Performance Analysis of Helical Radiator with Different Next Generation Fluids

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Abstract: The development in automobile technology is upgrading day by day. It's conjointly depends on flow capability of fluids and material employed in manufacturing of radiator. Thermal transmission of liquids is one in all the basic properties taken into consideration in coming up with and dominant the method. Automobile radiators are getting extremely necessary in terms of performance of car and most cooling, collectively they are extremely power-packed with increasing power to weight or volume ratio. Nearly thirty third of energy generated by the engine through heat lost within the combustion. Lean cooling may end up within the overheating of engine. The main work of radiator is providing cooling to engine, for this flow liquids inside helical tubes. In this proposed work present analysis of Robust Radiator with Different Next Generation Fluids.

Keywords – Next-Generation-Fluids (NGF), Robust-**Tubes (RT), Heat-Exchanger (HE), Robust-Radiator (RR) and Coolant**

I. INTRODUCTION

Now a nano fluids are very important, there fluids are also known as a next generation fluids. Nano fluid based radiator perform robust in nature. Advantages of Nanofluid Improvement in heat conduction - Base working fluid possesses lower thermal conductivity with compare to nanofluids, due to the larger surface area and volume the heat transfer increases between solid and fluid particles. Due to small size of particles the mobility is also increased. Lesser Pressure Drop - To increase the conductivity, nanoparticles are recognized with higher effectiveness due to its enormous specific surface area. Reduction in Erosion - Small size particles of nanofluid usually not generate so much momentum and kinetic impact on the surface of the wall. Applications of Nanofluid Radiator coolers Used in cooling devices In computer micro-chip Solar energy applications Biomedical applications Used as heat transfer medium Work Description This research work is subdivided into some sections or different chapters and it includes introduction, in this part of the report a detailed description of Nanofluid technology in Helical tube Radiator Use as coolant of different nanofluids (Al2O3 Cuo, TIO2) with base fluid methanol, characteristics along with applications. [1] [2] [3]

