# PHASE CHANGE MATERIAL APPLICATIONS pdf

## 1: Phase-change material - Wikipedia

*Teappcm, is the pioneer manufacturer supplier of Phase Change Materials for Air condition and heating, Electronic cooling etc and various Related Chemicals in India USA etc.*

Frequently asked questions about phase change materials Jun What are phase change materials? Phase change materials PCM are substances that absorb and release thermal energy during the process of melting and freezing. When a PCM freezes, it releases a large amount of energy in the form of latent heat at a relatively constant temperature. Conversely, when such material melts, it absorbs a large amount of heat from the environment. PCMs recharge as ambient temperatures fluctuate, making them ideal for a variety of everyday applications that require temperature control. They typically store 5 to 14 times more heat per unit volume than materials such as water, masonry or rock. Among various heat storage options, PCMs are particularly attractive because they offer high-density energy storage and store heat within a narrow temperature range. What is latent heat? There are two kinds of heat energy: Most common heat storage systems, such as a conventional water heater, use sensible heat, the energy needed to alter the temperature of a substance with no phase change. Latent heat, which can be times that of sensible heat, is the amount of energy required to change matter from one state to another, liquid to solid or vice versa. Sensible heat and latent heat work together in thermal storage materials like PureTemp. This results in the ability to maintain specific temperatures for extended periods of time. What are some examples of latent heat? Ice cubes, using their latent heat capacity, absorb large amounts of heat energy from a drink. When all the ice has melted, the cubes have essentially absorbed all their latent energy capacity and then the drink warms to room temperature. Conversely, when hot wax is dripped on skin, a burning sensation is caused by the wax releasing all its internal latent heat energy. Refrigerators and freezers that use less energy. High-performance textiles that provide relief from hot and cold conditions. Shipping containers that maintain goods at the desired temperature for longer periods. Construction material that keeps living spaces comfortable and reduces heating and cooling costs. What types of PCMs are in use? PCMs fall into four main categories: These low-cost devices have several advantages. They perform well and are nontoxic, non-flammable, environmentally friendly and easy to use. Salt hydrates consist of inorganic salts and water. The advantages of salt hydrates are low material costs, high latent heat storage capacity, precise melting point, high thermal conductivity and inflammability. Poor nucleating properties make them vulnerable to supercooling, the phenomenon in which a substance cools below its freezing point without solidifying. That can be beneficial in some applications, but for most uses nucleating agents must be added to address this problem. Special packaging must be used to accommodate the changing volume. Some salt hydrates fail to completely recrystallize following each cycle. Eventually, they lose all latent heat capacity. Some salt hydrates are toxic and many are corrosive to metals, presenting safety and disposal issues. Paraffins, typically, are derived from petroleum and have a waxy consistency at room temperature. They have good thermal storage capacity and are proven to freeze without supercooling. They also have the advantage of chemical stability over many heating and freezing cycles. They are non-corrosive and are compatible with most encapsulation materials. But they have a limited range of melting points and their cost is linked to unstable petroleum prices. And, like all fossil fuels, petroleum has significant environmental costs. Many paraffins are hazardous to health and the environment. Some can injure skin, eyes and mucous membranes. Some have narcotic effects if inhaled. Hexadecane, a petroleum alternative to PureTemp 18 , is one example. Biobased PCMs are organic compounds derived from animal fat and plant oils. The most common biobased PCMs are derived from fatty acids and have higher efficiency than salt hydrates and petroleum-based phase change material. The other advantages of biobased phase change material: They experience minimal volume change between phases. They can last for decades. They have high latent heat. What factors determine the quality of a PCM? Latent heat â€" Latent heat is measured in joules per gram. A high latent heat of fusion means that a lesser amount of material is needed to store a given amount of energy. Sharpness of latent heat release and absorption â€" To a first approximation, the release and absorption of latent heat over a narrow temperature range is an important performance criterion. However, for some applications, broad heat release rates of up to 10C or even 30C will not adversely affect performance in a properly engineered consumer device. Stability to cycling and aging â€" Over the course of hundreds or thousands of freezes and melts, the phase change transition temperature and latent heat energies should remain consistent. Changes in the hydration sphere of some PCM molecules over time can affect the melt and freeze points and their respective latent heats. This is the primary reason that one of the most used stability tests for PCMs is the thermal cycle test that involves multiple melt and freeze cycles. Non-corrosive to encapsulation â€" Encapsulation of the PCMs involves a PCM core and an outer shell to prevent leakage, degradation and contamination. Careful consideration must be given to the compatibility of the individual PCM with the plastic or metal chosen for the application. Plastic tends to be the least expensive container for PCM chemicals. However, containers with thick plastic walls suffer from low thermal conductivity. Various metals can be used for PCM encapsulation to increase thermal conductivity. However, metals tend to be more costly and can corrode with some PCMs. Cost effective â€" The useful heat in joules per gram of phase change material is a primary performance criterion for PCM chemicals. On a cost basis, a minimum in dollars per joule of useful heat is desired. Safe to use â€" The PCM should be nontoxic, nonflammable and environmentally friendly. Often the temperature desired is within 1 or 2 degrees. End of life cycle - At the end of the life of a PCM application the PCM should be able to be land-filled and degrade naturally within months. What is a thermal cycle test? In a thermal cycle test, a PCM is frozen and melted multiple times. Most PCMs today are chemical formulations derived from petroleum products, salts or water. Such PCMs are limited in temperature range options, containment methods and thermal cycles. PureTemp PCMs with comparable latent heats have been proven to be superior by those measures and more, including stability, flammability, toxicity and sustainable performance. Each production lot undergoes more than 10 separate quantitative and qualitative tests, including DSC , to guarantee quality. PureTemp phase change materials have earned the U. The label verifies that the amount of renewable biobased material in the product meets or exceeds levels set by the USDA. PureTemp has also been awarded the Federal Procurement Preference, meaning that the PureTemp product line is now preferred by federal agencies and their contractors when making purchasing decisions. The instrument used is called a differential scanning calorimeter. This allows for accurate melting point and latent heat values to be obtained. They are nontoxic and biodegradable. Properly contained, these fully hydrogenated compounds will not oxidize or become rancid. Fully hydrogenated fats and oils can be stable for decades because they do not have chemical sites for oxidation to occur. About 30 formulations, ranging from PureTemp to PureTemp 68, are in production mode. Here are some commonly ordered formulations and their attributes:

## 2: Application of Phase Change Materials - Textile Centre

*Phase Change Materials (PCMs) can help regulate the internal temperature of a room by their ability to absorb or release large amounts of heat energy when changing between solid and liquid states (or phases).*

Often, heating and cooling systems are installed to maintain temperatures within the comfort zone. Thermal energy storage through PCM is capable of storing and releasing large amounts of energy. The system depends on the shift in phase of the material for holding and releasing the energy. For instance, processes such as melting, solidifying or evaporation require energy. Heat is absorbed or released when the material changes from solid to liquid and vice versa. As Figure 1 illustrates, PCM depends on latent heat storage. Compared to the storage of sensible heat, there is no temperature change in the storage. In a sense every material is a phase change material, because at certain combinations of pressure and temperature every material can change its aggregate state solid, liquid, gaseous. In a change of aggregate state, a large amount of energy, the so-called latent heat can be stored or released at an almost constant temperature. Thus a small difference in temperature can be used for storing energy and releasing the stored energy. Principle of Phase Change Materials. Today, classic cooling systems are used for room cooling, and these ensure that the rooms are cooled to a comfortable temperature in all environment climates. These systems are effective, however they would be a lot more energy-efficient if they used the natural temperature differences between day and night for cooling purposes. The use of the building mass as a storage medium is well known. This concept of night-time cooling has already been successfully implemented in many construction projects. The objective of PCM is illustrated in Figure 2. As can be seen, PCM limits excessive temperatures by storing the excess heat during the day, and releasing it during the night. This mimcs the effect of thermal mass, which also stores heat during the day and releases it during the night. Phase-change materials PCMs allow large amounts of energy to be stored in relatively small volumes, resulting in some of the lowest storage media costs of any storage concepts. The functioning of PCM. As mentioned, essentially all materials are phase change materials. However, the characteristics required for effective and predictable thermal energy storage excludes a large number of materials. In Figure 3, several PCMs are illustrated with their corresponding temperature ranges and enthalpy energy storage characteristics. The Figure also illustrates the temperature band which represents a typical temperature comfort zone in households. It shows that parrafin and salt hydrates are useful PCMs for households. Salts and sugar alcohols are used for higher temperature ranges. An example of a high temperature energy storage use is in a Concentrated Solar Power CSP plant, which uses salt to store energy for later use. This alleviates part of the intermittency problem of solar power. Temperature ranges and corresponding enthalpy of fusion of several PCMs. Feasibility of technology and operational necessities top: First, the PCMs can be used to utilize natural heat and cold sources. Second, PCMs can use manmade heat or cold sources. In addition, different ways of using PCMs are available. In buildings, these again fall into two groups. PCMs can be located in building components such as walls or ceilings, or can be arranged in separate heat or cold stores. The heat or cold is stored automatically and released when indoor or outdoor temperatures rise or fall beyond the phase change point of the material. Using PCMs in seperate heat or cold stores are usually based on active systems. The commonly used phase change materials for technical applications are: Additionally,ice storage can be used for cooling applications. The differentiation between organic and inorganic is especially important for building based PCM use. Many other differentiations and catgeorizations exist, which are illustrated in Figure 4. Inorganic PCMs are salt hydrates. The advantages of these materials are: Some of these disadvantages are corrosiveness, instability, improper re-solidification, and a tendency to supercool. The high storage density of salt hydrate materials is difficult to maintain and usually decreases with cycling. This is because most hydrated salts melt congruently with the formation of the lower hydrated salt, making the process irreversible and leading to the continuous decline in their storage efficiency. Segregation can be prevented changing the properties of the salt hydrate with the addition of another material that can hinder the heavier phases to sink to the bottom []. This can be achieved either with gelling or with thickening materials. Gelling means adding a cross-linked material e. Thickening means the addition of a material to the salt hydrate that increases the viscosity and hereby holds the salt hydrate together [6]. Subcooling is another serious problem associated with all hydrated salts. It appears when a salt hydrate starts to solidify at a temperature below its congelating temperature Fig. Several approximations have been studied to solve this problem. One is the use of hydrated salts in direct contact heat transfer between an immiscible heat transfer fluid and the hydrated salt solution [4]. Another solution is the use of nucleators [6,]. Organic PCMs Organic PCMs have a number of characteristics which render them useful for latent heat storage in certain building elements. They are more chemically stable than inorganic substances, they melt congruently and supercooling does not pose as a significant problem. Moreover, they have been found to be compatible with and suitable for absorption into various building materials. Although the initial cost of organic PCMs is higher than that of the inorganic type, the installed cost is competitive. However, these organic materials do have their quota of unsuitable properties. Of the most significant of these characteristics, they are flammable and they may generate harmful fumes on combustion. Other problems, which can arise in a minority of cases, are a reaction with the products of hydration in concrete, thermal oxidative ageing, odour and an appreciable volume change. Appropriate selection and modification have now eliminated many of these undesirable characteristics. A comparison between organic and inorganic materials for heat storage is shown in Table 1. Comparison of organic and inorganic PCM for heat storage.

## 3: Phase change material applications | Phase Energy Ltd

*A phase change material (PCM) is 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.*

