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FABRICATION OF COMPOSITE WALL AND STUDY OF THERMAL CONDUCTIVITY WITH DIFFERENT MATERIALS: COMPARISON OF STEADY STATE CONDITION

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Abstract

Accurate calculation of the effective thermal conductivity of different materials isgreat importance. In this present fabricated the composite wall and studied the thermal conductivity of various materials like a Gun metal, as a composite material along with Hylam, Stainless Steel withvarying the voltage at 80V, 90V and 100 at steady state condition. It was found that the results from the present study, gun metal have high thermal conductivity compared to another material.

Key words: Gun metal, StainlessSteel, Hylam ,thermal conductivity

I.INTRODUCTION

In engineering applications, we deal with many problems. Rapid growth in usage and popularity for composite material in the field of engineering and material sciences is that they provide highly attractive combination of stiffness, toughness with light weight and corrosion resistance properties.Heat transfer through the composite wall is one of them. It is the transport of energy between the two bodies or more bodies of different thermal conductivity arranged in serials or parallel. For example, a fastener joining two mediums also acts as one of the layers between these mediums. Hence, the thermal conductivity of the fastener is also very much necessary in determining the overall heat transfer through the medium. An attempt has been made to show the concept of heat transfers through composite walls. The heat energy transition from a region of higher to one of lower temperature in such a way that the regions reach thermal equilibrium. This temperature difference is the driving force for the transfer of thermal energy, also known as heat transfer. This is the Second Law of Thermodynamics. There are three modes of heat transfer: Conduction, convection, and radiation.

II. LITERATURE REVIEW

Patil et al., (2015) examined of composite material's thermal characteristics is important for ensuring heat exchange rate and heat flow.They investigated the thermal functions of two composites in this study. The restricted component programme ANSYS is used to determine heat motion and heat flow rate. The heat flux and heat transfer rate of composite materials trial test has been completed. The exploratory results are compared to the ANSYS finite element results, and the validation is completed.**SachendraKori et al., (2016)** investigated the materials charcoal and normal gum in combination with mild steel, Bakelite, and wood. In which an inquiry was conducted on a composite material wall and a mica heater plate was installed midway in the mix on the composite wall, with the voltage varying between 80, 120, 160, and present. The observed result suggests that regular gum can be used as a future coating layer**.YogeshBelage et al., (2016)** Due to the low thermal conductivity of the adhesive layer, increasing the thickness of the adhesive layer in the Al1050/SS304 sandwich composite material.The effect of sandwich sheet thickness modification on the thermal conductivity of the Al1050/SS304 sandwich composite material determined the proper application in the fields of vehicles and aerospace by optimising the thickness of sandwich layers in the Al1050/SS304 sandwich composite sheet.**VikasMukhraiyaet al., (2016)** analysed the majority of experimental studies and concluded that natural gum had no thermal conductivity. As a result, we can use natural gum as an insulator. Electric wire, electrician gloves, pluggers, and cable covers are all fabricated with this material.**R.R. Naslain (2016)** combined of two or more constituent materials with considerably different physical or chemical properties, resulting in a material with unique qualities distinct from the constituent elements.**P. Sengottvel et al.,(2017)** investigated how the value of thermal conductivity varies from material to material, which is useful in determining which material is best for a certain application.**Haymes et al., (2017)** investigated a warm multi-scale detailing process for composite materials that relied on mechanical homogeneity. Through decreasing to the microscale level, the revealed specification evaluates the possible obviously evident thermal conductivity of the composite materials as well as the miniscule heat flux field.For the least amount of heat dissipation by the furnace wall, **Mohite et al., (2017)** focused on furnace wall composite materials. Alumina, Magnesia, and Zirconia are three different metals that are used. This research is carried out using Ansys Workbench programming, and the results are compared to the analytical results. They can reduce heat

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dissipation by 48 % through property enhancement and 64 % through design optimization as a result of the results.

