

# An experimental investigation of thermal analysis of natural fiber base polymer foam

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## ABSTRACT

This paper is an experimental examination of warm investigation of polyurethane foam material. Heat move in metal foam is one of the fields of specific examination enthusiasm because of the likelihood of conferring customized viable thermo-physical properties for different applications. In this paper, we propose to investigation of an integrated collector storage solar water heater. The discourse is connected firstly approval of thermal analysis model. The investigation of warmth exchange requires determination of the powerful warm conductivity and the warm contact resistance (TCR) connected with the interface between the metal foam and the neighboring surfaces or layers. The warm conductivity of polyurethane foam at mean temperature 55° c is examined tentatively and in addition warm examination. Select one use of polyurethane foam material e.g. sunlight based water radiator (solar water heater). The study concentrates on the relative warm execution of this gatherer and another authority, indistinguishable in configuration, working under the same condition utilizing polyurethane from as heat insulation material.

**KEY WORDS:** Thermal conductivity, Heat insulation, Polyurethane foam, Thermal analysis.

## 1. INTRODUCTION

Presently days there are such a large number of water radiator are utilized as a part of that sun powered and additionally electrical water warmer too. Polyurethane foam is warmth protection material. The quality with most minimal warm conductivity will have best warmth protection. The sun oriented water radiator use polyurethane froth as warmth protection. Ascertain warm conductivity of PU foam hypothetically and also tentatively. Polyurethane foam is best known for supporting our body for a huge part of the day, in sleeping pads, upholstered furniture and auto seats. Polyurethane can be a strong or can have an open cell structure, in which case it is called froth and froths can be adaptable or inflexible. Polyurethane foam can be made by responding polyols and diisocyanates, both items got from raw petroleum. Coordinated authority stockpiling sun oriented water warmers are extremely basic heavenly bodies showing worthy warm execution. Polyurethane froths are utilized as a part of basic boards and other composite structures.

Polyurethane foam having low thermal conductivity i.e. 0.046 w/mk at 55°c. At low warm conductivity will have the best insulation. Polyurethane foam won't pack or settle. This kind of solar water heater was contemplated by various creators who investigated its warm execution and proposed diverse solutions for enhance its working. The principle capacities of warm protection are preservation of vitality, control of temperature, control of heat exchange. Jhy (1999), introduced as warm conductivity of polyurethane froth and demonstrated that figuring of warm conductivity of PU froth hypothetically and also tentatively. Six distinctive size of cells are utilized. The compelling warm conductivity diminishes when the phone size gets to be smaller. Monia Chaabane (2014), displayed as Thermal execution of an incorporated gatherer stockpiling sun oriented water warmer (ICSSWH) with stage change materials (PCM) and demonstrated that numerically investigation of coordinated authority sun powered water radiator a created two numerical model in 3D i.e. Sensible warmth stockpiling unit and CFD model and utilize two materials myristic corrosive and RT42-graphite. Andoh (2010), exhibited as Thermal execution investigation of a sun oriented gatherer utilizing a characteristic vegetable fiber, coconut coir, as warmth protection and demonstrated that Local vegetable material utilized as warmth protection. Contrast warm execution of two authority and outline, creation and working framework under same condition. Glass fleece is utilized as warmth insulation. Mohammad Ali Fazilati (2013), exhibited as Phase change material for improving sun oriented water warmer, a test approach and demonstrated that the impact of PCM on sunlight based water radiator have been exploratory examined. Paraffin wax is utilized as PCM. Impact of three radiation force i.e. mean, peak, and solid are examined. Helal (2010), exhibited as Energetic execution investigation of a coordinated gatherer stockpiling sun based water warmer and demonstrated that exploratory investigation of incorporated authority stockpiling sun based water radiator and ascertain the estimation of sun powered radiation day by day.

Thinking about, the colossal enthusiasm of comprehension the operation of this nearby planetary group and need of its execution change an endeavor is made to study this setup of incorporated gatherer stockpiling sun powered water framework.

