Experimental and Investigation of Al-Ag with Magnesium Composite Material Heat Transfer by using Pin-Fin Apparatus

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Abstract **- The aim of the present study is to improve the heat transfer characteristics and to investigate the performance of fin efficiency by using fins of different materials in pin fin apparatus. Here the system follows forced convection as the mode of heat transfer and it is the principle used in it.Engine cylinder can be cooled by fluids like oil and air as media. To improve the efficiency of air cooling, fins will be provided as they provide the more surface area for heat dissipation. But when we keep increasing the surface area, there are other factors like weight & size will shoot up which will complicate the design of fins and engine cylinder.This paper discussed composite of Aluminium alloy, Silver and magnesium material and to evaluate the heat transfer properties through PIN- FIN apparatus**

I. INTRODUCTION

In reaction to increasing worldwide competition and developing concern for environment,the auto manufactureers have already been encouraged to meet up the conflicting demands of increased power and performance, lower fuel consumption, lower pollution emission and reduced vibration and effective heat transfer.Now days, most of the engineering processes require better design of fin configuration for any heat transfer application with progressively less weight, volume, accommodate shape, new manufacturing process and cost as well as the thermal behaviour. The rate of heat transfer depends on the surface area of the fin and selection of materials. The annular composite fin is one of the most popular choices for exchanging the heat from the primary surface to surrounding. An extended surface is a heatabsorbing or heat rejecting surface from base surface to surrounding fluid, when it is connected with the prime surface.

II. LITERATURE REVIEW

III.

- Al-Mg-Ag alloys are being increasingly used in automotive and aerospace industries for critical structure applications because of their excellent castability and corrosion resistance and, in treated

condition. These are known as 4xxx series of wrought alloys and 3xx.0 and 4xx.0 series of casting alloys. In these alloys, Mg is intentionally added to induce age hardening through precipitation of Mg2Si, metastable phases or Guinier Preston zones.

- In the research of J. Ajay Paul and Sagar Chavan Vijay Parametric Study of Extended Fins in the Optimization of Internal Combustion Engine they found that for high speed vehicles Engines thicker fins provide better efficiency. When fin thickness increases, the gap between the fins reduces that resulted in swirls being created which helped in increasing the heat transfer. Large number of fins with less thickness can be preferred in high speed vehicles than thick fins with less numbers as it helps inducing greater turbulence.

- Author plotted the experimental results, it shows the variation of the heat Transfer with respect to velocity.

Ansys fluent software was used to predict the behavior or wind flow and analysis. At zero velocity it is seen that the heat transfer from the 4mm and 6mm fins are the same. When the velocity is increased it can be seen that the heat transfer is increased with due to forced convection and also due to the swirl generated between two fins which induces turbulences and hence higher heat transfer. For a larger fin thickness, the corresponding fin spacing is comparatively small. As a consequence, the generated swirled flow may mingle with the main flow and result in a higher heat transfer performance.

- Pradeep singh et al, stated that the rectangular shaped extended surfaces shows the high rate of heat transfer when compared to other extensions at same length. Kang Hiechan, has made many experiments to find the fin efficiency and concluded that the efficiency of fin is useful when the value of NTU is zero otherwise the fin efficiency is high when the NTU is high and is used in air conditioning systems.

- Shivdas S Kharche et al, explained that the when a notch is provided on the surface of fin with a rectangular shape the fin supports for much heat transfer and compared the heat transfer rate of fins by changing the material from Aluminium to copper and found that copper shows much heat transfer value than aluminum. Sandhya Mirapalli, et al, had made a conclusion that for a triangular fin when the length is increased the heat flow percentage also increases at constant base temperature compared to rectangular fin.

