ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

CFD Analysis Improving the Performance of an Engine Block by Varying Cooling Fluids

Nukam Sangeetha
M.Tech Thermal Engineering,
Department of Mechanical Engineering,
Malla Reddy College of Engineering and Technology.

Mr.Y.Dilip Kumar
Associate Professor,
Department of Mechanical Engineering,
Malla Reddy College of Engineering and Technology.

ABSTRACT:

The engine block is the linchpin of vehicles that run on internal combustion, providing the powerhouse for the vehicle. It is called a "block" because it is usually a solid cast car part, housing the cylinders and their components inside a cooled and lubricated crankcase. This part is designed to be extremely strong and sturdy, because its failure results in failure of the car, which will not function until the engine block is replaced or repaired. Cooling system plays important roles to control the temperature of car's engine. One of the important elements in the car cooling system is cooling fluid. The usage of wrong cooling fluid can give negatives impact to the car's engine and shorten engine life. An efficient cooling system can prevent engine from overheating and assists the vehicle running at its optimal performance. This thesis was conducted to study the effectiveness of various types cooling agent in the vehicle cooling system which will influence the operation time of the engine block mainly cylinder in the light vehicle cooling systems. Three main types of fluids were used in this study, which are 1. water, 2.Ethylene , 3. Distilled water with Tio2 Nano fluid. Thermal analysis is done on the cylinder by varying the materials Aluminum alloy 7075-T6. Modeling is done in SOLIDWORKS and analysis is done in SOLIDWORKS SIMULATION.

I. INTRODUCTION TO COOLING SYSTEMS IN VEHICLES

Although gasoline engines have improved a lot, they are still not very efficient at turning chemical energy into mechanical power.

Most of the energy in the gasoline (perhaps 70%) is converted into heat, and it is the job of the cooling system to take care of that heat. [Leong, 2010]In fact, the cooling system on a car driving down the freeway dissipates enough heat to heat two average-sized houses! The primary job of the cooling system is to keep the engine from overheating by transferring this heat to the air, but the cooling system also has several other important jobs [Nice, 2012].The engine in your car runs best at a fairly high temperature. When the engine is cold, components wear out faster, and the engine is less efficient and emits more pollution. So another important job of the cooling system is to allow the engine to heat up as quickly as possible, and then to keep the engine at a constant temperature.

LITERATURE SURVEY:

Different Fluids and Its' Impact Towards Car Cooling System This study was conducted to study the effectiveness of various types cooling agent in the vehicle cooling system which will influence the operation time of the radiator fan in the light vehicle cooling systems. Cooling system plays important roles to control the temperature of car's engine. One of the important elements in the car cooling system is cooling fluid. The usage of wrong cooling fluid can give negatives impact to the car's engine and shorten engine life. An efficient cooling system can prevent engine from overheating and assists the vehicle running at its optimal performance. A simple model that consist car's cooling system components was design for this study. Two main type of fluid were used in this study, which are fluid with coolant and fluid without coolant[Pang, 2011]. This study used the fan operating time and temperature as a determinant to review the effectiveness of cooling agent.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Results showed that treated tap water is the most effective liquid without coolant. Meanwhile, for the liquid with coolant, we recommend the mixture of 60% long life coolant with 40% distilled water. It also proves that liquids containing coolant not necessary an effective cooling agent.

Heat Transfer Calculations

The overall heat transfer coefficient for a wall or heat exchanger can be calculated as:

1 / U A = L / k A + 1 / hA (1)

Where

U = the overall heat transfer coefficient (W/m2K)

A = the contact area for each fluid side (m2)

k = the thermal conductivity of the material(W/mK)

h = the individual convection heat transfer coefficient for each fluid (W/m2K)

L= the wall thickness (m)

The thermal conductivity - k - for some typical materials (varies with temperature)

