A STUDY ON IMPROVING THE PERFORMANCE OF AN ENGINE BLOCK FOR VARIOUS COOLING FLUIDS

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ABSTRACT:
Cooling framework assumes significant jobs to control the temperature of's motor. One of the significant components in the vehicle cooling framework is cooling liquid. The use of wrong cooling liquid can give negatives effect to the's motor and abbreviate motor life. A productive cooling framework can keep motor from overheating and helps the vehicle running at its ideal execution. This theory was led to ponder the adequacy of different kinds cooling operator in the vehicle cooling framework which will impact the activity time of the motor square basically chamber in the light vehicle cooling frameworks. Hypothetical estimations were done to decide the general warmth move coefficient and warmth lost by the chamber by changing the liquids and material of chamber. Three principle sorts of liquids were utilized in this examination, which are 1.Tap water, 2.Distilled water, 3. Refined water with Ethylene glycol. Warm investigation is done on the chamber by differing the materials Cast Iron, Aluminum compounds 7475 and 6061.

KEYWORDS: *CAD, ANSYS, Ethylene Glycol, Alloys.*

1.0 INTRODUCTION:

Despite the fact that fuel motors have improved a ton, they are as yet not extremely productive at transforming substance vitality into mechanical power. The majority of the vitality in the gas (maybe 70%) is changed over into warmth, and it is the activity of the cooling framework to deal with that heat. Indeed, the cooling framework on a vehicle driving down the expressway disperses enough warmth to warm two normal estimated houses! The essential occupation of the cooling framework is to shield the motor from overheating by moving this warmth to the air, however the cooling framework likewise has a few other significant jobs. The motor in your vehicle runs best at a genuinely high temperature. At the point when the motor is cold, parts destroy quicker, and the motor is less productive and emanates more contamination. So another significant activity of the cooling framework is to enable the motor to warmth up as fast as could be allowed, and after that to keep the motor at a steady temperature.

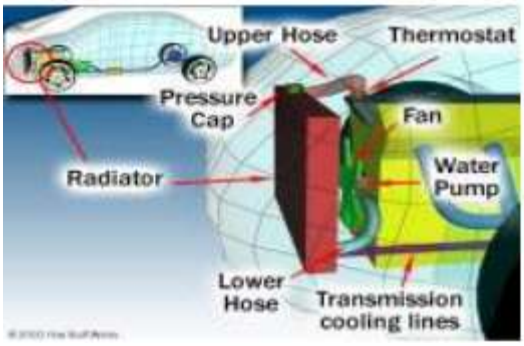

Figure 1.1: The Basic Parts of the Car Engine

THE BASICS

Inside your car's engine, fuel is constantly burning. A lot of the heat from this combustion goes right out the exhaust system, but some of it soaks into the engine, heating it up. The engine runs best when its coolant is about 200 degrees Fahrenheit (93 degrees Celsius). At this temperature:

• The combustion chamber is hot enough to completely vaporize the fuel, providing better combustion and reducing emissions.

• The oil used to lubricate the engine has a lower viscosity (it is thinner), so the engine parts move more freely and the engine wastes less power moving its own components around.

• Metal parts wear less.

TWO TYPES OF COOLING SYSTEMS

There are two types of cooling systems found on cars: liquid-cooled and air-cooled. Liquid Cooling The cooling system on liquid-cooled cars circulates a fluid through pipes and passageways in the engine. As this liquid passes through the hot engine it absorbs heat, cooling the engine. After the fluid leaves the engine, it passes through a heat exchanger, or radiator, which transfers the heat from the fluid to the air blowing through the exchanger.

Air Cooling

Some older cars, and very few modern cars, are air-cooled. Instead of circulating fluid through the engine, the engine block is covered in aluminum fins that conduct the heat away from the cylinder. A powerful fan forces air over these fins, which cools the engine by transferring the heat to the air. Since most cars are liquid-cooled, we will focus on that system in this article.

