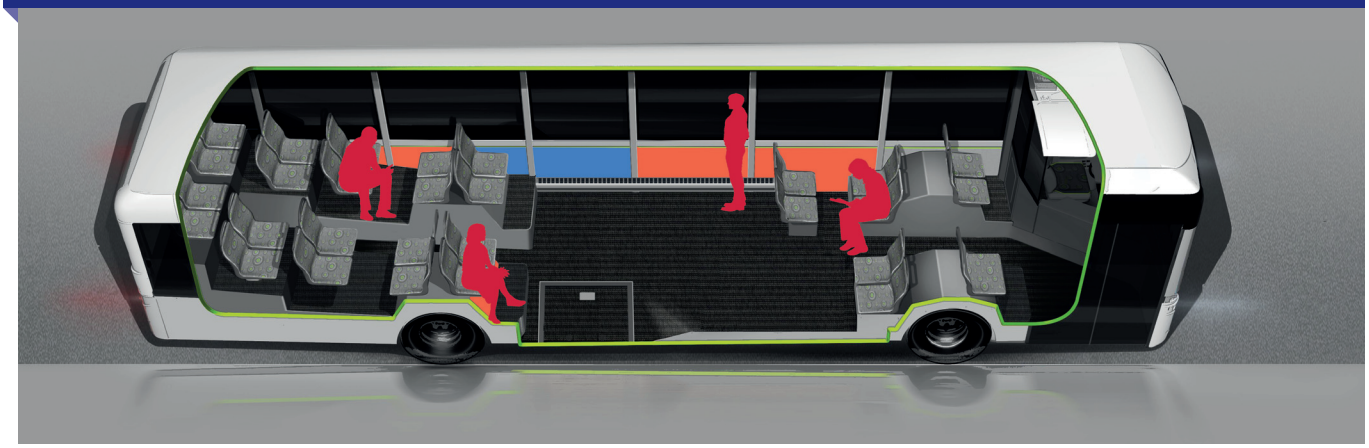
CELLO® HEATING PANELS



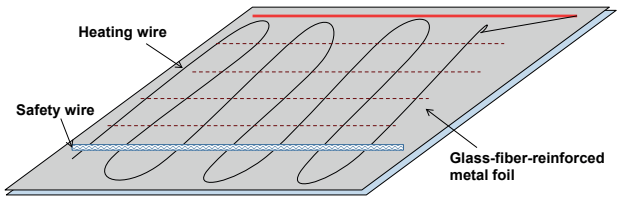
„Smart“ heating concept for emission-free buses – innovative heating panels based on phase-change material

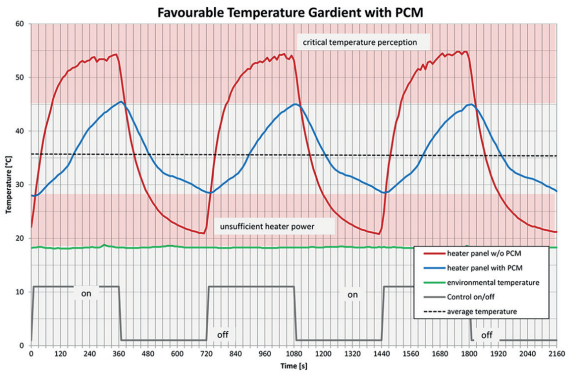
Global warming and extreme weather phenomena are among the direct effects of climate change. Today there is a high degree of consensus that the latter is largely caused by CO2 emissions generated by human activity. The use of fossil fuels is the source of major problems not only in the global context, but also on the regional level, where is adds to excessive pollution loads.

A valuable contribution to lowering emission levels comes from Zero Emission Vehicles (ZEV), for instance electric-powered buses. Yet, the still unsatisfactory range of such vehicles proves to be a persistent obstacle to their generalized use. In particular during the cold season, heating systems tend to drain a good portion of the valuable - because limited - battery power.

The heating panel introduced in the present article makes a substantial contribution towards solving this problem. In the best case, heating panels, like all resistance heating systems, have the performance indicator "1". So how can their deployment extend the vehicle's electric range?