Alloy Cast Iron : 53.3 W/mK

Aluminum 6061: 205 - 250 W/mK

Aluminum7475 : 138 W/mK

More about conductive Heat Transfer

Thermal Conductivity for Several Materials The convection heat transfer coefficient - h -

depends on

The type of fluid - gas or liquid

The flow properties such as velocity

Other flow and temperature dependent properties

Heat transfer coefficient for some common fluids:

Distilled Water: 10 000 W/m2K

Distilled water with Ethylene Glycol: 350 W/m2K

Tio2 Nano fluid: 874W/m2k

II. PROPERTY MANAGER IN FEATURE MANAGER DESIGN TREE :

The Property Manager is a means to set properties and other options for many Solid Works commands. The Property Manager appears on the Property Manager tab in the panel to the left of the graphics area. It opens when you select entities or commands defined in the Property Manager.

MODELING OF ENGINE BLOCK

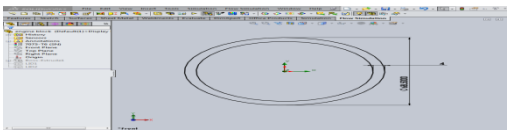
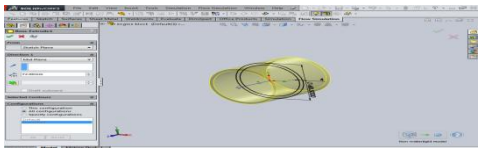


Figure: Diameter of engine block



Figurre:Extrusion of block

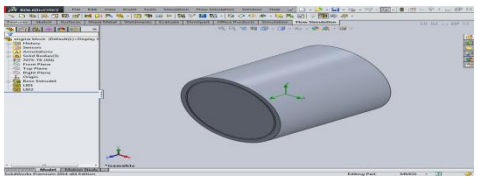


Figure: Different views of engine block

CFD ANALYSIS OF ENGINE BLOCK BY APPLYING ALUMINIUM ALLOY 7075-T6 USING DISTILLED WATER AS FLUID.

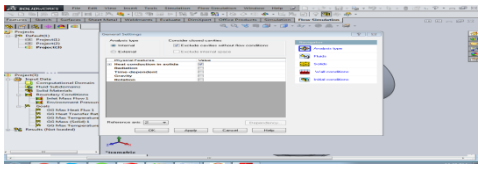


Figure: Internal analysis

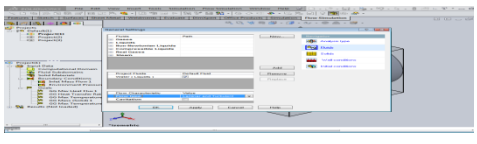
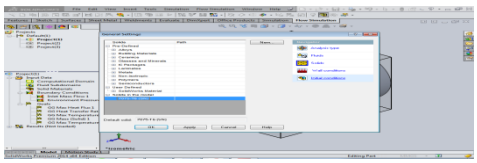
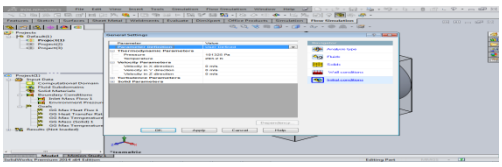


Figure: water as fluid



ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Figure: Aluminium alloy 7075-T6 as material



Fgiure: Initial conditions

BOUNDARY CONDITIONS:

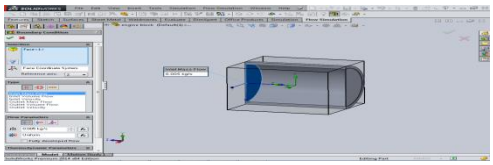


Figure: Inlet mass flow rate of 0.005kg/s with room temperature coolant .

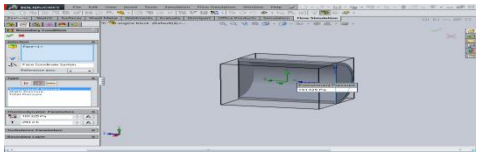


Figure: Environmental pressure as outside

INSERING GOALS:

Inserting global goals as Heat flux, Temperature of solid & Temperature of fluid.

