International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 04 | April - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

EXPERIMENTAL INVESTIGATION OF RADIATOR COOLING SYSTEM FOR S.I. ENGINE: BY INCREASING THE GLYCOL PERCENTAGE

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Abstract: The purpose of this investigation was to ascertain the radiator's heat transfer rate. There are two types of hot fluid, namely water and an ethylene glycol-mixed water of 50%.The results indicate that the higher the flow of water flowing on the radiator pipe causes a radiator heat transfer rate increase. The use of antifreeze agents, such as ethylene glycol, in radiator systems is common in many applications to prevent freezing and overheating. However, the performance of radiator systems can be affected by the concentration of ethylene glycol in the coolant. In this experimental investigation, the effect of different proportions of ethylene glycol in radiator systems was studied. A radiator system was set up, and experiments were conducted with varying concentrations of ethylene glycol (40%, 50%, and 60% by volume) in water as the coolant. The performance of the radiator system was evaluated in terms of heat transfer rate, temperature drop, and overall thermal efficiency. The experimental results showed that the proportion of ethylene glycol in the coolant significantly influenced the performance of the radiator system. Higher concentrations of ethylene glycol resulted in reduced heat.

Key Words*: *Radiator Cooling System, Car engine, Heat Exchanger, S.I. Engine, Ethylene Glycol, Coolant, Freeze Protection, Heat Transfer.

1. Introduction:

Maintaining optimal engine operating temperature is crucial for the performance and longevity of a Spark Ignition engine. The radiator cooling system plays a vital role in this process by rejecting excess heat generated during combustion. Ethylene glycol (EG) is a commonly used additive in engine coolant due to its ability to lower the freezing point of the mixture and prevent engine damage in cold climates. However, increasing the EG concentration can also affect the coolant's ability to transfer heat away from the engine. This study aims to experimentally investigate the impact of varying glycol percentages in a coolant mixture on the performance of an S.I. engine radiator cooling system. The research will analyze key parameters such as coolant temperature at the radiator inlet and outlet, engine operating temperature, and radiator fan duty cycle. Continuous technological development in the world has led to drastic increase in the demand of automobiles. According to automobile industries have a great challenge to provide an efficient and economical engine in terms of fuel supply, lubrication system, transmission system and of most important the cooling system among other systems. The need to create an engine with significantly increased performance has emerged. One of the most crucial systems in car engines is the cooling system, which is in charge of transferring a significant quantity of heat waste to the surrounding air to maintain an engine's efficient operation. It

improves fuel efficiency and heat transfer, which maximises engine performance. The majority of internal combustion engines are fluidly cooled by air or liquid coolant passing through an air-cooled heat exchange radiator. By optimizing the heat transfer area and raising the heat transfer coefficient, heat transfer via the radiator can be enhanced. Increases in the heat transfer coefficient can be achieved by either improving the coolant's thermo physical characteristics, which are its heat-transfer medium. Due to its excellent heat-holding and heat-transfer properties as well as its accessibility, water has been utilized as coolant in radiators for a long time. Later on, ethylene glycol and water were combined to create a coolant. The discovery of a novel class of heat transfer fluids known as nano fluids is the result of advancements in nanotechnology. In comparison to convectional coolants, these fluids provide great thermal conductivity, according to research. According to, nanoparticles—tiny, nanoscale particles—are spread throughout a carrier liquid, such as water, to create nanofluids.

1.1 Research Gap:

The conventional fluids (water and EG) have been used as a coolant in the automotive cooling system. However, the limited thermo-physical properties of these fluids limit heat transfer across the car radiator. The increasing demand for energy and better performance has led to the investigation of other methods. Space constraints are another key issue in the automotive cooling system. Sometimes overheating occurs in the engine because the radiator is not functioning up to the standard expectations.

1.2 Problem Statement:

Improve heat transfer capacity of Radiator. Ethylene glycol in car radiator will increase heat transfer of the engine. The enhanced efficiency of ethylene glycol in an automobile radiator leads to conclusions and recommendations.

2. Methodology

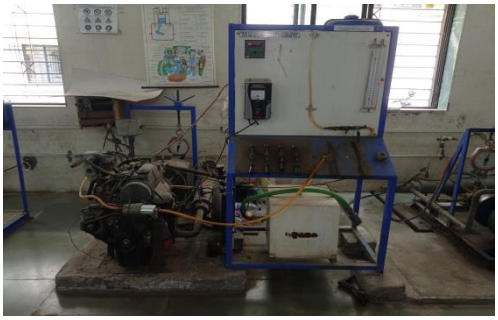
The Swift 1000 CC Radiator will be used, and ethylene glycol will be used as the coolant. Different coolant to water ratios will be used to prepare the coolant. Water and ethylene glycol are used as coolants in later radiator tests. It will compare the coolant flow rates with temperature differential, average heat transfer, effectiveness, and time and temperature difference as well as time and average heat transfer. To create a consistent and stable suspension, ethylene glycol pretreatment is crucial. Ethylene glycol is used as an engine coolant in the current study (in ratios of 1:1, 1:2, and 2:1).

