EXPERIMENTAL ANALYSIS OF HEAT DISSIPATION IN NANO COATED RADIATOR TUBES

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ABSTRACT

Radiators are a type of heat exchangers used to transfer thermal energy from one medium to another for the purpose of cooling and heating. Upwards of 33% of energy generated by the engine through combustion is lost in heat. Insufficient heat dissipation can result in the overheating of engine, which leads to the breakdown of the lubricating oil, metal weakening of engine parts, and significant wear between engine parts. It is necessary to reduce the heat in order to decrease the wear and tear. This is lead to the increased demand on the power packed radiators, which can dissipate maximum amount of heat for any given space. Our project aims to do a comparison between ordinary radiator tube material such as Aluminum and Copper to a new radiator tube material such as Brass alloy with the Nano coating. The Nano coating is nowadays becoming more popular because of its extensive application in many fields. Mostly the nano coating is used to increase the property of the material. In our project we used Al2O3 as the nano particle which is coated to the surface of the tubes.

Keyword: - *Radiator1, Brass tube2, Nano coating3, Aluminium oxide Nanoparticle4, Plasma spray technique5*

1. INTRODUCTION:

The radiators are made by brazing thin aluminum fins to flattened aluminum tubes. The coolant flows from the inlet to the outlet through many tubes mounted in a parallel arrangement. The fins conduct the heat from the tubes and transfer it to the air flowing through the radiator. The tubes sometimes have a type of fin inserted into them called a tabulator, which increases the turbulence of the fluid flowing through the tubes. The amount of heat transferred to the tubes from the fluid running through them depends on the difference in temperature between the tube and the fluid touching it. So if the fluid that is in contact with the tube cools down quickly, less heat will be transferred. By creating turbulence inside the tube, all of the fluid mixes together, keeping the temperature of the fluid touching the tubes up so that more heat can be extracted, and all of the fluid inside the tube is used effectively. Radiators usually have a tank on each side, and inside the tank is a transmission cooler. The transmission cooler is like a radiator within a radiator, except instead of exchanging heat with the air, the oil or water along with Nano-fluids exchanges heat with the coolant in the radiator.

2. LITERATURE REVIEW:

The survey of various papers helps us to get a clear view on the radiator and its cooling effects. It also helps us in understanding the process of the radiator.

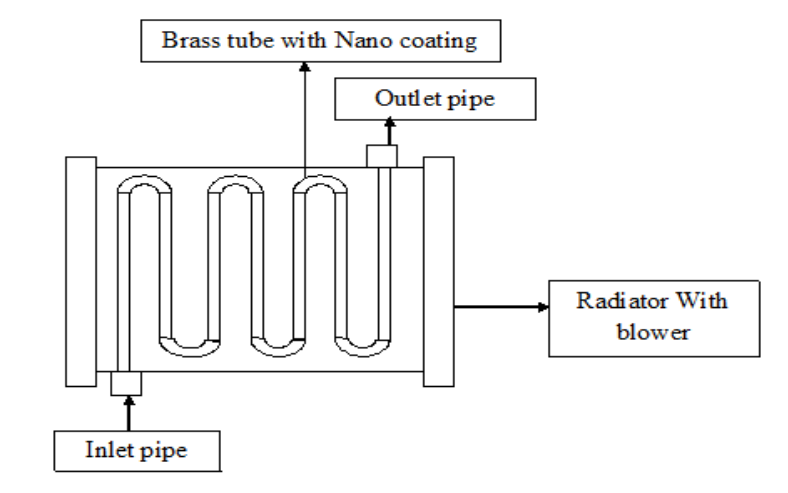
- [1] The coating of the nano particle sized graphene on the surface of the fins of pin fin apparatus with the help of PVD process helps in increasing the efficiency up to 2%.
- [2] The heat transfer in the radiator increases by changing the coolant. By adding a proper proportion of the Nano particles of Al_2O_3 along with water can significantly increases the efficiency of the radiator.

- [3] The use of metal oxides in the water which is used as a coolant will helps in increasing the heat transfer rate of the radiator. Thus metal oxides can be used as a Nano fluids
- [4] We inferred that the critical heat flux can be increased with the help of Nano fluids in the pool boiling and some surface modification will helps in these CHF changes.
- [5] The various data regarding the thermal conductivity of various Nano particles which are generally used in the radiator for the purpose of cooling is studied.

3. OBJECTIVE:

- The main objective of our project is to increase the heat transfer rate of the radiator which helps in increased cooling effect with the help of Nano- coating.
- To reduce the wear and tear in the radiator, the brass tube is used.
- Nano coating of the Al2O3 Nano powder on the surface of the fins and tubes may increase the surface area there by increases the heat transfer rates.
- To reduces the frequent maintenance and replacements of the radiator and its component.
- To improve the performance of the radiator.
- To increases the resistance to corrosion of the tubes of the radiator.

