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A Performance Evaluation of Radiator system for a Stationary C. I. Engine

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ABSTRACT- The radiator is an essential adornment of vehicle motor. Typically, it is utilized as a cooling arrangement of the motor and by and large water is the warmth exchange medium. For this fluid cooled framework, the waste warmth is evacuated by means of the circling coolant encompassing the gadgets or entering the cooling diverts in gadgets. In this paper different techniques for radiator execution assessment and testing of the radiator are considered in light of the fact that all inner ignition motors produce heat as a by result of burning and rubbing. This warmth can achieve temperatures up to 1925°C (3500°F) and can have disastrous effects on motor parts. Inner burning motors are fitted with a cooling framework which is in charge of expelling certain warmth from the motor and keeps the motor from overheating. This cooling framework requires an extensive space to address cooling issue furthermore have constrained warmth dispersal. Car radiator is key segment of motor cooling framework. Radiator warm investigation comprise measuring and rating of warmth exchanger. Radiator estimate for the most part relies on upon warmth dismissal prerequisite. Heat exchange estimations are imperative essentials to enhance radiator size. In this study, Ethylene glycol (EG) and Ethanediol with aliphatic added substances blended with refined water in different proportions as traditional coolant have been utilized as a part of car auto radiator. These warmth exchange liquid have low warm conductivity. In this Experimental study introduced the blend Ethylene glycol + water utilized as a part of auto radiator. General warmth exchange rate have been spoken to in the present work.

KEYWORDS – Car radiator, Engine Cooling, Efficiency, Coolants etc.

I. INTRODUCTION

Today, the interest of car vehicles is on top. There is a considerable measure of rivalry existing between car commercial ventures. In this way, it is an incredible test for car commercial enterprises to give a proficient and prudent motor. There are different elements influencing the productivity of motor specifically, fuel supply frameworks, Lubrication framework, Transmission framework, Cooling framework, Climatic conditions, Size of chamber head, Ignition timing. Here cooling parameter is taken into thought and investigates are finished. The warmth produced amid burning in IC motor ought to be kept up at more elevated amount to expand warm effectiveness, however to keep the warm harm some warmth ought to expel from the motor. In air-cooled motor, augmented surfaces called balances are given at the fringe of motor chamber to build heat exchange rate. However, these days because of different enhancements in car field, enhanced cooling frameworks are utilized as a part of vehicles to expand the warmth exchange rate .They are examine bellows.

II. LITERATURE SURVEY

Yiding Cao and KhokiatKengskool [1], had gave utilization of the warmth channel in a car motor was presented. In this application, heat funnels were fused into the radiator of the car motor for more productive warmth exchange. The cooling heap of the radiator can be expanded for overwhelming obligation motors, while the force utilization of the cooling fan can be diminished for higher vitality productivity. Heat channels including two-stage shut thermo siphon were two-stage heat exchange gadgets with a viable warm conductance many times higher than that of copper. For the physical applications, gravity was regularly used to right hand the arrival of the fluid condensate and no wick structure was required inside the warmth channel. A little measure of working fluid was filled in a tube.

Hwa-Ming Nieh, Tun-Ping Teng, Chao-Chieh Yu [2], This study receives an alumina (Al2O3) and titanium (TiO2) Nano-coolant to upgrade the warmth scattering execution of an air-cooled radiator. The two-stage combination strategy is utilized to deliver diverse convergences of Al2O3 and TiO2/water (W) Nano liquid by utilizing a 0.2 wt. % chitosan dispersant, and the Nano liquid is blended with ethylene glycol (EG) at a 1:1 volume proportion to frame NC1 to NC6(Nano Coolant). The investigations were led to gauge the warm conductivity, thickness, and particular warmth of the NC with various convergences of nanoparticles and test temperatures, and after that the NC was utilized as a part of an air-cooled radiator to assess its warmth scattering limit, weight drop, and pumping power under various volumetric stream rates and warming temperatures. The test results demonstrate that the warmth dissemination limit and the EF of NC are higher than EG/W, and that the TiO2 NC are higher than Al2O3 NC in the vast majority of the trial information. The upgraded rate of the normal EF increments as the fixation and volumetric stream rate of the TiO2 NC increments. sort of compartment. Air was emptied from the compartment and the holder was fixed. Warmth was connected to the evaporator area, which causes the fluid to vaporize. The vapor then spills out of the more smoking area because of the higher vapor weight to the colder segment of the warmth funnel, where it was consolidated. The fluid condensate then comes back to the evaporator segment from the condenser segment under the help of gravity.

