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Fabrication of new ceramics nanocomposites for solar energy storage and release

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ABSTRACT

The carbides nanostructures have huge applications in renewable energy fields such as the saving of solar energy and release which attributed to the good their properties (thermal, electrical, mechanical, optical and chemical). So, in this paper, the solar energy storage and release of carbides nanoparticles/water for building heating and cooling applications have been investigated with different concentrations of metals carbides nanoparticles (tantalum carbide-silicon carbide). The results showed that the melting and solidification times for thermal energy storage and release decrease with an increase (TaC-SiC) nanoparticles concentrations. From the obtained results, the TaC/SiC nanostructures/ water nano-system are considered as promising materials for solar energy storage and release with high efficiency and high gain (more than 50% compare with the water). Also, the TaC/SiC may be used for heating and cooling fields with good performance and high gain.

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1. INTRODUCTION

Modern projections forecast that the main power spending will increase to 48% during 2040. On the other hand, the reduction of relic funds in adding together to their negative shock on the surroundings has accelerated the move to energy of sustainable sources. Energies of renewable like wind, biogas, solar energy, and ocean waves have been acting a chief role in reforming the normal balance and getting the wants of the rising people command. But, owing to the vagaries of climatic, the income of renewable energy storing has happened to imperative. This has direct require to increase sustainable and efficient methods for energy storing. Storage of energy has suited a significant branch of technology systems of renewable energy.

Thermal Energy Storage (TES) is a technology that depends on thermal energy by cooling or heating a storage space as a result the stored energy can be used at an afterward time for cooling and heating applications and energy production. Thermal energy storage systems are used chiefly in manufacturing processes and in buildings. Advantages with thermal energy storage in system of energy contain a raise in better reliability and overall efficiency, and it can guide to better finances, decreasing in running costs and investment [1]. TES through latent heat is one of the majority significant renewable energy storage applications.

The thermal energy storage can classified to three necessary parts, chemical heat, latent heat, and sensible heat. Latent heat storage system is based on storage of thermal energy at the temperature of phase transition from solid to liquid stage. The fundamental role of this ability is the choice an exact (PCM) for an exacting application depend chiefly at which on temperature of melting range (change of phase) of that (PCM). Owing to the proper properties of the paraffin like nontoxic, stability, and noncorrosive can regard as an excellent options for utilizing like PCM. The disadvantage that related with using of paraffin like PCM is the small thermal conductivity [2]. Thermal energy storage can be explained as the storeroom of thermal energy at any temperature (i.e., both, low or high) for purposes of temporary.

Thermal energy are essentially stored in three dissimilar methods which contain latent heat storage, sensible heat storage, and a number of physiochemical reactions consequences in the thermal storeroom. Sensible heat storage is the storeroom systems in which the heat is stored straight with no the phase changing of the material. Heat transfer fluids are used for storage of sensible heat. Energy storage frequently arises dependability and steady the energy provide which increases the energy performance systems. A storage system increases the power generated performance by load leveling; the superior efficiency tends to energy protection and improves the effectiveness of cost [3].

Agreement about the achievement of environmental energy-saving practices and policies are gradually more present at the local, international or national level. The major reasons for achievement are, on the lone hand, to decrease the gradually more elevated cost of energy reliance on fuels of fossil and, on the second hand, to decrease the polluting emissions of those fuels of fossil, which are mostly dependable for the effect of greenhouse. The present two chief advantages: the decrease of the reliance on fuels of fossil and the option of similar energy provide and require when they do not agree in time [4]. As the cruces of energy are departing to the elevated extent it is extremely important to produce the energy which is available, it may be in small mark form or it may be in the waste heat shape which is departing to sink for recycling and cooling the procedure. It is very necessary to produce the obtainable energy and create use of it for more minor heating processes. Heat is a type of power which is typically goes to the go under after the dissimilar processes concerned; approximately 70 to 80% of heat energy is obtainable for using.

In the majority processes, excess thermal energy is free to the atmosphere or a big body of water to total a cyclic procedure or stop overheating of facilities or components [5]. There are many researchers are working on the phase change materials, energy storage and release [6-18]. The nanocomposites have numerous applications in the areas of automobiles, microelectronic packaging, injection molded products, optical integrated circuits, packaging materials, aerospace, coatings, consumer goods, adhesives, fire-retardants [19], sensor of pressure [20, 21], optoelectronic and electronic applications [22], radiation shielding and bioenvironmental [22], sensors of humidity [23], antibacterial [24].