III. MATERIALS

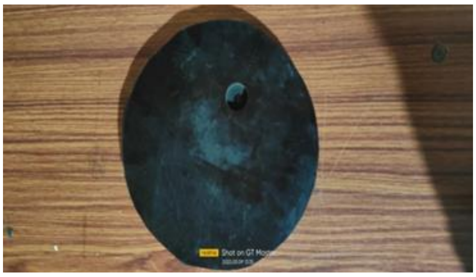

Fig.1 Gun metal

Fig.2 Hylam

Fig.3 Stainless Steel

Fig.4 Heater, Ammeter, Thermo couples

TABLE .1 PHYSICAL PROPERTIES OF MATERIALS

	Gun Metal	Stainless Steel	Hylam
Yield strength (MPa)	152	170	50
Tensile strength (MPa)	221 -310	500 - 700	99.3
Elongation (%)	25%	45%	2%
Fatigue strength (MPa)	90	334– 290.93	13.8-24.8

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IV. EXPERIMENTAL WORK

The schematic layout of the experimental setup of the composite walland its attachments are shown in fig (5,6).The apparatus consists of central heater sandwiched between the slabs of gun metal, stainless steel and Hylam, which forms composite structure. The technical specifications of the test composite wall are given in table.2. The technical specifications of the test The whole structure is well tightened make perfect contact between the slabs. A dimmer stat is provided to vary heat input of heaters and it is measured by a digital volt meter and ammeter. Thermocouples are embedded between interfaces of slabs. A digital temperature indicator is p rovided to measure temperature at various points.

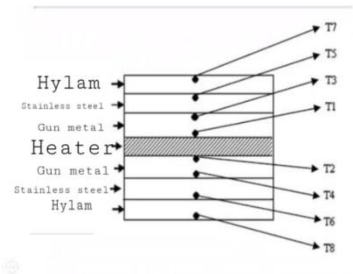

Fig.5 Experimental Setup Fig.6 Schematic diagram of composite wall

Specifications

1	Slab assembly arranged symmetrically on both sides of the Heater
2	Mica heater of 300-Watt capacity
3	Dimmer stat open type, 230v, 0-2 amp, single phase
4	Voltmeter Upto 1000V
5	Ammeter 1-10A
6	Digital temperature indicator
7	Slab diameter =200 mm
8	Thickness of Gunmetal= 18 mm
9	Thickness of Stainless steel= 16 mm
10	Thickness of Hylam=12mm

WORKING

First of all, arrange three plates. Centre one is heater plate (mica plate) and other is Gun metal plate, Stainless steel plate and Hylam plate. Three types of slabs are provided on both sides of the heater, which forms a composite structure. A small hand press frame is provided to ensure the perfect contact between the slabs. A dimmer stat is provided for varying the input to the heater and measurements of input are carried out by a voltmeter and Ammeter. Thermocouples are embedded between the interface of input slabs to read the temperature of the surfaces

- Arrange the plates in proper fashion (symmetrical) on both sides of the heater plates.
- See that plates are symmetrically arranged on both sides of the heater plates.
- Operate the hand press properly to ensure perfect contact between the plates.
- Close the box by cover sheet to achieve steady environmental conditions.
- Switch on the supply of heater.
- Give known steady input to the heater with the help of dimmerstat.
- Keep initially 80 V for 60 minutes almost and then increase to 90 V,100 V till steady state is reached so that steady state can be reached within less time.
- Check the input to the heater with selector switch, voltmeter &ammeter.
- Note down the temperature every 10 minutes till a steady condition is reached.
- Calculate the thermal resistance of the material based on the steady state condition readings.

V. RESULT AND DISCUSSION

Thermal Conductivity

Fig.10 shows the comparison between thermal conductivity calculated for constituent material. The transfer of heat from one portion of a body to another with which it comes into contact is known as thermal conduction. Thermal conductivity () is defined as a material's ability to transmit heat and is measured in watts per square metre of surface area for a temperature gradient of 1K per unit thickness of 1m for a temperature gradient of 1K per unit thickness of 1m.The density of the material, the moisture content of the substance, and the ambient temperature are the key elements that influence thermal conductivity. The thermal conductivity increases as the density, moisture, and temperature of the environment rise. The inherent structure of materials plays a significant role. The experimental work conducted at steady state conditionwith various materials as shown in Fig(7-9). Fig.10 found that theThermal conductivity of Gun metal ,Stainless Steel and Hylam are 69w/m.k,11 w/mk and 0.7w/mk at80 voltage Thermal conductivity of Gun Metal, Stainless steel and Hylam are 70w/mk ,12.6 w/mk and 0.78 at 90voltage. Thermal conductivity of Gun Metal , Stainless Steel and Hylam are 72 w/mk , 13 w/mk and 0.79w/mk at 100 voltage. According to changing the position of the dimmer.

