Student research team accelerates snow melt with 'Melt Mat'

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Karl Vitale positions a scale model of the Melt Mat, a type of thermal absorptive blanket, inside an experimental set up equipped with artificial sunlight that allowed students to monitor the rate of snow melt over time. Vitale belonged to an undergraduate senior project team in the Department of Biomedical Engineering and Mechanics that designed, constructed, and tested the Melt Mat, which accelerates snow melting times by threefold. Credit: Virginia Tech

Snow storms often leave behind reminders of their presence for days - sometimes weeks - after warmer and sunnier weather returns. Snowbanks, often created by snow plows as they clear major roadways, can linger in parking lots, on sidewalks, and in driveways even when temperatures rise well above freezing.

Fresh snow's highly reflective surface is the culprit of this phenomenon, dramatically minimizing any potential melting effects from the sun's heat. Cities in cold regions typically resort to active methods to remove snowbanks, such as hauling the snow to disposal sites or using gas-powered heaters. These efforts can rack up an annual bill somewhere in the range of $25 million to $125 million per city, making snow removal a perennial problem.

A Virginia Tech student research team has discovered the solution, both for municipalities looking to save millions and also for the homeowner hoping to avoid snow shovel duty: the Melt Mat.

The product of a senior design team in the Department of Biomedical Engineering and Mechanics within the College of Engineering, the Melt Mat is a thermally absorptive blanket made from a thin sheet of aluminum that has been spray-coated with an ultra-flat black paint. When draped over snow, the Melt Mat increases melting time by threefold, all without any effort or energy input.

The results of the students' Melt Mat design, fabrication, and testing research have been recently published in the journal *Langmuir*. The students have also been granted a provisional patent for the Melt Mat through Virginia Tech Intellectual Properties.

"The idea for a thermal absorptive blanket is novel, but also very practical," said Jonathan Boreyko, an assistant professor of biomedical engineering and mechanics and the team's faculty advisor. "For novelty's

sake, the team really needed to go for a journal publication. For practicality's sake, we went for a patent."

"They ended up getting both," said Boreyko. "I was very proud of them."

A hallmark of the engineering science and mechanics undergraduate program, senior design teams form in the spring of students' junior year. During this time, program faculty members visit junior classes on a rotating schedule to pitch their ideas for senior projects. After selecting an idea, team members immerse themselves in the design project until graduation - sometimes longer - with the aim of conducting research and designing products alongside their faculty advisors.

"Generally, snow reflects about three-quarters of the sun's radiation back into the air, so it's actually really hard for the sun to melt a snowbank," said Boreyko. "Even if temperatures are above freezing and the sun is out, the snow's surface just bounces most of the heat right off. That's the fundamental problem we're trying to address here."

In spring 2016, Boreyko pitched the idea for a thermal absorptive blanket, something that would not only absorb the sun's heat, but could also conduct that heat across the blanket's surface to accelerate snow melting times. After selecting Boreyko's idea as the focus of their project, the team then began the process of designing, constructing, and experimenting with several scale models, one of which would emerge as the Melt Mat more than a year later.

The Melt Mat's simple, passive design means it would be less expensive to make and ideal for repeated use. Its durable construction also prevents the Melt Mat from degrading over time, a problem observed with other passive methods of snow removal, such as spreading large amounts of soot particles over snowbanks for a similar effect. Because the Melt Mat does not rely on antifreeze or other chemicals that could run off into

groundwater, its use has no adverse effects on the environment.

With a wide array of applications - including residential driveways and sidewalks, parking lots, and athletic fields - several design team members explored the possibility of starting a company to manufacture, market, and sell the Melt Mat. But now, with their provisional patent in hand, the team is hoping to find an established company that might be interested in working toward a full patent, which could allow for licensing agreements to use the Melt Mat's technology.

"When our senior design class had concluded, we felt like we were really on to something," said Sarah Wray, a senior design team member and one of the study's co-authors. "We decided to push ourselves further."

With any luck, the Melt Mat could be coming to a store near you.

More information: Owen L. Hansen et al. Thermally Absorptive Blankets for Highly Efficient Snowbank Melting, *Langmuir* (2018). DOI: 10.1021/acs.langmuir.7b03182

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