IJARES/June 2016/Volume-4/Issue-6/2414-2419 **ISSN 2347- 9337**

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN ENGINEERING AND SCIENCE

COMPUTATIONAL APPROACH TOWARDS STORAGE OF THERMAL ENERGY USING PHASE CHANGE MATERIALS

Nenavat Parsuram[1], R.Srikanth[2]

[1]M.Tech Student, Dept of Mechanical, Nishita college of Engineering and Technology, Hyderabad, T.S, India

[2]Assistant Professor, Dept of Mechanical, Nishita college of Engineering and Technology, Hyderabad, T.S, India

ABSTRACT:

The Convection Heat transfer is the most important mode of heat transfer we observe often in Thermal industry. Our project deals with storing of energy in appropriate forms, which can conventionally be transformed into necessary form, are recent days challenge to technologists. Energy storage reduces mismatch among supply as well as demand but moreover improves performance as well as consistency of energy systems and plays a significant role in energy conservation. It leads to saving of first-class fuels and makes system more cost efficient by means of reducing wastage of energy as well as capital cost. Storage would get better performance of a power making plant by means of load levelling and higher effectiveness would lead to energy preservation as well as lesser generation cost. One of potential methods of storing thermal energy is application of phase change materials. Unfortunately, prior to important practical application of this knowledge, it is essential to resolve several problems at research as well as development stage.

Keywords: Convection Heat transfer, Energy conservation, Thermal energy, Phase change materials, Energy storage.

1. INTRODUCTION:

The constant increase in level of greenhouse gas emissions and rise in fuel prices are most important driving forces behind efforts to effectively make use of a variety of sources of renewable energy. In several areas of the world, direct solar radiation is considered as one of the major potential sources of energy [1]. The scientists are in search of new as well as renewable energy sources and one of the options is to build up energy storage devices, which are as essential as developing novel sources of energy. The storage of energy in appropriate forms, which can typically be converted into necessary form, is a recent day challenge for technologists. Energy storage reduces mismatch among supply and demand but what's more improves performance as well as consistency of energy systems and plays an essential role in conservation of energy. It leads towards saving of premium fuels and makes system more commercial by means of reducing wastage of energy as well as capital cost. Our project deals with storage of energy in appropriate forms, which can conventionally be transformed into necessary form, are recent days challenge to technologists. One of potential techniques of storing thermal energy is application of phase change materials application of phase change materials [2]. A phase change material is a substance by means of a high heat of fusion which melting as well as solidifying at a certain temperature, stores and releases huge amounts of energy. Heat is absorbed or else released when material changes from solid to liquid as well as vice versa; therefore, phase change materials are classified as latent heat storage units.

2. METHODOLOGY:

The intention of our work is to study performance of thermal energy storage structure by means of different phase change materials. The performance of these materials considering different parameters and their masses are being studied. Rate of heat loss is measured as the index of performance. Best phase change materials between certain materials are determined experimentally and heat transfer analysis by means of ANSYS was done on particular phase change material capsule [3]. Based on the applications, the phase change material has to first be certain on the basis of their melting temperature. Materials that melt under 15 °C are used in support of storing coolness within air conditioning

applications, whereas materials that melt over 90 °C are used in support of absorption refrigeration. The entire other materials that melt among these two temperatures are functional in solar heating and in support of heat load levelling applications. A phase change material by means of a high heat of fusion which melts as well as solidifies at a certain temperature, stores and releases huge amounts of energy. Huge numbers of phase change materials for instance organic, inorganic and eutectic are obtainable in any selected temperature range. On the other hand, most of the phase change materials don't assure necessary criteria for sufficient storage except for melting point in functioning range. Several number of phase change materials such as organic, inorganic and eutectic are obtainable in any necessary temperature range as shown in fig1. There are a fat number of organic as well as inorganic chemical materials, which are identified as phase change material from the viewpoint melting temperature as well as latent heat of fusion. On the other hand, except for melting point within operating range, majority of phase alter materials does not assure criteria necessary for an sufficient storage media.

