PCM

THERMAL ENERGY STORAGE

natural

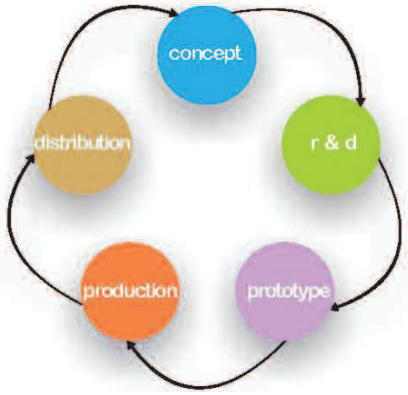
energy-saving

unique

Welcome to PCM:
Phase Change Material Products Limited

For more than a decade we have been involved in the development of Phase Change Materials (PCMs). With unrivalled experience in designing and advising on PCM installations and applications, we continue to push the boundaries in PCM usage for the benefit of our ever-growing customer base.

In addition to our technical expertise, we offer (under the PlusICE branding) what we believe to be the most comprehensive range of PCM solutions currently available commercially ***(-100ºC (-148ºF)*** to ***+885ºC (1,625ºF)***).



From initial concept, research and development to production and distribution, our office and manufacturing facility in the UK and our Licensed outlets around the world offer bespoke products to meet unique customer requirements.

And of course, good ideas are not the exclusive right of PCM! Many of the non-standard applications are initiated by our customers, whether end-user or developer. Our technical team is happy to take ideas from conception through to completion including full commercialisation, with or without our production under a Licensee option.

Thermal Energy Storage (TES):

Thermal Energy Storage TES is the temporary storage of high or low temperature energy for later use, bridging the gap between requirement and energy use. The storage cycle might be daily, weekly or seasonal depending on the system design requirements, and whilst the output will always be thermal, the input may be thermal or electrical.

REDUCED RUNNING COST *-load shifting provides reliable operation and lower annual electricity/energy running costs*

REDUCED MACHINERY *-shifting some of the peak load may enable designers to reduce the main machine size*

INCREASED CAPACITY *-as a retrofit application, the additional TES load may increase the system output without any additional machinery*

GREEN SOLUTION *-reduced machine size means reduced energy consumption, giving lower direct and indirect CO2 emissions*

FLEXIBLE SYSTEM *-the overall machinery capacity and TES capacity can be exactly matched to system loads*

STAND-BY CAPACITY *-incase the main machinery fails, the stored energy can be utilised to handle the system loads, thereby providing a degree of back-up facility*

Phase Change Materials (PCMs):

Phase Change Materials, commonly referred to as PCMs, are products that store and release thermal energy during the processes of melting and freezing. Phase Change Materials release large amounts of energy upon freezing in the form of latent heat but absorb equal amounts of energy from the immediate environment upon melting. This enables thermal energy storage; heat or coolness being stored from one process or period of time and used at a later point in time or transferred to a different location. PCMs can also be used to provide thermal barriers or insulation, particularly useful for industry sectors such as temperature-controlled transport.

Interestingly, the simplest, cheapest and most effective Phase Change Material is water/ice. Unfortunately, its freezing point of 0˚C (+32˚F) precludes it from the majority of energy storage applications. However, a number of alterative Phase Change Materials have been identified and developed that freeze and melt like water/ice, but at temperatures from the cryogenic range to several hundred degrees centigrade.

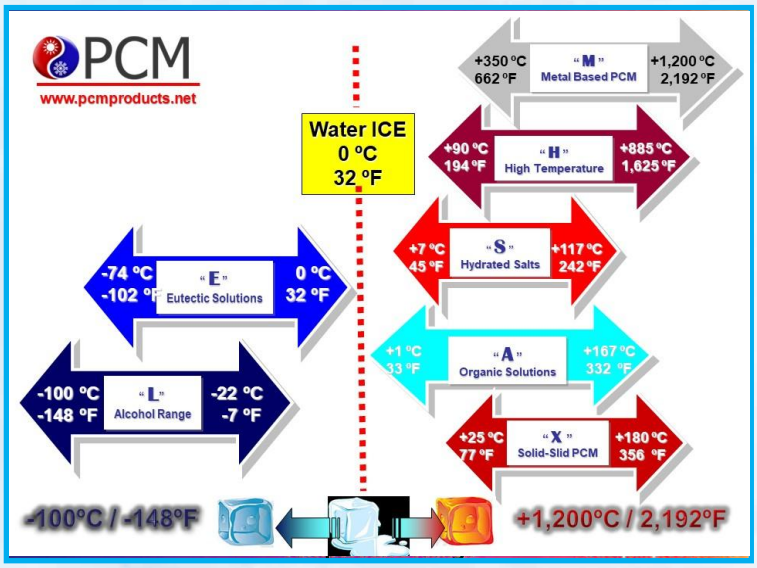
The PlusICE range is arranged into four categories;

Eutectics, solutions of salt in water with a phase change temperature below 0˚C (+32˚F)

Salt Hydrates, specific salts able to incorporate water of crystallisation during the freezing process, normally above 0˚C (+32˚F)

Organic Materials, which tend to be polymers composed primarily of carbon and hydrogen. These mostly change phase above 0˚C (+32˚F) and can be as simple as coconut oil, waxes or fatty acids.