M. Naraki and S.M. Peyghambarzadeh [3], In this exploration, the general warmth exchange coefficient of CuO/water Nano liquids is examined tentatively under laminar stream administration (100 _ Re _ 1000) in an auto radiator. The Nano liquids in all the examinations have been balanced out with variety of pH and utilization of appropriate surfactant. The outcomes demonstrate that the general warmth exchange coefficient with Nano liquid is more than the base liquid. The general warmth exchange coefficient increments with the improvement in the Nano liquid fixation from 0 to 0.4 vol. %. On the other hand, the general warmth exchange coefficient diminishes with expanding the Nano liquid delta temperature from 50 to 80 C. In this article, the test general warmth move coefficient in the vehicles radiator has been measured utilizing CuO/water Nano liquid at various air and fluid volumetric stream rates, different Nano liquid fixations and a few bay temperatures of the fluid. Likewise, the outcomes have been factually examined utilizing Taguchi strategy.

Rahul Tarodiya, J. Sarkar, J. V. Tirkey [4], the utilized of "Nano liquids" have been created and these liquids offer higher warmth exchange properties contrasted with that of traditional car motor coolants. Vivacious examinations and also hypothetical execution investigations of the level balance tube car radiator utilizing Nano liquids as coolants have been done to study its execution change. Impacts of different working parameters utilizing Cu, SiC, and Al2O3 and TiO2 Nano liquids with 80% water-20% ethylene glycol as a base liquid are exhibited in this article. Utilization of Nano liquid as coolant in radiator enhances the viability, cooling limit with the lessening in pumping power. SiC-80%

H_2O-20% EG (base liquid) yields best execution in radiator having plate balance geometry taken after by Al_2O_3-base liquid, TiO_2-base liquid and Cu-base liquid. The greatest cooling change for SiC is 18.36%, while that for Al_2O_3 is 17.39%, for TiO_2 is 17.05% and for Cu is 13.41% as coolants. Present study uncovers that the Nano liquids may viably use as coolant in car radiators to enhance the execution.

Feovbokhan, Vincent Enontiemonria, Ohiozua, Ohireme Nathaniel [5], The cooling properties of a privately figured coolant (test C) versus, its bubbling qualities and particular warmth limit were examined close by with a typical coolant-water (as test An) and a business coolant (test B). The consequences of the examination demonstrated that example C gave the best execution contrasted with the other two specimens An and B: the breaking points of test C was 1100C, example A 1000C, and test B 1010C. This implies the likelihood of a bubble out of test C from the radiator is little contrasted with tests An and B. Likewise, for the same amount of coolant more warmth would be required to raise test C to its breaking point than for tests An and B. In other word, better cooling would be accomplished utilizing test C.

S.M. Peyghambarzadeh, S.H. Hashemabadi, S.M. Hoseini , M. Seifi Jamnani [6], Traditionally constrained convection heat move in an auto radiator is performed to cool coursing liquid which comprised of water or a blend of water and hostile to solidifying materials like ethylene glycol (EG). In this paper the warmth exchange execution of unadulterated water and immaculate EG has been contrasted and their double blends. Besides, diverse measures of Al_2O_3 nanoparticle have been included into these base liquids and its impacts on the warmth exchange execution of the auto radiator have been resolved tentatively. Fluid stream rate has-been changed in the scope of 2–6 l for each moment and the liquid gulf temperature has been changed for all the tests. The outcomes show that Nano liquids unmistakably upgrade heat exchange contrasted with their own base liquid. In the best conditions, the warmth exchange upgrade of around 40% contrasted with the base liquids has-been recorded.