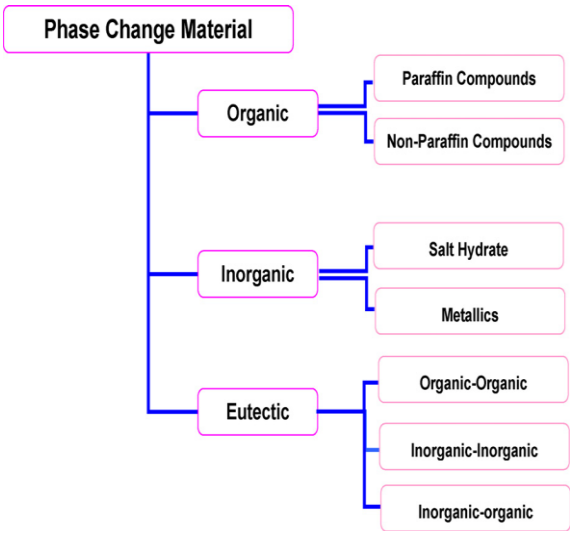


Fig1: Classification of phase change materials

3. AN OVERVIEW OF EXPERIMENTAL WORK:

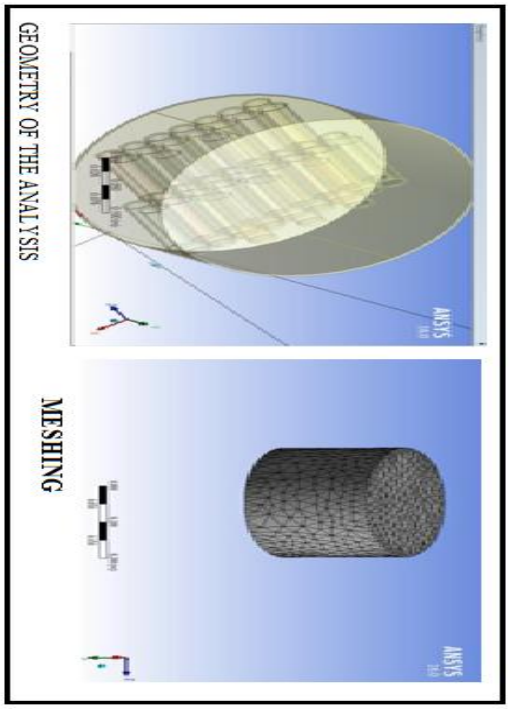
A phase - change material by means of a high heat of fusion melts and solidifies at a certain temperature , stores and releases large amounts of energy. Heat is absorbed or else released when material changes from solid to liquid as well as vice versa therefore, these material are classified as latent heat storage units. Phase change materials are energy storage materials able to absorb or else release huge quantities of energy at steady temperature by means of undergoing the change of phase [4]. Thermal energy transfer takes place when a material changes from solid towards liquid as well as vice versa. A thermal energy storage system is

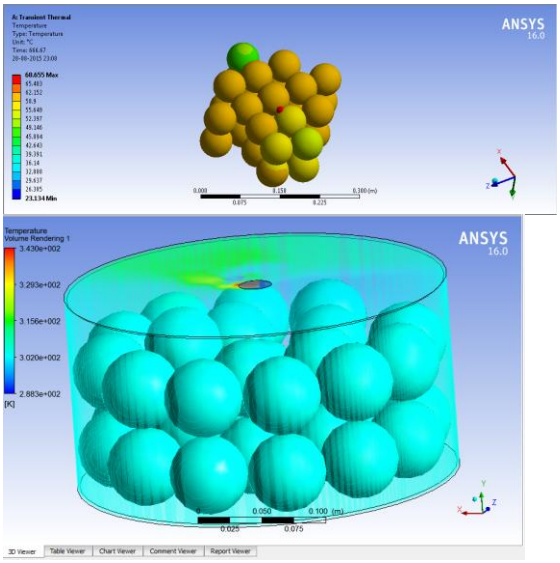
considered for its thermal performance considering that system has to preserve heat for extra time when compared to conventional thermal insulating system. The thermal performance of system is assessed on rate of heat lost as well as time for which heat energy is accumulated by system. More the time for which system stores heat energy, more is performance of system. In this procedure, the quantity of heat stored by Phase changing materials is calculated. Also time for which energy is stored up is calculated. The phase changing materials used are sodium thio-sulphate, sodium acetate. A storage system is considered in such a means that storage tank made of stainless steel includes SHS material where sensible heat materials as well as phase - change material is placed. A cylindrical tank of 10.602 litres capacity is utilized by dimensions **Φ**300 X 150 mm. The storage tank is insulated by means of glass wool layer of 25 mm thickness to put off loss of heat towards surroundings. A tight packing is made by means of rubber bands along with cello tape. A digital thermometer is utilized to record temperature of heat transfer fluid as well as phase change material. At first water is heated within an insulated plastic vessel by an immersion water heater and subsequently hot water is poured into insulated tank considered for thermal energy storage. The temperature of water is measured by thermometer. The energy that is stored within the material as latent heat. Temperature of Latent heat material is recorded at an interval of each five minutes and time taken by Sensible heat material, to reach room temperatures is recorded. In the process of charging process, energy is gained constantly by the material by supplied HTF. As charging process proceeds, energy storage enhances until it reaches equilibrium position. The discharging procedure is a constant process as heat is lost constantly towards surroundings .The difference within rate of heat transfer among insulated tank as well as insulated tank with sensible heat material is calculated [5]. The time lag among heat losses in both cases can moreover be calculated. ANSYS is total FEA software package utilized by engineers globally in virtually in the entire fields of engineering. ANSYS reduce designs that are not appropriate for prototype testing. The bottom line: Cost savings, Savings of time, makes more consistent, better-quality designs. To simulate actual physical models

