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Phase Change Material (PCM) incorporated bricks: A passive alternative for building energy conservation

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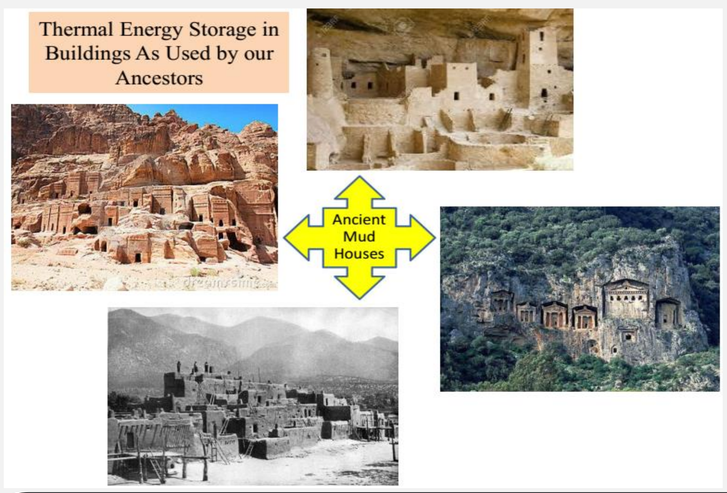
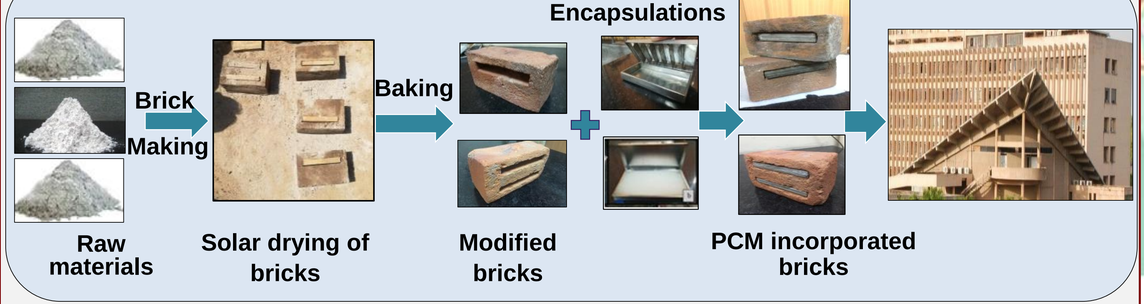
ABSTRACT

The use of phase change materials (PCMs) in buildings is an efficient way to reduce the building energy consumption. The aim is to find a suitable PCM for composite climate of Delhi, experimentally test its thermophysical properties and determine its impact on incorporation within building elements. The study also discusses, measures to increase the thermal conductivity of the PCMs so that their dispatchability can be improved, thus, helping their charging and discharging. The impact of increase and decrease in latent heat capacities of the PCM, has also been discussed.

INTRODUCTION





MATERIALS AND METHODS

Challenges

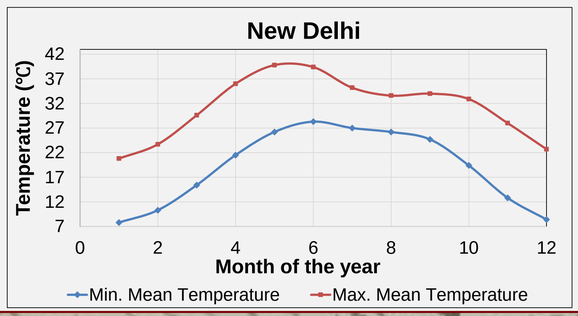
- To find suitable materials within the appropriate temperature range for Indian conditions
- Heat transfer enhancement for PCM regeneration during off-sunshine hours
- To determine the temperature dependence of thermophysical properties
- Other considerations are its cost and method of incorporation within a building

Methodology

- Mapping of PCM to a particular place
- PCM enhancement (in heat transfer rate) without affecting the storage capacity
- Characterization of PCM to access the appropriateness
- Assessment of PCM impact in terms of temperature difference achieved
- PCM comparison in terms of temperature fluctuation

Mapping of PCM to a Place

A PCM is mapped to a place based on its average min.-max. temperature. For e.g.: Mean temperature of New Delhi varies from 41°C to 27°C in summer. Thus PCMs melting in this temperature were selected for carrying out the study.



CONCLUSIONS

1. 17% to 30% increase in thermal conductivity with nano particle addition.
2. The temperature reduction of 6°C is achieved, with the incorporation of selected PCMs, on the peak inside surface temperature.
3. The value of latent heat capacity for PCM 1 (OM35) is found to be around 157 J/g and temperature range of solidification starting at 32°C and completing at 28°C.
4. It is observed that with PCM incorporation the amplitude of temperature fluctuation decreases by 10°C. It is also observed that with the increase in latent heat capacity of PCM the peak temperature is also reduced as in the case of PCM 2 (Eicosane)

INDUSTRIAL SIGNIFICANCE

- Prospects of direct application in residential buildings for maintaining comfort conditions within. Energy conservation in terms of cooling load reduction in summer and heating load reduction in winter.
- Promoting use of PCMs would increase their market demand thereby a good industry set-up possibility for their mass scale production.
- Heat resistant bricks can be a new revolution in the market if produced economically, having large-scale impacts.

