Annexure – I

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Title of Thesis: Experimental investigation of paraffin wax as an energy storage system

Abstract

The solar energy is increasing reported to be utilized to generate electric power as well as heat in large scale. The main limitation of solar energy is its intermittent nature and hence it becomes more challenging. Latent heat energy storage (LHES) is one of the ways to store available energy to use it later for application during off-sunshine hours. The paraffin wax is one of the most reported phase change material (PCM) used as LHES. But energy charging and discharging times to store energy are long due to the poor thermal conductivity of paraffin wax. Experimental investigation of paraffin wax based four pass thermal energy storage (TES) unit is reported here since it is one of the method to improve the performance of TES unit. A special cylindrical test section is also used to know the solid-liquid (S-L) interface boundary. The main outcomes of this experimental work are: the charging time is reduced by about 24 %, 29 % and 32 % with variation of heat transfer fluid (HTF) flow rate from 50 to 70 LPH for inlet temperature of 60^{o}C, 65^{o}C, and 70^{o}C respectively. Similarly, discharging time is reduced by about 32%, 30% and 28% with variation of flow rate from 50 to 70 LPH for inlet temperature of 20^{o}C, 25^{o}C, and 30^{o}C respectively. The experiment shows the S-L interface moves faster at a higher flow rate and higher inlet temperature.

This PhD Thesis would be useful for providing guideline relating the performance of TES unit for the variation of inlet temperature and flow rate of HTF as a function of input heat energy. This knowledge can be utilized for solar energy system specifically solar water heater (SWH) and for waste heat recovery where hot water is source of energy.

List of Publications:

1. Hadiya, J.P. and Shukla, A.K.N. (2016) ‘Experimental thermal behavior response of paraffin wax as storage unit’, Journal of Thermal Analysis and Calorimetry, Springer, Vol. 124, No. 3, p.1511–1518. https://doi.org/10.1007/s10973-016-5276-2.
2. Hadiya, J.P. and Shukla, A.K.N. (2018) ‘Thermal Energy Storage using phase change materials – A way forward’, Journal of Global Energy Issues, Inderscience Enterprises Ltd, Vol. 41, Nos. 1-4, p.108-127. https://doi.org/10.1504/IJGEI.2018. 092311.