AIR COOLED ENGINES

The reason of an air-cooled motor is in reality quite basic: Let wind current over the motor to keep it cool. In any case, since this article should be somewhat longer than that, we'll address a couple of more subtleties (for the wellbeing of my editor, in any case). Most current autos use water-cooled motors with radiators, water siphons and hoses that course a water and coolant blend all through the motor. The warmth from the motor is moved to the coolant, and after that the coolant is cooled in the radiator and sent back around once more. Air-cooled motors need none of this. They depend on great antiquated air to chill them off. To be reasonable, all motors are in fact aircooled in light of the fact that even water-cooled motors use air to cool the liquid in the radiator. Be that as it may, how about we not split hairs. Air-cooled motors have blades stretching out from the motor to force heat away. Cool air is then constrained over the balances - regularly by a fan in autos. For flying machine and cruisers, the vehicle's speed alone moves enough cool air over the blades to keep the motor cool.

Benefits and Limitations of Air-Cooled Engines

So an air-cooled engine has no need for a radiator, a water pump, coolant, hoses or any other associated parts a liquid-cooled engine has. But is this actually a good thing? The short answer: Sometimes. Obviously, and air-cooled engine doesn't have coolant leakage problems and won't ever require things like the water pump or radiator to be replaced, which can be a great thing. Typically, they're lighter than liquid-cooled engines, too, because they have fewer parts. Air-cooled engines also warm up a lot faster than liquid-cooled engines and don't have any risk of the coolant freezing, which is beneficial if you're operating the vehicle in extremely cold temperatures.

Cooling Components Consist of

1. Source of heat
2. Radiator
3. Water pump
4. Thermostat
5. Fan
6. Expansion tank

2.0 LITERATURE REVIEW:

Choi, (1995) has done broad research on the impacts of different parameters, for example, the proportion of the warm conductivity of nano particles to that of a base liquid, volume division, nano molecule size, and temperature on the successful warm conductivity of nanofluids. It was discovered that nanofluids have irregularly high warm conductivities at extremely low volume division and firmly temperature-and size ward conductivity. The consequent investigations of different writers and scientists on liquids blended with various sorts of nano particles uncovered the improvement of warm conductivity just as warmth move coefficient. Nano measured Carbon Nano Tubes are contemplated as coolant added substances. Broad experimentation and studies are done to assess the reasonableness of CNT as coolant added substances. Trial results and perceptions by numerous specialists have appeared there exists an upgraded cooling execution on utilization of coolant containing Carbon Nano Tubes.

Kim et. al. (2009) arranged Au nanofluids with an extraordinary steadiness even following multi month with no dispersants. The soundness is because of huge negative zeta capability of Au nano particles in water. The impact of pH and sodium dodecyl benzene sulfonates (SDBS) on the dependability of water based nanofluids was examined, and zeta potential examination was a significant method to assess the solidness. Moreover, blending of surfactant in base liquids can improve the security of the nano liquid suspensions. Zeta potential estimations are utilized to think about the assimilation instruments of the surfactants on the MWNT surface with the assistance of the Fourier change infrared spectra.

Madhu Kiran J, (2017) In this paper trial examination performed on vehicle radiator utilizing water and water based Nanofluids (Al2O3/CuO). Two Nanofluids of concentrations0.5 and 1% by volume were taken to direct examinations. The sizes of the Nano particles utilized in this present work roughly 50-100nm. Liquid bay temperature and speeds were differed to think about the Heat Transfer Rate utilizing water and water based Nano liquids. From the outcomes plainly Nanofluids improves the warmth move rate contrasted with unadulterated water. By fluctuating the liquid temperature and speeds improvement in warmth move rate watched both in unadulterated water and Nanofluids. Comparision additionally done between two Nanofluids Al2O3&CuO. CuO shows slight increment in warmth move rate contrasted with Al2O3.

3.0 METHODOLOGY:

A system, which controls the engine temperature, is known as a cooling system.

Introduction to ANSYS

ANSYS is general-purpose finite element analysis (FEA) software package. Finite Element Analysis is a numerical method of deconstructing a complex system into very small pieces (of userdesignated size) called elements. The software implements equations that govern the behaviour of these elements and solves them all; creating a comprehensive explanation of how the system acts as a whole. These results then can be presented in tabulated, or graphical forms. This type of analysis is typically used for the design and optimization of a system far too complex to analyze by hand. Systems that may fit into this category are too complex due to their geometry, scale, or governing equations. ANSYS is the standard FEA teaching tool within the Mechanical Engineering Department at many colleges.