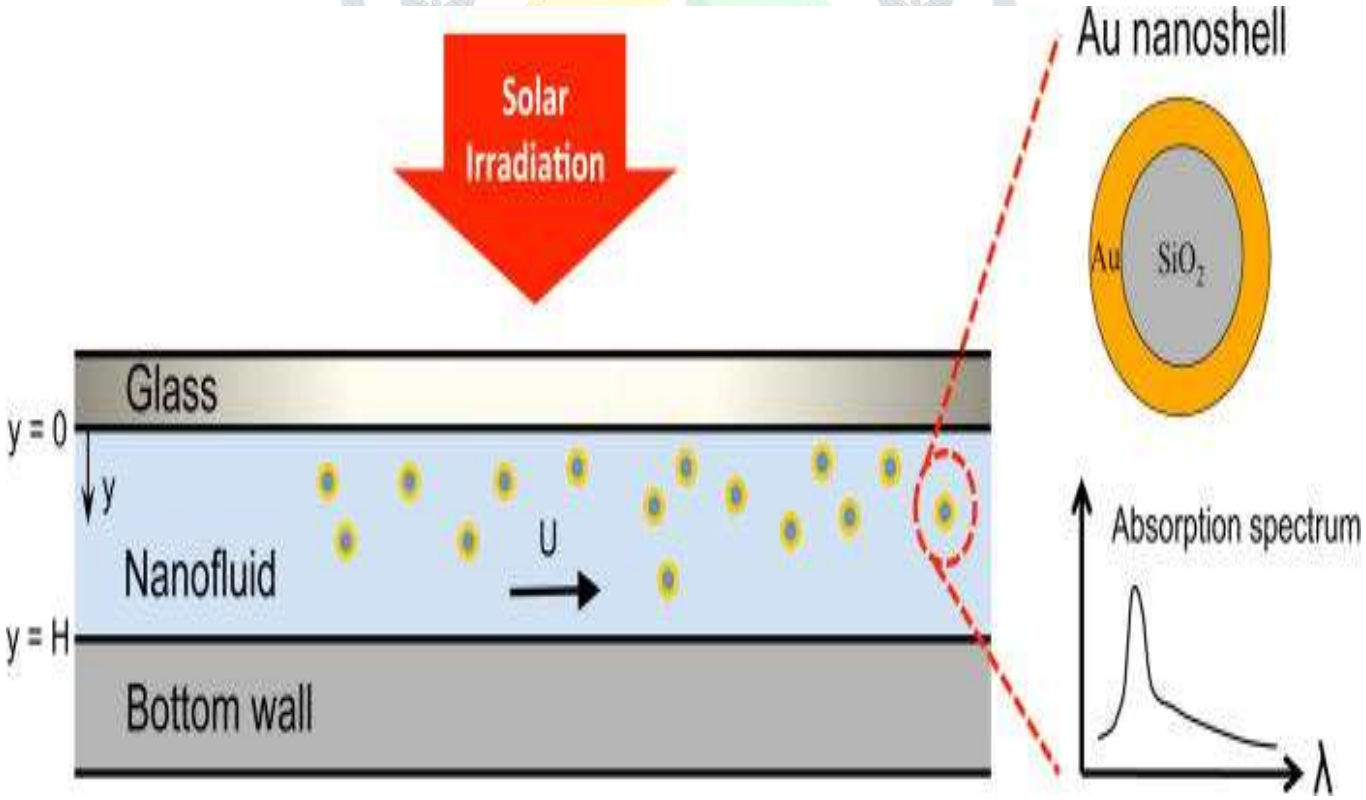

Fig. 1 Shows working of nano fluids [7]

Above figure 1 discourse the robust process of nano fluids and functioning singularities.

Most automotive cooling systems includes the subsequent components: radiator, electrical cooling fan pump, thermostat, and radiator pressure of those elements, the radiator is that the foremost outstanding a section of the system because it transfers heat.

As fluid travels through the engine's engine block, it accumulates heat. Once the coolant temperature can increment past a specific esteem, the vehicle's thermostat triggers a valve that powers the coolant to move through the radiator. Because of the liquid courses through the containers of the radiator, temperature is exchanged through the blades and tube dividers to the air by convection. Vehicle radiator is used to cool off down car motor. On the off chance that it isn't done differed issues like cylinder twisting, chamber, and piston. On the off chance that radiator works legitimately cooling framework can work appropriately progressively motor execution can increment.[4]

Automobile makers have challenge of developing compact and energy economical cars that warrants a radical improvement technique within the design of all engine elements. Radiators are one of the vital elements of engine that are put in in automobiles to remove heat for better engine performance so providing engine cooling and also heat removal throughout air-conditioning method. Today's engine require higher output with slashed space out there for cooling air circulation that necessitates an improved understanding of the difficult cooling fluid flow characteristics and thermal performance of the radiator is critical because the performance, safety and lifetime of engine depends on effective engine cooling. [5]

II. PROPOSED SYSTEM MODEL

This section in brief describes the final ideas and theory involving victimization CFD to analyses fluid flow and heat transfer, as relevant to the current project. It begins with a review of the tools required for final the CFD analyses and also the processes required, followed by define of the governing equations and turbulence models. [6]

In the beneath table 1 demonstrates the material property of proposed material, that is utilized as a part of the nano tubes. In the underneath table take diverse materials. Watchfulness of materials properties are appeared in underneath table 1.

Table 1: Material Property: Flowing fluid is Nano fluids

Material	**Density[kg m^{-3}]**	**Specific Heat[J kg^{-1} K^{-1}]**	**Thermal Conductivity [W $m^{-2}K^{-1}$]**	**Viscosity[kg/m-s]**
Ethylene glycol	1110	2470	0.258	
Methanol	791	773	0.204	$8.91x10^4$
Aluminium oxide(AL_2O_3)	3970	765	40	$8.91x10^4$
Copper oxide (cuo)	6.31	551	33	$8.91x10^4$
Titanium oxide (TIO_2)	4250	656.2	8.9538	$8.91x10^4$