Kazi Zakaria Ahmed M. PCM possesses the ability to change their state with a certain temperature range. These materials absorb energy during the heating process as phase change takes place and release energy to the environment in the phase change range during a reverse cooling process. Insulation effect reached by the PCM depends on temperature and time. Recently, the incorporation of PCM in textiles by coating or encapsulation to make thermo-regulated smart textiles has grown interest to the researcher. Therefore, an attempt has been taken to review the working principle of PCM and their applications for smart temperature regulated textiles. Phase Change Materials, Microencapsulation, Clothing Comfort, Thermal Change Introduction Protection from extreme environment has always been a critical requirement of textile industries. Clothing that protects from water, extreme winter intensive heat, open fire, high voltage, propelled bullets, toxic chemicals, nuclear radiations and biological toxins, etc. These clothing finds application as a sportswear, firefighting wear, defense wear, bullet proof jackets and other professional wear. Textile products can be made more comfortable when the properties of textile material adapt to the environment. One of such important intelligent material at the present is Phase Change Material PCM , which absorb, stores or release heat according to the change of temperature during Phase Change Process are most frequently used in the manufacturing of smart textiles. For thermal energy storage there are four alternatives viz. Material has four state viz. When a material converts from one state to another, this process is called phase change. There are four kinds of phase change, such as a solid to liquid b liquid to gas c solid to gas and d solid to solid. Heat is absorbed or release during the phase change process. This absorbed or released heat content is called latent heat. PCM which can convert from solid to liquid or from liquid to solid state is the most frequently used latent heat storage material, and suitable for the manufacturing of heat-storage and thermo-regulated textiles and clothing. Modes of heat transfer are strongly depending on the phase of the substances involve in the heat transfer processes. For substances that are solid, conduction is the pre dominate mode of heat transfer. For liquids, convection heat transfer predominates, and for vapors convection and radiation are the primary mode of heat transfer. For textile applications, we will only consider the phase change from solid to liquid and vice versa. Therefore, the principle of solid to liquid phase change and vice versa would be discussed. When the melting temperature of a PCM is reached during heating process, the phase change from the solid to the liquid occurs. During this phase change, the PCM absorbs large quantities of latent heat from the surrounding area. PCM may repeatedly converted between solid and liquid phases to utilize their latent heat of fusion to absorb, store and release heat or cold during such phase conversions. Phase change materials as such are not new. They already exist in various forms in nature. In order to compare the amount of heat absorbed by a PCM during the actual phase change with the amount of heat absorbed in an ordinary heating process; water can be used for comparisons. Conclusions Textiles containing PCMs are considered smart because they react to changes in environmental temperature absorbing and releasing latent heat and provide a thermo-regulating effect. Due to the thermal properties of PCMs, such textiles have become important for use in many applications such as: Weder, Scale of change, Textile Month October 37â€” Nelson, Microencapsulation in textile finishing, Review of Progress in Coloration 31 57â€” Setterwall, Technical grade paraffin waxes as phase change materials for cool thermal storage and cool storage systems capital cost estimation, Energy Conversion and Management 43 13 â€” Bajaj, thermally sensitive materials, in:

## 4: More Applications - Croda Phase Change Materials

*Phase change materials (PCM) General. PCM can be used to store energy or to control the temperature swings within a specific range. Therefore, applications for heating and cooling in buildings are expected to have great potential for PCM use.*