S.M. Peyghambarzadeh, S.H. Hashemabadi, M. Naraki, Y. Vermahmoudi, [7], the warmth exchange execution of the vehicles radiator is assessed tentatively by ascertaining the general warmth exchange coefficient (U) as per the traditional ε-NTU Technique. Copper oxide (CuO) and Iron oxide (Fe_2O_3) nanoparticles are added to the Water at three focuses 0.15, 0.4, and 0.65 vol. % with considering the best pH for more steadiness. In these investigations, the fluid side Reynolds number is fluctuated in the scope of 50-1000 and the bay fluid to the radiator has a steady temperature which is changed at 50, 65 and 80 _C. The impacts of these variables on the general warmth exchange coefficient are profoundly examined. Nano liquids demonstrated more prominent warmth exchange execution contrasting and water. Expanding fluid and air Re builds the general warmth exchange coefficient. Expanding the channel fluid temperature diminishes the general warmth exchange coefficient.

D. Madhesh, R. Parameshwaran, S. Kalaiselvam, [8] An examine the warmth exchange potential and rheological qualities of copper–titania cross breed Nano liquids utilizing a tube as a part of the tube sort counter stream heat exchanger. The Nano liquids were set up by scattering the surface functionalized and crystalline copper–titania cross breed Nano composite in the base liquid, with volume focuses going from 0.1% to 2.0%. The surface functionalized and exceptionally crystalline nature of mixture Nano composite have added to the production of viable warm interfaces with the liquid medium, along these lines empowering the accomplishment of accomplishing enhanced warm conductivity and warmth exchange capability of Nano liquids. The viable warm conductivity and dispersion energy of half and half Nano composite in the liquid medium made ready for the enhanced warmth exchange Characteristics of crossover Nano liquid.

III. PROBLEM DEFINITION

CALCULATION OF HEAT TRANSFER RATE & HEAT TRANSFER COEFFICIENT.

To obtain Overall heat transfer rate.

Heat transfer rate can be calculated as follows.

$Q = m*Cp*\Delta T = m*Cp* (T2-T1)$

Where,

m is mass flow rate which is the product of density and volume flow rate of fluid,

Cp is the specific heat of fluid.

A is circumferential area of radiator tubes,

T1 and T2 are inlet and outlet temperatures, and It should also be mentioned that all the physical properties were calculated.

We will also calculate overall heat transfer coefficient are as follows.

$Q = H*A*\Delta T = H*A* (T2-T1)$

$H= Q/ A*\Delta T$

Where,

H = Overall heat transfer coefficient

A is circumferential area of radiator tubes, T1 and T2 are inlet and outlet temperatures,

AND To calculate Nusselt no.

Nusselt no = H*L/K

Where,

L = Length of Radiator.

FORMULATION OF PROBLEM AND EXPERIMENTAL PLAN

An aluminum stock radiator was tried with a 5L Tata Indica auto out of gear conditions. The coolant utilized as a part of the radiator was unadulterated water. The gulf and outlet temperatures for water were measured utilizing a thermocouple. For the water, a test can be embedded in the tube just before the liquid enters the radiator and directly after it exits. The gulf temperature of air will be accepted to square with the surrounding. A test was put around five inches from the fan on the posterior of the radiator to gauge the outlet air temperature. Ultimately, the stream rate through the radiator was measured by appending a Rota meter just before the coolant enters the radiator.

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The TECHNICAL SPECIFICATION used in this research study is as follows:-

1.	Make	:	**Tata Indica Car**
2.	Material	:	**Aluminum**
3.	Flow Type	:	**Cross Flow**
4.	No. of plates	:	**02 {Top & Bottom}**
5.	Height	:	**14.5 inch (368.3 mm)**
6.	Width	:	**24 inch (609.6 mm)**
7.	Material for Tubes & Plate	:	**Aluminum**
8.	No. of Tubes	:	**36**
9.	Fin & Tube Spacing	:	**<0.5 inch (12.7 mm)**
10.	Diameter of Tube	:	**10mm**
11.	Total No. of Fins	:	**11*24 inches = 264 Fins (1 inch contain 11 fins & Total Width is 24 inches)**

IV. PROPOSED SOLUTION

EXPERIMENTAL TEST RIG AND PROCEDURE

The test rig in Fig. 4 which is used to measured Temperature difference, Overall heat transfer rate & heat transfer coefficient in the automobile radiator engine cooling system. This experimental setup includes a reservoir plastic tank, electrical heater, water pump, a flow meter, tubes, thermostatic valves, a fan, a DC power supply, and Digital thermocouples for temperature measurement heat exchanger (Car radiator). The water flows through plastic tubes centrifugal pump from the tank to the radiator. And constant in all the experimental steps .Two thermocouples have been fixed on the flow line for recording the inlet and outlet water temperatures. Digital thermocouples. Two digital thermometer with the accuracy are used to read all the temperatures from thermocouples. Calibration of thermocouples and thermometers carried out by using a constant temperature water bath.

