A model made of phase-change materials | Photo source Dharmesh Patel

3D-PRINTABLE COMPOSITES COULD HELP MAINTAIN PROPER BUILDING TEMPERATURES

PROPERTY & CONSTRUCTION

A new process can create building materials that better regulate indoor temperature and thus partially substitute our energy demanding heating and cooling systems

Spotted: Heating, ventilation and air conditioning are amongst the most used methods to regulate indoor temperature. These systems, however, not only guzzle a lot of energy but also use greenhouse gassessuch as refrigerants, which damage the ozone layer. These concerns have encouraged research into alternative materials and technologies that don't use as much energy to function.

Amongst these, engineers at Texas A&M have developed a new composite for phase-change materials (PCMs) that can be 3D-printed.

PCMs are substances which when they go through a change in their physical state (from solid to liquid and vice versa), absorb and release significant quantities of "latent" heat. Thus, these substances are highly efficient when it comes to thermal storage and have the potential to create building materials that better regulate indoor temperature and thus partially substitute our energy-demanding heating and cooling systems.

For example, the melting of PCM into liquid as it absorbs heat cools the surroundings. Likewise, when room temperature cools down, the material would solidify, releasing the heat it had stored.

For the new study, published last June issue of the journal Matter, the researchers focused on incorporating PCM directly into a building material. For this, they combined paraffin wax, as the PCM, with liquid resin to create a soft, paste-like material that can be easily moulded to demand. Once the desired shape is acquired, it is set with UV light which hardens the resin. The product is a solid

material that can be used to build with. Unlike previous efforts that rely on extra shells, the PCM can be densely packed in up to 63 per cent of the material.

Moreover, the malleability means that it can be made into a 3D-printable ink, making the product more economical than other PCM building materials.

“We’re excited about the potential of our material to keep buildings comfortable while reducing energy consumption,” Dr Peiran Wei, an author of the study, stated on the Texas A&M website. She added that “We can combine multiple PCMs with different melting temperatures and precisely distribute them into various areas of a single printed object to function throughout all four seasons and across the globe.”

The process has been demonstrated with the print of a small hollow house model. The test was to place the model in an oven, revealing that the hollow interior was 40 per cent cooler than the outside environment. This was tested across 200 cycles of melting and solidifying, showing almost no leakage of the PCM.

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Takeaway:

Previous PCMs had been so far inefficient and costly. The work carried out at Texas A&M to increase the scalability of incorporating phase-change materials into construction materials could eventually lead to proper temperature regulation in buildings. The next step will be to play with extending the temperature range at which the process operates. According to the researchers, this could help reduce the energy consumption required with operating heating and cooling systems.