Pleasant indoor climate due to phase change materials

Combination of insulation and thermal mass

When the summer sun burns in the sky, phase change materials (PCM) integrated in building envelopes absorb the heat – it remains cool inside. When it is getting colder outside, the materials give off heat. Several grams of these storage media can protect against overheating and undercooling for a long time. For the first time, researchers have combined insulating characteristics of foams with PCM thermal masses via established procedures of shaping processes. Due to this combination of materials the heat transfer through walls is reduced for hours.

- PCM in building materials absorb and give off heat
- They regulate heat, to secure a pleasant indoor climate
- Fraunhofer researchers have combined the thermic and insulating characteristics of PCM and foams

In the evening, it is nice and warm in the living room. However, when you enter the room in the morning it is chilly. It takes time until the heating gets started and the air in the room warms up again. Phase change materials – media made up of salts or organic compounds that store heat – can compensate for such temperature differences. Temperature peaks on hot summer days in indoor areas can also be mitigated.

Insulation and thermal mass

Researchers of the Fraunhofer Institute for Chemical Technology ICT in Pfinztal near Karlsruhe/Germany have combined the traditional advantages of a foamed insulation with the thermic regulating and storing characteristics of PCM within a single component. "The material is able to restore and give off huge amounts of heat within a short time intervall where it changes its temparature while tranforming to another aggregate condition. Via established procedures of shaping processes the PCM were integrated in foamed sheets for the first time. The next step will be to test the long-term resistance of these components," explains Sandra Pappert, a scientist at the ICT. Storage media are already available as microcapsules; they can be stirred into wall paint or plaster. What is special about the new technology: "Instead of a few micrograms, several grams of the phase change materials have been integrated. Therefore the thickness of the wall is not changing by increasing the thermal mass," says Pappert.

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The physical principle is known from lakes, which are covered by an ice layer on bitter cold days. Although the air is much colder, the water has a constant temperature of four degrees Celsius for the entire time until the last drop of water in the lake has frozen to ice. The freezing temperatures that the lake absorbs from the air do not cool the water down any further. Rather, they convert the water into ice.

Comfortable feel-good ambience

The researchers use this effect to optimize the temperature of rooms. If the heating runs during the day, the phase change materials are liquefied and some of the heat is stored. If the room temperature cools down at night, they solidify – and thereby release the stored heat to the room. During the summer, the indoor rooms stay cool. This is due to the fact that when the sun beats down, the materials liquefy. To be able to do this, the materials need heat, which they extract from the room.

The greater effectiveness of the huger PCM amounts is noticeable, for example, during long heat periods: If the air does not cool down noticeably at night, the phase change materials, which have already become liquid, cannot solidify again. In the case of the microcapsules, this means that all the capsules are eventually converted and no further heat can be absorbed. However, this is not so if sufficient amounts of PCM are available. They can provide a pleasant indoor environment for longer periods of time during continuing hot or cold periods. In principle it is possible to remove the stored heat through a cooling system selectively. On the one hand, the PCM could absorb new heat, while on the other hand, via an energy converter, the heat could be used for other purposes, such as to preheat the water in the shower.

The researchers will present the mode of action and the potential of the phase change materials at the BAU trade fair from January 16 - 21, 2017 in Munich, Germany. Using two climatic chambers, they will demonstrate the extent to which these materials can compensate for temperature fluctuations (Hall C2, Booth 538/531).

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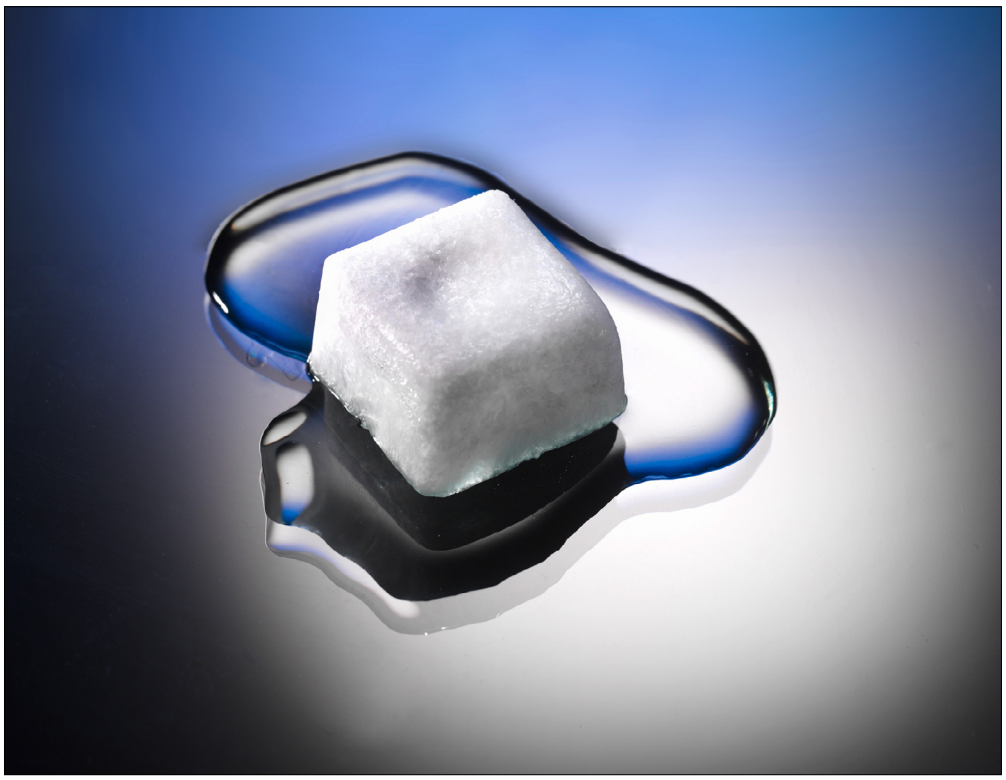
What are phase change materials?

Phase change materials (technical term PCM) are able to absorb, restore and release huge amounts of heat in a small time intervall while changing their aggregate condition depending on their surrounding temperature. This works by storage media, such as salts or organic compounds, changing their aggregate states as soon as heat is added. If, for example, they change from the liquid to the solid state or vice versa, they absorb or release heat.



The PCM cube maintains a temperature of 21 degrees Celsius until it is completley melted.
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