Solid-Solid Materials, They have no visible change in the appearance of the PCM (other than a slight expansion/ contraction) during phase change and therefore overcome all problems associated with handling liquids, i.e. containment, potential leakage, etc.



Applications - Buildings:

Air conditioning:

The picture right shows the Malaysian ZEO Project. This is the Zero Energy Office, designed to capture energy during night time for release during daytime hours.

Free Cooling:

The Headquarters of Melbourne City Council, known as the CH2 building is the only 6* energy efficiency building in the world. Cooling towers are run during hours of darkness, freezing the PCM energy storage which is then released as cool during the day.

Passive Cooling:

Ceiling tiles, as pictured right, at the University of Westminster, London naturally freeze overnight and release cool during the day as an energy-free cooling.

Fabric TES:

Granular PCM is absorbed into building materials, such as plasterboard and concrete to aid the balance between temperature extremes in much the same way that old properties with high ceilings and thick walls achieve a comfortable temperature range.

Heat Recovery:

An entire village close to Turin has been designed to utilise CHP (Combined Heat & Power) using PCM energy storage for both hot and cold sides of the system with superior economics.

Solar House:

A purpose-built property in USA provides Comfort cooling and heating without the need for any external energy input.

Solar Heating:

The village used to house the athletes at the Melbourne Commonwealth Games had been built for normal residential occupation. However, during the Games, the village was full to capacity and the resultant demand on the energy sapping services such as showers meant that the capacity of the hot water tanks had to be increased sevenfold with the introduction of PCM.

Solar Air Conditioning:

The winning bid for the FIFA 2022 World Cup by Qatar is based on a zero carbon cooling design using solar energy to drive the air conditioning machinery, and storing the cooling energy in PCM tanks. This occurs while the stadium is not in use, and the stored cool energy can then be used to provide the air conditioning during Word Cup matches.

Applications - Temperature Controlled Packaging & Transport:

Road Transport:

A huge percentage of our food is transported by road with refrigerated vehicles now commonplace. PCM technology offers both mechanical-refrigeration-free and back-up cooling options.

Cold Store Back-up:

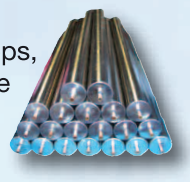
A power failure is potentially extremely costly in food storage. In countries with less reliable power supplies, PCM technology has been employed in warehouses to effectively soak the heat out of the storage area to ensure that the products remain unspoilt.

Shipping:

Phase Change Material is now utilised in road, air and sea freight as a cooling medium that provides electricity-free cooling solutions.

Marine Back-up Cooling

On some vessels, as soon as the engine stops, the refrigeration facility does likewise. These beams pictured right allow the temperature to remain under control.



Eutectic Plates:

Imagine a picnic cooler box, well these plates work in exactly the same way but on a larger scale and for a wide range of cold and hot temperature applications.

Electric-free Refrigeration & Food Display Cooling:

Free cooling or heat retention - utilised on food trolleys, salad cabinets and serve-over counters that are seen on public transport and the London Underground.

Packaging - Pharmaceutical and Medical:

Pharmaceuticals, medical supplies and blood products are temperature critical. PlusICE solutions are used by military organisations around the world for the packaging and transportation of medicine, blood and tissue.

Applications - Passive Cooling:

Telecom Shelters:

It is imperative to keep electronics under 45°C (+113°F) safety limit in order to keep the system functioning. PCM based passive cooling system freezes over night and later this stored energy soaks up both the internal and external heat loads during day-time and keep the shelter's inside termperatures under control.

Shelter Passive Cooling:

The PCM freezes overnight to absorb heat during hotter daylight hours as well as internal heat generation in applications such as remote pump-station control rooms, to provide an electric-free solution.

Electronic Cooling:

Performing the role of a thermal shock absorber, the PCM prevents electronics exceeding their critical temperature.

Electronic Back-up Cooling:

Many I.T. centres have their own power supply backed up by generators or UPS for the computers.

Unfortunately, as soon as the power goes off, the temperature rises. The PCM acts like a thermal sponge, soaking the heat from area and offers an electric-free back-up cooling solution.

Battery Cooling:

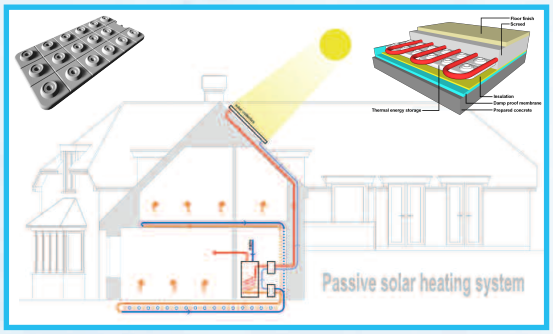
PCM technology gives extended life to the batteries by keeping the temperature down. Cooler batteries result in longer life and better performance.