Boundary Condition:
Operating Condition: Pressure = 101325 Pa
Inlet: Velocity inlet –Coolant Mass flow rate= .555 kg/s
Turbulent intensity = 5%
Hydraulic Dia. = .015 m
Air Convection At Tube:
Heat transfer coefficient: 90 w/m2
Air temp: 308.15
Outlet: Pressure outlet: Define the same outlet condition for all the fan outlet
Gauge pressure = 0 Pa Turbulent intensity = 5%
Hydraulic Dia. = .015

Solution: In the solution of method pressure use velocity coupling simple, momentum of the method is IInd order, turbulent kinetic energy of the system is Ist order and turbulent dissipation rate (e) is Ist order. There are parameters and method specification which is used for validation of proposed design. In the next section describe the result and analysis of proposed design.

RESULT

In the section discuss the result of proposed method which is based on different result parameters. In the below figure 2 shows the contour statics of temperature plot.

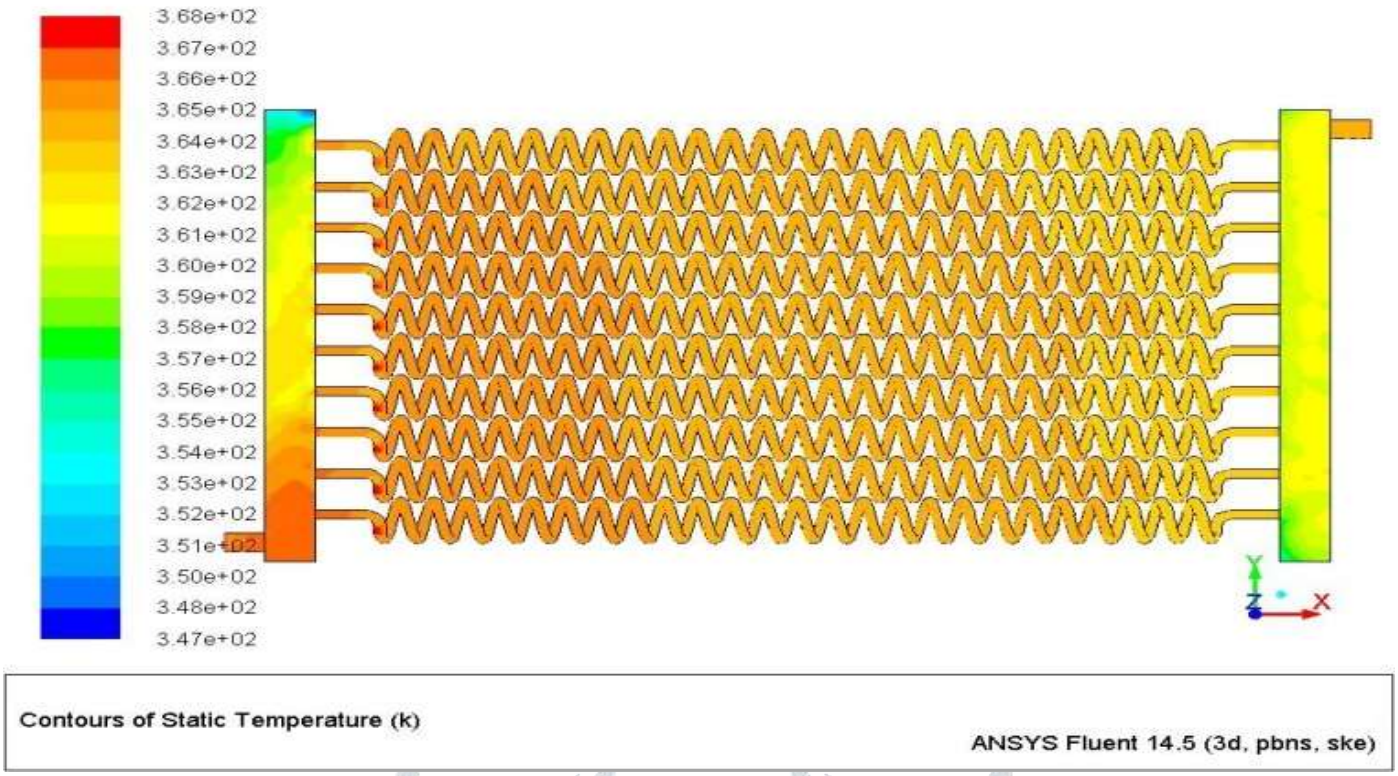

Figure: 2 Helical-Tube-Radiator-P20-Ethylene-Glycol-Temp1

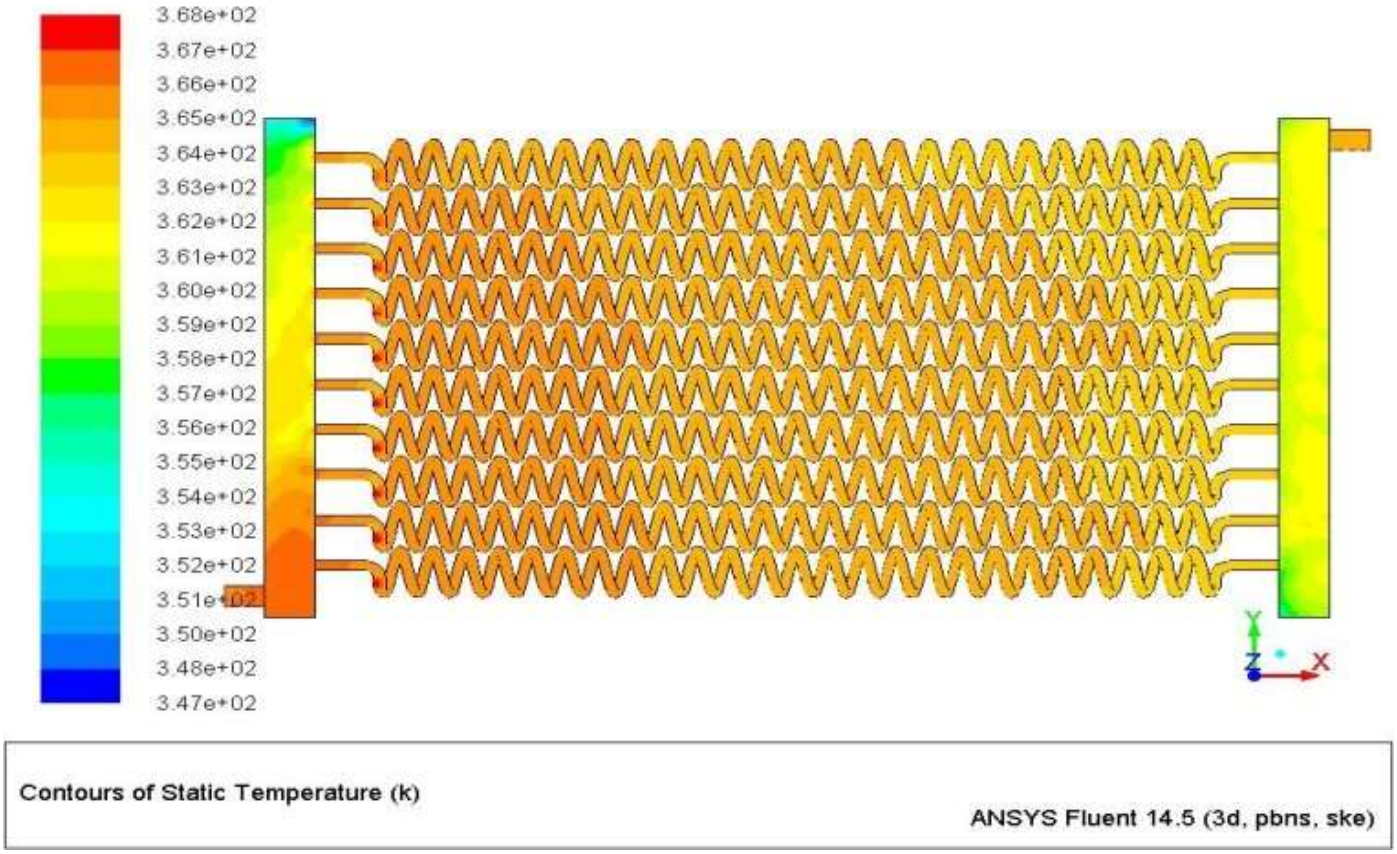

Figure: 3 Helical-Tube-Radiator-P20-Ethylene-Glycol-Temp2

In the both above two figure 2 and figure 3 shows the temperature changes in helical tubes in which flow nano liquid floods. In the above figure there are two different type of flutes are used first one is Ethylene-Glycol and other one is the Ethylene-Glycol.

Similar that in the next figure 4 shows the pressure level of the helical-tube-radiator. On the basis of the optimization calculate the outputs of the pressure drop on nano tubes that is shown in below table 2. In this table shows the different nano tube types with shows the different pressure drops Methonal+AL203 shows highest pressure drop in all tubes.

