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OPTIMISATION OF RADIATOR INCLINATION ANGLE TO MAXIMIZE EFFECTIVENESS

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ABSTRACT
The heat exchanger, used in refrigeration unit, radiator, air conditioning unit used with IC engine automobiles is either square or rectangular in shape. In that heat transfer is take place by convection. The rate heat transfer depends on velocity of air surface area of tube. Generally it is placed vertically in flowing air so velocity of air will reduce hence heat transfer rate will affect adversely so we have decided to change inclination of radiator and to find effectiveness at different angle.

INTRODUCTION
In an automobile, fuel produces power in the engine through combustion. The total generated power actually supplies the automobile with power the rest is wasted in the form of smoke and heat. If this excess heat is not eliminate, the temperature of engine becomes too high which results in overheating and viscosity breakdown of the lubricating oil, metal weakening of the overheated engine parts, and stress between engine parts resulting in quicker wear, among other things. Figure 1: Components within an automotive cooling system. To remove this excess heat a many cooling systems used. Most automotive cooling systems consist of the following components: radiator, electric cooling fan, water pump, radiator pressure cap, and thermostat. Of these components, the radiator is the most important part of the system because it transfers heat. As coolant or water travels through the engine's cylinder block, it accumulates heat. Once the temperature increases of coolant or water above a certain threshold value, the vehicle's thermostat triggers a valve which forces the coolant to flow through the radiator. As the coolant or water flows through the tubes of the radiator, heat is transferred through the fins and tube walls to the air by convection and conduction.

MATERIALS
Radiator, electric cooling fan, water pump, radiator pressure cap, and thermostat.

METHODOLOGY

Selection of proper radiator for experimentation
↓
Fabrication of experimental setup
↓
Conduction of expetriment of different inclination
↓
Calulation of effectivness at different angle
↓
Depending on calculation selection of proper inclination angle
↓
At last we get maximum effectiveness at specific angle

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DESIGN CALCULATIONS FOR RADIATOR

Table 1: Observations of Air and Water

Sr. No.	Observation	Air (cold)	Water (Hot)
1	Inlet Temperature (°C)	28	52
2	Outlet Temperature (°C)	34.376	44
3	m i.e mass flow rate (kg/hr)	525.35	100
4	Cp. Specific Heat (kJ/kg °C	1	4.187
5	K Thermal Conductivity(W/mK)	0.024	0.66
6	ρ Density (kg/m3)	1.1	1000

Assume: For this **air cooled heat exchanger** we use aluminum tubes of following dimension,

- Outer Diameter = 11.25 mm
- Inner Diameter = 10.00 mm
- Thickness =1.25/2= 0.0625 mm

From the chart of typical values of overall heat transfer coefficient, we know that for air cooled heat exchanger value of overall heat transfer coefficient (U) ranges from 300-450 W/m2K. So here we assume it to be equal to 350
W/m2K[42].

$$U=350 \text{ W/m2K}$$

Using Energy balance equation,

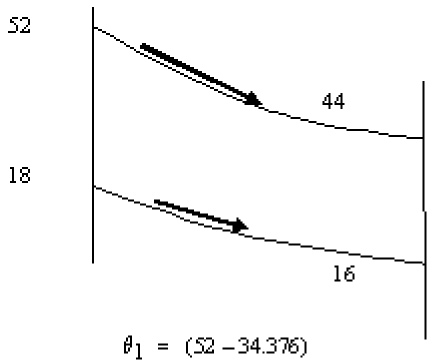
$$(\dot{m}\,Cp)_h (T_{hi} - T_u) = (\dot{m}\,Cp)_c (T_{ce} - T_{ci})$$
$$100 \times 4.187 \times (52 - 44) = 525.35 \times 1 \times (T_{ce} - 28)$$

$$T_{ce} = 34.376 \text{ °C}$$

So outlet temperature of air is = 34.746 °C.
We know that, $q = m_w \times Cp_w \times \Delta T_w$

$$q = 100 \times 4.187 \times (52 - 44)$$
$$q = 3349.6 \text{ Watt}$$

Assuming the Heat Exchanger (Radiator) to be counter flow we get,



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$$\theta 1 = 17.624°C$$
$$\theta 2 = (44 - 28)$$
$$\theta 2 = 16°C$$

Substituting these values in equation (5.10) we get,

$$\theta m = \frac{\theta 1 - \theta 2}{\ln \frac{\theta 1}{\theta 2}}$$

$$\theta m = \frac{(17.624 - 16)}{ln\,(17.624 / 16)}$$

$$\theta m = 16.8°C \quad \text{i.e. } 289.8°K$$

i.e. LMTD=16.8°C

Now, using the average velocity of water in tubes and its flow rate the total flow area is given as,

