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Thermal analysis of PCM based building wall for cooling

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Abstract
The application of phase change materials (PCM) as energy storage materials in buildings has gathered momentum over recent years. One potential concept being pursued for minimizing cooling and heating loads is the integrated PCM wallboard system. Room is constructed by attaching PCM wallboardsPCM wall board consist of Gypsum wall board is packed by means of phase change materials fatty acid such as coconut oil. This study evaluates the concept of laminated-PCMs as integral part of wallboard system in building fabric. The integrating PCM promotes rapid transfer of latent heat, sharp response to indoor temperature and minimizes multidimensional mode of heat transfer. It also facilitates production and recycling methods of wallboards. The investigation into the thermal performance of the laminated wallboard system was done numerically and experimentally. Through series of heat transfer simulations and under different sets of properties and conditions, the surface temperature variations were obtained. The temperature variations were then used to calculate the heat flux and the total amount of heat transferred in and out of the wallboard.

Index Terms—**Phase Change Material, Wall board, Heat transfer, Brick wall**

1. INTRODUCTION

Rapid development has lead to huge demand on energy. In an attempt to conserve energy and reduce dependency on fossil fuels and also to reduce the greenhouse gas emission, it is essential to seek effective means of reducing peaks in power consumption and to shift portions of the load from periods of maximum demand. Storage of thermal energy, hence, becomes an important aspect in engineering application, especially in energy conservation in buildings. For example, heat collected during periods of bright sunshine can be stored, preserved and later released for utilisation during the night in solar energy systems. Heat storage can also be applied in buildings where heating needs are significant and electricity rates allow heat storage to be competitive with other forms of heating. The search for suitable heat storage materials has recently been directed towards the use of low melting organic materials in an effort to avoid some of the problems inherent in inorganic phase change materials, for example super cooling and segregation. An overview of the literatures on the characterisation, application and limitations of fatty acids as phase change material (PCMs) energy storage. Large thermal storage devices have been used in the past to overcome the Shortcomings of alternative cooling sources, or to avoid high demand charges. Buildings designed to make use of thermal storage include features which increase thermal mass. These may be used for storage only, or may serve both as storage and as structural elements. Several structural materials satisfy the requirements for sensible heat storage; these include concrete, steel, adobe, stone and bricks. Latent heat storage uses a phase change material as a storage medium. This concept is particularly interesting for lightweight building construction. When developing strategies to minimise energy consumption within buildings it is crucial to understand the dynamics of energy generation and loss. This project aims to investigate some of the contributions to heat generation and loss studied through the development of a number of empirical models[4]. From these models of the heat flows within a building a thermal model may be derived allowing us to relate heat flows to the variations in temperature. The models developed will have adjustable parameters corresponding to different contributions to the heat budget and so by accurately understanding the form of temperature variation we aim to appreciate the most important factors in the energy consumption and production within the building. Latent heat storage is a developing technology that has been found to be very promising in recent times due to the several operational advantages it offers. Research is underway to develop many kinds of phase change materials (PCMs) as thermal energy storage. Fatty acids have good potential thermal characteristics PCM since they have desired thermodynamic and kinetic criteria for low temperature latent heat storage. An added advantage is that fatty acids are derived from the common vegetable and animal soil that provides an assurance of continuous supply. This article has summarised the studies that have been carried out by many other workers on fatty acid as PCM in thermal energy storage. However, in the present market situation, an investment in fatty acids as PCM storage in the building materials may not be economically justified if only energy savings were accounted for. Therefore, the effect of improved thermal comfort should also be taken into consideration. In order that more interest would be shown in the use of PCM building elements, it is obvious that more work should be done on enhancing and improving the economic viability of such an investment.