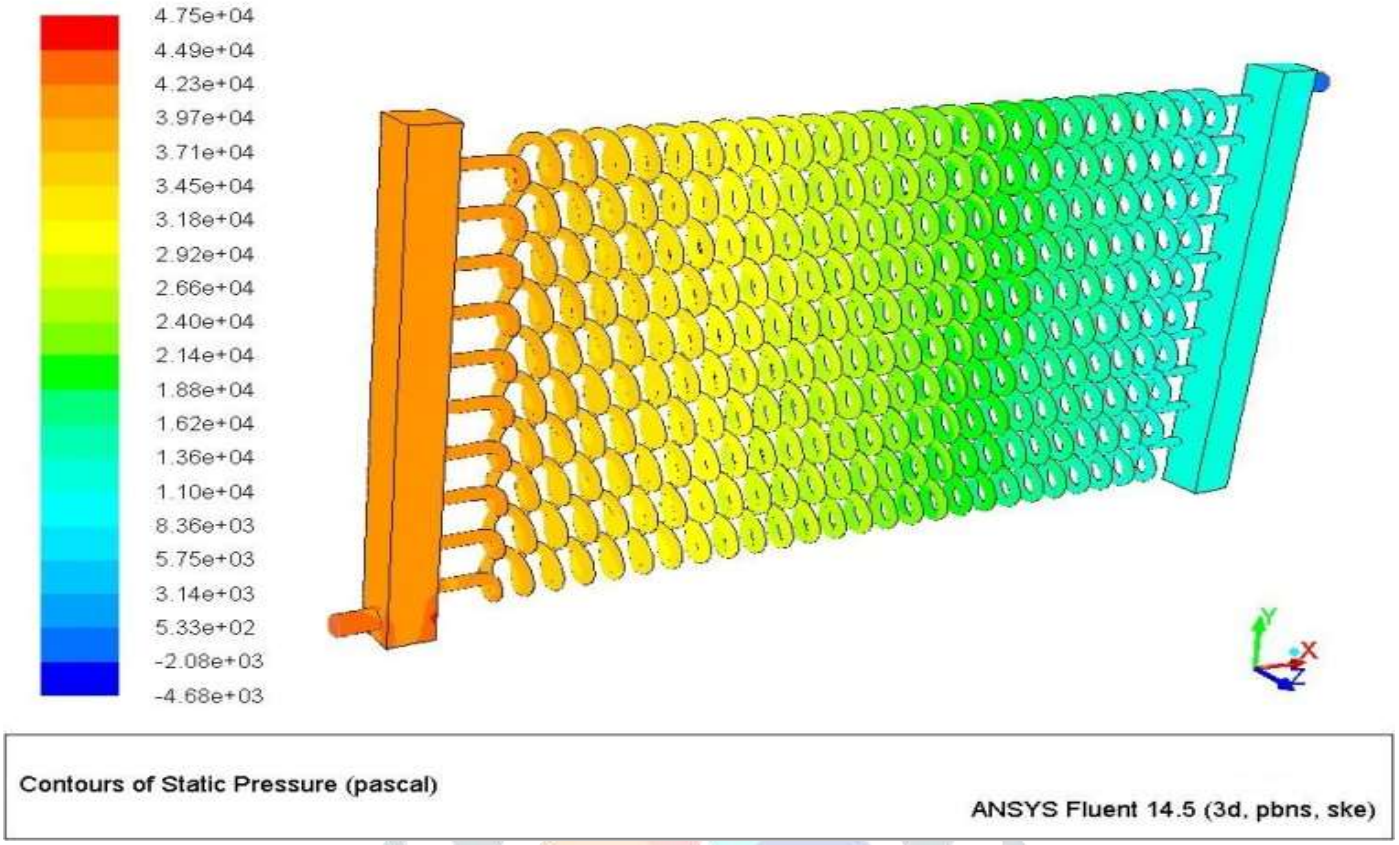

Figure: 4 Helical-Tube-Radiator-P20-Ethylene-Glycol-Pressure

On the basis on above analysis of CFD in the below table shows the pressure drop in different nano fluids.

Table 2: Pressure drop in different nano fluids

Nano fluid	Ethylene-Glyco	Methonal	Methonal+AL203	Methonal + CuO	Methonal + TiO2
Pressure Drop	88293.219	39794.64	94295.422	93748.602	94201.016

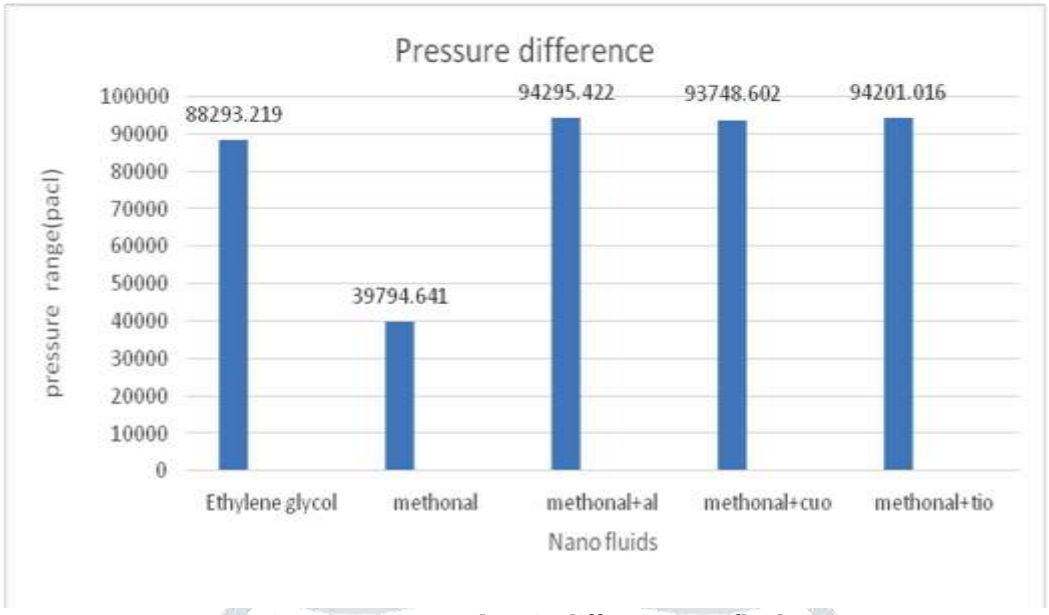

Figure: 5 Pressure drop in different nano fluids

In the above figure 5 shows the comparison of different nano tubes pressure drop result. In the X axis shows the different nano tube material and in the y axis shows the pressure range. Pure methanol contain lowest pressure drop and hybrid methanol aluminum shows highest pressure drop in the comparison.

When discuss about the robust radiator inlet – outlet temperature difference play a critical role for performance analysis of proposed analysis. On the basis of above analysis shows the result of inlet – outlet temperature difference of nano fluid, that is shown in below table 3. In the below table shows different nano tube martial compare on the basis of temperature difference, highest temperature obtain methanol based hybrid nano fluids with copper oxide. That is shown in below table 3.

