Energy Management
CASE STUDY:

University of the Arts Berlin

Controlling Room Temperature Through Thermal Regulating Curtains

Past Present – Conservation for Innovation

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There's little doubt that the world's climate is changing. According to the U.S. National Oceanic and Atmospheric Administration (NOAA) twenty of the warmest years ever recorded have occurred in the past twenty-five years. Increasingly hot summers and cold winters will further strain energy consumption and the environment as we become even more dependent on fans, HVAC, and other energy-consuming solutions.

How can the average household or business reduce energy use without sacrificing comfort or safety? Is there a solution that is both practical and affordable? In 2019, University of the Arts Berlin students Anna Koppmann and Esmeé Willemsen were presented with just such a challenge in a course project: Past Present – Conservation for Innovation.

As the project's name suggests, students were asked to identify past artifacts, objects, methods, systems, rituals, etc. that could be adapted to solve today's challenges. "Esmeé and I were interested in historical methods of controlling climate within the home," explained Anna. "We wanted to explore the use of common items to address the effects of climate change by regulating indoor temperature in a sustainable, cost-effective, and simple way."

The classmates found inspiration in a simple and common household item dating back thousands of years: curtains. In addition to restricting airflow, curtains have a long history of insulating and protecting against direct sunlight and drafts. Excavations at Olynthus, Pompeii, Herculaneum, and other ancient sites reveal evidence as to some of their earliest use.

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Phase Change Material

To prepare themselves, the students visited the Futurium museum in Berlin. "We learned that phase change material (PCM) was integrated into the walls of the building which sparked our curiosity," said Esmeé. The students recognized that, with a wide variety of applications, this could be their answer.

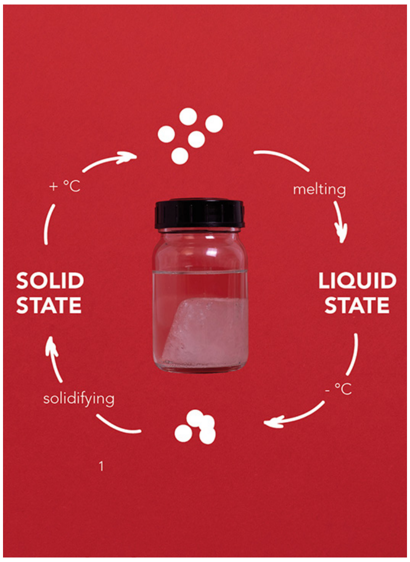
"We theorized that adapting the technology for household curtains could provide a more controlled temperature environment and offset heating and cooling demands. So, we set out to learn more."

Further research led to the discovery of microencapsulated PCM and Microtek Laboratories (a division of CAVU Group). The company was quick to assist in the project by providing material (Micronal® 24D and nextek® 24D) and recommending best practices for its application.

How It Works

Applying PCM to a rigid surface is one thing; but how can the material be adapted to something as delicate and flexible as a curtain? Furthermore, how can this combination have more than an incremental impact on reducing energy usage and costs?

As the material transforms between a solid and a liquid state it absorbs and releases energy in the form of heat or cooling. Because microencapsulated PCM comes in a variety of forms (powder, wet cake, and slurry) it can be easily adopted for developing new products. Incorporating the material into textiles, for example, opens the door for a wide variety of innovative heating or cooling applications.