1.1PHASE-CHANGE MATERIAL

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. 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.PCM undergoing phase change freezing, melting, condensing, or boiling process. A material absorbs or releases large amounts of heat with small changes in temperature. Phase change applications typically involve liquid/solid transitions. The Phase Change Material (PCM) is solidified when cooling resources are available, and melted when cooling is needed. PCMs have two important advantages as storage media: they can offer an order-of magnitude increase in heat capacity, and for pure substances, their discharge is almost isothermal So far, only samples of PCM-treated wallboard exist. There are several approaches to treat wallboard with PCM material; however, none of these approaches has been tried in the industrial production process. The manufacturing of phase change material (PCM) imbedded in gypsum board, plaster or other wall-covering material would allow the thermal storage to become part of the building's structure [4]. This would permit the storage of high amounts of energy without changing the temperature of the room envelope. Since storage would take place inside the building where the loads occur, rather than outside, additional transport energy would not be required. Phase change materials can only store energy, but not remove it. In passive applications of structural thermal storage, the heat is being released into the room as soon as the room air temperature falls below the phase change temperature. This heat release mechanism keeps the surface temperatures of the room envelope at a high temperature level for a long time. This has certain advantages for the heat transfer mechanism during the discharge of the thermal storage. Besides the passive application, treated wallboard could be coupled with a hydronic loop. Combining continuous discharge and phase change material allows the discharge of thermal energy storage without releasing the energy back into the conditioned space.

1.2 FATTY ACIDS AS PCMS

Fatty acids are one of the organic phase change materials. They possess some superior properties over other PCMs such as melting congruency, good chemical stability, non-toxicity and suitable melting temperature range for solar passive heating applications. These materials, in their liquid phase, have a surface tension in the order of 2-3 x10^{-4} N/cm that is high enough to be retained in the structure of the host material. These materials possess elevated latent heat of transition and high specific heat (in the range 1.9-2.1 J/g °C). It also exhibits only small volume changes during melting or solidification (example: melting dilatation is around 0.1-0.2 ml/g). In addition, little or no super cooling occurs during the phase transition with these materials, which is an important advantage over many other PCMs [5].Because of the protected carboxyl group, fatty acid base PCMs are chemically, heat and colour stable, low corrosion activity and nontoxic. The raw materials of fatty acids are derived from renewable vegetable and animal sources. This assures a continuing non pollutant source of supply.

1.3 PRODUCTION OF FATTY-ACID BASED PCM

Fatty-acid based PCM can be produced in the following categories [5]:

1. Naturally occurring triglycerides.
2. Hydrates of acids of triglycerides and their mixtures.
3. Esters of the fatty acids of naturally occurring triglycerides.
4. Refined/synthesised triglyceride products produced by a combination of fractionation and Trans esterification on processes.
5. Synthesised triglyceride products using hydrogenation (or dehydrogenation) and fractionation.
6. Synthesised triglyceride products using cis-trans isomerisation and fractionation.
7. Synthesised fatty acid derivatives that have the desired freezing point temperatures.
8. Refined fatty acid hydrates that have the desired freezing point temperatures.
9. Prepared mixtures produced by essentially any of the previous processing approaches with other chemicals (preferable cheap and nontoxic) to produce eutectic compositions with the desired freezing point temperature range.