The radiator of the engine was 368.3 mm in height by 609.6 mm in width as showed in Fig. 5, and had a total number of 36 tubes. All the 36 tubes were in a single row and each tube was 2 mm thick. The space between fins & tubes is 12.7 mm apart as shown in fig.5 the radiator was completely clean before the experiments has started.

First of all we will fill up the water in the radiator tank & then water circulates in engine through the water pump At this conditions initial reservoir temperature will be note down before start vaporizations, when it reached at 70 to 80 degree Celsius temperature, at this situations thermostat valve gets open & water start vaporizes.it goes to at the inlet of the radiator at this end T1 temperature will be note down from outlet of the engine. Further, temperature rises water circulates it in to radiator .T2 is measured at outlet of the radiator. If any case overflow problem water it goes to the bypass to the tank.

Fig. 1 Coolants Sample

Fig. 2 Actual Experimental Radiator Test-rig.

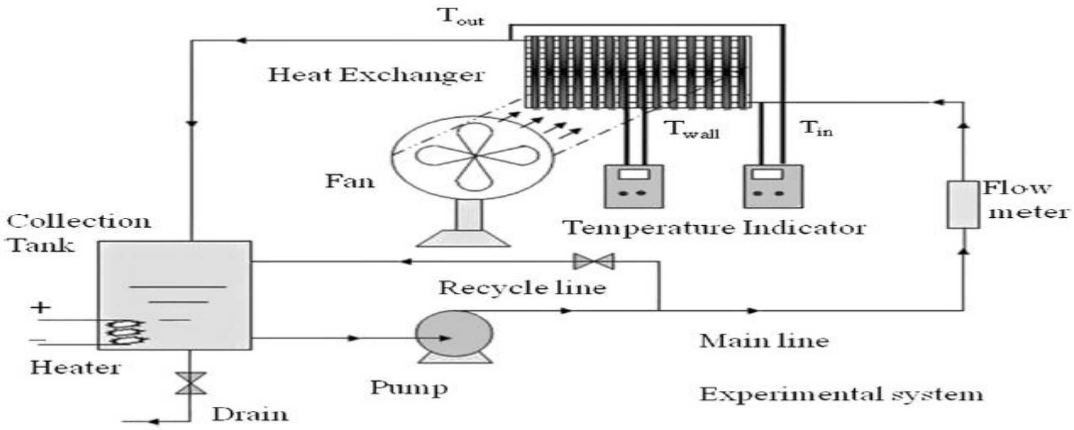

Fig.3 Experimental investigation of cooling performance of an Automobile radiator using Water + ethylene Glycol.

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Table 4.1 Thermal And Physical Properties Of Coolants.

Properties	Water (A)	Coolant 1			Coolant 2		
		B(1:2)	C(1:1)	D(2:1)	E(1:3)	F(1:1)	G(2:1)
Density (Kg/m3)	1090	1140	1165	1190	1113.2	1136.4	1151.87
Specific Heat (J/Kg K)	4240	3370	2935	2500	3140	2040	1306.67
Thermal Conductivity (W/m-K)	0.563	0.363	0.263	0.163	0.149	-0.265	-0.54
Viscosity (Kg/m s)	0.000896	0.00198	0.002522	0.003064	0.000971	0.001046	0.001096
Molecular Weight (Kg/Kgmol)	18	62.079	40.0395	47.386	62	40	47.33

Table 4.2Actual Experimental Comparison of Results [Validation]

