



## **THERMAL CHARACTERISTICS OF PHASE CHANGE MATERIAL USED AS THERMAL STORAGE SYSTEM BY USING SOLAR ENERGY**

**Kadhim F. Nasir<sup>1</sup>, Munir Ali<sup>2</sup> and Ameer H. AL Mamoori<sup>3</sup>**

<sup>1</sup> PhD, Farm Machinery and Equipment Eng. Dept., AL Mussaib Technical College, AL Furat Alawsat Technical University, Email: [kka\\_ff70@yahoo.com](mailto:kka_ff70@yahoo.com),

<sup>2</sup> PhD, Ankara Yildirim Beyazit University, Email: [monierelfarra@hotmail.com](mailto:monierelfarra@hotmail.com)

<sup>3</sup> Mechanical Dept., AL Mussaib Technical Institute, AL Furat Alawsat Technical University, Email: [aemirhassan48@gmail.com](mailto:aemirhassan48@gmail.com)

<http://dx.doi.org/10.30572/2018/kje/090101>

### **ABSTRACT**

In this paper, the melting processes of phase change material in a shell and tube heat exchanger by using solar thermal energy have been investigated numerically and experimentally. All experimental were outdoor tested at AL-Mussaib city-Babylon-Iraq (Lat 32.5 ° North, and long 44.3 ° East) with N-S collector direction at tilt angle of 32.5 ° with the horizontal. The phase change material used in this work is black color Iraqi origin pure Paraffin with amount of 12 kg. In the experimental setup evacuated tube solar collector is employed for melting phase change material in shell regime. Different volume flow rates for the water flow inside the inner tube of heat exchanger namely (200, 300, and 500 LPH) for Reynolds number namely (15000, 23000, 38000) respectively were used for each season from August 2016 to January 2017. The numerical investigation involves a three dimension numerical solution of model by a commercial package ANSYS FLUENT 15.0. The boundary conditions of the model that solved by the numerical solution have been taken from the experimental tests. The experimental results indicated that the inner tube inlet and ambient temperatures has a significant effects on the melting process compared with the volume flow rates. Studying phase change material temperature distribution, it is exposed that a melting temperature of the phase change material in summer season needed time of (3-4) hours only, while it needed more time; (14-16) hours in winter season. Increasing solar radiation and ambient temperature reduces the melting time of phase change material. Increasing water temperature difference of inner tube increased the heat gained for phase change material. The results obtained from numerical solution presented the static temperature contours and showed that the temperature distribution of phase change material give good validations with experimental results with percentage deviation of 2.7%. The present experimental results have been compared with the previous studies and give a good agreement with increasing for present work of 25.9 %.

**KEY WORDS:** phase change material, paraffin, solar energy, shell and tube, heat exchanger