Applications - Solar Heating & Heat Recovery:

Industrial Applications:

PlusICE solutions enable designers around the world to apply the PCM technology, stabilising heat loads and matching heat load time balance for an economical and reliable operation. Loads in dairies, breweries and food factories can be simply balanced by PCM TES systems to suit the operating temperatures of the system to cut any waste energy.

Underfloor Heating:



Although solar collectors are not capable of producing high enough energy to charge the hot water during winter periods but they can still be capable of charging a +27° (81°F) PCM underfloor energy storage circuit whereby the surplus sun energy can be stored and later used over-night. Effectively, the whole building heating loads can be satisfied by simply using solar circuit.

Domestic Hot Water:

Phase Change Materials added to standard domestic immersion tank increase the hot water storage capacity many times over.

Commonwealth Games Village Australia:

Utilising Solar TES. During the period of the Games, the requirements for additional hot water in order to cover the excessive occupancy level were increased dramatically.

Heating Solar TES:

The time lag between energy availability and consumption between the midday sun and hot water heating requirements is bridged by PCM TES which offers economic and efficient installation.

Solar House Project USA:

Built for the Solar Decathlon competition, the Solar House provides comfort cooling by simply storing cold night energy and heating by storing daytime solar energy, negating the need for any energy input.

Product & Application Development;

Aerospace and Military Applications:

We are extremely proud to have been involved in providing our expertise to such an enormous project. PCM technology has been utilised within the capsules used for collecting and retaining samples. The PCM ensures that the samples collected remain at the same temperature until opened for examination and research.

Automotive & Personal Passive Cooling:

In some parts of the world experiencing hotter climates without the luxury of air conditioning in motor cars, PCM Passive Cooling has been adopted to keep the driver cool. Using a +32°C (+90°F) PCM that freezes overnight, the driver's comfort is ensured when the PCM melts.

Battery Cooling:

The battery backpack used by the armed forces enjoys longer life and better performance when kept cool. The PCM technology increases battery life at a critical time for EV applications.

Drink Can Passive Cooling:

A project undertaken for a major global player resulted in a +4°C (+39°F) PCM ensuring that a can of drink remained at this temperature for four hours.

Passive Furniture Cooling:

PCMs have been introduced into fabrics used in furniture production and even bed-sheets to achieve optimum comfort. Data safety boxes may stand the fire but the heat generated by the fire renders the data useless and by using PCM to keep the content of the safe below upper temperature limit for 4~6 hours provides enough time for the fire fighters to rescue the safety box and save the data files inside the safe.

Human Comfort & Body Cooling:

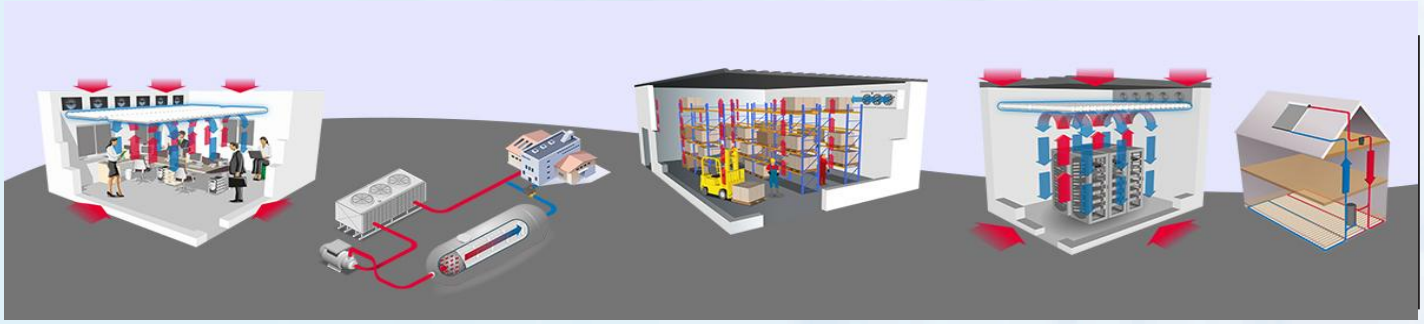
This technology has finally made it into 'ice jackets', used by firefighters and operatives in uncomfortable working environments. In another application, PCM based cooling cushions have been incorporated into prosthetic breast implants to contain excess heat generated by the chest wall. PCM's are also used in cushions for wheelchair users to protect and overcome hotpsots.

Since 1996 our design team has been working on many different produces and applications, from the International Space Station to the submarine cooling applications.

Our PlusICE range of products including FlatICE, BallICE, TubeICE, Eutectic Plates and Pouches enables us to develop and apply both organic and hydrated salt based PCMs for a variety of applications around the world.

We have many licencees using our PlusICE product range, either as raw material or manufactured product. Some of the applications are initiated by our organisation, but the majority of non-standard applications come from the minds of the end-user or developer.

Our technical team prides itself on taking customer ideas from concept to completion.



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