4. BLOCK DIAGRAM:



5. COMPONENTS USED:

5.1 Brass Tube:

Brass is a metallic alloy that is made of copper and zinc. The proportions of zinc and copper can vary to create different types of brass alloys with varying mechanical and electrical properties. It is having some more other important properties such as it is highly resistant to the wear and tear when compared to aluminum. Brass is used for decoration for its bright gold-like appearance; for applications where low friction is required such as locks, gears, bearings, doorknobs, ammunition casings and valves; for plumbing and electrical applications; and extensively in brass musical instruments such as horns and bells where a combination of high workability (historically with hand tools) and durability is desired. It is also used in zippers. Brass is often used in situations in which it is important that sparks not be struck, such as in fittings and tools used near flammable or explosive materials. Thus the brass material is having more useful properties that might be very much helpful in the case of using it in the radiator as tubes.

5.2 Aluminium Oxide:

Aluminium oxide is one of the most common metal oxides used as it is having more advantages. Its chemical formula is Al_2O_3. Nano sized aluminium oxide (Nano sized alumina) occurs in the form of spherical or nearly spherical nanoparticles, and in the form of oriented or undirected fibers. Since there is need for Nano particles the Aluminium oxide best suits for the needs. It is mainly chosen because of its thermal properties as it has high

thermal conductivity (39 W/mK). Also the particle size ranges from 30 to 60 nm. Thus it can be well suited to the various purpose of Nano coating.

5.3 Radiator:

The radiator which is used for the purpose of experimentation is of the down flow type. In general the down flow type radiator is one in which the tanks are placed above and below the radiator core. The radiator used in this belongs to Tata ace.

5.4 Blower:

Blowers are mechanical or electro-mechanical devices used to induce gas flow through ducting, electronics chassis, process stacks, etc.--wherever flow is needed for exhausting, aspirating, cooling, ventilating, conveying, and so on. Motors usually drive blowers, though they can be powered by other means such as engines.

5.5 Temperature Sensor:

A temperature sensor is a device, typically, a thermocouple or RTD that provides for temperature measurement through an electrical signal. A thermocouple (T/C) is made from two dissimilar metals that generate electrical voltage in direct proportion to changes in temperature.

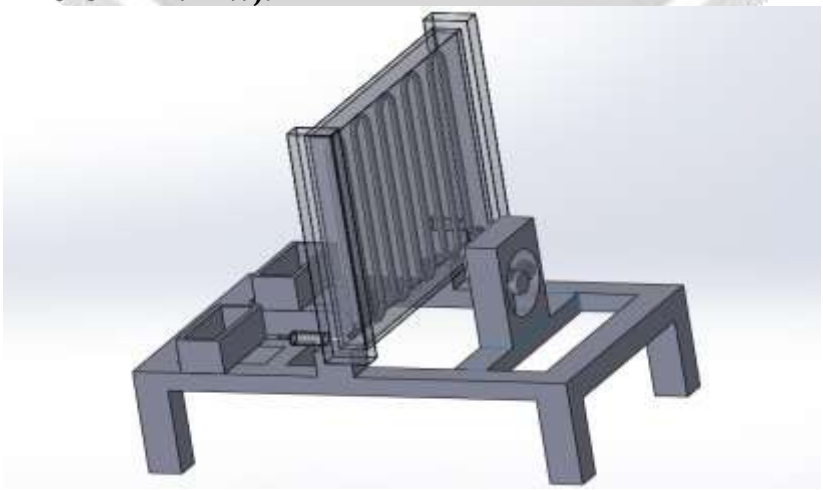
6. PROCESS INVOLVED:

The main process which is required in our project is the Nano coating of the tubes and fins. The Nano coating of the tubes and fins are done by the method called thermal spraying. It is also called as Plasma arc spraying. It is a coating deposition technique in which solid feedstock in the form of powder (i.e.) the Nano particle of Aluminium oxide is introduced to the plasma jet to form liquid droplets which are accelerated towards the surface of the tubes and fins. It sticks to the surface of the tubes and fins because of the adhesive nature. After that it is made assembled to the radiator and fins are attached. Then the setup is made and the experiment at various temperatures are measured.

7. WORKING:

The working involves the circulation of the hot water from the hot water tank through the inlet of the radiator and is made to flow through the tubes and exit out through the outlet of the radiator and it falls into the cold water tank. There is a pump which is fixed to the hot water tank to pump the hot water into the inlet of the radiator. Since the radiator tubes and fins are subjected to Nano coating of Aluminium oxide, which is done by the process of plasma arc spraying method. The rate of cooling of the water indicates the efficiency of the radiator. There is a temperature sensor placed over the inlet and outlet of the radiator by which the inlet and outlet temperatures are measured. Thus the variation in the temperatures of the inlet and outlet of the radiator indicated the efficiency of the radiator. Then a comparison is made between the non-coated radiator tubes and coated radiator tubes by experimental means.