PCMs in Thermal Packaging Phase Change Materials PCMs are employed in various types of thermally regulated packaging as a means of protecting the payload against damaging temperature changes during transit. PCMs are an appropriate solution for the shipping of thermally sensitive or perishable payloads such as pharmaceuticals, biologics, blood, organs, vaccines, food etc. PCMs improve over a basic insulation approach by passively maintaining the payload space within a controlled temperature range influenced by the properties of the PCM. However, it is often necessary to insulate the payload from the ice pack to prevent damage by freezing and therefore alternative PCMs selected to operate at a suitable temperature are often preferred. PCMs are available at operating temperatures to meet the needs of the various shipping applications requiring stable temperatures even under extreme ambient conditions. The phase change temperature dictates the controlled temperature range of the payload space and the PCM quantity and latent heat capacity determines the duration of protection depending also on other factors such as ambient temperatures, insulation levels etc. High performance PCMs deliver precise temperature transitions with high heat capacity. The best organic PCMs that are crystalline waxes in their solid state provide reliable and repeatable thermal performance with precise thermal transitions. These may be simple hydrocarbons n-alkane type or may be bio-based PCMs of, for example, vegetable origin and therefore renewable. Alternatively, packs of high quality salt hydrate PCMs can be suitable for certain packaging applications. PCMs can be supplied in a diverse range of containers suitable for most shipping requirements such as pouches, rigid containers, mouldable bags, blankets etc. PCM packs in their various formats can be reused for multiple shipments and in this way represent a very cost-effective thermal management solution. Textiles Phase change materials in spacesuits for US astronauts were developed by NASA in the s to protect against the wide variations in temperature that can occur in space. PCMs provided a thermal buffer which helped stabilize the temperature within the spacesuit. A suitable transition temperature for a comfortable microclimate can be provided by organic PCMs , for example, n-alkane paraffin PCMs with particular chain lengths and thermal properties. Many textile applications require the PCM to be microencapsulated to enable it to be incorporated satisfactorily within the textile fibre, fabric coating or foam. Particle-size suitable for the application e. Hence, the dope used to prepare the fibres must be compatible with aqueous mPCM slurries. So far this has led to the development of both acrylic and viscose mPCM-containing fibres. As many of the textile coatings are hydrophobic, or have low moisture vapour transfer properties, the coatings can be applied as a discontinuous layer i. This permits the transport of moisture through the uncoated fabric e. Not all textile applications require the use of microencapsulated PCMs. Several companies have investigated the use of macroencapsulating the PCM within e. This is of particular use when the fibre forming process is carried out at temperatures and pressures which may be too high for mPCMs to withstand. As well as PCM fibres and fabric coatings, PCMs are also applied to foams such as polyurethane or latex foams that can be used in mattresses or furniture upholstery. Compression of the foam by the body facilitates heat transfer, accessing the PCMs temperature-specific heat capacity, providing the sensation of thermal comfort or coolness. Again, the use of microencapsulated PCMs is one of the common ways of producing suitable thermo-regulating foams. This is a developing market and there are already several suppliers of thermo-regulating foams and mattresses containing PCM. PCMs in Buildings Phase Change Materials PCMs can help regulate the internal temperature of a room by their ability to absorb or release large amounts of heat energy when changing between solid and liquid states or phases. For example, a PCM operating at 20 â€” 24oC will work to buffer the interior climate towards this temperature, helping to maintain cool and comfortable conditions and avoid overheating; hence eliminating or reducing the need for conventional mechanical cooling. Alternatively, systems comprising PCM heat batteries can store renewable thermal energy at a particular temperature depending on the application, which can be accessed on demand for heating or cooling. PCMs can also store renewable heat efficiently in the temperature range required to provide hot water for buildings. There are generally three approaches for using PCMs in buildings:

## 5: Phase-Change Switch Project

*Phase Change Materials for Building Cooling Applications ET11SCE/HTSCE Southern California Edison Page ii Design & Engineering Services December*

PCM HXs store energy by thawing a phase change material i. Sending the collected data to the ground team for processing and assessing how the PCM HX is performing in a micro-gravity environment. This change-out will be capable of being performed by the on-orbit crew. Advancing the technology readiness level of phase change heat exchangers for use on future exploration missions. Assessing the performance of phase change heat exchangers in a micro-gravity environment. The ability to test numerous phase change heat exchangers capable of being installed by the on-orbit crew. Phase change material heat exchangers are a useful technology that helps certain space missions in regulating the thermal conditions on their particular spacecraft. It does so by storing waste energy by melting a phase change material during peak loads. It can then reject this energy through a radiator when conditions allow, causing the phase change material to freeze. Wax phase change material heat exchangers were used on the Apollo lunar rover and Skylab with inconsistent results. Water based phase change material heat exchangers offer considerable mass savings due to its superior energy storage over baseline wax heat exchanger, but it is unknown how they function in a microgravity environment. Both wax and water phase change material heat exchangers need to be tested in a microgravity environment to better understand their performance in space. It is used to test interchangeable phase change material heat exchangers in a microgravity environment, thereby providing stakeholders like Orion with flight-proven phase change material heat exchanger options. The components within the double locker include a pump, instrumentation, valves, heater, and cold plates, and a thermoelectric heat exchanger. These components are used to condition coolant to allow freezing and thawing of phase change material heat exchangers. Applications Space Applications Wax-based phase-change heat exchangers have been used in space before, including on the Apollo lunar rover and the former Skylab space station, but with inconsistent results. A water-based phase-change heat exchanger has significantly better energy storage than wax, but it has not yet been tested in space. This investigation tests these heat exchangers in a microgravity environment, providing data needed to use phase-change heat exchangers on future space missions. Earth Applications Phase-change heat exchangers are a low-energy means to control temperatures in chemical plants, power plants and other settings. By using materials that change phase from liquid to vapor depending on the temperature, facilities like power plants and factories can more easily move heat into areas that must be warmed by removing heat from areas that must be cooled. While this investigation is geared to space-based use, results improve basic research on phase-change heat exchangers. For Initial Installation, crew installs the double locker into the Express Rack and makes 4 bolt connections to secure the locker into the rack. Tightening these bolts with a torque wrench is required. The crew then activate the experiment via a circuit breaker on the front panel-an LED light on the front panel indicates "good health. The crew loosens 2 captive bolts on the top drawer to allow it to slide out. The crew installs the new top drawer and tightens 2 captive bolts. These bolts need to be torqued with a torque wrench. The crew activates the payload via the circuit breaker on the front panel.