**Problem definition:** Most of the solar water heaters uses paraffin vax, myristic acid and glass wool as heat insulation but all insulation material does not maintain hot water for longer time so by using polyurethane foam we have to check whether it is more applicable or not.

## 2. MODELLING AND SIMULATION

**Geometric Description and Materials:** The model of SWH is created utilizing solid work's programming. The main model translates the geometry of ICSSWH tentatively. The geometry of SWH in which the capacity tank is secured with polyurethane foam material. It depends on same suspicions model and limit conditions. The ICSSWH tried by Monia Chaabane (2014), comprises of stainless steel tank of 95 L stockpiling volume. The stainless steel tank secured with polyurethane foam and there is one glass surface of 3mm on polyurethane foam.

This SWH which is south east-bound to delineated in fig.1. The computational lattice of the SWH intended for the model approval is appeared in fig.2. The cross section created in whole field of this SWH appeared in fig.3. The thermo physical properties of polyurethane froth utilized as warmth stockpiling material as appeared in table.1.

The study looks at the warm execution of sun based water radiators utilizing heat protection with one utilizing option material polyurethane foam.

**Assumptions and limit conditions:** a) Atmosphere conditions relating to reasonable climate conditions, b) Beginning conditions for time (t) =0 and temperature of water = 294k.

The limit conditions are characterized as takes after: a) The capacity tank and polyurethane froth side surfaces are characterized as coupled, b) The external surfaces of model have heat flux= 0 w/m<sup>2</sup>.

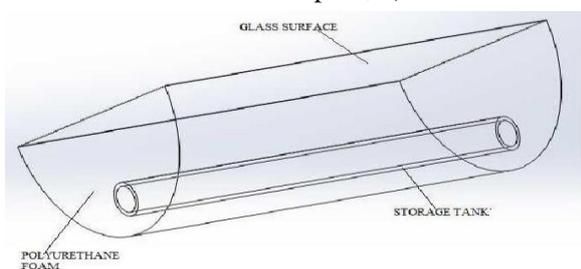


Fig.1. Cross sectional area of SWH

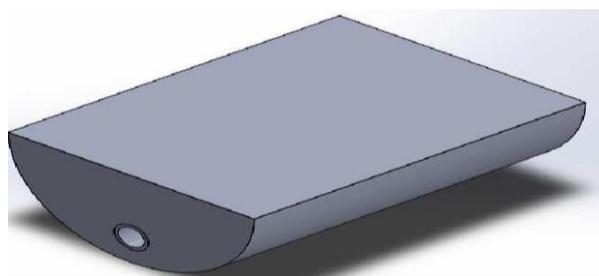


Fig.2. Description of the ICSSWH with PU foam

Table.1. Thermo physical properties of PU foam

Parameter	Values
Thermal conductivity of PU foam (w/mk)	0.046
Density kg/m <sup>3</sup>	40
Specific Heat j/kg/k	2359 to 2996

**Thermal analysis of Polyurethane foam:** A few presumptions, models and limit conditions utilized for the model acceptance are considered for warm examination study. According to given model the length of sun based authority is 2232mm and width is 1658mm. Span of water stockpiling tank is 116mm. the thickness of glass surface is 3mm. the meshing size of surface is 20mm. the quantity of hubs are 284138 and components are 63300. There are 20 hubs and just 1 level of opportunity i.e. temperature. The component is solid90. There is surface to surface contact thus conta174 taken and target is 170. For conta174, conta171 and conta172 target170 is utilized. The utilization PU foam can withstand a most extreme temperature of 393k and least temperature of 63k. Past this range the froth won't ready to execute as proposed.