Table 3: Temperature (inlet-outlet) of different nano fluid

Nano Fluids	Ethylene-Glyco	Methanol	Methonal+AL203	Methonal + CuO	Methonal+TiO2
Inlet Temp	368	368	368	368	368
Outlet Temp	365.665	365.6328	365.5354	365.5277	365.5385
Temp Difference	2.335	2.3672	2.4646	2.4723	2.4615

In this table comparing the temperature (inlet, outlet and temperature difference) of the types of Nano Fluids.

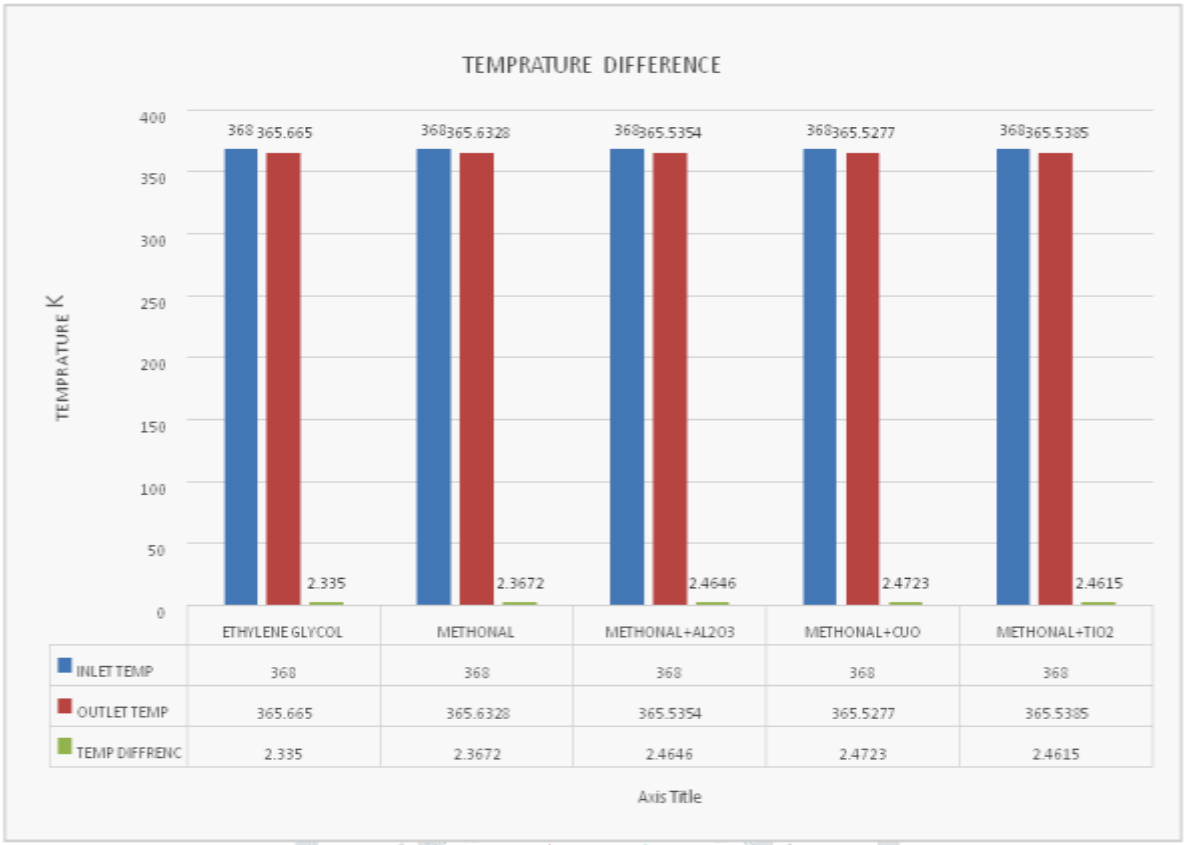

Figure: 6 Temperature difference of Nano fluids

On the basis of above table 3 create a graphical comparison of different nano fluids which is shown in the above figure 6. In the last of this section but not least shows the heat loss rate of different nano tube Martials. In the below table 5 and figure 7 shows the compression of different nano fluids.

