



International Conference on Technologies and Materials for Renewable Energy, Environment and Sustainability, TMREES15

A Review on Thermal Energy Storage Unit for Solar Thermal Power Plant Application

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Abstract

In the present scenario of a huge energy demand, dependency on fossil fuels only, certainly creates crisis in future especially for developing country. Although renewable resources of energy like solar energy is being utilized on a broad scale now a days but the problem comes in law and economy i.e. social and acceptability. Main reasons of this kind of difficulties are low density of solar radiation on earth's surface and if it is available then fluctuating in nature with time of the day and the day of the year. To remove these kinds of difficulties solar energy storage unit must be introduced in solar thermal power application. In this paper, literatures on thermal energy storage unit with phase change material has been rigorously studied to select the best suitable PCMs and materials for the design of test bench of the thermal energy storage unit.

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Peer-review under responsibility of the Euro-Mediterranean Institute for Sustainable Development (EUMISD)

Keywords: Storage Unit; Helical Coil Solar Cavity Receiver; PCMs

1. Introduction

In the present scenario when the demand is more than resources available, it's our necessity to develop an energy storage device to store energy at the time of availability and supply it whenever demand is more than available. Although Sensible heat storage is the most common method of thermal energy storage, but the recent research on advance material and system shows that density of stored energy is greater for latent heat storage than that of sensible heat storage[1-4]. Phase change material is generally used in latent heat storage system and this type of system has been widely used for heat pumps, solar engineering, and spacecraft thermal control applications [5].

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Tremendous increase in the price of fossil fuel and continuous upgrading in the level of greenhouse gas emissions are the main driving forces behind the effective utilization non conventional energy resources. The storage of energy in suitable forms, conveniently converted into the required form, is a present day challenge to the technologists. Solar energy storage unit has the following characteristics (a) To conserve energy (b) To improve the performance and reliability of energy systems and (c) to reduce the mismatch between supply and demand. Scientists in many parts of the world are in search of new and renewable energy resources and stated that direct solar radiation is a prospective renewable source of energy and the solar energy storage unit is the new source of energy. In other words solar energy storage unit can be called as the sub renewable sources of energy [6, 7]. There are various kinds of phase change materials but paraffin has been widely used for latent heat thermal energy storage system because of their large latent heat and proper thermal characteristics such as no super cooling, low vapour pressure, good thermal and chemical stability and self nucleating behaviour [8-12].

Nomenclature

Q	Quantity of heat stored (J)
T_i	initial temperature
T_f	final temperature
T	temperature
T_m	melting temperature
m	mass of heat storage medium(kg)
C_p	specific heat (J/kg K)
C_{ap}	average specific heat between T_i and T_f
C_{sp}	average specific heat between T_i and T_m
C_{lp}	average specific heat between T_m and T_f
ΔH_m	heat of fusion per unit mass(J/kg)
ΔH_r	endothermic heat of reaction
a_r	fraction reacted
a_m	fraction melted

2. Energy storage methods

There are various forms of energies and their storage methods or mechanisms have been described below. Atul Sharma et al. [5] describes in their review paper on, thermal energy storage with phase change materials and applications, about different type of energy storage methods and their mechanisms. In this paper main emphasis is given to the latent heat storage method to store solar thermal energy.

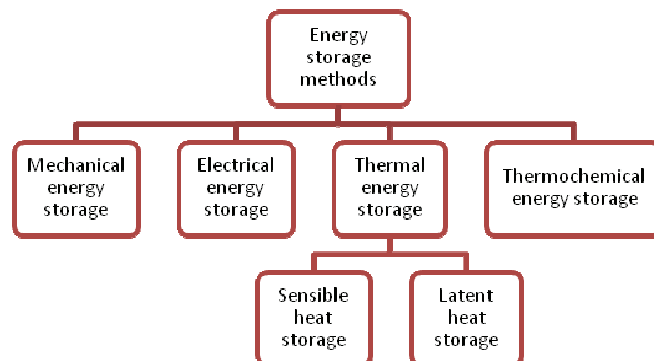


Figure 1 Different types of energy storage methods [5].

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