'Fungi tiles' inspired by elephant skin keep buildings cool without electricity: 'Promising eco-friendly alternative'

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BY KAMRIN BAKER

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With record-high temperatures likely to sweep the globe this summer, access to cool air will be vital. But cranking the air conditioning increases energy use and can be both environmentally and financially devastating.

Scientists from Nanyang Technological University Singapore, in partnership with biomimicry design firm bioSEA, have turned to elephants for the solution.

“Elephants are large animals that live in hot and sometimes humid tropical climates,” Dr. Anuj Jain, the founding director of bioSEA, explained in a statement.

“To withstand the heat, elephants evolved to develop a skin that is heavily wrinkled which increases water retention and cools the animal by evaporation.”

FOUR TILES SHOW ELEPHANT SKIN-LIKE TEXTURES. PHOTO COURTESY OF NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

The researchers were inspired by an elephant's ability to cool itself in hot weather without sweat glands.

"[We] tried to see how we could replicate the same cooling mechanisms of shading, trapping cool air, and increasing the surface area for water to evaporate," Dr. Jain added.

To do this, the researchers devised hexagonal wall tiles made from a biomaterial that combines the root network of fungi — called mycelium — and organic waste.

Expanding on prior research indicating that mycelium-bound composites are more energy-efficient than traditional building materials, the NTU Singapore team and bioSEA also gave the tile a bumpy, wrinkly texture, mimicking the skin of an elephant.

"In laboratory experiments, the scientists found that the cooling rate of their elephant skin-inspired mycelium tile was 25% better than a fully flat mycelium tile," a statement from NTU Singapore shared.

Researchers also found that the elephant-skin-inspired tile cooled fastest when heated from the flat side, losing over 4 degrees Celsius per minute.

Based on their findings, they recommend that the tiles be installed with the flat side adhered to a building's facade, and the textured surface exposed to external heat.

As for the materials that make up the tiles, the mycelium-bound composite is created by growing fungi on organic matter, like sawdust or agricultural waste. As the fungi grow, they bind the organic matter into a solid, porous composite.

RESEARCHERS MIX A COMBINATION OF MYCELIUM AND BAMBOO SHAVINGS IN THE HEXAGONAL MOLD. PHOTO COURTESY OF NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

"Insulation materials are increasingly integrated into building walls to enhance energy efficiency, but these are mostly synthetic and come with environmental consequences throughout their life cycle," Associate Professor Hortense Le Ferrand, who led the study, said in a statement.

"Mycelium-bound composite is a biodegradable material that is highly porous, which makes it a good insulator."

For this study, which was recently published in "Energy and Buildings," NTU scientists used the mycelium of oyster mushrooms and bamboo shavings collected from a furniture shop.

From here, the two ingredients were mixed with oats and water and packed into a hexagonal-shaped mold covered in an elephant skin-inspired texture treatment.

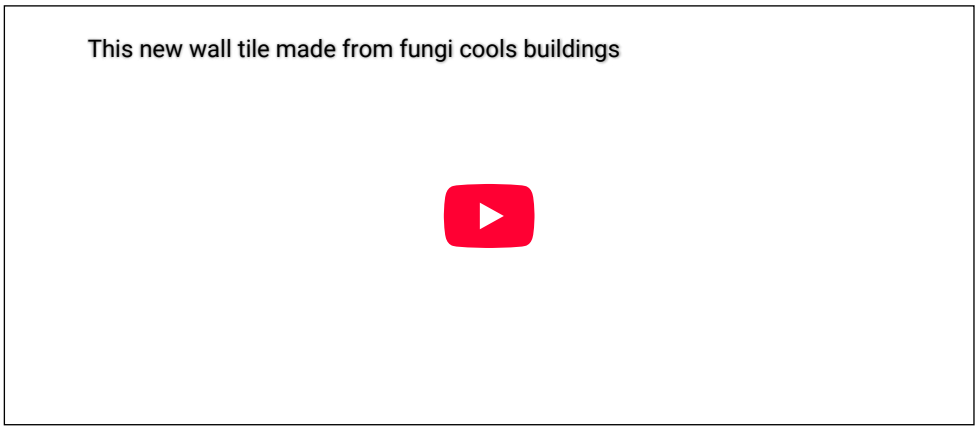
To complete the process, the mycelium tiles were left to grow in the dark for two weeks, removed from the mold, and left to grow for another two weeks. Then, they were dried in an oven to remove any remaining moisture, prohibiting further fungal growth.

FROM LEFT: NTU ASSOCIATE PROFESSOR HORTENSE LE FERRAND; BIOSEA'S DR. ANUJ JAIN; NTU RESEARCHER TEO JIA HENG; NTU RESEARCHER EUGENE SOH. PHOTO COURTESY OF NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

"The result is a promising proof of concept that takes us one step closer to efficient, sustainable, and cheaper passive cooling solutions in hot and humid conditions," Le Ferrand said.

Now, the team is exploring how to integrate these tiles into real-world use with a startup called Mykílio. They hope to scale up the size of the tiles and conduct further outdoor testing on buildings.

One major challenge in scaling up production is the time needed to grow the mycelium tiles. Despite the lengthy wait time, the process requires minimal energy resources, which Le Ferrand says could inspire adoption in the construction industry.



"We've developed a promising eco-friendly alternative that transforms waste into a valuable resource while rethinking conventional thermal management materials," Le Ferrand concluded.

"This opens the pathway for more elephant skin-inspired designs and the use of different mycelium strains to overcome the challenges that come with using

mycelium tiles as an alternative construction material."

Soon, the researchers hope, their invention will help cool buildings without heating the Earth.

Header image courtesy of Nanyang Technological University Singapore

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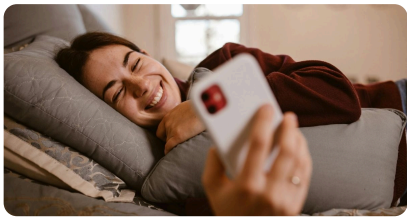

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