Table 5: Heat Loss Rate with Different Coolant

Nano fluids	Ethylene glycol	Methanol	Methanol+Al_2O_3	Methanol + CuO	Methanol+TiO_2
Heat Transfer	3129.659	3329.159	3427.833	3433.453	3421.759

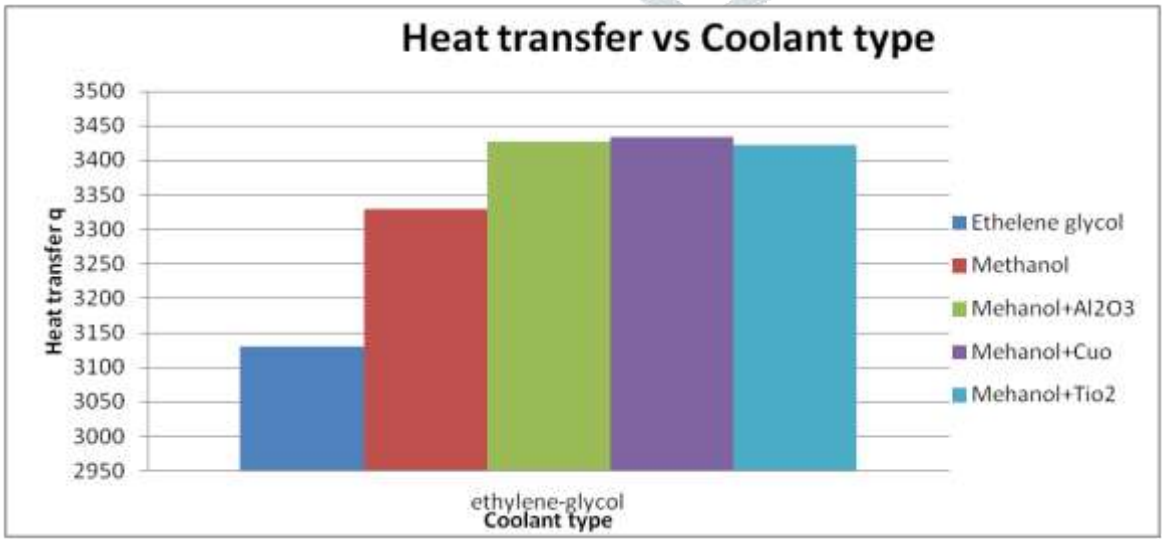

Figure: 7 Heat transfer rate with different Nano fluids

In all about the simulation and result section now discuss the conclusion of proposed research analysis.

IV. CONCLUSION

The simulation is performed for 5 nanofluid material at varied inlet velocity of the fluid. Nano fluid showed higher thermal potency than water for all period of time and velocity. For helical tubes Radiator in 20mm Pitch; there are used 5 coolants ethylene glycol, Methanol, aluminium oxide, copper oxide, titanium oxide with methyl alcohol as Base Fluid CuO/Methanol 2.4723k most temperature drop compared to ethylene glycol ,Methanol AL2O3/Methanol, CuO/Methanol, Tio2/Methanol thus, there CuO/Methanol that is best among 5 coolants. For helical tubes Radiator in 20mm Pitch most temperature reduction CuO/Methanol 3433.453k most compared to ethylene glycol, methyl alcohol AL2O3/Methanol, CuO/Methanol, Tio2/Methanol thus, there (Methonal + CuO) that is best among 5 coolants, involving most pressure drop get in Methanol+ AL2O3 compared to the ethylene glycol , Methanol , CuO/Methanol, Tio2/Methanol Minimum pressure drop get in methyl alcohol compared to the ethylene glycol , methyl alcohol AL2O3/Methanol, CuO/Methanol, Tio2/Methanol CuO/Methanol showed best results overall.

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