3. Objective

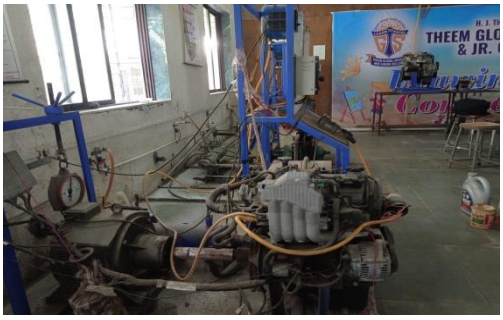
A mixture of ethylene glycol and water in different ratios, such as 1:1, The ratios of 1:2 and 2:1 are primarily utilised in automobiles.

- Conventional coolants, such as water and ethylene glycol, have long been used extensively in automobile radiators.
- We increased the proportion of EG to 50% in order to improve coolant performance.
- By raising the EG %, we may improve the engine's cooling capabilities, which will require less engine maintenance.

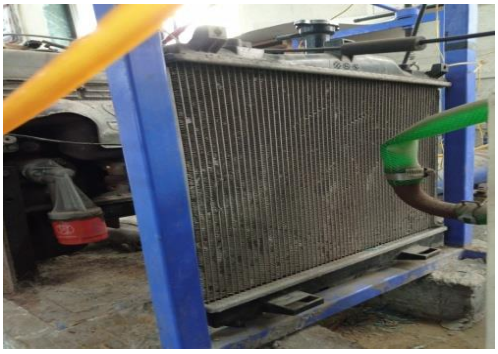
4. EXPERIMENTAL SETUP



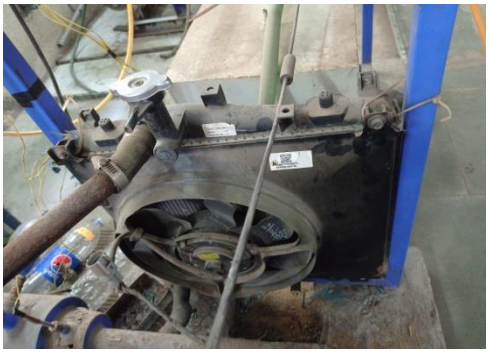
1) **Complete Experimental Setup**



2) **Engine**



3) **Radiator**



4) **Radiator Fan**

5. MATERIAL

Preparation of Coolant that is water/ ethylene glycol the preparation by the ratio of 1:1 water and ethylene glycol was ready by adding distilled water to ethylene glycol and the other two samples were prepared by mixing proportions of 1:2 and 2:1 simultaneously.

Apparatus used for finding properties of coolant –

❖ **Physical Properties Of Coolant**

- Density is measured by using Beaker & Weighing Machine.
- Viscosity is measured by Viscometer .
- Mass flow rate
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❖ **Thermal Properties Of Coolant**

- Specific Heat measured by using Calorimeter.
- Thermal Conductivity is measured by using Modified Transient
- Heat Transfer Rate

6. RESULT AND CALCULATION

The test facility was calculated for the accuracy and reliability of measurement by carrying test runs with base fluid in the automobile radiator.

Properties	Water (A)	Coolant		
		(B) (1:2)	(C) (1:1)	(D) (2:1)
Density(kg/m3)	995.68	1024.3	1020.4	1063.1
Viscosity(Kg/m.s)	0.001	0.0072	0.0085	0.0123
Mass Flow Rate(Kg/s)	1.636	0.9952	0.8595	0.7854
Specific Heat(J/Kg.k)	4236	3857.154	3554.75	3470.73
Thermal Conductivity(W/m- K)	0.542	0.295	0.249	0.230

Table 6.1 Thermal And Physical Properties Of Coolants.

Sr. No	Coolant		Inlet tube Temp of Radiator T1(C)	Outlet tube Temp of Radiator T2(C)	Temp Diff. across Radiator tube ΔT(C)	Specific Heat,Cp (J/Kg.K)	Heat Transfer (KW)
1	Pure Water	With Fan	74	70	-4	4236	10.5
		Without Fan	74	72	-2	4236	8.5
2	$C_2H_6O_2$+Water (1:2)	With Fan	74	70	-4	3857.154	-13.905
		Without Fan	82	80	-2	3857.154	-7.46
3	$C_2H_6O_2$+Water (1:1)	With Fan	72	69	-3	3554.75	-9.069
		Without Fan	78	76	-2	3554.75	- 6.046
4	$C_2H_6O_22$+Water (2:1)	With Fan	70	62	-8	3470.73	-20.86
		Without Fan	81	79	-2	3470.73	-10.44

Table 6.2 Actual Exploratory Examination of Results [Validation]

7. Conclusion

This experiment has tentatively investigated the heat transfer coefficient for working liquid ethylene glycol in an automobile radiator. the ratio of three working liquids, ethylene and water, respectively, at a certain load and temperature, which is 2:1, 1:1, and 1:2. The data indicates that there is a possibility that the engine's heat will be removed by the nano fluid coolants. We may deduce that the radiator system's thermal performance is significantly influenced by the amount of ethylene glycol present in it. Because ethylene glycol has a lower freezing point than water and an increased thermal conductivity, higher glycol concentrations often led to better heat transfer performance. However, the fluid's viscosity rose at very high glycol concentrations, which may lead to an increase in pumping power. requirements and lower flow rates, which results in a reduction in the efficiency of heat transfer.

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