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UTILIZATION OF PHASE CHANGE MATERIAL IN BUILDING CONSTRUCTION

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Abstract

One of the important issue's today's scientific worlds is in the topic of sustainable development and sustainable architecture which is followed. The building sector accounts more thermal energy,It is necessary to reduce the amount of energy in Buildings which causes toward sustainable development which consistent with the needs of today's generation which put future generation . This paper gives the review over the such kinds of materials from which thermal energy stored such materials now a days recognized as a PHASE CHANGE MATERIALS.PCM plays an important role as a thermal energy storage device by utilizing its high storage density and also latent heat property. One of the potential applications for Phase change material is in buildings by incorporating,in the building envelope for energy conservation.During the summer season, the advantages are a decrease in overall energy consumption by the air conditioning unit and a time shift in peak load during the day. The integration of a Phase change material layer into an external building wall diminished the amplitude of the instantaneous heat flux through the wall. The effects of a layer of PCM mounted on the internal vertical and horizontal opaque walls are investigate.So in these paper three-dimensional transient heat transfer model has been developed and solved numerically using the commercial Thermal analysis package.

Keywords: *phase change material, wallboard, energy storage, experimental investigation, temperature fluctuation.*

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1. INTRODUCTION

Energy storage is a key issue to be addressed to allow intermittent energy sources, typically renewable sources, to match energy supply with demand.latent heat is the amount of heat released or stored by a substance during a change of state that occurs without much change in temperature. Latent heat storage can occur as solid-liquid phase change, liquid-vapor phase change, and solid-solid phase change. For solid-liquid phase change material, the latent heat stored is equal to the enthalpy difference between the solid and the liquid phase. There are numerous storage technologies that are capable of storing energy in various forms including kinetic energy, chemical solutions, magnetic fields, or other novel approaches. Phase-change material (PCM) is a substance with a high heat of fusion which, on melting and solidifying at a certain temperature, is capable of storing and releasing large amounts of energy. PCMs are regarded as a possible solution for reducing the energy consumption of buildings. For raising the building inertia and stabilizing the indoor climate, PCMs are more useful because of its nature of storing and releasing heat within a certain temperature range. Experimental work was carried out by Arizona Public Service (APS) in collaboration with Phase Change Energy Solutions (PCES) Inc. with a new class of organic-based PCM. PCM has non-flammable properties and can be safely used in buildings. The experimental setup showed maximum energy savings of about 30%, a maximum peak load shift of ~ 60 min, and maximum cost savings of about 30%.

2. METHOD AND MATERIAL

CLASSIFICATION OF PHASE CHANGE MATERIALS.

PCM are classified in two types are:these are Organic PCMs e.g. Paraffin Wax and Inorganic PCMs

It is the efforts in the development of latent TES materials used in inorganic PCMs.So in these materials are salt hydrates, including Glauber’s salt (sodium sulphate decahydrate), which was studied extensively in the early stages of research into Phase change materials

The phase change properties of inorganic PCMs are below the table and the most promising selection of organic PCMs

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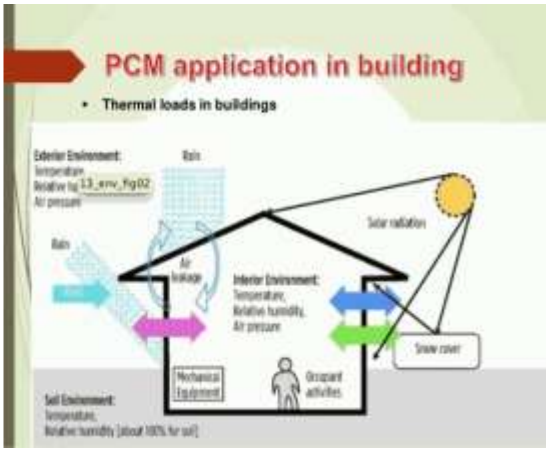

