

Engine Oil Mixing in Radiator Water: Study on I.C. Engine (Diesel) Performance

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Abstract: A high compression internal combustion engine, in which the fuel is ignited by the heat of compression. The diesel cycle may be completed in either two or four strokes. A German Engineer, Dr. Rudolf Diesel designed an engine in 1802, which worked on a much higher compression ratio than petrol engines working on Otto cycle. Diesel oil which fits the requirements for use in diesel engine. The reason that the application of an oil or grease to reduce friction between two or more moving parts. This lubricating system, in the engine that supplies moving parts with lubricating oil to prevent actual contact between any of the moving metal surface. Because as per theories of lubrication, is consisting by Hydrocarbons, Boundary and Hydrostatic respectively.

In automobile engine, only 25% of the total heat produced by the combustion of fuel is actually converted into useful mechanical energy. The rest of the heat energy is used up in the cooling and exhaust systems. The main function of radiator, in the cooling system, a cooling chamber through which the water heated by the engine, passes so that the temperature of the water can be controlled.

Key Words: Adiabatic, Heat exchanger, Lubricating Oil, Thermal Efficiency, Thermostat.

2. INTRODUCTION:

A working cycle of a four stroke engine with Suction, compression, explosion at constant volume, expansion and exhaust. This involves heating and reversible cooling at constant volume and it is called Otto cycle.

The thermal efficiency means the percentage of the total chemical energy in the fuel consumed that is converted into useful work.

$$\text{Thermal Efficiency} = \frac{\text{Heat Supplied} - \text{Heat rejected}}{\text{Heat Supplied}}$$

$$\begin{aligned} \eta_{th} &= \frac{[C_v (T_5 - T_4) + C_p (T_1 - T_5) - C_v (T_2 - T_3)]}{C_v (T_5 - T_4) + C_p (T_1 - T_5)} \\ &= 1 - \frac{C_v (T_2 - T_3)}{C_v (T_5 - T_4) - C_p (T_1 - T_5)} \\ &= 1 - \frac{(T_2 - T_3)}{(T_5 - T_4) + \gamma (T_1 - T_5)} \end{aligned}$$

Assuming, $P = \text{Cut off ratio} = \frac{V_1}{V_5}$

$$r_v = \text{ratio of compression} = \frac{V_3}{V_4}$$

$$\frac{P_5}{P_4} = \text{Pressure Ratio.}$$

$$(V_4 - V_5) = \text{Unity}$$

3. LITERATURE REVIEW:

The frictional force means that the movement of two components parts of an engine entails an opposing force which tries to reduce the related speed. However, it was noticed that if the surfaces are dry, heat is generated and the rate of wear between surfaces increases. Both the problems can be solved by interposing a layer or film of a suitable lubricant between the two components parts. The layer of oil reduces friction, dissipates heat, absorbs impulsive loads and cleans the surface.

From the above, cooling system is most important towards development of thermal efficiency. While the vehicle is going to start, within a times water temperature raised and the

said hot water is cooled by thermostat. If coolant of the radiator is mixing lubricating oil, does not reduce engine output and as a result, causes detonation and it also reduces the compression ratio and volumetric efficiency of the engine.

In terms of low heat rejection engine, a special class of experimental prototype internal combustion piston has been developed over several decades with the goal of improving efficient by reducing heat loss. These engines are variously called adiabatic engine. Adiabatic means, "no pass through". Adiabatic compression or expansion takes place without the loss or gain of heat through the cylinder walls. By means of adiabatic expansion, low heat rejection engines or high temperature engines. As a result, developing lubricants able to withstand the higher temperature involved has been a major barrier commercialization. However, in terms of Adiabatic Change, three conditions which must be satisfied:

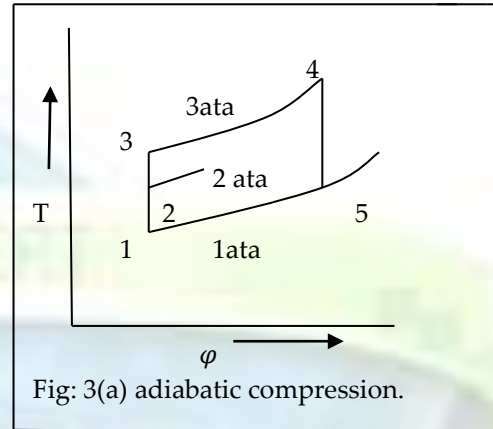
- 3.1. No heat is rejected or supplied during the process,
- 3.2. The expansion is taken as frictionless,
- 3.3. Work is done by the expanding gases, etc.