1.4 FATTY ACIDS AS PCMS IN BUILDING MATERIALS APPLICATION

The characteristics of PCMs have made them inherently suitable for use in buildings for energy conservation purposes without the complications brought about by other thermal storage devices requiring separate plant and space. Solid/liquid transitions within the pores do not cause any leaking of materials in wallboard. Concepts of wallboard with PCMs thermal energy storage have been receiving increasing attention, particularly in countries with fluctuating climate conditions several works have been carried out in order to study the thermal properties of the binary mixtures of fatty acid and its compatibility with the building materials. Gypsum wallboard to be compatible with a broad range of PCMs, including fatty acids and esters [7]. The compatibility of concrete blocks is basically dependent on the presence of calcium hydroxide ($Ca(OH)_2$) in the block, since certain organic PCMs will react with it. A mixture of 20% methyl palmitate and 80% methyl stearate provided a sharp solid-liquid phase transition at ambient temperature with a latent enthalpy similar to that of paraffin's. This mixture is one of many possible derivatives of fats and oils. Unfortunately, the highly refined methylpalmitate and methyl stearate are too costly to compete with paraffin's. The absorption capacities of PCM in the specimens and compressive strength tests show that the composite was capable of storing up to 30% wt of PCM. The composite can be produced in the form of floor, wall or ceiling tiles capable of storing energy up to 766 kJ/m^2. The mechanisms of absorption and established a means of developing and using absorption constants for PCM concrete to achieve diffusion of the desired amount of organic PCM and hence the required thermal storage capacity. The effects of temperature, PCM viscosity, concrete density and hydrogen bonding on PCM penetration was studied in order to optimise the effective use of PCM concrete. Properties of fatty acids (capric, lauric, palmitic and stearic acids) and their binary structures. The melting range of these fatty acids was observed to vary from 30 to 65°C and having the latent heat of transition vary from 153to182 kJ/kg. These properties have made these fatty acids be the potential candidates in TES applications. Specific heat of these composites materials in the temperature range –1060°C, which area. Gypsum: before impregnation, C_p= 1.8 kJ/kg °C after impregnation, C_p= 2.0 kJ/kg °C. Brick: before impregnation, C_p = 1.6 kJ/kg °C after impregnation, C_p = 1.7 kJ/kg °C. Their findings indicate that the latent heat of fusion has contributed to the overall heat storage capacity in a wallboard impregnated with the esters and their mixtures. Unlike the pure methyl stearate system, the thermal storage capacity of a gypsum wallboard impregnated with eutectic mixture of methyl stearate and methyl palmitate, as well as the value of the melting point of the eutectic, makes this combination promising for possible use in passive solar building. The eutectic mixture has shown the most sharp phase transition at the lowest temperature, 23.9°C, which has been almost an ideal value for passive solar applications. Several phase-change materials mixtures (methyl esters, methyl palmitate and methyl stearate, and mixtures of short chain acids, capric and lauric acid) to be suitable for introduction into gypsum wallboard with possible thermal storage application for the Florida climate. Although these materials had relatively high latent heat capacity, the temperature ranges required to achieve that thermal storage did not fall sufficiently within the range of comfort for buildings in hot climates the thermal dynamics of gypsum wallboards impregnated by fatty acids and paraffin waxes as PCMs that are subjected to diurnal variation of room temperature. His findings had shown that the PCM wallboard thermal storage would be sufficient enough to capture large solar heating fractions.

1.5 THERMAL PERFORMANCE

As all organic PCM will continue to burn in normal atmospheric conditions after Igniting, potentially severe fire-hazards related to PCM-treated wallboard exist. Two tested methods have shown promising results in eliminating the fire hazard for treated wallboards: limiting the amount of PCM to 20%, and sequentially treating the plasterboard with PCM, and with insoluble fire retardant only ultra-pure paraffin's melt and freeze sharply at a given temperature. Mixtures of PCM show a region of temperatures where melting takes place.

Table 1. Physical Properties of Treated Wallboard

Wallboard	*Density Kg/ m^3*	*Specific heat kJ/kg-k*	*Conductivity W/m-k*	*Latent heat kJ/kg*
Con-v	696	1.089	0.173	0
10%PCM	720	1.215	0.187	19.3
16%PCM	760	1.299	0.192	31.0
20%PCM	800	1.341	0.204	38.9
30%PCM	998	1.146	0.232	58.3

Results from experimental studies and simulation exercises showed clearly that the treated wallboard does not act like an ideal storage material, which would melt and freeze at a specific temperature. Comparison between measured data and simulation results for the dynamic behaviour of a stack of wall boards showed that the best agreement was obtained if the specific heat as a function of temperature was modelled by the typical triangular-shaped curve. Numerical Description of Phase Change Material. As the specific heat is taken as the temperature derivative of the specific enthalpy, the specific

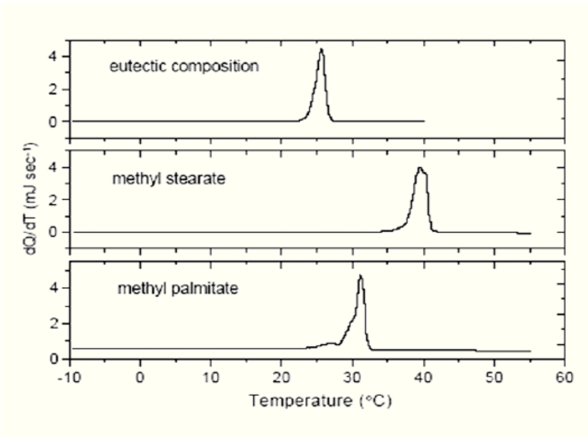

Fig.1 the endothermic DSC thermo grams

heat as a function of temperature shows a discontinuity at the melting temperature Tm.