Fig.1

CLASSIFICATION OF PCM

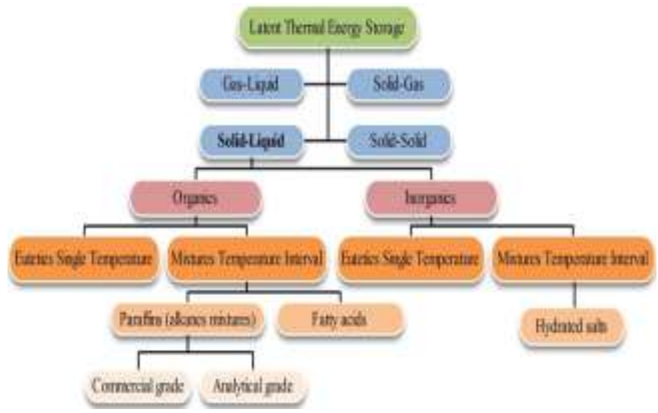

Fig. 2

Table.1- In Inorganic PCMs

PCM Name	**Melting Temperature [ºC]**	**Heat of Fusion [kJ/kg]**	**Thermal conductivity [W/mK]**	**Density [kg/m3]**
KF·4H2O Potassium fluoride tetrahydrate	18.5	231	n.a.	1447 (liquid,20 ºC) 1455 (solid, 18ºC)
Mn(NO3)2·6 H2O Manganese nitrate hexahydrate	25.8	125.9	n.a.	1738 (liquid,20 ºC) 1728 (liquid, 40ºC) 1795 (solid, 5ºC)
CaCl2·6H2O Calcium chloride hexahydrate	29.0	190.8	0.540 (liquid, 38.7ºC) 1.088 (solid, 23ºC)	1562 (liquid, 32ºC) 1802 (solid, 24ºC) 1710 (solid, 25ºC)
CaBr2·6H2O Calcium bromide hexahydrate	34	115.5	n.a.	1956 (liquid, 35ºC) 2194 (solid, 24ºC)
Na2SO4·10H 2O	32.4	254	0.544	1485 (solid)
Na2CO3·10H 2O Sodium carbonate Decahydrate	34.2	246.5	n.a.	1442
Na2HPO4·12 H2O Sodium orthophosphat e dodecahydrate	35.5	265	n.a.	1522
Zn(NO3)2·6H 2O Zinc nitrate hexahydrate	36.2	146.9	0.464 (liquid, 39.9ºC) 0.469 (liquid, 61.2ºC)	1828 (liquid, 36ºC) 1937 (solid, 24ºC) 2065 (solid, 14ºC)

Table.2-Organic PCMs (typical values)

PCM Name		**Melting Temp. [ºC]**	**Heat of Fusion [kJ/kg]**
CH3(CH2)16COO(CH2)3CH3	Butyl stearate	19	140
CH3(CH2)11OH	l-dodecanol	26	200
CH3(CH2)12OH	l-tetradecanol	38	205
CH3(CH2)n(CH3…	Paraffin	20-60	200
45%CH3(CH2)8COOH 55%CH3(CH2)10COOH	45/55 capric-lauric acid	21	143
CH3(CH2)12COOC3H7	Propyl palminate	19	186

3. PCM PROPERTIES

Inorganic phase change material have some attractive properties are including: high latent heat values; higher thermal conductivity; not flammable; lower in cost in comparison to organic compounds; high water content means that they are inexpensive and readily available.Tthey require containment, they have been deemed unsuitable for impregnation into porous building materials [7].

Nucleating and thickening agents can be added to the Inorganic PCM to minimize super cooling and decomposition. Unlike conventional sensible thermal storage methods, PCMs provide much higher energy storage densities and the heat is stored and released at an most of the constant temperature. PCMs can be used for both active and passive space heating and cooling systems [6].

They are more chemically stable than inorganic substances, they are non-corrosive, they have a high latent heat per unit weight,So this are recyclable, they melt congruently and they exhibit little or no super cooling i.e. they should not need to be cooled below their freezing point to initiate crystallization.

Table.3-Advantages and disadvantages of PCM

	Organic (Paraffins)	Inorganic (Salt Hydrates)
Advantages	-non-corrosive; -chemically and thermally stable; -no or little sub-cooling.	-high melting enthalpy; -high density.
Disadvantages	-lower melting enthalpy; -lower density; -low thermal conductivity; -flammable.	-sub-cooling; -corrosive; -phase separation; -phase segregation, lack of thermal stability; -cycling stability.

4. APPLICATION OF PCM

1. Air Condition

Until very recently, pcms should not reliable enough to be used in air condition. So we have developed pcm with almost infinite life and also good performance is in the human comfort range of 18C (64F) to 29C (84F) and further for electronic comfort at higher temperature.

2. House Heating, Warm Water:

Solar energy is not available at all times, therefore solar installations require in an intermediary storage of the energy for heating or warm water. PCM based on the system will be offer in the following benefits over a conventional system: Low volume in the comparison to water storage systems and a higher efficiency due to lower temperature difference between the loading and discharging of the energy. Latent heat storage can also be implemented in conventional heating systems. PCM based on the solar water heater will also give a better controlled water temperature.

3. Construction Material:

The atmosphere in a room is found to be comfortable if it varies little in the course of the day. For this reason, homes with very walls are found to be especially comfortable: cool in the summer and warm in the winter. To achieve this comfort in less massive constructions are, one of the implement materials containing PCM and second is demonstrating the same properties as thick walls. By absorbing heat at the peaks (e.g. during sunshine) and delayed release in the night, in most of the cases one can even do without air conditioning.

4. Green Houses:

It is important to maintain temperature is in the small range to enable plants cultivated in a green house to flourish. However, due to large temperature swings in daytime and nighttime temperatures, most of the green houses need air-conditioning and/or heating. PCM installed in floor of such green houses will be the eliminate or reduce in the dependence on air-conditioning/heating.

5. Temperature Peak Stabilization:

In the chemical industry, there are applications where refrigeration and heating are required in the same batch. In such cases, use of phase change material will reduce utility costs, as PCM will store energy from the chemical reaction for use at a later stage in the same batch.

5. CONCLUSION

This paper concentrates on the thermal analysis of walls with and without phase change material. So in this ANSYS analysis of the two wall configurations has been carried out. So this simulation results showed that the PCM introduced in the rectangular holes can improve considerably the thermal inertia of the building, which is very important for improving for the heat penetration into the indoor space. Aoptimized PMT of about 25°C was evaluated. The best of the solution, in terms of the energy needs, is PCM mounted into the internal vertical partitions. As regards the cooling season, an energy need reduction between 18% and 58% concerning Cosenza and between 30% and 80% for Milan related to a PCM thickness range from 5 to 15 cm was achieved. Instead, concerning the heating season there are fewer benefits, showing a reduction of about 20% in Cosenza and 9.2% in Milan related to the maximum PCM thickness of 15 cm. Furthermore, it is important to notice that the winter energy savings in Cosenza are greater than in Milan for all cases, whereas the opposite situation occurs in the summer.

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