However, the gas turbine is used in automobiles and the operation of gas turbine is basically not very different from that of the reciprocating I.C. Engine. The essential difference is that reciprocating engines the air is admitted into the cylinders intermittently at the beginning of the turbine is smooth and continuous. Gas turbine is a rotary machine.

For example:

Problem: In a gas turbine plants enters the first of the two compressors at a pressure of 1 ata and 15° C. The pressure ratio for each of the compressor is 3 to 1. The air from the second compressor is delivered to a burner where the temperature is raised to 700 ° C at constant pressure. The gases then enter the turbine and expand adiabatically to a pressure of 1 ata. Find the efficiency of the plant and the shaft H.P. per kg of air per second. Take Cp = 0.24.

Solution: Process 1.2 is the adiabatic compression in first compressor at a pressure of air while 2.3 is the is the compression of air second compressor 3.4 shows heating at constant pressure , 4-5 represent adiabatic expansion in turbine and 5-1 indicates heat rejection at constant pressure (1 ata).



$$\frac{T_3}{T_1} = \left(\frac{P_3}{P_1}\right)^{\gamma-1/\gamma} = (9)^{0.4/1.4}$$

$$\therefore T_3 = T_1 \times (9)^{0.4/1.4}$$

$$= 288 \times (9)^{0.4/1.4} = 540^\circ \text{K.}$$

$$T_4 = 973^\circ \text{K (given)}$$

$$T_5 = \frac{T_4}{\left(\frac{P_4}{P_5}\right)^{\gamma-1/\gamma}}$$

$$= \frac{973}{(9)^{0.4/1.4}}$$

$$= 519^\circ \text{K}$$

$$\text{Compressor work: } C_v (T_3 - T_4)$$

$$= 0.24 (540 - 288)$$

$$= 60.5 \text{ kcal/kg of air.}$$

$$\text{Turbine work: } C_v (T_4 - T_5),$$

$$= 0.24 (973 - 519)$$

$$= 100 \text{ kcal/kg of air.}$$

$$\text{Heat supplied in the burner} = C_v(T_4 - T_5),$$

Plant efficiency:

$$= \frac{\text{Turbine work} - \text{Compressor Work}}{\text{Heat Supplied}}$$

$$= \frac{109 - 60.5}{103.9}, = \frac{48.5}{104} = 46.6\%$$

Shaft H.P. per kg of air per second:

$$= \frac{48.5 \times 427}{75}$$

$$= 276.$$

4. METHODOLOGY:

[4.1] Aim: Engine Oil Mixing in Radiator.

[4.2] Vehicle Regn No.: xxxxxxxxxxxx

[4.3] Chassis No: xxxxxxxxxxx xx
 [4.4.] Engine No: xxx xxx x xxx xx
 [4.5.] Kms. xxxxxx

4.6] Investigation & Observation:

4.6.1. Cooling System:

= Fen belt tension, water level in the Radiator, Found OK.

4.6.2. Thermostat (Wax type):

= Thermostat checked for opening Temperature at 80° - 95° and Found OK.

4.6.3. Assy. Plate type Heat Exchanger (No. 2534 1817 01 05, Make: not visible except V5/94)
 = Found internal leakage (marked with white paint) and feel that due to leakage oil mixed with the water.

4.6.4. Gasket:

= Found OK, re-used same.

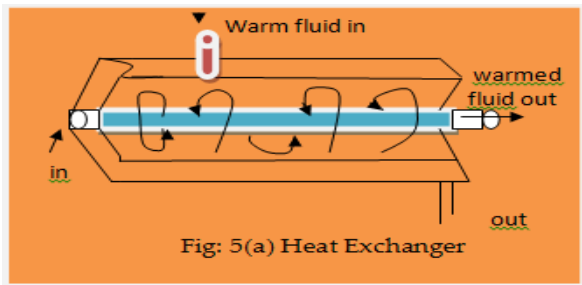
4.7. Corrective Action Taken:

Fitted the new Heat Exchanger and tested and found OK.

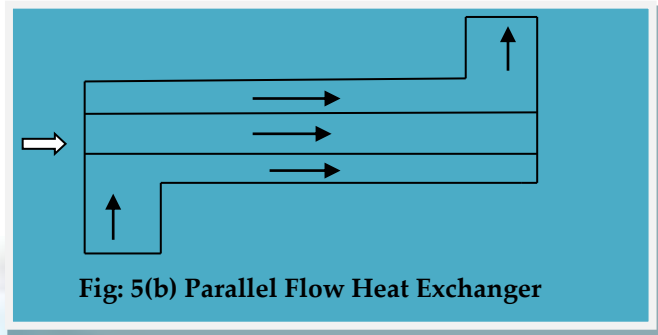
5. RESULT & DISCUSSION:

As per experimental study, it was found that I.C .Engine that most automobiles heat exchangers are similar to shell and tube cross flow design, with multiple tube passes and the said tubes are open to the air which is depending upon outside atmosphere. While the engine oil mixing with water, as the major problems towards flow and as result, excessive heat does not reduce by cooling system and heat exchanger may damaged.

