Introduction

A short story. While sitting at the office and staring at the ceiling, thinking about work, an interesting though appeared. For decades, ceiling tiles used for ceiling in offices, schools etc., were still the same as being introduced in the 70's. Can these tiles be changed so they have more value than just only hidden the cables and plumbing of the building? Is there an idea to add value to those tiles? Is it possible to make those tiles climate adaptive? This, because during a day there is a surplus of heat and light and a shortage. Of course we are talking about climates zones in countries which has a temperature climate with a summer and a winter. How to use the surplus of heat and light and release it when there is a shortage? This with the goal of increasing need of energy needed to heat, cool or illuminate the space. But with the criteria that it is simple, low cost and a passive system…….A real challenge!

MIS7 bv
Martin's Imagineering Studio

Pre-design

After the idea was born, a pre-design was made. See below picture. It consist the following elements:

1. Glow-in-the dark paint: absorbs light and releases it when it is becoming dark;
2. A solar panel with battery, light sensor and LED: absorbs energy in the battery and releases the stored energy in the battery to the LED for illumination;
3. Phase Change Material (PCM). A substance with a high heat of fusion which, melting and solidifying at a certain temperature, is capable of storing and releasing large amounts of energy.

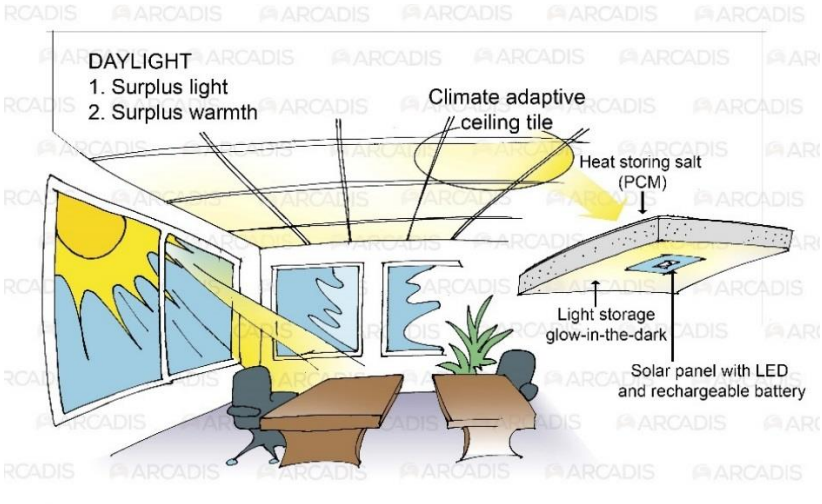


Figure 1: pre-design Climate Adaptive Ceiling Tile.

Extra technical info

1 Glow-in-the-dark-paint: by adding more layers, more light van be absorbed. But when the mixture is to dense, light will not penetrate to the deeper pigmented. The use of a transparent filler with the right volume of pigment, is important in gaining a high efficiency. Glow-in-the-dark paint is known from toys, but nowadays it can be bought in different colors like white and blue. Green has the highest illumination rate;

2 A solar panel absorbs light. The generated energy is transformed to a electrical current, which is stored in a battery. To this system a light sensor is added. When the sensor senses darkness, the current from the battery will be releases to power the added LED. By this method, the LED is powered by a surplus of light during the day;

3 PCM. A substance with a high heat of fusion which, melting and solidifying at a certain temperature, is capable of storing and releasing large amounts of energy. Heat is absorbed or released when the material changes from solid to liquid and vice versa; thus, PCMs are classified as latent heat storage (LHS) units. 100gram is capable of absorbing about 2.500 Joule. The prototype we have made, consist 1.200 gram. From studies of the British Brunel University can be concluded that about 7°C temperature is possible. At a temperature transition from 10 to 30°C, 1 m^2 can absorb 70 to 80 Watthour. PCM is cheap and safe in use. The threshold on which the PCM absorbs or release the heat, can be pre-determined. In this showcase we decided to use the threshold of 22°C.

Extra possible features (has to be determined)

4 The tile itself is usually made of a mixture of gypsum and bio fabrics. An alternative could be, the use of Zeolite. This is a mineral which has the same features as PCM.

5 Added could also photocatalytic paint. This is paint consisting TiO2 which is known to be able to reduce bacterial and viruses by forming radicals under influence of UV radiation from sunlight. It is also a method which is being used for breaking down NOx (tunnels with motorcars). Perhaps this application can help to improve the quality of the air of a classroom.

6 There are also minerals available with low cost, which are known capable of absorbing CO2. A classroom with children generates a lot of CO2. When the room is not ventilated good, the room will feel stuffy, and the learning achievements will drop. Perhaps this could improve learning capabilities.

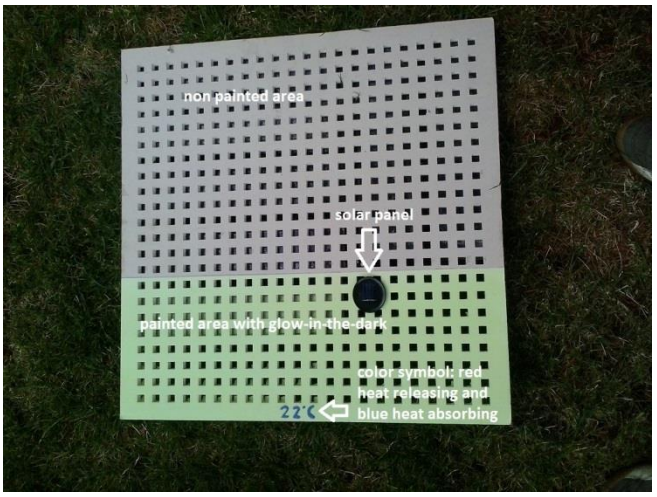
Prototype

MIS7 has made the tile, which consist of parts 1, 2 and 3. The cost were about € 25. Below a few photos are shown of the prototype:

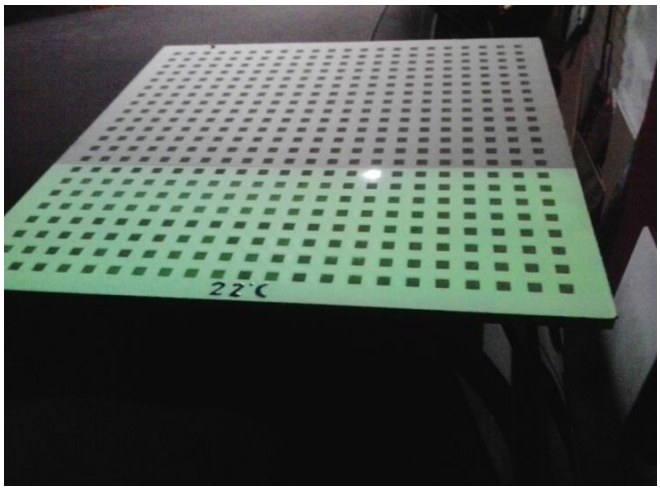
- Picture 1: rear side with PCM bags. At this side also the light sensor and battery is being constructed:
- Picture 2: tile painted for 30% with glow-in-the-dark (green) and at this side also the solar panel can been seen:
- Picture 3: Picture 3: here the light sensor is being excluded to test the LED:
- Picture 4: Picture 4: artificial light is being switched off and the and battery is being constructed light sensor is switched on. The surface painted with glow-in-the-dark is illuminating as well as the LED.

Visual, the effect of the light can been seen, but not the process of the PCM. So, this is why we added a temperature depended colored paint to the tile. We added the text "22°C" in blue, which shows the tile is cooling the room, by absorbing a surplus of heat: picture 2. In picture 4 is shown that the text "22°C" has been changed to the color red, which says the tile is releasing the stored heat of the PCM, caused by a temperature drop of the room.

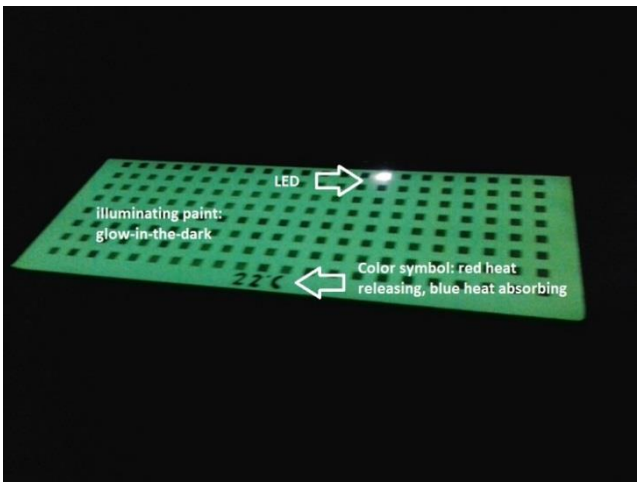
Picture 1: rear side with PCM bags. At this side also the sensor and the battery is constructed



Picture 2: tile painted for 30% with light glow-in-the-dark (green). At this side the solar panel is visible.



Picture 3: here the light sensor is being applied to test LED.



Picture 4: artificial light is being switched off . The glow-in-the-dark paint and the LED is now illuminating the room.

Project design

How to use this knowledge for education and increased perception of climate change?
The project consists of three elements:
1 perceptive climate change;
2 how technical methods can help;
3 connecting to today's teenage needs to stimulate teenagers in today's earth challenges : Smartphone and social websites.

The children (11-15 years) can make their own design. If they want for example to make a smiley with the paint, it is okay. If they want to add more LED or a different color, it is okay. During the construction process they have to make a movie by their smartphone. After the building process they have to add to YouTube. By doing this, they can generate a QR-code (part of the teaching process how to use youngsters popular internet sites to solve todays challenges). This codes the maker can print and add to his tile. By this method an interested person can scan the tile and see how it is made and by which person. The goal is that each year a classroom is being changed, but still after some

years can be followed who has done what. We hope that during this process, the tile gets even better and more efficiently and generates more info.

We know the principle of crowd-funding and crowd-sourcing, but could this be a start of a crowd-making?

MIS7 has the following plan:

1. MIS7 is making a manual of how to make a climate adaptive ceiling tile;
2. MIS7 is producing material boxes. One material box includes enough materials to make 20 climate adaptive titles;
3. If needed, workers of MIS7 are guiding the teacher with their class. Production time with the class is estimated on maximum four hours:
    a. ½ hour explanation by the teacher and with the help of a MIS7 assistant;
    b. ¼ hour making a design:
    c. ½ hour start painting;
    d. ½ hour constructing PCM;
    break
    e. ¾ hour constructing LED and solar panel;
    f. ¼ hour adding text or symbol "22°C";
    g. ¼ hour uploading movie to YouTube and generating a QR-code, inclusive printing the QR-code and adding it to the tile.
    h. ½ hour wrap up teacher, with the help of an assistant of MIS7.

Spin-of

In addition to the project, when a class room has been changed with climate adaptive ceiling tiles, a follow up can been imagined. Why not using this project to teach children how to use mathematics to solve todays challenges? It will stimulate the use of mathematics, which is needed, because a lot of children do not understand why mathematics is such an important course. The children can been given a project to monitor the effect of the ceiling tiles during a few weeks. They learn how to measure differences, filling up a database, how to use units and quantities, how to visualize the data (graphics) and how to interpret data and conclude.