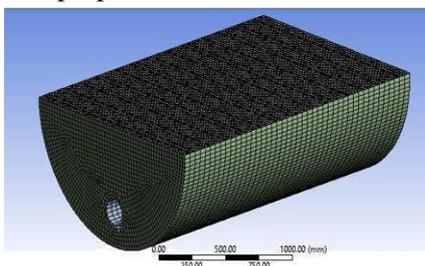


Fig.3. Meshing model

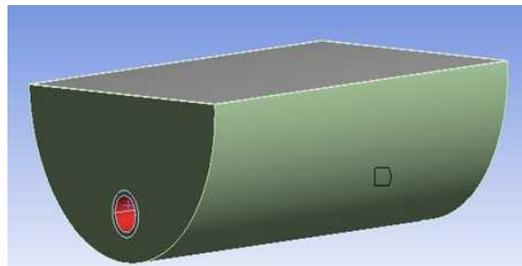
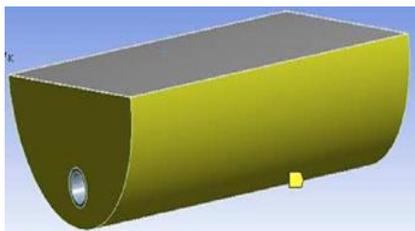


Fig.4. Inlet temps. of water

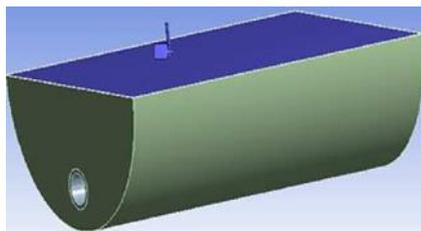
The following shows the material properties used in thermal analysis of solar water heater:

Table.3. Thermo physical properties

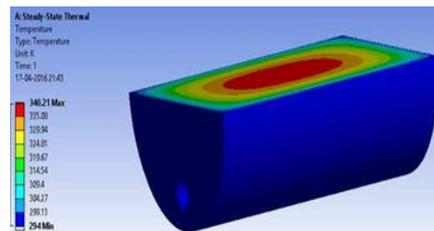
Parameter	Values
Thermal conductivity of PU foam	0.046w/mk
Thermal conductivity of stainless steel	16 w/mk
Thermal conductivity of glass	1.05 w/mk
Convective heat transfer coefficient	35.17 w/m <sup>2</sup> k
Heat flux of glass surface	5.1142 KWh/m <sup>2</sup>
Temperature of water	294k



**Fig.5. convective heat transfer coefficient**



**Fig.6. heat flux of glass surface**



**Fig.7. temperature distribution**

The analysis of fig.7 demonstrates that the temperature of air is higher than that of the water and the SWH presents the most noteworthy temperature in the whole area. The consequence of thermal analysis of the ICSSWH working have in this manner demonstrated that the utilization of PU foam in ICSSWH presents a noteworthy point of preference with respect to the warm misfortune decrease.

### 3. RESULTS AND DISCUSSION

**Table.4. Thermal analysis results**

Material	Temp.
Polyurethane foam	340.21 k
Myristic acid	327 k
RT-42 Graphite	317 k

These outcomes plainly point the change of execution of the ICSSWH with the presentation of PU froth. The warm execution relies on upon the outline parameters, thickness and kind of protection, working conditions and sort of glass spread. In this way the thickness and warm conductivity of the protection constitute deciding variables. Thus higher the warm conductivity of the protections, higher the warm misfortunes through the side and base of the gatherers, subsequently weaker is the warm adequacy. The study concentrates on the capacity of every framework to change over sunlight based vitality into warmth. The information displayed for the correlations are those acquired for the best working conditions.

### 4. CONCLUSION

Solar water heating system plays an important role in sustainable energy management in Indian households as well as worldwide. This paper is focused on performance of the polyurethane foam in the solar storage system. Polyurethane foam is used as heat insulation to evaluate the thermal performance of solar water heater. Presentation of polyurethane foam in SWH is the influence the warmth exchange from capacity tank that can enhance the warm execution of this nearby planetary group. Its great warm execution demonstrates that this material is great option material to consider sun based water radiator at sensible cost.

### 5. ACKNOWLEDGEMENT

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