## 6: Phase-Change Material (PCM) - C-Therm - Thermal Conductivity Instruments

*Phase Change Materials: Science and Applications provides a comprehensive overview of the properties that characterize phase change materials from theoretical and experimental perspectives, with a focus on emerging technological applications.*

This phenomenon may be used to moderate daytime temperature variations in a housing environment, to help mitigate the urban heat island effect, to ensure thermal comfort in bedding , cool electronics and for a variety of other applications. Unfortunately, many materials which would otherwise make very attractive PCMs, such as paraffin and natural oils e. C-Therm TCi Thermal Conductivity Analyzer The C-Therm TCi Thermal Conductivity Analyzer provides the optimal solution for measuring Phase-Change Materials as it is the only commercial instrument that offers the versatility to test the thermal conductivity of solids, liquids, powders, pastes, and textiles. Coconut oil and n-hexadecane were the base PCMs, and exfoliated graphite nanoplatelets xGNP were used the characterize the thermal conductivity. Data obtained using the MTPS sensor Figure 3 showed that the composition of the final mixed SSPCM had a substantial effect on the thermal conductivity with more coconut oil being related to a higher thermal conductivity but also that the mixed SSPCM had a much higher thermal conductivity than either pure coconut oil 0. The researchers noted that there seemed to be a trade-off between economics and heat capacity, with fatty acid esters being more economical but having a lower heat capacity than paraffin based materials. Measuring Thermal Effusivity Case Highlight 2: PCMs can be organic, inorganic, eutectics, and hydroscopics where the phase change is not a change of fusion but rather of absorption and desorption of water vapor. PCMs with higher thermal effusivity can absorb or release more thermal energy, faster. Thermal effusivity is governed by the following equation: Thermal inertia effusivity of gypsum board with an embedded paraffin-based PCM. Their results are seen above in Figure 1. However, this approach may be difficult, as it is often hard to obtain accurate density and thermal conductivity data during a phase transition â€" which can introduce error to the process and is time-consuming as it requires collection of thermal expansion and thermal conductivity data as well as DSC data. Researchers are increasingly benefitting from the ability to directly measure the thermal effusivity instead of calculating it â€" and thus reduce the error introduced by assumptions of constant density or thermal conductivity. A sample of paraffin wax, a commonly used base for many organic phase-change materials, was obtained and its thermal effusivity was monitored as a function of temperature on cooling through the phase change. The resulting data is plotted below in Figure 2: Measured thermal effusivity of paraffin as a function of temperature. At the highest point, the measured thermal effusivity is 1. The performance of paraffin in this metric is best illustrated by comparison to the results obtained by the Korean group, whose shape-stabilized PCM exhibited a thermal effusivity at its peak of  As expected from the well-known thermal performance issues of pure paraffin in phase-change applications, this suggests that paraffin has difficulty exchanging heat with its surroundings, which limits its utility as a PCM. A C-Therm representative will be happy to discuss your application and to recommend a solution.