The specific heat can be described by
$C_p(T)=dh/dt$
And enthalpy by
$h = \int C_p(T)dt$

At the melting point Tm, the specific heat shows very high positive values. The thermal diffusivity a is constant at high and low temperature levels, where we find the linear temperature regimes. While crystalline substances and eutectics show a discontinuous transition, many materials (e.g., mixtures) show continuous enthalpy curves as a function of temperature. This leads to a "mushy region" between the solid and the liquid phase. In the mushy region, the thermal diffusivity decreases, with different derivatives on both sides of the melting point.
The following description for the specific enthalpy:

$h(T) = C_{p1}T+h_1 \quad T \leq T_m$
$h(T) = C_{p1}T_m+(h_2-h_1)+ C_{p2} (T-T_m)-\eta_2 \quad T>T_m$

2. PROJECT DESCRIPTION

2.1. DEFINITION OF PROBLEM

The objective of this work is to demonstrate the possibility of using microencapsulated PCM in concrete, achieving high energy savings in buildings. The work here presented is the experimental installation of two real size concrete cubicles to study the effect of the inclusion of a phase change material with a melting point of 26ºC, and a phase change enthalpy of110 kJ/kg. The results of this study show the energy storage in the walls by encapsulated PCMs and the comparison with the standard concrete without phase change material. The cubicle with PCM showed higher thermal inertia than the reference cubicle, a given temperature is reached about 2 hours later in the cubicle with PCM than in the cubicle without PCM, for example in Summer this thermal inertia appears early in the morning due to freezing of the PCM and during the afternoon due to the melting of the PCM. Different experiments were performed in order to have a real behaviour of a building. After seeing the results with the different cases and the comparisons among them, it can be concluded that all the cases had their advantages or disadvantages according to the months or seasons.

2.2. MODIFIED SYSTEM

The proposed system room is constructed by attaching PCM wallboards.PCM wallboard consists of Gypsum wall board is packed by means of phase change materials such as paraffin wax and fatty acid such as lauric acid and air ventilation holes are present.

2.3. METHODOLOGY

The following methods occurred from the start of the project right up to the finish:
(1) Thermal analysis of with and without brick wall
(2) Analytical modeling of the system
(3) Analyzing using ANSYS 12

2.4. SELECTION OF PCM

After various studies, it was decided to use paraffin wax and Lauric acid as the phase change material. Lauric acid is selected because of its melting temperature and its thermal properties suitable for building application and its economic is also one of the reasons. The thermal properties of Lauric acid are available in Table 1.

