

EXPERIMENT ON HEAT DISSIPATION IN INTERNAL COMBUSTION ENGINE BLOCK FINS WITH & WITHOUT COPPER WINDING

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ABSTRACT

Copper is a good heat conductive material. Winding of copper on the fine may dissipate heat in a better way. The existing two wheeler engine block is taken and heat source is given by means of heater. The engine block is heated up 80^o c and the cooling time and temperature is calculated till the temperature declines to 40^o c. The experiment is conducted by natural conduction method. The experiment is repeated by winding copper wire on the surface of fins. The readings are tabulated and compared with the engine block without winding. The result shown that the taken for temperature drop got increased for the engine block leaving copper winding than that of the non-winding engine block. It reveals that heat will be trapped from engine block on using copper winding.

Keywords: Thermocouple, copper wire, heating coil

I. INTRODUCTION

Since the study of fins are surfaces heat extend from an object to increase the rate of heat transfer or from the environment by increasing convection. The amount of convection, conduction and radiation of an objects determines the amount of heats it transfer increasing the temperature gradient between the object and the environment, increasing the convection heat transfer co-efficient, or increasing the surface area of the object increase the heat transfer. Something it is not feasible or economical to change the two options. Thus, adding a fin to an object, increase the surface area and can sometimes be an economical solution to heat transfer problems.

II. WORKING

In two wheeler engine the engine block is made up of aluminum during the working of engine the thermal conductivity is less in aluminum. The heat is increased in the engine due to the aluminum so that the fuel is burned before entering into the engine, Hence the efficiency is reduced and fin efficiency also reduced. That we are trying to made the engine in different material. So the copper is better choice among that. So that we use copper only in fins are the testing is carried out to check the heat dissipation.

3.1.Cylinder block (Refer Figure No:1)

A cylinder is a central part of working part of a reciprocating engine or pump, the space in which a piston travels. Multiple cylinders are commonly arranged side by side in a bank, or engine block, which is typically cast iron or aluminum are before receiving precision machine work. Cylinder may be sleeved or sleeveless wear resistant coating such as a sleeveless engine may also be referred to as a bore engine.

Cylinder displacement or swept volume can be calculated by multiplying cross sectional area square of half the bore by the distance the piston travels with in the cylinder stroke. The engine displacement can be calculated by multiplying swept volume of one cylinder by the no of cylinders.

During the earliest stage of engines life, its initial breaking in or running period, small irregularities in the metals are encouraged to gradually from congruent grooves by avoiding the extreme operating conditions , later in its life after mechanical wear has increased the spacing between the piston and the cylinder .



Fig No:1

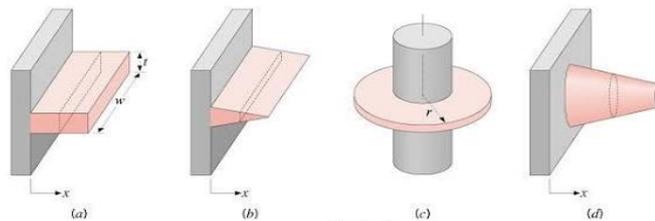


Figure 4

Fig No:2

3.2.FINS

Since the study of fins are surfaces heat extend from an object to increase the rate of heat transfer or from the environment by increasing convection. The amount of convection, conduction and radiation of an objects determines the amount of heats it transfer increasing the temperature gradient between the object and the environment, increasing the convection heat transfer co-efficient, or increasing the surface area of the object increase the heat transfer. Something it is not feasible or economical to change the two options. Thus, adding a fin to an object, increase the surface area and can sometimes be an economical solution to heat transfer problems.

3.2.1.Types: (Refer Figure No:2)

- a) Rectangular fin
- b) Circular fin
- c) Triangular fin
- d) Conical fin.

IV.USES

Fins are mostly used for heat exchanging devices such as radiator, in cars, computer CPU heat sinks and heat exchanger in power plant. They are also used in new technology such as hydrogen fuel cells. Nature has also taken advantages of the phenomenon of fins.