Sr. No.	Coolant			Inlet Tube Temp of Radiator T1(C)	Outlet Tube Temp of Radiator T2(C)	Temp Diff. across Radiator Tube ΔT(C or K)	Specific Heat, cp (J/Kg K)	Heat Transfer Q=m*cp*ΔT (kW)
1		A. Pure Water	With Fan	84	79	5	4240	53
			Without Fan	89	90	-1		-10.6
2	Coolant 1	B. Ethelene Glycol + Water **(1:2)**	With Fan	84	71	13	3370	**109.525**
			Without Fan	87	90	-3		-25.275
3		C. Ethelene Glycol + Water **(1:1)**	With Fan	84	75	9	3110	69.975
			Without Fan	87	88	-1		-7.775
4		D. Ethelene Glycol + Water **(2:1)**	With Fan	84	72	12	2840	85.2
			Without Fan	90	91	-1		-7.1
5	Coolant 2	E. Ethanediol with Additives + Water **(1:3)**	With Fan	84	76	8	3140	62.8
			Without Fan	87	90	-3		-23.55
6		F. Ethanediol with Additives + Water **(1:1)**	With Fan	84	76	8	2860	57.2
			Without Fan	88	89	-1		-7.15
7		G. Ethanediol with Additives + Water **(2:1)**	With Fan	84	73	11	2550	70.125
			Without Fan	89	90	-1		-6.375

