A comparative study on thermophysical properties of functionalized and non-functionalized multi-walled carbon nano tubes (MWCNTs) enhanced salt hydrate phase change material

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ABSTRACT

Thermal energy storage (TES) system is one of the best options for harvesting, storing, and saving energy for long-term or short-term use of a modern energy production system. The nano-enhanced phase change materials (NePCM) are a new type of phase change materials (PCM) formed by suspended nano-sized particles in base PCM to improve the thermophysical properties of the base PCM. The major challenge in nanoparticle dispersion in PCM, especially for solar energy applications, is its poor thermal conductivity and light transmission capability. Present research aims to address the thermal conductivity and light transmission capability issues by dispersing pristine multi-walled carbon nanotube (MWCNT) and functionalized multi-walled carbon nanotube (FMWCNT) particles in various weight concentrations (0.1, 0.3, 0.7, and 1.0%) into the salt hydrate PCM. A two-step technique was implemented to develop the NePCM for various weight percentage of MWCNT and FMWCNT. The Fourier transform infrared (FTIR) spectrum shows the MWCNT and FMWCNT nano-sized particles physically mixed well in salt hydrate PCM and without disturbing the chemical properties. The thermal conductivity of developed composites at 0.7 wt% MWCNT/S50 (S50M-0.7) and 0.7 wt% FMWCNT/S50 (S50F-0.7) are 0.78 W/mK, and 0.92 W/mK, respectively. The Differential Scanning Calorimetry (DSC) results revealed that the maximum improvement in latent heat by 14.66% and 31.17% for 0.1 wt% MWCNT/S50 (S50M-0.1) and 0.3 wt% FMWCNT/S50 (S50F-0.3) respectively. Light transmittance of S50M-0.7 and S50F-0.7 reduced to 92% and 93.49% than pure salt hydrate PCM. It exhibits the reduction in transmittance, greater improvement in solar spectrum absorption, and excellent photothermal conversion.

KEYWORDS

Phase change materials; Nano-enhanced phase change materials; Thermal conductivity; Thermal energy storage; Salt hydrate PCMs

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