V.TEMPERATUE CONTROLLER WITH LED DISPLAY (Refer Figure No:3)

Temperature indicators are designed for the temperature monitoring and analysis. Temperature indicators either come equipped with an integral of sensors or with the required sensor input. Approximately 16% of all process instrumentation measures, indicates or controls temperature. In many industrial applications it is necessary to collect temperature as a permanent record due to government or manufacturing requirements, or to provide a historical data that may be later used to determine a problem within a system.

The temperature indicators include sensed temperature range, input options and number of input channels. The sensed temperature range refers to the temperature range the device is rated for sensing. Choices for input options include permanent sensors or probe thermocouple inputs, RTD inputs, thermistor inputs and solid state inputs. The number of inputs or channels specifies the number of inputs available for probe or sensor attachment.



Fig No:3

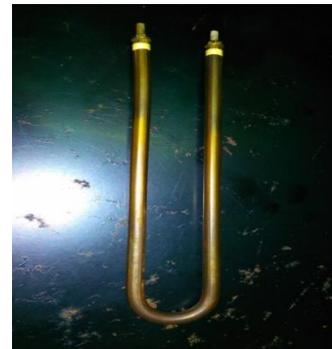


Fig No:4

VI.HEATING COIL (Refer Figure No:4)

Most heating elements use Nichrome 80/20 (80% nickel, 20% chromium) wire, ribbon, or strip. Nichrome 80/20 is an ideal material, because it has relatively high resistance and forms an adherent layer of chromium oxide when it is heated for the first time. Material beneath this layer will not oxidize, preventing the wire from breaking or burning out.

Metallic resistance heating elements may be wire or ribbon, straight or coiled. They are used in common heating devices like [toasters](#) and [hair dryers](#), furnaces for industrial heating, floor heating, roof heating, pathway heating to melt snow, dryers.

VII.SENSOR

Thermocouple is a device it is used for measuring temperature in which a pair of wires of dissimilar metals such as copper and iron are joined and the free ends of wire connected to an instrument as the voltmeter that measures the difference in potential created at junction of the two metals.

7.1.Uses and types

A thermocouple is an electrical device consisting of two different conductors forming electrical junctions at different temperatures.

A thermocouple produces a temperature dependent voltages as result of the thermoelectric effect, and this voltage can be interpreted, to measure temperature. Thermocouples are widely used type of temperature sensor.

Thermocouples are widely used in science industries, applications include temperature measurements for gas turbines exhaust, diesel engines, and other industrial process Thermocouples are also used in homes , office as the temperature sensors in the thermostats and also as flames sensors in safety devices for gas powered and major appliances. The types of thermocouples are K, J, N, AND T.

VIII.MATERIAL SPECIFICATION

8.1.Engine block

- Bore diameter = 50 mm
- Total height = 61.2 mm
- Bore thickness = 7.7 mm
- Fin thickness = 2 mm
- Distance between fins = 9 mm
- Distance from centre and outer edge = 81.15 mm
- Fin length = 38.5 mm
- Engine block volume = 98 cm³

8.2.Heating coil

- Type = coil type
- Material = nichrome
- Thickness = 8 mm
- Capacity = 230v
- Heat produced = 100 to 150°c

8.3.Thermocouple and temperature indicator

- Type = K,J,PT- 100 type
- Range = 0 -1200 °C
- Sensitivity = 41 μV/°C
- Quantity = 1nos
- Type = digital
- Range = up to 1200°c
- Input type = thermocouple

8.4.Copper wire

- Diameter = 2 mm
- Length = 1500 mm.

IX..FABRICATION WORK

9.1.Cylinder head

In an internal combustion engine, the cylinder head sits above the cylinders on the top of the cylinder block. It closes in the top of the cylinder, forming the combustion chamber. This joint is sealed by a head gasket. In most

of the engines, the head also provides space for the passages that feed air and fuel to the cylinder and that allow the exhaust to escape. The head can also be a place to mount the valves, spark plugs, fuel injectors.