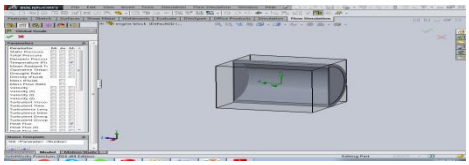
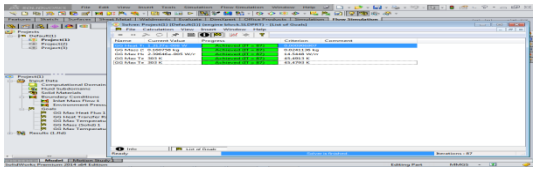


Figure: Inserting global goals

RUNNING THE FLOW SIMULATION:



RESULTS:

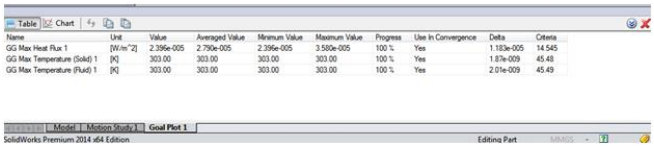


Figure: Global goal results

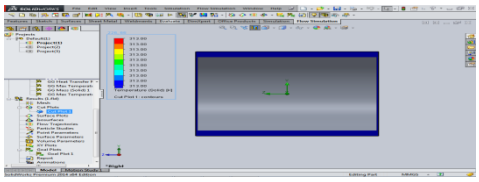


Figure: Tempertaure of solid(engine block)

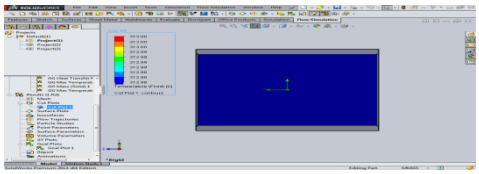


Figure:Temperature of fluid

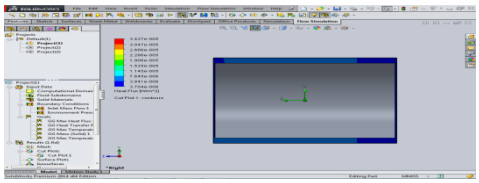


Figure: heat flux

CFD ANALYSIS OF ENGINE BLOCK BY APPLYING ALUMINIUM ALLOY 7075-T6 USING ETHYLENE AS FLUID.

By using same input conditions and changing coolant as Ethylene the results are as follows:

Goal Name	Unit	Value	Averaged Value	Minimum Value	Maximum Value	Progress [%]	Use In Convergence	Delta	Criteria
GG Max Heat Flux 1	[W/m^2]	3.61571E-05	2.257263883	1.86987E-05	22.09274519	100	Yes	22.09272649	1251.473339
GG Max Temperature (Solid)	[K]	303	302.9920329	302.9236769	303	100	Yes	0.076323131	1.455664895
GG Max Temperature (Fluid)	[K]	303	303	303	313	100	Yes	4.85443E-11	3.03E-06

