EXPERIMENTAL ANALYSIS OF PCM BASED ENERGY STORAGE SYSTEM

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ABSTRACT

The use of latent heat storage system using phase change materials(PCMs) is an effective way of storing thermal energy and has the advantages of high-energy storage density and the isothermal nature of the process. Thermal energy storage is essential for both domestic water heating and space heating applications and for industrial applications. Energy can be stored by the heating, melting, or vaporization of material and the energy is made available as heat, when reversed. The main objective of the project is to analyse the temperature distribution pattern of the phase change material during the process of charging and discharging. Also the study is carried out for different mass flow rates of the heat transfer fluid. Paraffin wax has been used as the phase change material. This is because paraffin maintains its properties even after thousands of charging and discharging cycles. This type of thermal energy storage system has a good potential of acting as a thermal storage device and can be used in solar water heating applications.

Keyword : - *Flat Plate collector, PCM heat exchanger, Paraffin Wax ,Pump*

1. INTRODUCTION:

The continuous increase in the level of greenhouse emissions and the rise in fuel prices are the main driving forces behind efforts to more effective utilization of various sources of renewable energy. Energy storage units can be used to reduce energy consumption by using available waste heat or alternate energy sources. Environmental problems, electricity deregulation, and anxiety over energy security are contributing to growing attention being paid to more solar energy utilization. This also leads to saving of primary fuels and makes the system more cost effective by reducing the wastage of energy. Thermal energy storage (TES) is one of the key technologies for energy conservation and is used to assist in the effective utilization of thermal energy in wide number of applications. Among the thermal heat storage techniques, latent heat thermal energy storage is particularly attractive due to its ability to provide high energy storage density typically 5 to 10 times higher can be reached and its characteristics to store heat at constant temperature corresponding to the phase transition temperature of the PCM. Phase Change Materials can store a lot of energy as heat compared to sensible heat storage materials.

2.LITERATURE REVIEW:

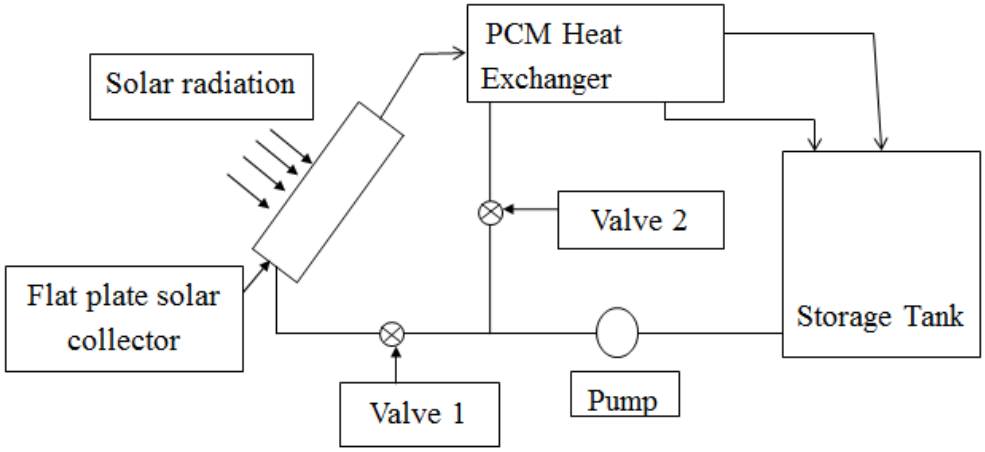
The following are some of the terminologies obtained from the journal paper:

- In the study, an experimental system was designed, constructed and used to investigate the performance (charging and discharging) of vegetable-based PCM applied to a solar energy storage system for air and water heating. Solar energy was applied in the system to power all the electrical components to ensure applicability of the system in parts of the world where electricity is not readily available. Energy storage is essential in solar energy utilization to cater for its intermittence.[1]
- This work describes the energy and exergy analysis of a diesel engine integrated with a PCM based energy storage system, and provides more realistic and meaningful assessment than the conventional energy

analysis. Using actual system data, the assessments of energy and exergy saved, and energy and exergy efficiencies are done.[2]

- The article summarizes the recent designs of thermal energy storage systems containing Phase Change Material that has been adopted for effective energy storage. It is important that the thermal energy storage systems have the necessary characteristics to improve the performance of the storage systems. Usage of Phase change materials for energy storage provides a great benefit but their low thermal conductivity becomes a major drawback. This can be compensated with the use of phase change material in an appropriate design for effective functioning of the system. PCM was implemented in cylindrical form of diameter 0.04m in order to increase the surface area for heat transfer.[3]
- In the present article some of different phase change materials are studied for solar cooking and among them stearic acid (commercial grade) is found to be a good latent heat storage which is experimentally tested in a simple box type solar cooker and the comparison is made with another similar design solar cooker without PCM. TES systems have a variety of applications such as thermal protection and control of electronic components, heating and cooling of buildings and hot water preparation.[4]

3. BLOCK DIAGRAM:



4.COMPONENTS USED:

4.1 Flat Plate Collector:

The flat plate collector is a rectangular box which consist of copper tubes for the passage of water and thermocol as the insulation material and and the copper tubes are placed below an Aluminium foil inorder to increase the heat transfer through the tubes. A glass is placed above the flat plate collector so that radiations passes through it and reaches the foil.