2.5. LIMITATION OF EXISTING SETUP

(1) More time for construction
(2) High complication
(3) High cost

2.6. EXPERIMENTAL SETUP

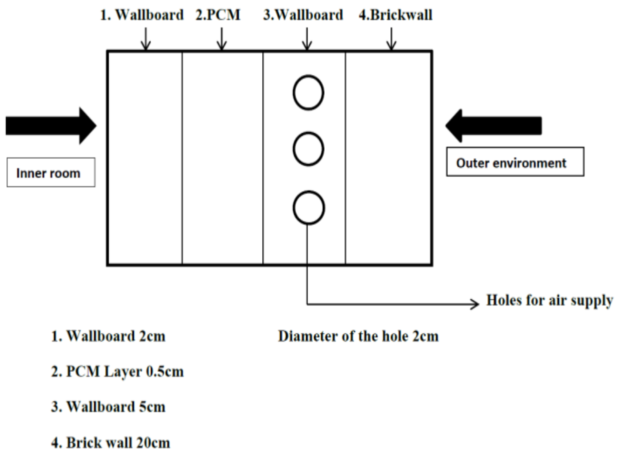

Fig.2 With brick wall

Room is constructed by attaching PCM wallboards PCM wall board consist of **Gypsum wall board is packed** by means of phase change materials such as fatty acid such as coconut oil. Along with wallboard PCM ceilings are also present. The inner room temp get transferred to the 1st wallboard. Then the heat is absorbed by the PCM then PCM temp get increases. So PCM may be happen due to heat transfer. This heat in the PCM material is transferred to the next wallboard layer and it is cooled by ventilation holes (air holes 50% area of wallboard) air is circulated naturally. The melting time of PCM may be increased by means of this natural circulation of air that PCM absorbed heat continuously from the room. So the cooling effect in the inside room. Temp measurement of all layer of composite wall will be noted. PCMs utilizing latent heat produced during phase change transformation processes do attain higher energy density with small temperature difference than other storage media using sensible heat. This concept is minimizing cooling and heating loads is the integrated PCM wallboard system. This system based on randomly packed PCMs into wallboards. This study evaluates the concept of laminated-PCMs as integral part of wallboard system in building fabric. The modified system consists of PCM wallboard with and without brick wall as shown in fig.2.These wallboard consist of three layers. The lauric acid PCM is place between the first and third layer of the wallboard. Thickness of the wallboard is 0.2m and thickness of the PCM layer is 0.1m.Each layer consist of 1m height; the melting point and phase change enthalpy of PCM is about 44 C and 1.76 kJ/kgk. Thermal conductivity of the gypsum wallboard is 0.17 w/mk and lauric acid is 0.14w/mk .Using the above properties packed PCM in the brick wall was developed. The third layer of wallboard consists of ventilation hole and its diameter is 0.2m, which is used to dissipate the generated heat to the atmosphere.

2.7 ADVANTAGES OF PCM

(1) Freeze without much super cooling.

(2) Ability to melt congruently.

(3) Self nucleating properties.

(4) Compatibility with conventional material of construction.

(5) No segregation.

(6) Chemically stable.

(7) High heat of fusion.

(8) Safe and non-reactive.

(9) Recyclable.

3. THERMAL ANALYSIS OF WALLBOARD

The thermal analyses of the wallboard with brick wall have been performed. In order to generate heat in the room and heat is transferred to the composite wallboard and heat dissipated to the outside of the room should be calculated.

3.1CALCULATION OF TOTAL HEAT GENERATION IN THE ROOM:

Specific heat of air (C_P) =1.005 kJ/kg .K

Max temp of the room (T_{max}) = 38 °c

Minimum temp of the room (Tmin)=25 °c

Density of air (ρair) = 1.165Kg/m^3 @ 30°

$Q_{Room} = \rho_{air} . V_R .C_p. (T_{max} - T_{min})$

Q_{Room} = 316.122 k w

3.2 ONE DIMENSIONAL STEADY STATE CONDUCTION EQUATION.

Heat is transferred to the composite wallboard**,** Consider the setup is composite wallboard

Thickness of the wallboard (L_1, L_3) =0.2, 0.4m

Thickness of the PCM (L2) =0.1m

Thickness of the concrete wall (L_4) =0.20m

Thermal conductivity of the wallboard (k_1, k_3) =0.17W/mk

Thermal conductivity of the PCM k_2 =0.15W/mk

Thermal conductivity of the concrete wall k_4 =1.4W/mk

$Q_{wallboard} = (T_{max} - T_{min}) / R_{thermal}$

$R_{thermal} = 1/A\,[1/h_a + L_1/K_1 + L_2/K_2 + L_3/K_3 + L_4/K_4 + 1/h_b]$

Q_{wall} = 0.294 kW

Heat absorbed by the PCM is dissipated by atmospheric air circulated in the ventilation hole

$Q_{dissipation} = h.A. (T_{max} - T_{min})$

$Q_{dissipation}$ – dissipation by air circulation

h– heat transfer coefficient

h = 31.8 w/m^2 k

Calculate free convection method of vertical surface of a plate

Calculate Grashoff number

Thickness of the hole (x) =0.2m

Kinematic viscosity of the air (v^2) = 16.00×10^{-3} m^2/s

Local Nusselt number (${}^{NU}{}_{X}$)

$G_{rx} = g.\beta.x^3. (T_{max} - T_{min})/v^2$

β - $1/T_F$

T_F - Film coefficient

$T_F = (T_{max} + T_{min})/2$

= (37+28)/2

T_F = 32.5 °c

β = 1/32.5=0.03

$G_{rx} = 9.81 \times 0.03 \times 0.003^3 \times (37-28)/ 16.00 \times 10^{-6}$

G_{rx} = 496

If the condition is laminar flow $G_{rx} . p_r < 10^9$

P_r - Prandtl number of atm air 0.701

$G_{rx} . P_r$ = 496×0.701

$G_{rx} . p_r$ = 347.64

laminar flow for constant temperature.

