

Energy-Saving Construction Elements with Self-Regulated Thermal Conductivity: A New Method

Post-formed PCM integration gives bricks and panels self-regulating thermal conductivity to cut building energy use.

Researchers at Purdue University have developed a new process to incorporate phase change materials (PCMs) into construction materials. According to the World Green Building Council, the buildings and construction sector is responsible for 39% of global energy-related carbon emissions, and the U.S. Energy Information Administration reports that over half of energy use in homes is for heating and air conditioning. PCMs store energy by undergoing phase changes, which reduces energy consumption in buildings. PCMs moderate the effect of outside temperature changes on the indoor environment by converting changes in thermal energy into phase changes. Currently, PCMs are incorporated into other materials via microencapsulation or macroencapsulation. However, use of PCMs is limited either due to their negative effect on strength and durability in the case of microencapsulation or by limitations of the shape and production method in the case of macroencapsulation. The Purdue researchers' method involves incorporating the PCMs into construction materials after they've already formed, thereby increasing strength and enhancing durability while increasing the thermal inertia of the material. This method can be used to turn bricks, concrete panels and drywall into materials that store thermal energy, reducing energy consumption of heating and cooling, improving thermal comfort and making buildings more energy resilient against power outages and energy crises. This would reduce the carbon footprint of the buildings as well as operational costs. The method can be also applied to produce pavers and other precast elements to reduce formation of ice and cause a higher rate of snow and ice melting.

Advantages

- reduces building energy consumption and, thus, CO2 emissions
- provides better thermal comfort in buildings

Technology ID

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Category

Infrastructure &
Construction/HVAC & Building
Energy Efficiency
Infrastructure &
Construction/Demand-
Responsive Heating & Cooling
Systems

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- increases strength and durability of construction materials
- decreases water permeability of construction materials
- decreases energy cost costs
- has a scalable, automatable manufacturing process

Applications

- incorporation into construction materials to reduce energy use

Technology Validation: In a test incorporating paraffin (a type of PCM) into brick, paraffin filled 99.88% of the initial pore volume, increased thermal inertia by 5.9%, and increased the peak load resisted (strength) by 11.9%.

TRL: 3

Intellectual Property:

Provisional-Patent, 2022-04-18, United States

PCT-Patent, 2023-04-18, WO

NATL-Patent, 2024-09-17, United States

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