EXPERIMENTAL INVESTIGATION OF FREEZING BEHAVIOUR OF NANO PARTICLE ENHANCED PCM IN SPHERICAL CAPSULES OF DIFFERENT DIAMETERS

SRM UNIVERSITY
(Under section 3 of UGC Act 1956)

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ABSTRACT

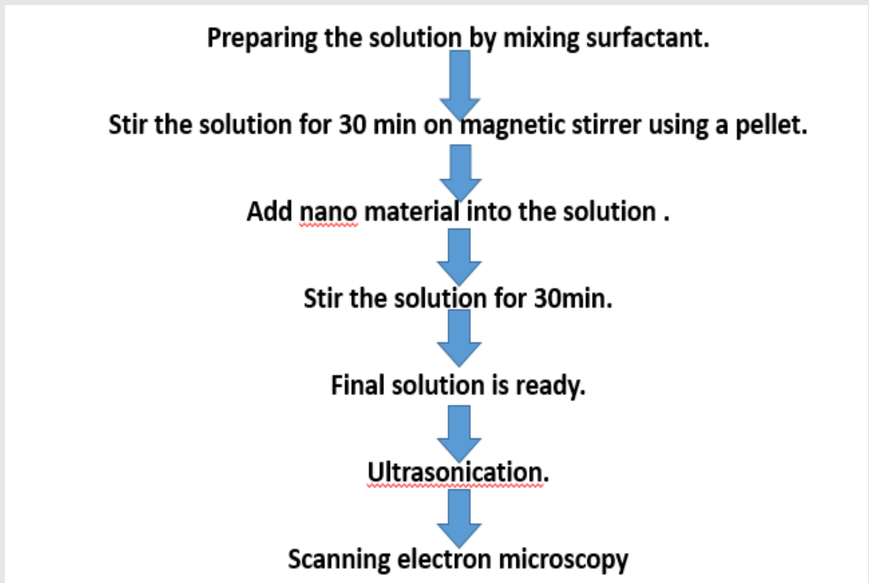
This present study presents the solidification behaviour of water based Nano fluid phase change material encapsulated in a spherical container. The Nano fluid phase change material (NFPCM) was prepared by dispersing the multi wall carbon nanotubes (MWCNT) with volume fractions of 0.3%, in de-ionized (DI) water as the base phase change material. The solidification experiments were conducted with DI water and the NFPCM and maximum reductions of 10% was observed in the solidification time with the NFPCMs at surrounding bath temperature of 9 C and 12 C respectively. The experiment was conducted in spherical capsules of stainless steel of 3 different diameters . The presence of MWCNT also acted as nucleating agent that caused appreciable reduction in the sub cooling. there is a possible energy saving potential of approximately 6e9% in the CTES using the NFPCMs

INTRODUCTION

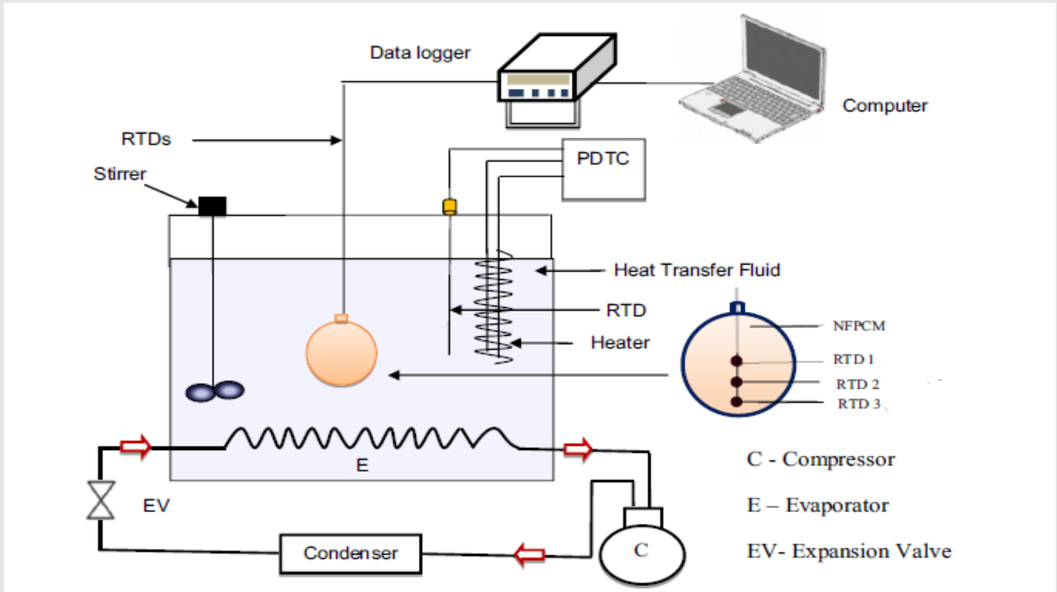
Cool thermal energy storage (CTES) technique which is best described as ‘storing cool energy for later use in order to bridge the time gap between the energy availability and energy use’ is being considered as a useful tool for thermal management. The CTES plays a vital role in central air-conditioning in the large buildings refrigeration in supermarkets high powered electronic cooling applications, and various industrial process cooling applications where the cooling requirement is highly intermittent