3.3 CONSTANT WALL TEMPERATURE

${}^{NU}{}_{X} = 0.508 p_r^{0.5} (0.952 + p_r)^{-0.25} G_{rx}^{0.25}$ (for constant heat flux)

${}^{NU}{}_{X} = 0.508 (0.701)^{0.5} (0.952 + 0.701)^{-0.25} (496)^{0.25}$

${}^{NU}{}_{X}$ = 1.78

Avg

N_{UX} =3.56

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NU_X = hd/k

NU_X = local Nusselt number

NU_X = hx/k

3.56 =h×0.003/0.02675

h = 31.8 W/m^{2}K

$Q_{dissipation}$ = h.A. (T_{max} –T_{min})= 31.8 ×3×3×(37-28)

$Q_{dissipation}$ = 2.576 KW

In this analytical calculation method concluded that 316.122KW amount of heat is generated in the inside of the room. Considering the one dimensional steady state conduction equation, 0.294KW amount of heat is transferred to the composite wallboard. If the atmospheric air is circulated in the ventilation hole free convection takes place. Therefore 2.576KW amount of heat is dissipated to the atmosphere.

3.4 THERMAL ANALYSIS USING ANSYS

1. ELEMENTAL SELECTION

The elemental type is **used** in this thermal analysis**.** Because of its suitable for the accurate thermal performance for the thermal storage in building application.Tet node 87 can used for the 2 dimensional steady-state or transient analysis.

2. MATERIAL PROPERTIES

The thickness of the wallboard is 0.2m and thickness of the PCM layer is 0.1m ana thickness of the brick wall is 0.20m. Each layer consist of 1m height and thermal conductivity of the gypsum wallboard is 0.17 w/mk and lauric acid is 0.14w/mk, brick wall is 1.4 w/mk and lauric fatty acid density about 1.007Kg/m^3, Specific heat of solid PCM 1.76 kJ/kgK. The third layer of wallboard consist of ventilation hole and its diameter isof.001m.Using the above properties packed PCM in the without brick wall was developed.

3. MESH SIZE

Meshing is done at elemental edge length of 5m.So that efficient elemental analysis is made.

4. BOUNDARY CONDITION

The boundary condition can be in the form of temperature and convection heat transfer coefficient. Minimum room temperature is 298K and maximum room temperature is 311K can be applied in the 2 dimensional transient analysis. Third layer of gypsum wallboard convection heat transfer coefficient about 31.8W/m ^{2} k can be applied. In the fourth layer of brick wall heat flux can be applied in the various time period. As well as heat flux increases and temperature also increases.

4. ANALYSIS RESULTS AND DISCUSSION

The performance analysis of Lauric fatty acid phase change materials for thermal energy storage in building application were analyzed using the ANSYS 12. This chapter explains analysis conducted followed by the results obtained.

4.1 RESULTS

4.1.1 NODAL SOLUTION

The temperature distribution during thermal flux for the thermal analysis of wallboard with brick wall has been performed. The lauric fatty acid such as coconut fatty acid have high heat retention capabilities in that they do not lose and heat absorbed quickly. Heat is absorbed or released as the material changes from the solid phase to the liquid phase. As a result, PCMs are also referred to as latent heat storage materials.