4.2 P.C.M Heat Exchanger:

The Phase Changing Material (PCM) heat exchanger is the storage part where the heat gets stored due to the passage of hot water. The heat exchanger is filled with paraffin wax and copper tubes are passed through it.

4.3 Paraffin wax:

Paraffin wax is chosen as the Phase Changing Material since the material can store large amount of heat and it is non corrosive in nature and it is chemically stable.

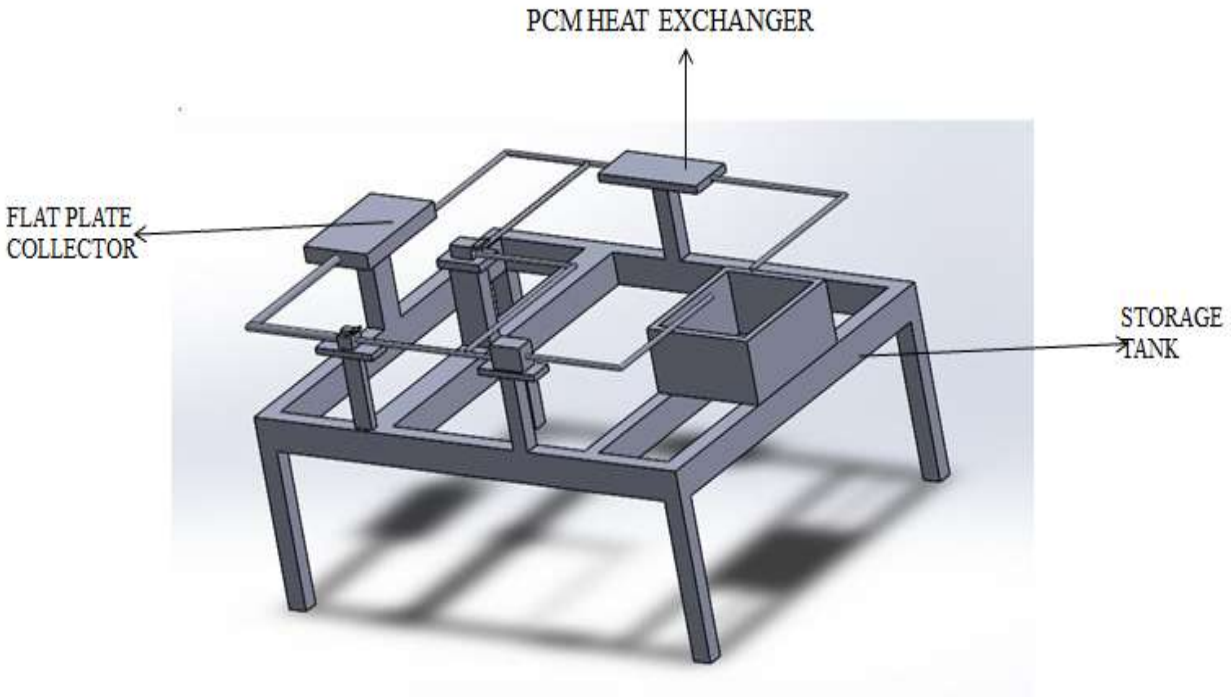
4.4 Pump:

A pump is a mechanical device which converts electrical energy into mechanical energy and is used for the circulation of water throughout the entire apparatus.

5.WORKING:

During sunshine period, valve 1 is kept open and valve 2 is kept closed. The cold water from the storage tank goes through the flat plate solar collector, absorbing heat energy from the solar radiations. It then passes through the PCM heat exchanger, where it loses its heat to the phase change material. It then goes back to the storage tank. In this way, the PCM gains heat energy which will then be used to heat water during non-sunshine period. During non-sunshine period, valve 1 is kept closed and valve 2 is kept open. The cold water from the storage tank goes through the PCM heat exchanger, absorbing heat energy from the heat stored in the phase change material. It then goes back to the storage tank. By this way cold water is heated with the help of heat stored in the PCM

6.FRAME SETUP:



7.FABRICATION IMAGES:

PCM HEAT EXCHANGER

FLAT PLATE COLLECTOR

8.EXPERIMENTAL RESULT:

Inlet and Outlet temperature of water after passing through PCM

Trial	Inlet Temperature(t1)	Outlet temperature(t2)
1	38	43
2	38	42
3	37	41
4	36	39
5	36	39

Heat Transfer Rate:

TRIALS	HEAT TRANSFER RATE(Q)
1	20.935
2	16.738
3	16.738
4	12.561
5	12.561

9.CONCLUSION:

With the help of our project we were able to find out heat transfer rate from the pcm to water at night time and the amount of time we were able to store the heat in the PCM are studied

10.REFERENCES:

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