Heat generated by air cooled engine is released directly into the air so it is also called as the direct cooled engine typically this is facilitated with metal fins covering the outside of the cylinder head and the cylinders which increase the surface area that act on it. Efficient cooling is achieved by increasing the air flow with well-designed and angled fins.

9.2. Fabrication of cylinder head

There are various types of casting methods based on the specification of the engines they are sand casting, permanent mould casting, lost foam method, pressure die casting method.

In sand casting both the mould and the core are manufactured on the basis of the silica sands or special sands. The mould is based on betonies-bonded binders and the cores are based on chemical binders.

The permanent method of casting is used in the case of the materials such as cast iron or the hot-work steels which are used to produce light metal alloys. The lost foam method is a special type of sand casting method in this various parts of the cylinder head are formed by the foaming of the polystyrene material and then glued together. Then they are dipped in ceramic coatings repeatedly and the dried in an air flow and used as a mould. Hot treated hot work steels are used in the pressure casting method. For our project we brought a SUZUKI MX100cc two wheeler engine with rectangular aluminum fins.

X.CALCULATION

10.1.Aluminium

Thermal conductivity (k) = 220 w/mk

Length of fin = 40 mm

Thickness of fin = 2 mm

Number of fins = 7

Wall temperature (T_b) = 403 k

Fin to at atmospheric t_{mep}. = 303 k

Heat transfer co-efficient (h) = 10 w/m²k.

10.2.Heat dissipated

$$Q = [H.P.K.A]^{0.5} [T_b - T] \tan h [M.L].$$

10.3.Perimeter of the fin

$$P = 2[L+W]$$

$$= 2[40+2]$$

$$P = 84 \text{ mm} = 0.084 \text{ m.}$$

10.4.Area of the fin

$$A = L.T. (\text{number of fin})$$

$$= 0.04 * 0.002 * 7$$

$$A = 5.6 * 10^{-4} \text{ m}^2.$$

$$M = [H.P/K.A]^{1/2} = [(10*0.084)/(220*(5.6*10^{-4}))]^{1/2}$$

$$M = 2.6 \text{ m}^{-1}.$$

10.5.Heat dissipated

$$Q = [H.P.K.A]^{0.5} [Tb-T] \text{ Tan h [M.L].}$$

$$= [10*0.084*220*0.04*0.002*7]^{0.5} .[403-303].[\text{tan h}(2.61*0.04)]$$

$$Q = 3.3 \text{ W.}$$

XI.WHEN COPPER WIRE WIND AROUND ALUMINIUM FIN**11.1.Aluminium**

Thermal conductivity (k) = 220 w/mk

Length of fin = 40 mm

Thickness of fin = 2 mm

Number of fins = 7

Wall temperature (Tb) = 403 k

Fin to at atmospheric tmeP. = 303 k

Heat transfer co-efficient (h) = 10 w/m²k.

11.2.Copper

Diameter of copper wire = 2 mm

Thermal conductivity (k) = 400 w/mk.

11.2.Heat dissipated

$$Q = [H.P.K.A]^{0.5} [Tb-T] \text{ Tan h [M.L].}$$

11.3.Perimeter of the fin (aluminium + copper)

$$P = [(2*(3.14)*r) + 2*(L+W)]$$

$$= [(2*3.14*0.001) + (2*(40+2))]$$

$$P = 0.09 \text{ m.}$$

11.4.Area of the fin (aluminium + copper)

$$A = [L.T. (\text{number of fin}) + (0.785.d^2)]$$

$$= [(5.6*10^{-4}) + (0.785*(0.002)^2)]$$

$$A = 5.6314*10^{-4} \text{ m}^2.$$

$$M = [H.P/K.A]^{1/2}$$

$$= [(10*0.084)/(620*(5.6314*10^{-4}))]^{1/2}$$

$$M = .61 \text{ m}^{-1}.$$

11.5.Heat dissipated

$$Q = [H.P.K.A]^{0.5} [Tb-T] \text{ Tan h [M.L].}$$

$$= [(10*0.09)*620*(5.6314*10^{-4})]^{0.5} (403-303) \text{ tan h } (1.61*0.04)]$$