The CTES system with the PCMs is preferable in many applications compared to sensible heat storage, owing to its high storage capacity within a small phase transition temperature range. However, the PCMs possess very low thermal conductivity especially in the liquid state and hence it is very difficult to retrieve the stored energy. Reviews of the available literature was carried out pertaining to CTES on the selection of PCM, geometry of encapsulation and heat transfer enhancemen and the thermal performanceof commonly used secondary refrigerant

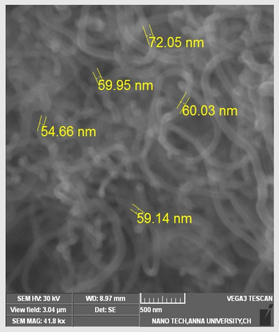
SAMPLE PFREPARATION

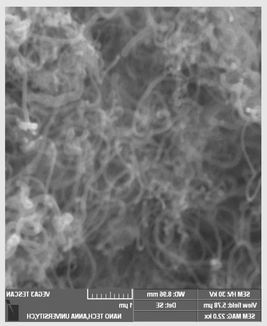


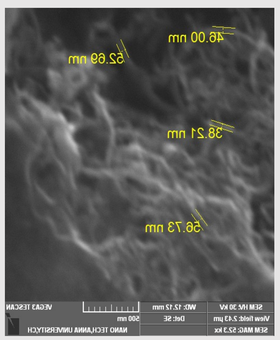
SETUP DIAGRAM

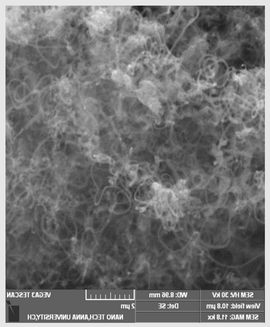


SEM IMAGES

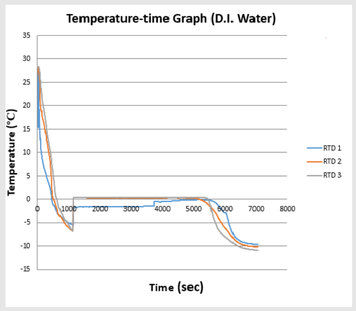


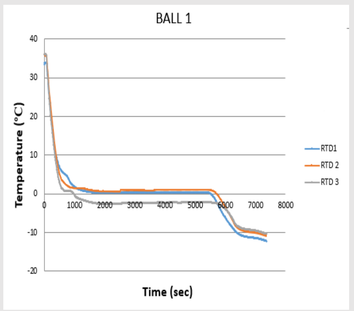


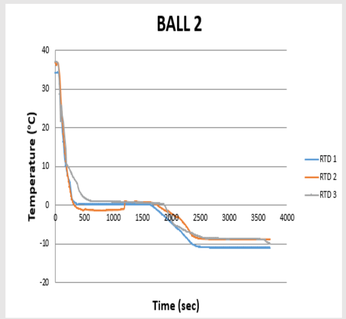


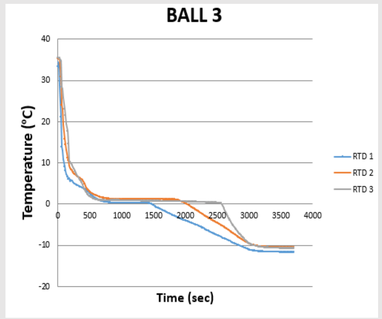


GRAPHS AND RESULTS









CONCLUSIONS

The solidification time was considerably reduced 10% with the NFPCM containing volume fraction 0.3% MWCNT compared to the pure water PCM at the surrounding temperature of 12 C and 9 C respectively due to its enhanced heat transport properties. The presence of high conductive MWCNT acted as the nucleating agent to initiate the solidification in advance to that of pure water PCM. The subcooling was significantly reduced for the NFPCM containing minimum concentration of the MWCNT and the subcooling increased with increase in the concentration of MWCNT owing to the suppression of the micro convection effects in the liquid PCM. It is predicted that there is an energy saving potential of 6%e 9% in the chiller integrated with the CTES system using the NFPCM.