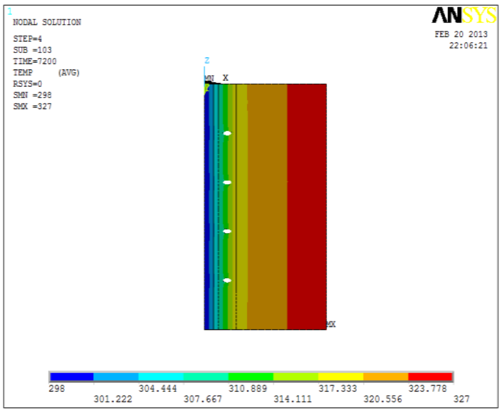

Fig 3.Nodal solution

The 2D analysis of the system is made using transient thermal analysis. The PCM temperature value corresponding to the distance was analyzed in the system. The modeling of the thermal performance is made using the designed values obtained from the above calculations of the system and the convection heat transfer coefficient, surrounding ambient temperature are provided for the wallboard without brick wall of thermal analysis. During the without brick wall analysis in the PCM storage unit will be maximum heat which is stores in the PCM. In this fig 3 shows that the given inlet room temperature is 298K in the gypsum wallboard of first layer. Then room temperature get transferred to the second layer of lauric fatty acid PCM try to observe the more amount of inlet room temperature. In certain period PCM converts solid state to the liquid state attain at melting point temperature is 44□C led to maximum energy savings. Third layer of gypsum wallboard convection heat transfer coefficient about 31.8W/m^{2}k can be applied in the above calculation. This third layer of wallboard having a ventilation hole for heat absorbed by PCM is dissipated by the atmosphere and free convection is take place for constant wall temperature. More amount of inside room temperature is get transferred to the outside of the wallboard and atmosphere.

4.1.2 TEMPERATURE VARIATIONS

The graphical representation shown in fig4(a),(b) it elaborate that the temperature variations with respect to time and distance is plotted. In this process due to increase in room temperature when the distance is increases it seems the wall temperature also increased. During the second layer PCM storage unit will be absorbed maximum heat and the heat stores in the PCM Lauric fatty acid 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.

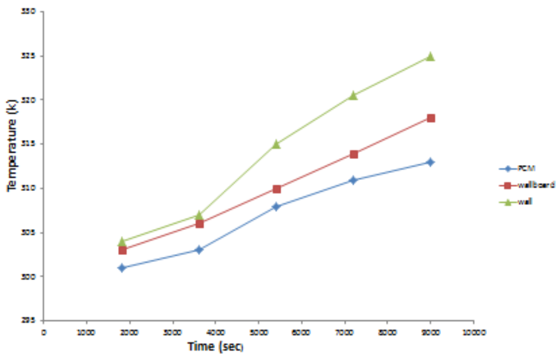

Fig 4 (a) Temperature with respect to time

Heat is absorbed or released when the material changes from solid to liquid and vice versa.The flow analysis of wallboard has been performed and results has been obtained visually are presented.Integrating PCMs promotes rapid transfer of latent heat, sharp response to indoor temperature, and minimizes multidimensional mode of heat transfer

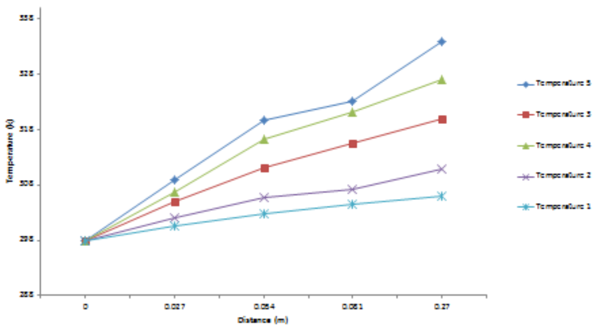

Fig 4 (b) Temperature with respect to distance

Thermal performance of the laminated wallboard system is to be done numerically. Through series of heat transfer simulations and under different sets of properties and conditions, the surface temperature variation is to be obtained. The temperature variations used to calculate the heat flux and the total amount of heat transferred in and out of the wallboard.

5. CONCLUSION

The storage of thermal energy using PCM was studied. The thermal analysis of wallboard was designed. The composite wallboard setup was analyzed usingANSYS12 analysis was done for the with brick wall of wallboard and PCM layer. The thermal and physical properties of lauric fatty acid studied in detail. The result have been obtained by the analysis of lauric acid PCM delivers the maximum heat storage and try to absorb the more amount of heat. More amount of inside room temperature is get transferred to the outside of the wallboard and atmosphere. Not only can reduce the cost and energy consumption of air condition system, but also is an effective way of improving building energy consumption to environment's negative effects. TES using solid to liquid phase change has been carried out. In order to build a light building envelope, an investigation was carried out to define, build and test wallboards containing a phase change material. From the wallboards in order to obtain a certain indoor passive air conditioning and to avoid overheating of building during summer. This project has discussed all the efficient way that the heat can be utilized in the sun shine hours. It is concluded that these are the various techniques to enhance the heat transfer to the building application. The various techniques included and modification in the design of the building, various materials used the PCM storage unit.