7. SETUP (3 DIMENSIONAL VIEW):



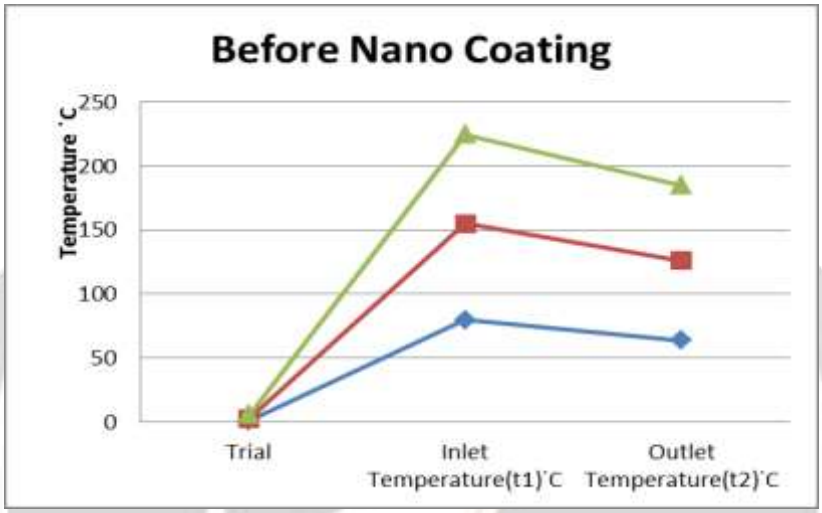
8. EXPERIMENTAL RESULTS:

In this the experiment is conducted by supplying the hot water to the inlet which flows through the tubes and exit through the outlet. The temperature at the inlet and outlet are measured using the temperature sensor.

8.1 Before Nano coating:

Trial	Inlet Temperature(t_1)˚C	Outlet Temperature(t_2)˚C
1	80	68
2	75	65
3	70	62

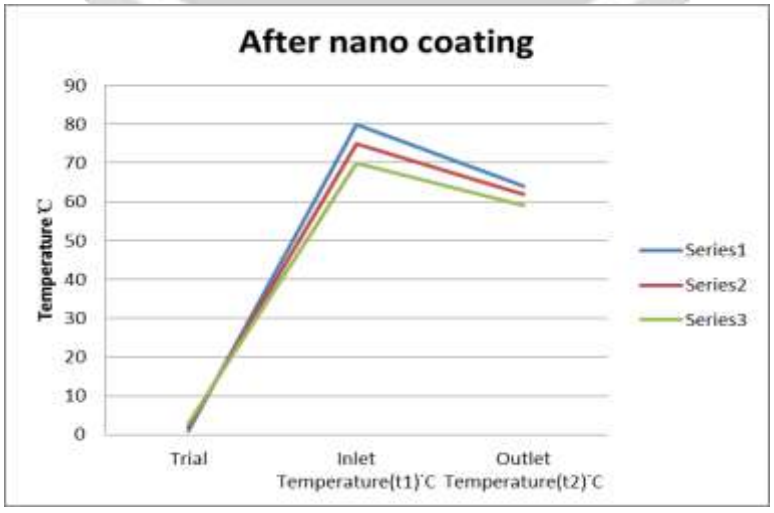
Graphical Representation:



8.2 After Nano coating:

Trial	Inlet Temperature(t_1)˚C	Outlet Temperature(t_2)˚C
1	80	64
2	75	62
3	70	59

Graphical Representation:

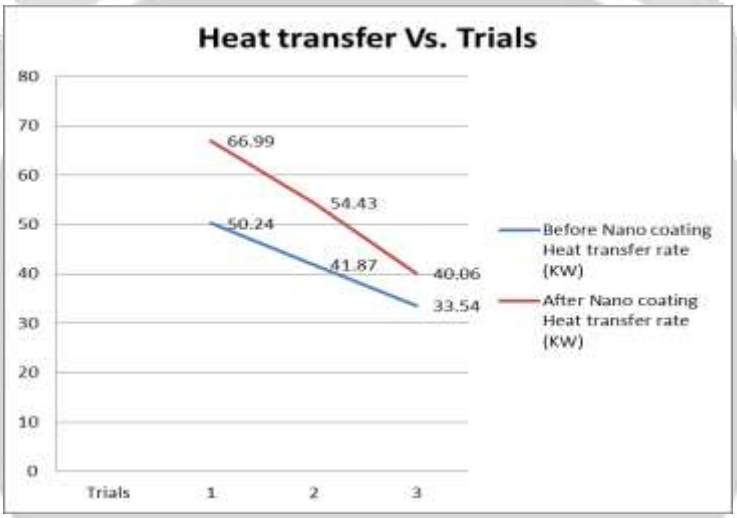


8.3 Heat Transfer rates:

Here occurs the conduction and convection. Thus the heat transfer rates are measured and tabulated as,

Trials	Before Nano coating Heat transfer rate (KW)	After Nano coating Heat transfer rate (KW)
1	**50.24**	**66.99**
2	**41.87**	**54.43**
3	**33.54**	**40.06**

Graphical Representation:



9. CONCLUSIONS:

Thus from the above experimental results we came to know that the heat transfer rate increases with the help of Nano coating on fins and the tubes of the radiator when compared to that of the conventional radiators.

10. REFERENCES:

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