ANSYS is also used in Civil and Electrical Engineering, as well as the Physics and Chemistry departments.

NECESSITY OF COOLING SYSTEM

The cooling system is provided in the IC engine for the following reasons:

- ✓ The temperature of the burning gases in the engine cylinder reaches up to 1500 to 2000°C, which is above the melting point of the material of the cylinder body and head of the engine. (Platinum, a metal which has one of the highest melting points, melts at 1750 °C, iron at 1530°C and aluminium at 657°C.) Therefore, if the heat is not dissipated, it would result in the failure of the cylinder material.
- ✓ Due to very high temperatures, the film of the lubricating oil will get oxidized, thus producing carbon deposits on the surface. This will result in piston seizure.
- ✓ Due to overheating, large temperature differences may lead to a distortion of the engine components due to the thermal stresses set up. This makes it necessary for, the temperature variation to be kept to a minimum.
- ✓ Higher temperatures also lower the volumetric efficiency of the engine.

Liquid Cooling

The cooling system on liquid-cooled cars circulates a fluid through pipes and passageways in the engine. As this liquid passes through the hot engine it absorbs heat, cooling the engine. After the fluid leaves the engine, it passes through a heat exchanger, or radiator, which transfers the heat from the fluid to the air blowing through the exchanger. Today, most engines are liquid-cooled.

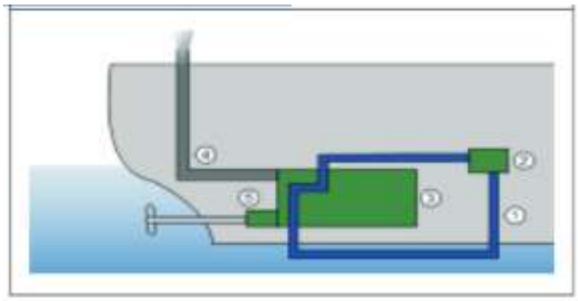

Figure 2: A Fully Closed IC Engine Cooling System

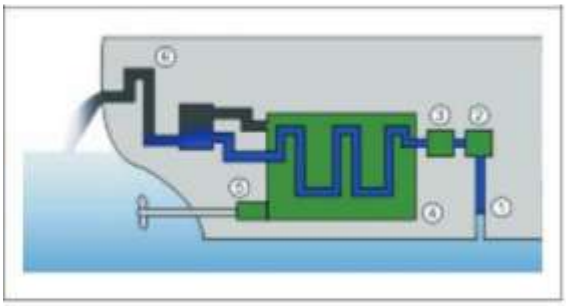

Figure3: Open IC Engine Cooling System

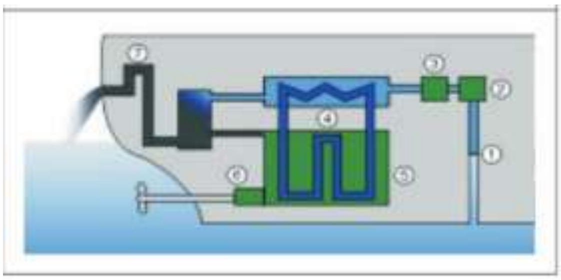

Figure 4: Semi closed IC Engine cooling system

Air Cooling

Some more established vehicles, and not many present day autos, are air-cooled. Rather than circling liquid through the motor, the motor square is canvassed in aluminum blades that lead the warmth far from the chamber. An incredible fan powers air over these balances, which cools the motor by moving the warmth to the air. Since most autos are fluid cooled, we will concentrate on that framework in this article. Vehicles and trucks utilizing direct air cooling (without a middle fluid) were worked over an extensive stretch start with the approach of mass created traveler autos and finishing with a little and for the most part unrecognized specialized change. Prior to World War II, water cooled vehicles and trucks routinely overheated while ascending mountain streets, making springs of bubbling cooling water. This was viewed as typical, and at the time, most noted mountain streets had auto fix shops to pastor to overheating motors.