Relevant Industries

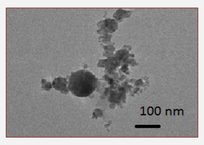
TARA Machines & Tech Services Pvt. Ltd. | PLUSS® Synergism at Work | SHAKTI SUSTAINABLE ENERGY FOUNDATION 10 YEARS towards a clean and secure energy future | GRIHA

TECHNOLOGY READINESS LEVEL: 7.5/10

(Simple process using local labour and materials)

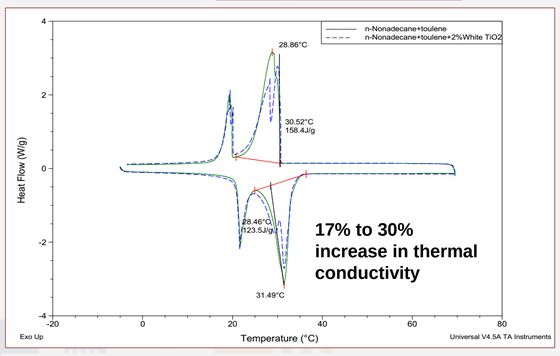
Heat Transfer Enhancement

Nano particle addition

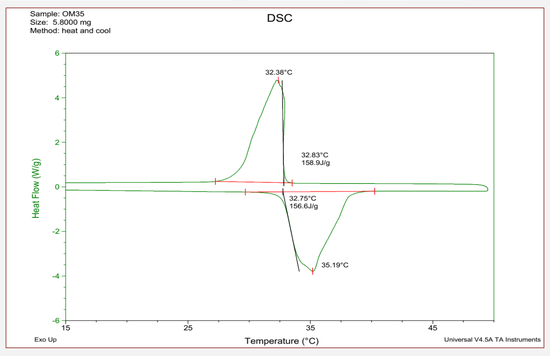


TiO_2 nano particle

Metallic encapsulations with and without fins



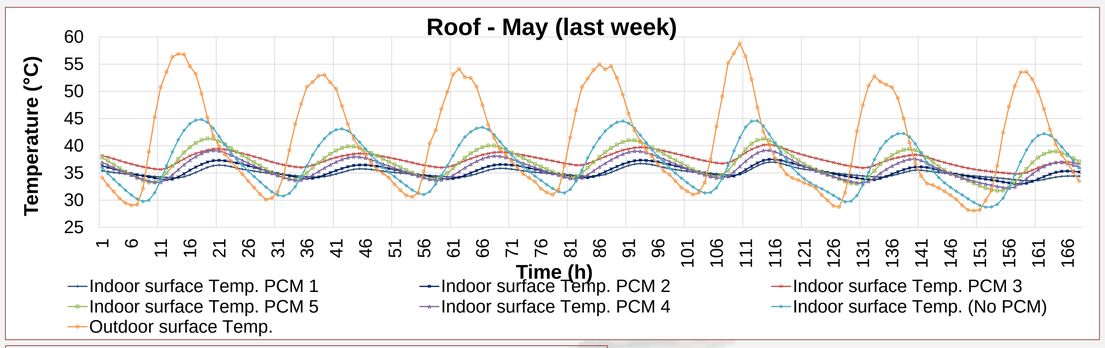
17% to 30% increase in thermal conductivity

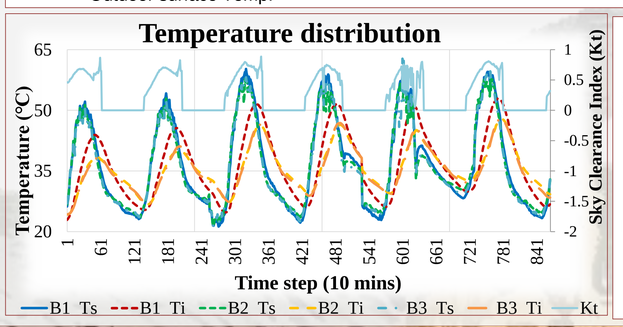


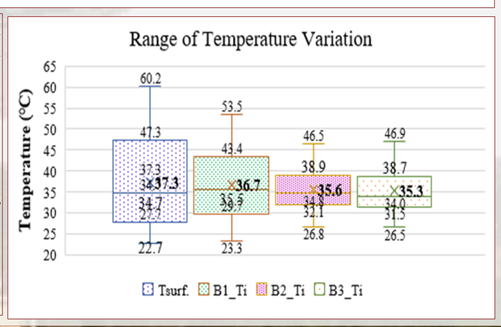
Characteristic melting and solidification curves for PCMs from Differential Scanning Calorimeter (DSC)

Test Setup Developments

RESULTS







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