V. EXPECTED RESULTS

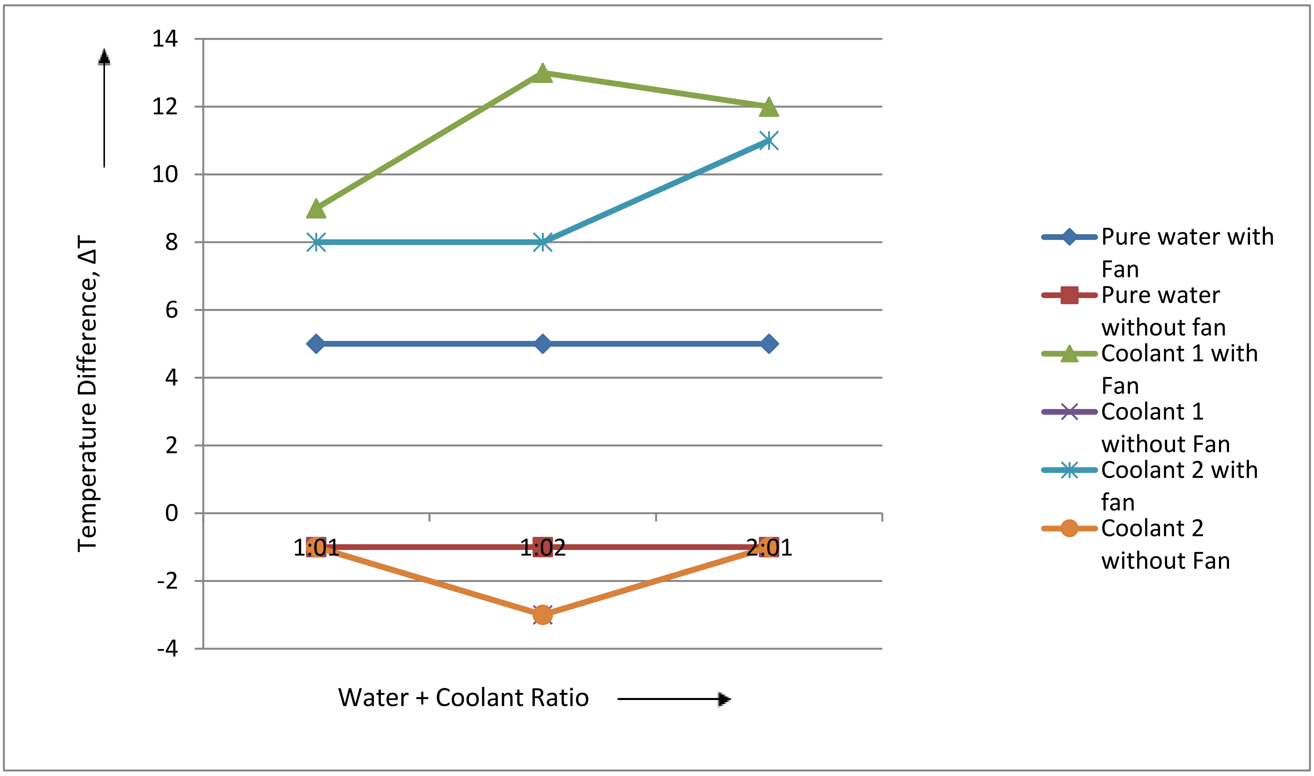

Fig. 4 Temperature difference vs water +coolants ratio

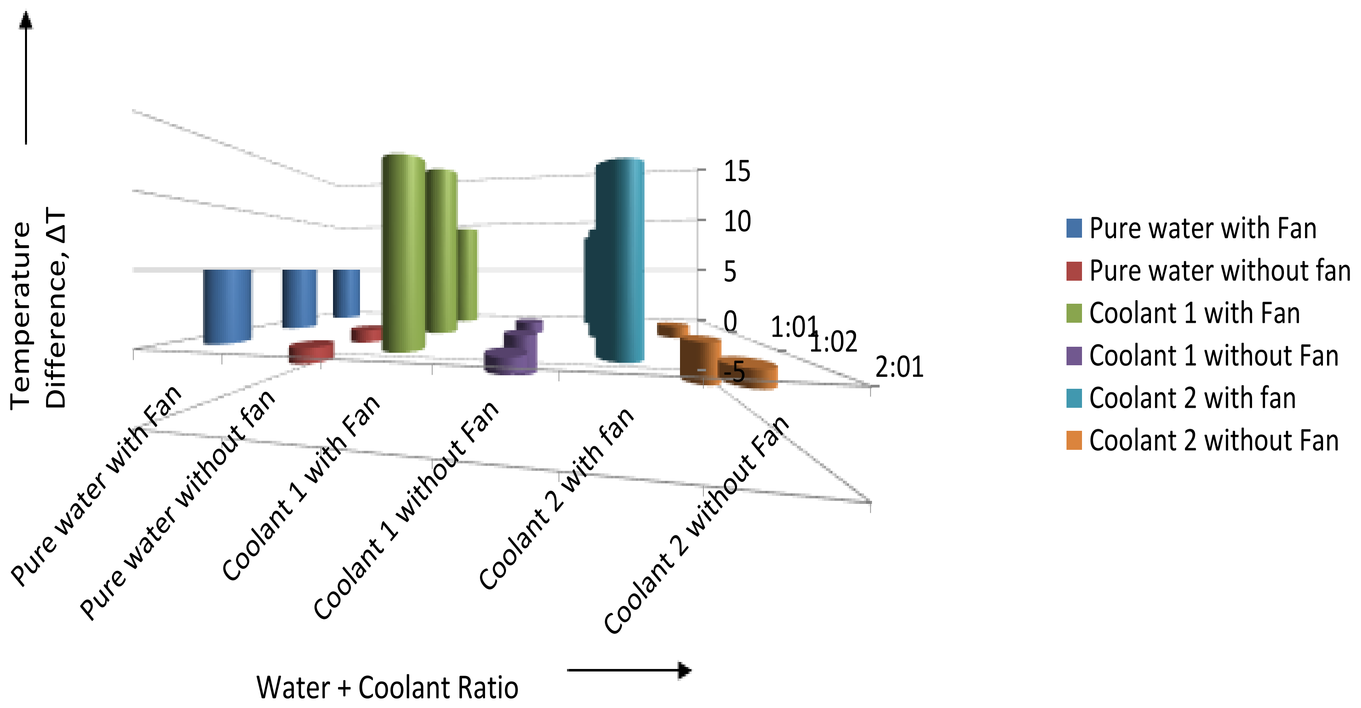

Fig. 5 Temperature difference vs water +coolants ratio

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VI. CONCLUSION

In this article, trial heat move rate in the vehicles radiator was measured with two distinct liquids blended with immaculate water i.e. Ethylene Glycol and Ethanediol with aliphatic added substance at various fixations (1:1, 1:2, 1:3 and 2:1) and the accompanying conclusions were made.

1. The Cooling limit and viability of Coolant 1 i.e. Ethylene Glycol with water blended in proportion 1:2 gives most extreme worth which is 109.525 kW.
2. The general warmth exchange rate diminishes with expanding grouping of coolant in water.
3. In motor cooling framework there is diminishment in fuel utilization.
4. To build warm proficiency of vehicles radiator.
5. To expand life of radiator motor cooling framework.
6. To minimize the weight on the motor cooling framework.
7. To expand cooling limit of the motor.
8. To minimize commotion and vibration issue when contrasted with air Cooled motors.

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