Notice

Proposal Defense

PhD in Sustainable Energy Engineering

Bahir Dar Energy Center

Bahir Dar Institute of Technology

Title: Numerical and Experimental Investigation on Optimal Solar Thermal Energy Storage System for Agroproduct Drying Application

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Date and Venue

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Excuitive Summary

Drying of food products using solar energy as an environmentally friendly and sustainable energy source represents an effective and economical method to preserve food products for a sustainable world. A very common problem in solar drying and various other industrial processes is the existing gap between the period of thermal energy availability and its period of usage. This situation creates the need for an effective method by which excess heat can be stored for later use. Latent thermal energy storage is one of the most efficient ways of storing thermal energy through which the disparity between energy production or availability and consumption can be corrected, thus avoiding wastage and increasing the process efficiency. Despite its low thermal conductivity, paraffin wax is the most common and commercially viable phase change materials used by many researchers for latent heat solar thermal energy storage application. Most of the previous techniques that were used to improve heat transfer rate of a phase changing materials include, use of porous materials (metallic foams), extended surface of materials (fins), encapsulation of phase changing materials and inserting carbon fibers and use of multi walled carbon Nanotubes (MWCNT) with a phase changing materials. Although the preceding approaches increased the heat transfer rates of the system, they all occupy volume within the phase change material storage vessel and hence reduced the thermal energy storage capacity. Nano material enhancement technique is a new approach conducted in the last decade by a number of researchers by adding various types of Nanoparticles into different types of phase changing materials including paraffin wax. From the results of these studies, a significant heat transfer enhancement was achieved with a minimum reduction in latent heat thermal energy storage capacity. However, by adding Nanoparticles into phase changing materials; an increase in conductive heat transfer was observed due to enhancement of thermal conductivity but a decrease in convective heat transfer was shown due to increment of viscosity. Few researchers recently studied numerical and experimental investigation of Nano enhanced phase changing materials. These studies used various types of Nanoparticles and paraffin wax or other phase changing materials. An optimal concentration of Nanoparticles for better thermal performance was determined from results of the study. In addition, a good prediction of the thermal behaviour in agreement with experimental results was obtained. Numerical and experimental approaches of heat transfer enhancement study of phase changing materials using a mixture (hybrid) of Nanoparticles is rare. The purpose of this study is to develop an effective latent heat solar air heater thermal energy storage using Nano-hybrid phase changing materials ; for crop drying process applications. This work will use two methods, a numerical approach to model melting/solidification behaviour of a new hybrid Nano enhanced solar thermal energy storage and an experimental method to synthesize, characterize and to carry out test using small-scale prototype hybrid Nano enhanced phase changing materials (NePCM) thermal energy storage integrated to a double pass air heater agro product dryer.

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