Water Pump

This is a diffusive sort siphon. It is halfway monunted at the front of the chamber square and is typically determined by methods for a belt. This sort of siphon comprises of the accompanying parts: (I) body or packaging, (ii)impeller (rotor), (iii) shaft, (iv) orientation, or shrubbery, (v) water siphon seal and (vi) pulley. The base of the radiator is associated with the suction side of the siphon. The power is transmitted to the siphon shaft from a pulley mounted toward the finish of the crankshaft. Seals of different plans are consolidated in the siphon to keep loss of coolant from the framework.

Radiator

The reason for the radiator is to chill off the water got from the motor. The radiator comprises of three primary parts: (I) upper tank, (ii) lower tank and (iii) tubes. Heated water from the upper tank, which originates from the motor, streams downwards through the cylinders. The warmth contained in the high temp water is directed to the copper balances gave around the tubes.An flood pipe, associated with the upper tank, grants abundance water or steam to get away. There are three kinds of radiators:

- gilled tube radiator,
- tubular radiator and
- honey comb or cellular radiator

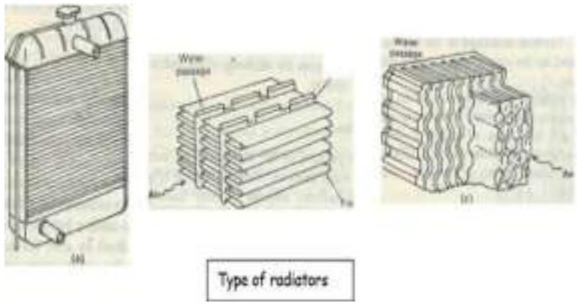

Figure 5: Types of radiators

Gilled tube radiator: This is perhaps the oldest type of radiator, although it is still in use. In this, water flows inside the tubes. Each tube has a large number of annular rings or fins pressed firmly over its outside surface.

Tubular radiator: The only difference between a gilled tubes radiator and a tubular one is that in this case there are no separate fins for individual tubes. The radiator vertical tubes pass through thin fine copper sheets which run horizontally.

Honey comb or cellular radiator: The cellular radiator consists of a large number of individual air cells which are surrounded by water. In this, the clogging of any passage affects only small parts of the cooling surface. However, in the tubular radiator, if one tube becomes clogged, the cooling effect of the entire tube is lost.

Thermostat Valve: It is a kind of check valve which opens and closes with the effect of temperature. It is fitted in the water outlet of the engine. During the warm-up period, the thermostat is closed and the water pump circulates the water only throughout thecylinder block and cylinder head. When the normal operating temperature is reached, the thermostat valve opens and allows hot water to flow towards the radiator. Standard thermostats are designed to start opening at 70 to 75°C and they fully open at 82°C. High temperature thermostats, with permanent anti-freeze solutions (Prestine, Zerex, etc.), start opening at 80 to 90°C and fully open at 92°C. There are three types of thermostats: (i) bellow type, (ii) bimetallic type and (iii) pellet type.

Bellow type valve: Flexible bellows are filled with alcohol or ether. When the bellows is heated, the liquid vaporises, creating enough pressure to expand the bellows. When the unit is cooled, the gas condenses. The pressure reduces and the bellows collapse to close the valve.

Bimetallic type valve: This consists of a bimetallic strip. The unequal expansion of two metallic strips causes the valve to open and allows the water to flow in the radiator.

Pellet type valve: A copper impregnated wax pellet expands when heated and contracts when cooled. The pellet is connected to the valve through a piston, such that on expansion of the pellet, it opens the valve. A coil spring closes the valve when the pellet contracts.