## 7: Automotive - PCM - Phase Change Material

*For more information on how the C-Therm TCi can be applied to testing of phase-change materials, our technical library has a collection of papers on PCMs, and we also frequently highlight PCM applications on our blog or in our webinars.*

Until very recently, pcms were not reliable enough to be used in air condition. We have developed pcm with almost infinite life and good performance in the human comfort range of 18C 64F to 29C 84F and further for electronic comfort at higher temperature. Telecom shelters are insulated, air-conditioned enclosures that house the heart of mobile communication, the Base Transceiver Station BTS. BTS, and also the battery, is very temperature sensitive and its surroundings should always be maintained below 35 deg C. In under-developed countries, there are frequent power cuts and single phasing, forcing cellular service providers to install Diesel Generators to support the air-conditioner in case of power cuts or single phasing. PCM will get re-charged when power source is available. Thus, PCM store energy using a cheap source of power and release it when that cheap source of power is not available, thus saving on Diesel Cost. Telecom Shelters PCM 3. Transportation of perishable foods, temperature sensitive pharmaceuticals, sundry electronics like ignition transformers and chemicals explosives require refrigerated trucks. Such refrigerated trucks are prohibitively expensive to operate as they use Diesel as a source of energy. Cost of diesel-generated energy is 6 times higher as compared to conventional electricity cost. Thus, Phase Change Material store energy using a cheap source of power and release it when that cheap source of power is not available. The principle is quite simple, the storage material is connected to the radiator and stores excess heat when the motor runs at operating temperature. This heat is then available at the next cold start to heat up the motor quickly better gas mileage and for the interior driving comfort. As an extension to this application, PCM can also be used in tail-pipes exhaust of vehicles. This will maintain the catalytic converter at its design temperature, reducing excessive Hydro-carbon emissions during vehicle start up. House heating, warm water: Solar energy is not available at all times, and therefore solar installations require an intermediary storage of the energy for heating or warm water. PCM based system will offer the following benefits over a conventional system: Low volume in comparison to water storage systems and a higher efficiency due to a lower temperature difference between loading and discharging of the energy. Latent heat storage can also be implemented in conventional heating systems. Phase Change Material based solar water heater will also give a better controlled water temperature. The atmosphere in a room is found comfortable if it varies little in the course of the day. For this reason, homes with very thick walls are found especially comfortable: To achieve this comfort in less massive constructions, one can implement materials containing PCM and thus demonstrating the same properties as thick walls. By absorbing heat at the peaks e. The transportation of warm meals requires a heat source; otherwise it will not meet the quality standards set by the consumers. An electric heating source cannot always be implemented, in such cases Phase Change Material offer an ideal, self-regulating heating element. The melting point of the PCM depends upon the temperature at which the food should be kept. Electronic circuitry is extremely sensitive to over-heating, negatively influencing both lifetime and reliability of the parts. To date, metal fins are used for heat sinking improving their cooling capacity with additional fans. The sinking of heat peaks using PCM is absolutely reliable since no motor or temperature measurements are required. The PCM regenerates itself between peaks by emitting the heat with cooling fins. The advantage is a smaller cooling system with a very high reliability. It is important to maintain temperatures in a small range to enable plants cultivated in a green house to flourish. In the chemical industry, there are applications where refrigeration and heating are required in the same batch.

## 8: Phase Change Material (PCM) Selection | PCM Technology

*The most common application is for very large thermal storage applications (e.g., solar heating), where much lower cost is very attractive. Other PCM materials such as non-paraffin organics, and liquid-to-gas phase change materials are available, but are not often used for electronics heat sinks.*

## 9: Frequently asked questions about phase change materials

*Phase Change Energy Solutions is a global leader in the development and deployment of innovative energy-efficiency and thermal storage solutions that harness the power of phase change materials.*

# PHASE CHANGE MATERIAL APPLICATIONS pdf

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