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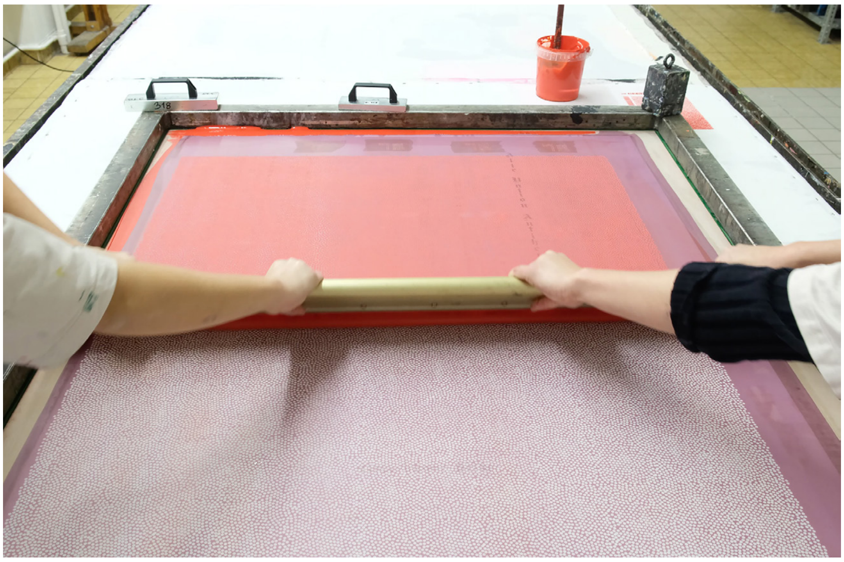
Creating a Prototype

PCM powder was mixed with paint and applied to fabric via a screen-printing process. Curtains were printed front and back with each side containing a total of two layers. In all, four layers would help guarantee an effective temperature regulation. Applying approximately 1kg of PCM for each square meter of fabric would keep the temperature at about 25°C (77°F).



The curved line pattern of the screen-printed PCM is based on the shape of conventional radiators and cooling systems. At the same time, the narrow gaps create an elegant movement of the fabric. The pattern is inspired by the change in structure of the PCM particles. As the temperature rises the particles transform from an arranged structure to a chaotic movement.

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When embedded into the curtain, the material changes from a solid to a liquid state as it absorbs heat from the sun or incoming air during the summer or from the radiator in winter. Conversely, heat is released as temperatures fall below 25°C (77°F) and the material is returned to its solid state. This continuous process essentially turns the curtain into a self-maintaining thermal system.

To help extend the effect, curtains were manufactured with one side containing foam. This allows that side to absorb and release heat more slowly. Temperature regulation can be further intensified by combining two curtains with the air between the fabric providing insulation.

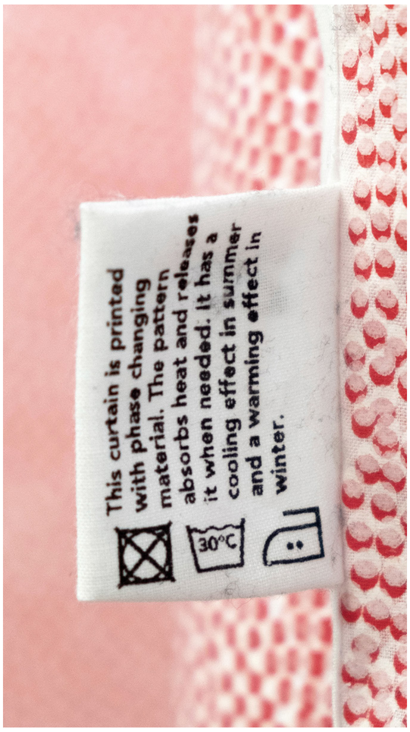
"Microtek supported us with general guidance about phase change materials and with their specific products," said Anna. "Their support and guidance with textiles were critical to our success. At least one to one-and-a-half kilograms of PCM per cubic meter of a room is needed to achieve a noticeable effect. Theoretically, the curtain plus/minus 25°C should eliminate the use of replacement devices such as air conditioners in order to save energy."

Making the Grade

The project received high praise as being both innovative and practical. Because little to no changes are required during the manufacturing process, the application of phase change material can be easily adapted to any textile producer.

Anna and Esmeé are leveraging this technology to address environmental, personal comfort, and safety challenges. Because they can be customized to a variety of shapes, sizes, material layers, fabric, and patterns - these curtains offer a practical and affordable solution to reducing energy usage in homes, offices, and public spaces. The two hope to one-day sell their intelligent curtains internationally. Having produced initial prototypes, they are working on ways to source materials for mass production while continuing with further experiments and drawing attention to their idea.

“We want to examine and collect data on the impact of our curtains in a more scientific way,” concluded Anna. “We recently had the chance to apply for the Bundespreis Ecodesign 2020 and are hoping to get some more recognition for our project. We are convinced that it could have a tremendous impact.”



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