$$Af = \frac{m}{V \infty \rho}$$

Where,

Af = Total flow area
V = Average velocity of water
ρ = Density of water

Here, we have average velocity of water = 65 m/hr

V=65 m/hr

So we get,

$$Af = \frac{100}{65 \cdot 1000}$$

$$Af = 1.538 \times 10^{3}\ m^{2}$$

But we know that,

$$Af = n \times \frac{\pi}{4} \times d_i^2$$

Where, n = Number of tubes
di = Inlet diameter of tube

Substituting respective values, we get

$$1.538 \times 10^{-3} = n \times \frac{\pi}{4} \times (10 \times 10^{-3})^2$$

After solving the above equation we get,

n = 19.582 approximate = 20
n=20

For correction factor required dimension parameters are,

$$P = \frac{(Tce - Tci)}{(Thi - Tci)}$$

$$P = \frac{34.376 - 28}{} = 0.3985$$

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52 – 28

$$\mathbf{R = \frac{(Thi - The)}{(Tce - Tci)}}$$

$$R = \frac{52 - 44}{34.376 - 28} = 1.26$$

So referring the chart 5.14,

we get value of correction factor as 0.96,

$$F = 0.96$$

That area of the heat transfer after considering correction factor is given as,

$$A = \frac{q.}{U \cdot F \cdot \theta m(\text{counter flow})}$$

$$A = \frac{3349.6}{350 \cdot 0.96 \cdot 16.8}$$

$$A = 0.5934\ m^2$$

Final Acceptable Design Parameters are as Under

- Number of tubes per pass = 20
- Number of passes = 1
- Length of tube per pass = 0.284 m

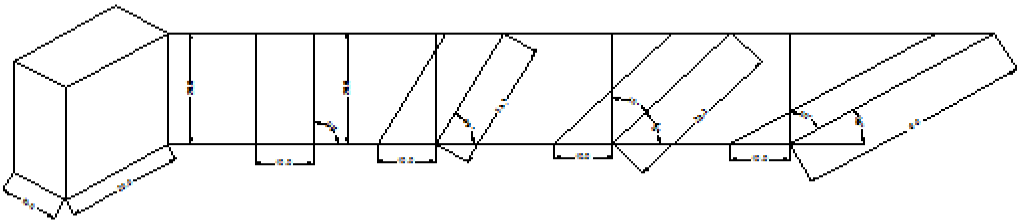

Fig: Radiator CAD Drawing

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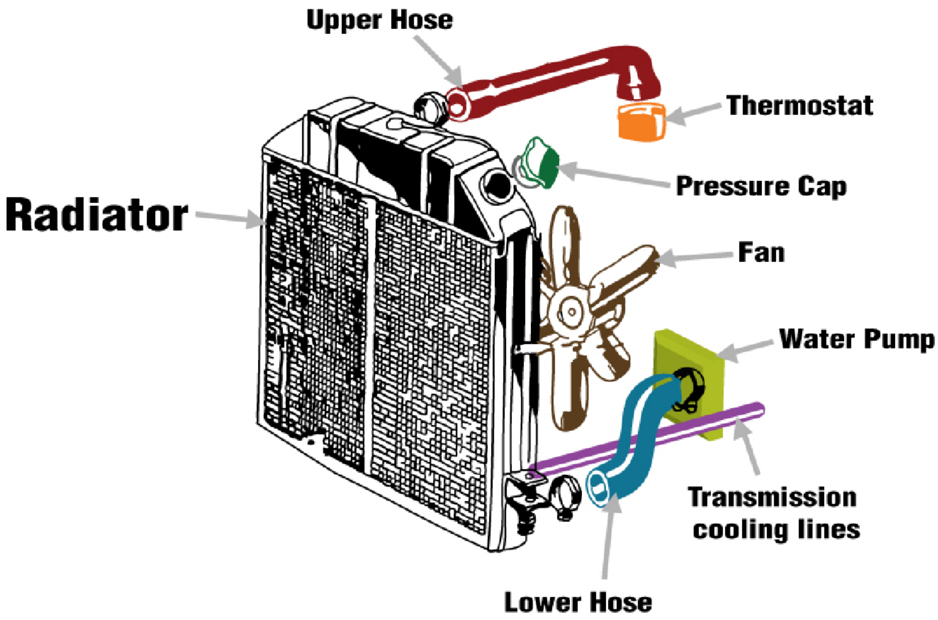

Fig 2: Proposed experimental set-up

CONCLUSION

Low velocity zones and high temperature regions (low heat transfer regions) are identified in corners we observe. That velocity increases with the increase in rpm of radiator fan. For optimum efficiency eliminate corners and develop radiator of Circular shape.

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REFERENCES

1. *Cihat Arslanturk & A. Feridum Ozguc, (2006), "Optimization of Central heating radiator," Applied Engg, Vol. no. 83, issue 11, pp. 1190-1197.*
2. *Chen Sun, (2004),"Fast Beamforming of Electronically Steerable Parasitic Array Radiator Antennas: Theory and Experiment" IEEE transactions on antennas and propagation, vol. 52.*
3. *JP Yadav and ,Bharat Raj Singh,(2011) "Study on Performance Evaluation of Automotive Radiator", S-JPSET : ISSN : 2229-7111, Vol. 2, Issue 2.*
4. *William H Crouse,"Automotive Mechanics" 10th edition pp no 318-321*
5. *Maddiptla, Sridhar, Guessous, Nov (2002), "Shape optimization of vehicle radiator" using CFD, American Physical Society, Division of Fluid Dynamics, 55th Annual meeting, Vol no. 2, pp 213-222.*
6. *Max S.Peters and laus D. Timmerhuaus, (1958), "Plant Design and Economics for Chemical Engineers", 4th edition, McGraw-Hill Book Company.*
7. *Prof. John R.Thom, (2004), "Wolverine Tube Heat Transfer Data Book III", Wolverine Tube Inc.*
8. *Arthur P Fraas, "Heat Exchanger Design" (II Edition) Published by John Wiley& Sons New York,*