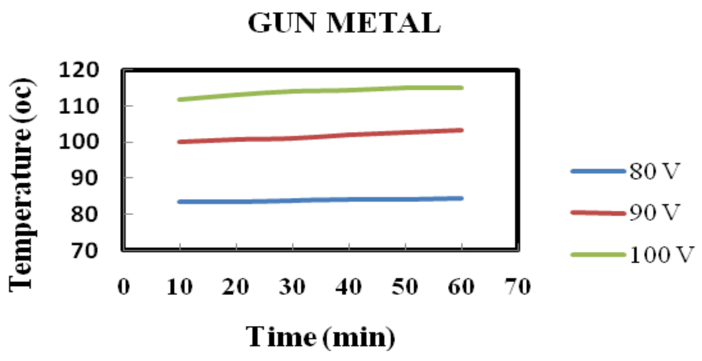

Fig.7 Variation of Temperature with time

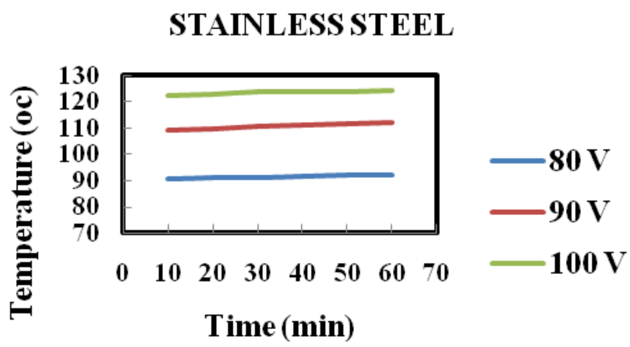

Fig.8 Variation of Temperature with time

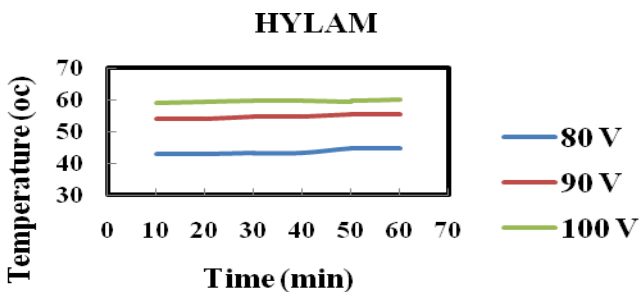

Fig.9 Variation of Temperature with time

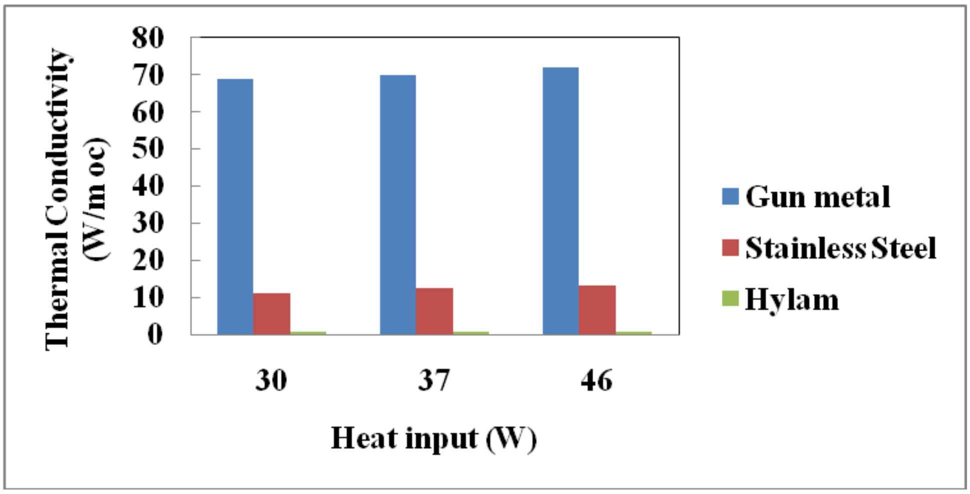

Fig.10 Variation of thermal conductivity with heat input

VI.CONCULSION

From the above experiment we concluded that this apparatus is useful to find out thermal conductivity of composite slab, consisting of different materials. From the result it is seen that for different material of composite slab the value of thermal conductivity varies according to material to material which is useful to select the specific material for given application.

Hence experimental investigation is proved by our apparatus. “The future is in composites” is the acknowledgment of numerous many years of high innovation advance towards diverse materials and parts gathered and consolidated as solid units that would give a mix of adaptability, quality and different properties past the potential outcomes of traditional materials like metal, wood, or cement. In this paper the thermal analysis of composite wall are analyzed for a steady state condition.

VII. ACKNOWLEDGEMENT

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