Iterations: 40
Analysis Interval: 20

Figure: Global goal results

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

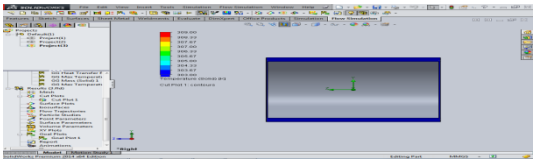


Figure: Temp of solid

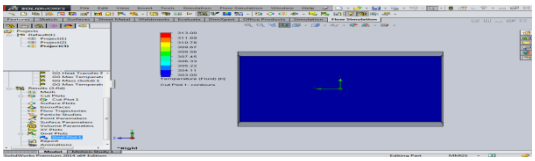


Figure: Temperature of fluid

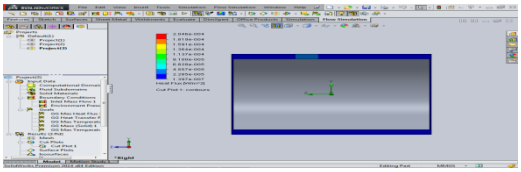


Figure: Heat flux

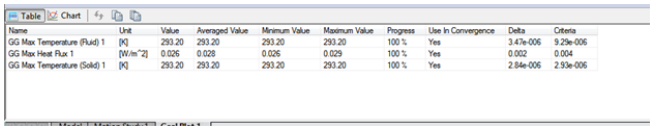


Figure: Global goal results

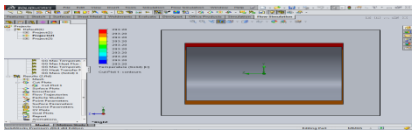


Figure: Temp of solid

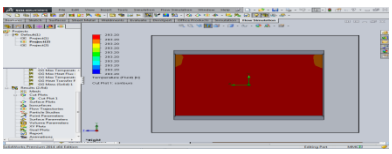


Figure: Temperature of fluid

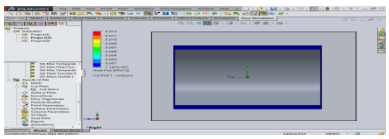


Figure: Heat flux

RESULTS AND DISCUSSIONS

	Distilled water	Ethylene	Tio2 Nano fluid
Temperature of solid(block)	313.2K	303K	293.2K
Temperature of fluid	313K	313K	293.2K
Total Heat Flux(w/m²)	3.427e-005	2.046e-004	0.013

Table: Comparison of results for Aluminum 7075-T6 alloy

By comparing the above results the temperature of the Engine block is less for the fluid Tio2 Nano compared to other two fluids. Also the heat flux is more for the fluid used is Ti02 Nano. So the heat transfer rate can be improved by using Nano fluids compared to conventional fluids.

III. CONCLUSIONS

- The engine block is the linchpin of vehicles that run on internal combustion, providing the powerhouse for the vehicle. It is called a "block" because it is usually a solid cast car part, housing the cylinders and their components inside a cooled and lubricated crankcase. This part is designed to be extremely strong and sturdy, because its failure results in failure of the car, which will not function until the engine block is replaced or repaired.

- Cooling system plays important roles to control the temperature of car's engine. One of the important elements in the car cooling system is cooling fluid. The usage of wrong cooling fluid can give negatives impact to the car's engine and shorten engine life. An efficient cooling system can prevent engine

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

from overheating and assists the vehicle running at its optimal performance.

- This thesis was conducted to study the effectiveness of various types cooling agent in the vehicle cooling system which will influence the operation time of the engine block mainly cylinder in the light vehicle cooling systems.

- Three main types of fluids were used in this study, which are 1. water, 2.Ethylene , 3. Distilled water with Tio2 Nano fluid. CFD analysis is done on the cylinder by varying the materials Aluminum alloy 7075-T6. Modeling is done in SOLIDWORKS and analysis is done in SOLIDWORKS SIMULATION.

- By comparing the above results the temperature of the Engine block is less for the fluid Tio2 Nano compared to other two fluids. Also the heat flux is more for the fluid used is Ti02 Nano. So the heat transfer rate can be improved by using Nano fluids compared to conventional fluids.

REFERENCES:

- Leong, K.Y., Saidur, R., Kazi, S. N., &Mamun, A. H. (2010). Performance Investigation OfAn Automotive Car Radiator Operated With Nanofluid-Based Coolants (Nanofluid As A Coolant In A Radiator). Applied Thermal Engineering, Vol 30, Issue 17/18, P2685-2692.

- Heat and Mass transfer by R.K. RajputMohdRajuli, M. B. (2006). TeknologiAutomotif :PengenalanSistem. PetalingJaya : IBS BukuSdn Bhd.

- Nice, K. (n.d.). How Car Cooling Systems Work.Retrieved 11 July 2012 from http://auto.howstuffworks.com/coolingsystem 3. htm

- Ofria, C. (2006). A Short Course on Cooling Systems. Retrieved 11 July 2012 from http://www.familycar.com/classroom/Cool ingSystem.htm