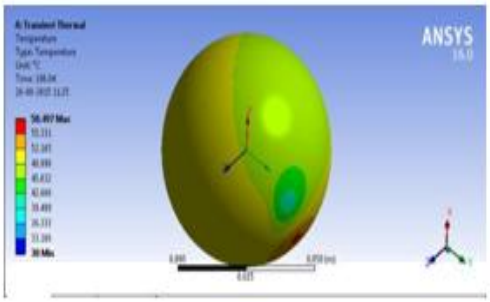
in actual working conditions by computers. The ANSYS program is self-contained common purpose restricted element program which is developed as well as maintained by Swason Analysis Systems Inc. The program includes numerous routines, all consistent, and all for most important purpose of achieving a solution towards an engineering problem by means of finite element method.

4. RESULTS:

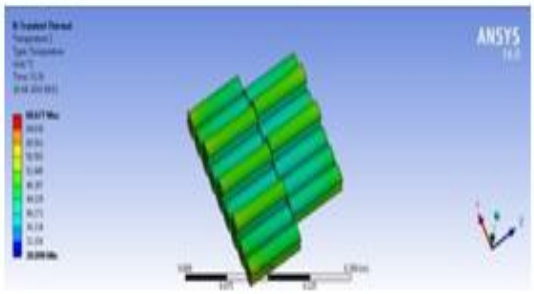
The following results are obtained from our work.



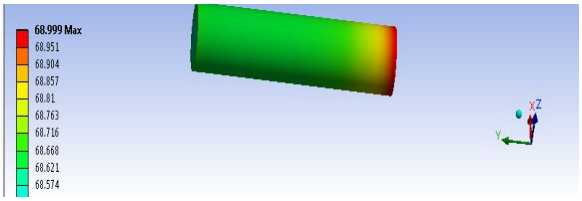


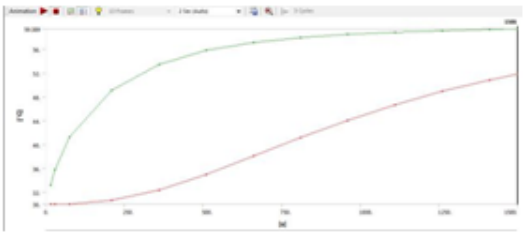


Convection@ 162sec



Cylinder @1min





Graph

5. CONCLUSION:

Our project deals with storing of energy in appropriate forms, which can conventionally be transformed into necessary form, are recent days challenge to technologists. A storage system is considered in such a means that storage tank made of stainless steel includes SHS material where sensible heat materials as well as phase change material is placed. A thermal energy storage system is considered for its thermal performance considering that system has to preserve heat for extra time when compared to conventional thermal insulating system. The thermal performance of system is assessed on rate of heat lost as well as time for which heat energy is accumulated by system. ANSYS is total software package utilized by engineers globally in virtually in the entire fields of engineering and it reduce designs that are not appropriate for prototype testing. From our work we can observe difference among cylinder and sphere where sphere receive less time in convection process. The Paraffin wax is phase change material that is used in analysis.

REFERENCES

[1]. Günther, E., H. Mehling, S. Hiebler, Measurement of the Enthalpy of PCM, Proceedings of Eff stock 2009 – 11th International Conference on Thermal Energy Storage, 2009, Stockholm, Sweden.

[2]. Hauer, A., Thermochemical Energy Storage Systems, CIMTEC, 5th Forum on New Materials, June 2006, Montecatini Italy.

[3]. Garg, H.P. et al., Solar Thermal Energy Storage, D. Reidel Publishing Company, Dordrecht/Boston/Lancaster, 1985, ISBN 90-277-1930-6

[4]. Kroenauer, A., E. Laevemann, A. Hauer, Mobile Sorption Heat Storage in Industrial Waste Heat Recovery, International Conference on Energy Storage, InnoStock 2012, May 2012, Lleida, Spain.

[5]. Hauer, A., Storage Technology Issues and Opportunities, Committee on Energy Research and Technology (International Energy Agency), International Low-Carbon Energy Technology Platform, Strategic and Cross-Cutting Workshop "Energy Storage – Issues and Opportunities", 15 February 2011, Paris. France