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REFERENCES

[1] Alicia Oliver, "Thermal characterization of gypsum boards with PCM included: Thermal energy storage in buildings through latent heat", *Energy Buildings, vol.48*,pp.1–7,2012.

[2] Amar. M, Khudhair, "A review on energy conservation in building applications with thermal storage by latent heat using phase change materials", *Energy Convers Manag, vol.45*,pp.263–275,2007.

[3] Angela C. Evers a , "Evaluation of the thermal performance of frame walls enhanced with paraffin and hydrated salt phase change materials using a dynamic wall simulator",*Building Environ,vol.45*,pp.1762-1768,2010

[4]Castellon.C,Medrano.M,Roca.j, "Use of Microencapsulated Phase Change Materials in Building Applications", *Energy Convers Manage,vol.42*, pp.234–255,2007

[5] Chao Chen, HaifengGuo, " A new kind of phase change material (PCM) for energy-storing wallboard", *Energy Buildings,vol.40*,pp.882–890,2006.

[6] ChuahT.G,Rozanna D, "Fatty Acids used as Phase Change Materials (PCMs) for Thermal Energy Storage in Building Material Applications*", Vol.36*, pp.311-322,2008

[7] Edwin Rodriguez-Ubinasa "Applications of Phase Change Material in highly energy-efficient houses", Energy Buildings,vol.50,pp. 49–62,2012.

[8] Fr´ed´ericKuznik a , "Optimization of a Phase Change Material Wallboard for Building Use", *Applied therm Eng,vol.28*,pp.1291-1298,2008

[9] Hakan Caliskana,1, Ibrahim Dincerb , "Energy and exergy analyses of combined thermochemical and sensible thermal energy storage systems for building heating applications", *Energy Buildings,vol.48*,pp.103–111,2012.

[10] He´bertSalle´e a, Daniel Quenard a, "Thermal testing and numerical simulation of a prototype cell using light wallboards coupling vacuum isolation panels and phase change material", *Energy Buildings, vol.38*, pp. 673–681,2006.

[11] Javier Neilaa, " Experimental tile with phase change materials (PCM) for building use," *Energy Buildings, vol.43,* pp.1869–1874,2011.

[12] Kooa. J, H. Sob , "Effects of wallboard design parameters on the thermal storage in buildings", *Energy Buildings, vol.43*,pp.1947–1951,2011.

[13] Liangyu Wu, MinghengShi , "Thermal response of brick wall filled with phase change materials (PCM) under fluctuating outdoor temperatures", *Energy Building,vol.43*,pp.3514–3520,2011.

[14] Lin K.P a, R. Yang b , "Preparation, thermal performance and application of shape-stabilized PCM in energy efficient buildings", *Energy Buildings,vol 38*,pp.1262–1269,2006.

[15] Maha Ahmad , "Experimental investigation and computer simulation of thermal behaviour of wallboards containing a phase change material, *Energy Building,vol.38*,pp 357–366,2006

[16] Mohammed M, Farid a, "A review on phase change energy storage: materials and applications",*EnergyConsers Management,vol.45*, pp.1597-1615,2004.

[17] Mohammad Rostamizadeh, " Simulation of energy storage system with phase change material (PCM)",*Energy Buildings,vol.49*,pp.419–422.2012.

[18] Paolo Principi, Roberto Fioretti, " Thermal analysis of the application of pcm and low emissivity coating in hollow bricks", *Energy Buildings, vol.51*,pp.131–14,2012

[19] Pasupathy A , R. Velraj, "Phase Change Material Based Thermal Storage for Energy Conservation in Building Architecture" , *Int Energy J,Vol.7*, No. 2,2006

[20] Ruben Baetens , "Phase change materials for building applications: A state-of-the-art review", *Energy Buildings, vol.42,* pp.1361–1368,2010.

[21] ShileiLva, FengGuohui b, "Experimental study and evaluation of latent heat storage in phase change materials wallboards", *Energy Buildings, vol.39*,pp 1088–1091,2007

[22] Xinhua Xu, Zhenjun Ma , "A simplified dynamic model of building structures integrated with shaped-stabilized phase change materials*", Int J ThermSci, vol. 49*, pp.1722-1731,2010