The solution: a “smart” operational control concept. In concrete terms this means that the heating system must, as far as possible, draw on the vehicle’s electric power only when this will not put a strain on the battery charge, i.e. during charging cycles, power recuperation or, for hybrid vehicles, while the engine is running. Conventional heating panels will only provide heat while energized, which prevents their use as “smart” source of heat.





In contrast, heating panels with integrated phase-change material (PCM) can store heat for later release. Hence they are an ideal complement for conventional vehicle heating systems. PCM are capable of storing large amounts of heating or cooling energy for extended periods of time and later release it without loss. The radiated heat directly benefits the passengers, who perceive it as very pleasant and comfortable.

Composition of the PCM heating panels

Via a heating wire, the heating energy is fed into the PCM layer that is mounted on a baseplate. The aluminum foil between the two layers ensures that the heating energy is distributed quickly and evenly across the entire panel. The PCM heating panel can be conveniently integrated in a vehicle’s head liner or side wall liner. The range of fixation options includes Velcro systems, adhesive fixation, profile rails etc.

Our PCM heating panels are available in different dimensions to fit any application. They can be customized for use with power systems operating at a voltage between 24 and 700 V AC/DC. The light-weight panels are maintenance-free and not subject to wear. As they are electric-powered, they work independently of the drive engine, hence their operation is locally emission-free.

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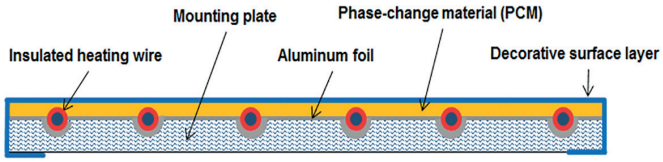

Operating principle of the heating panel

Thanks to the high thermal conductivity of the aluminum foil between baseplate and PCM, the heating panel starts radiating heat immediately after activation. Thus it efficiently complements the conventional heating system, which is fed by the engine or an auxiliary heater and hence usually takes some time to produce enough hot air.

The surface temperature of the heating panel shall not exceed 45°C, a temperature level that is still comfortable to the touch. Since the heat radiated by the panel is absorbed directly through the skin, the passengers perceive the interior climate as comfortable even at a relatively low air temperature of around 15°C. This allows lower target temperatures and saves considerable amounts of energy.

Integration, control and safety of the heating panels

In the ideal case, the heating panels are connected to the climate control system of the vehicle. However, the innovative solution is also available as a stand-alone, complete system with a standard control unit. As an option, the operation of the panel can be regulated via temperature sensors. Further safety features are protective devices against overheating and short-circuit.

Application example: city buses

The low energy consumption of the heating panels makes it possible to keep the interior temperature at a constant (no-frost) level while the bus is parked at the bus depot over night. This means that the vehicle is not completely chilled through in the morning and does not require lengthy heating up.

In a city bus with an interior volume of 50 m³, keeping the temperature at a constant level requires only about 10 m² of heating panels, which can be integrated in the side walls, for instance. Since frequent door opening lets escape considerable amounts of warm air, the panels will not suffice as the sole source of heat, but the constant warmth radiated by the PCM ensures a comfortable interior climate even in case of a noticeable drop in air temperature.

The current design of the panels allows a reduced target air temperature of only 15°C or even below, leading to substantial energy savings.

The PCM heating panels are an excellent solution not only for busses, but also for municipal and utility vehicles as well as for construction and agricultural vehicles.

Heating panels – an innovative solution

- Heat radiation instead of hot-air blowers. Heat-radiating elements provide better heat retention than air, which will quickly escape whenever the doors are opened.
- argeted heating of only those areas where passengers are sitting or standing.

Advantages

- Targeted heat distribution and improved heat retention
- Reduced energy consumption and costs
- Selectively controllable via sensors that detect the presence of passengers
- Immediate heat release (Quick-PCM)
- When the doors are open, heat stored and radiated by PCM does not get lost as quickly as hot air
- Heating elements can be cleverly integrated in window-sills, interior liners, seats, arm rests, seat backs etc.
- Radiated heat is perceived as more constant and thus more comfortable than heat provided by hot air blowers
- IoT (Internet of Things): individually controllable systems can be interconnected
- Suitable for power systems with voltages between 24 V and > 700 V

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