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Synthesis and Characterization of Shape-Stable Bio-Char Composite PCM Material for Solar Desalination Application

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Abstract: In the present study, three different D-Mannitol based activated bio-char composite shape-stable phase change materials (PCM) were developed for medium temperature energy storage applications like solar desalination, solar thermal storage and waste heat recovery with varying bio-char compositions. The activated bio-char (A-BC) composite-based samples were prepared from sawdust by using the pyrolysis method. The phase composition, morphology, latent heat capacity and phase change temperature of the fabricated samples were assessed by XRD, SEM, differential scanning calorimetry (DSC) and Fourier transform infrared spectroscopy (FTIR). The fabricated bio-char composite materials exhibited good thermal properties and structural stability compared to pure PCM. The phase change material with a blend of minimum 15 wt.% activated bio-char and 85% D-Mannitol was observed to be leak resistant. FTIR and XRD results confirm that the chemical properties of the bio-char composite remain the same as the pure PCM, which confirms that there are no chemical interactions between the PCM and bio-char. PCM sample with 15% activated bio-char exhibited an enhanced thermal stability compared to the pure PCM.

1.Introduction

In recent years, the growth of renewable energy and recovery of commercial and industrial waste heat has attracted a lot of attention due to the worldwide energy crisis and environmental pollution [1-3]. Most of the renewable energy sources are incapable of providing constant power. To overcome the current energy crisis and environmental concerns, highly efficient thermal energy storage (TES) materials and technologies are play important role. Thermal energy can be stored in the form of two types, one is sensible heat thermal storage systems (SHTS) in which the temperature of the storage material varies the amount of energy stored. SHTS system requires more volume because it depends on the mass of the material and specific heat capacity. Second one is the latent heat thermal storage system (LHTS) in which the energy is stored when a substance changes from one phase to another phase while melting or freezing [4-7]. During the phase transition, the