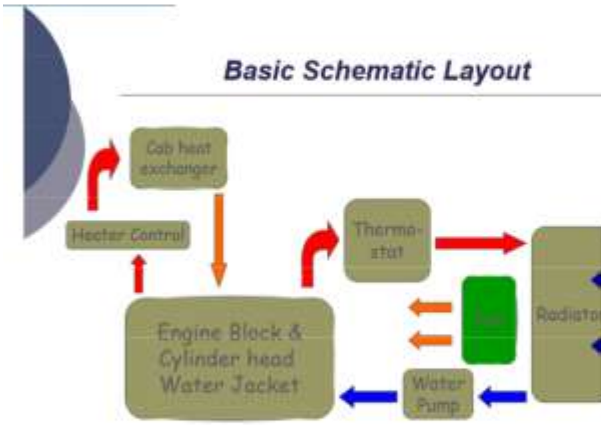

Figure 6 Basic Schematic Layout

4.0 CONCLUSION:

In this theory we have structured a chamber in the motor of a vehicle. The present utilized material for motor square is solid metal. We are supplanting with aluminum amalgams 7475 and 6061 because of their high conductivity esteems. Three kinds of liquids were viewed as Tap water, Distilled Water and Distilled Water with Coolant Ethylene Glycol. Hypothetical estimations were done to decide the general warmth move coefficient and warmth lost by motor chamber. By watching the qualities, utilizing material Aluminum combination 6061 and liquid Distilled Water with Ethylene Glycol has high warmth move rate. Warm examinations were done in Ansysto decide the warmth move rate diagnostically on the motor chamber. By watching the examination results,using Aluminum amalgam 6061 for chamber and liquid Distilled Water without coolant has high warmth move rate since warm transition is more. So we can presume that by systematically and hypothetically Aluminum Alloy 6061 is better for chamber. However, cooling liquid Distilled water without coolant is better logically and Distilled water with coolant is better hypothetically. The motor square is the linchpin of vehicles that keep running on interior burning, giving the powerhouse to the vehicle. It is known as a "square" since it is normally a strong cast vehicle part, lodging the chambers and their segments inside a cooled and greased up crankcase. This part is intended to be incredibly solid and durable, on the grounds that its disappointment results in disappointment of the vehicle, which won't work until the motor square is replacedor fixed. Cooling framework assumes significant jobs to control the temperature of's motor. One of the significant components in the vehicle cooling framework is cooling liquid. The use of wrong cooling liquid can give negatives effect to the's motor and abbreviate motor life. A proficient cooling framework can keep motor from overheating and helps the vehicle running at its ideal execution.

REFERENCES

[1] Leong, K.Y., Saidur, R., Kazi, S. N., & Mamun, A.H. (2010). Performance Investigation Of An Automotive Car Radiator Operated With NanofluidBased Coolants (Nanofluid As A Coolant In A Radiator). Applied Thermal Engineering, Vol 30, Issue17/18, P2685-2692.

[2] Mohd Rajuli, M. B. (2006). Teknologi Automotif : Pengenalan Sistem. Petaling Jaya : IBS Buku Sdn Bhd.

[3] Nice, K. (n.d.). How Car Cooling Systems Work.Retrieved 11 July 2012 from

[4] Peyghambarzadeh, S. M., Hashemabadi, S. H.,Hoseini, S. M., &SeifiJamnani, M. (2011). Experimental Study Of Heat Transfer Enhancement Using Water/Ethylene Glycol Based Nanofluids As A New Coolant For Car Radiators. International Communications In Heat & Mass Transfer, Vol. 38, Issue 9, P1283-1290

[5] Pang, S. C., Masjuki, H. H., Hazrat, M. A.,&Kalam, M. A. (2011). Integration of 1D and 3D Simulations of Engine Cooling System: After Keyed- Off. IEEE, P46 -50. DOI 10.1109/DCABES.2011.53

[6] Ross, S. (2006). An Antifreeze Antidote? Aftermarket Business, Vol 116, No.7, Advanstar Publication.

[7] Salah, M. H., Mitchell, T. H., Wagner, J. R., & Dawson, D. M. (2010). A Smart Multiple-Loop Automotive Cooling System—Model, Control, and Experimental Study. IEEE/Asme Transactions On Mechatronics, Vol. 15, No. 1, 117 – 123.

[8] Schappell, K. (2011). The Car Cooling System. Retrieved 11 July 2012 from http://www.whatprice.co.uk/car/maintainance/carcooling.html.