2. MATERIAL AND METHODS

The metals carbides nanoparticles/water were prepared for thermal energy storage and release with different concentrations of (tantalum carbide-silicon carbide) nanoparticles are water/$(TaC)_{0.5x}$-$(SiC)_{0.5x}$ where x=0.02, 0.04 and 0.06. The thermal energy storage and release contain the melting and solidification processes during heating and cooling. The water/(TaC-SiC) nanoparticles were used like the heat transfer, whose temperature can be varied from 30ºC to 90 °C with stirrer and measuring the temperature during the heating and cooling processes by digital device.

3. RESULTS AND DISCUSSION

Figure 1 and Figure 2 show that the curves of heating and cooling water/(TaC-SiC) nanoparticles respectively. From the figures, the times of heating and cooling reduce with increase in ratios of (TaC-SiC) nanomaterials. This is a useful method to repair the thermal conductivity of (TaC-SiC) nanoparticles. Furthermore, quicker rates of heating and cooling nanofluids would be clear to the improvement of thermal conductivity for foundation material [25-27].

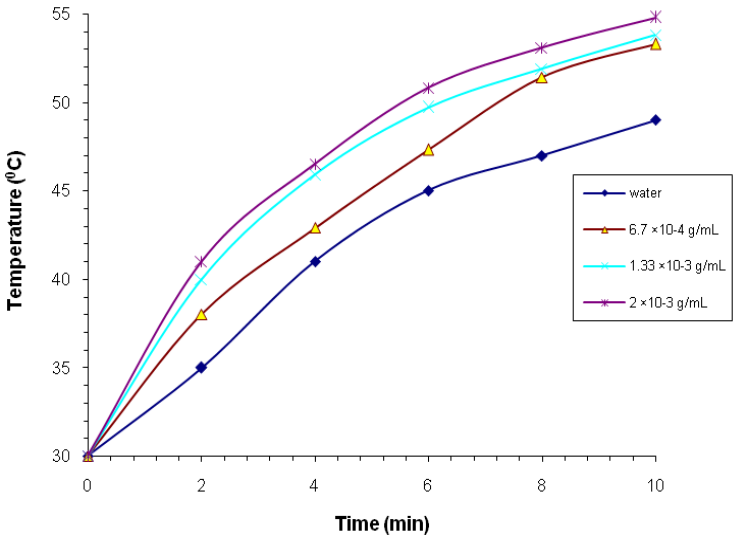

Figure 1. Melting curves of (TaC-SiC)/water

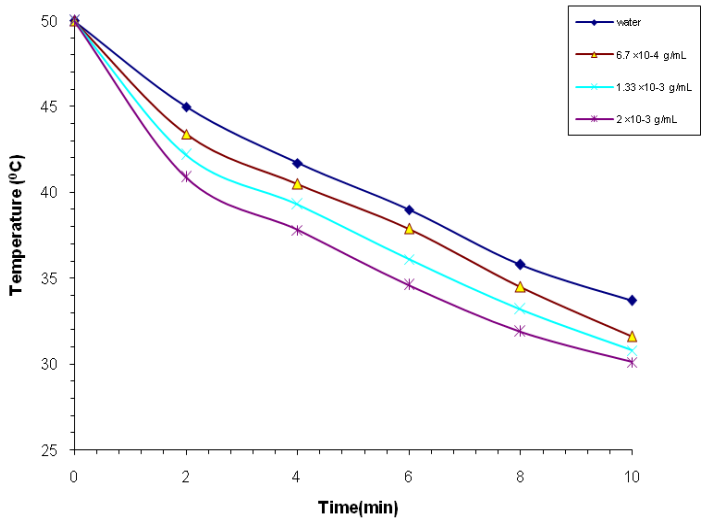

Figure 2. Solidification curves of (TaC-SiC)/water

4. CONCLUSION

The water/(TaC-SiC) nanoparticles have high efficiency for thermal energy release and storage. The heating and cooling times reduce with increase in (TaC-SiC) nanoparticles ratios. The water/(TaC-SiC) nanoparticles could be considered efficient for solar water heating system.

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