$$Q = 3.6 \text{ w.}$$



The steps we followed in the assembly of the equipment's are as follows,

1. First step in the assembly is removing supports for the fins in the engine block so that we can give the copper tube across the supports between the fins.
2. Then the thermocouples are taken and then attached to the copper tube and the walls of the cylinder block.
3. Then the thermocouples are attached to a digital temperature indicator.
4. After that the heating coil is fixed inside the cylinder in order to produce heat to the cylinder.
5. The ends of the heating coil are given to the power supply by means of wires.
6. Then the temperatures at the various points are determined by using the digital temperature indicator and the specimen temperature is determined.
7. Using the specimen temperature and the ambient temperature the film temperature can be found.
8. By using the values of the film temperature the properties of air at that temperature is found.
9. Then using these property values and the properties of copper the amount of heat transferred is found as shown below.
10. Using the values of the heat transfer rate of the copper and aluminium material the heat transfer capacity is compared.

XIII. ADVANTAGES

- Copper has more thermal conductivity than aluminium
- Copper conductivity is twice than that of aluminium
- Efficient in conducting heat
- Copper is easily repaired when damaged whereas aluminium requires an entire body change
- It is corrosion resistance
- It is bio fouling (resistance to algae, microorganisms, plant, moisture)
- No harmful emissions while thermal expansion.

XIV.LIMITATIONS

- Manufacturing cost is high
- Copper is a good conductor but not a good radiator when compared with aluminium
- Density of copper is high when compared with aluminium
- Weight of the fins also high
- Cost is high.

- Heat exchangers in oil coolers, air coolers, radiators
- Copper alloys are extensively used as the heat exchangers in the fossil and nuclear steam generating electric power plants
- Copper with nickel is used as heat exchanger is high pressure feed water heaters and sea water piping
- Heat exchangers in solar thermal water systems
- Air conditioning and refrigeration systems
- Used in HVAC(Heat Ventilation and Air Conditioning) system
- As a cooling application in the electronic applications.

Table No:1

Comparison Table for Aluminium And Copper

Properties	Copper	Aluminium
Electrical resistivity	1.7μohm.cm	2.7μohm.cm
Thermal conductivity	400W/mk	220W/mk
Yield strength	140Mpa	29MPa
Elastic modulus	110-140Gpa	50Gpa
Melting point	1083°c	660°c

Table No:2

THERMAL PROPERTIES

S. NO.	CHARACTERITICS	COPPER	ALUMINIUM
1	Thermal conductivity	400 w/mk	220 w/mk
2	Thermal expansion	Less	High
3	Radiation	Less	High
4	Heat transfer	High	Less

Table No:3

OTHER PROPERTIES

S. NO.	CHARACTERITICS	COPPER	ALUMINIUM
1	Corrosion	Less	High
2	Bio fouling	Yes	No
3	Tensile strength	55000 lb/in ²	25000 lb/in ²
4	Density	100 kg/m ³	30 kg/m ³
5	Weight	100 lb	48lb
6	Specific resistance	10.6 w/mft	17 w/mft
7	Electrical resistivity	16.5nΩ-m	23.1 nΩ-m



8	Market price ratio	3	3
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XVI..RESULT**16.1.Without copper winding**

Heating coil temperature – 150⁰c

Rise in temperature of block from 32⁰c to 80⁰c – 30 minutes 16 sec

Drop in temperature of block from 80⁰c to 40⁰c – 19 minutes 28 sec.

16.2.With copper winding

Heating coil temperature – 150⁰c

Rise in temperature of block 32⁰c to 80⁰c – 42 minutes 35sec

Drop in temperature of block from 80⁰c to 40⁰c – 15 minutes 20sec.

XVII..CONCLUSION

The fins used in automobiles engines fins are made with aluminum alloy material. The heat dissipation of aluminum alloy is 3.3w. The fins material is by changing of aluminum alloy addition of copper alloy the heat dissipation of fins will be better than present exiting fins used in automobile engine. If is experimentally found that the heat dissipation of fins made of aluminum copper alloy is 3.6w that greater the exiting fins.

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