- I.Lakshmi Anusha et al, concluded that total weight of the system made of splayed pin fins can be reduced to the minimum level by using the advanced composite materials like polyphenylene sulphide (PPS), carbon foam, graphite epoxy at the same thermal inputs. Zhang, H.S et al., resulted that a fabric heat sink temperature distribution is so nearer to common pin fin heat sink but the temperature decreases in axial direction by increasing the pin fin length. The temperature of the common pin fin heat sink is lower than the fabric pin fin heat sink at the root level (base), while the temperature increased at the length of pin fin because of the presence of base plate at the fin root level.

- Sampath SS et al., compared the temperature distribution of a cylindrical element at various points is carried out by providing the thermal conductivity and heat transfer coefficient and with prescribed boundary conditions and analysed with the help of simulation software and DOT NET software and the results are almost equal expect at the middle of the specimen it is just deviated..

- Amol B. Dhumne et al. resulted that to achieve high thermal performance the cylindrical perforated pin fins are used they leads to high heat transfer than the cylindrical pin fins. The efficiency varies depending upon clearance ratio and inter-spacing ratio and also lower clearance ratio, lower inter-fin spacing ratio and lower Reynolds numbers are suggested. M. P. Shah et al., compared the study of cylindrical pin fin was done by changing the material conductivity and heat transfer coefficient for copper ,AA1100,AA2011 materials and concluded that the heat transfer rate increases when thermal conductivity of material increases.

- Y. Pratapa Reddy et al., had made an experimental analysis on a pin fins made of different materials (aluminum, copper) and composite bars (brass and aluminum, copper and aluminum) and concluded that the composite made of copper and aluminum shows higher efficiency than the solid pin fin and from these the values of base temperatures are considered as input source for simulation analysis on different materials.

IV. EXPERIMENTAL SET UP

The composites were prepared by stir casting process. Shows schematic diagram the original setup of the stir casting process. Resistance furnace with a temperature range of 3000 C was used to melt the matrix material. The furnace has a temperature controller with k type thermocouple to control and measure the temperature.

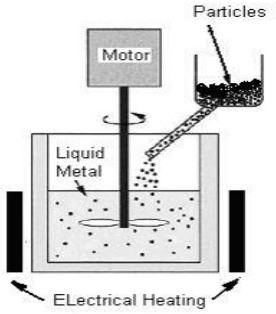

Fig:Schematic Diagram of Stir Casting

An electric motor is fixed at the top of the furnace to provide stirring motion to the stirrer. The speed of the stirrer can be varied as the setup has a speed controller attached to it.

Fig. Heat transfer in pin fin apparatus

IV.RESULTS AND DISCUSSION

HEAT TRANSFER TEST:
PIN FIN APPARATUS

Table 1 reading for Aluminium:

Volt	Amps (A)	T1 (°c)	T2 (°c)	T3 (°c)	T4 (°c)	T5 (°c)	T6 (°c)	Heat transfer coefficient (h) w/m^{2}k	Efficiency ŋ %
50	0.45	45	41	35	33	28	25	16.41	86.25
60	0.60	53	49	37	35	29	28	19.11	84.33

Table 2 Reading for composite

Volt (V)	Amps (A)	T1 (°c)	T2 (°c)	T3 (°c)	T4 (°c)	T5 (°c)	T6 (°c)	(h) w/m^{2}k	Efficiency ŋ %
50	0.45	43	39	33	30	26	23	26.28	89.51
60	0.60	50	46	34	31	27	26	29.89	86.71

V. CONCLUSION

Micron-sized Silver particles were incorporated into a melt of aluminium with magnesium the aid of addition as a wetting agent to fabricate aluminium matrix composite. Two casting temperatures and stirring time were applied to focus on the ceramic particle incorporation, porosity formation, agglomeration of ceramic particles, and interfacial reactions between Composite materials especially aluminum and silver composites having good mechanical properties compared with the conventional materials. It is used in various industrial application these materials having light weight along with high hardness. It with stand high load compare with the existing materials are most applicable in the engineering products instead of existing materials. Finally it was concluded that the percentage of al-ag-mg increases automatically the heat transfer rate increased.

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