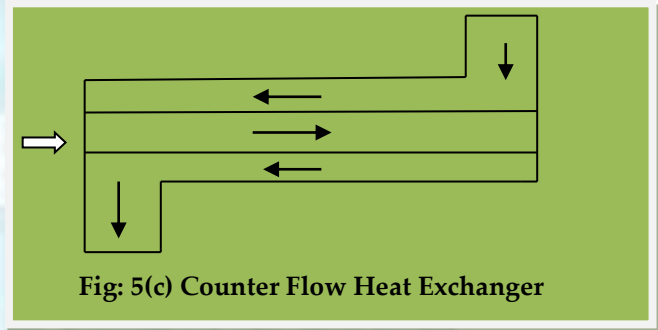
5.1. Heat Exchanger: A heat exchanger is a device designed for allowing heat transfer from one medium to another by different temperature. Heat exchanger consists by three categories, which is Parallel flow, Counter flow and cross flow etc.



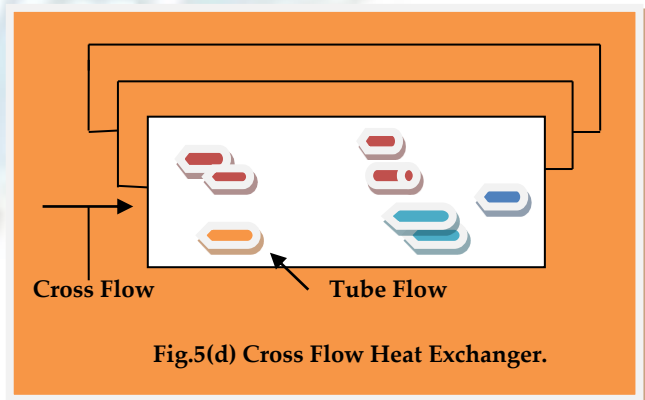
Parallel flow heat exchanger fluids pass through parallel by same direction.



Counter flow heat exchanger has got two fluids pass through the heat exchanger in opposite direction.



Cross flow heat exchanger fluids pass perpendicular to one another and design consists of fins which evenly distribute free flowing fluids across tubular pass-troughs that contain the second fluids.

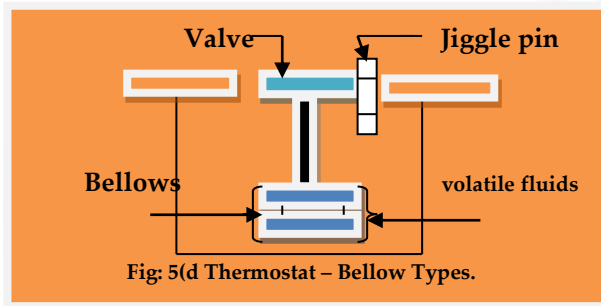


5.2. Thermostat:

The thermostat prevents the engine from getting over cooled when running under normal conditions. The cooling system at large keeps the

engine temperature within limits under full throttle conditions. The thermostat starts opening when hot water temperature about 78 ° C and is fully open at 80 ° C. Thus, the hot water is allowed to flow through the radiator core and subsequently cooled and mainly two types of thermostat, i.e.

- 5.2.1. Bellows type,
- 5.2.2. Wax element type.



Bellows type thermostat has a thin brass bellows fitted to the frame at the bottom and to a valve at the top. It is filled with ether, alcohol or acetone. The liquid vaporizes at about 78° C. At lower temperature the poppet valve remains seated as the bellows remain contracted. Water is prevented from flowing through the radiator. As the water gets hotter, the liquid turns into vapour due to the heat and exerts pressure inside the bellows. The valve starts opening at about 78° C and is fully open at 80° C. A jiggle pin located at the top allows flow of air from the bellows while charging it with ether or alcohol.

6. TYPE OF DATA:

Modern cars like the Maruti in India, have got sealed and Semi-Sealed Cooling System. The overflow pipe of radiator is immersed in a small tank full of water. At elevated temperature, the coolant is forced into this tank, from the radiator top header. Reduction of temperature and pressure forces the coolant back into the header from the tank. It is called sealed as no attention is required except during radiator leaks.

Part	Ambassador	Mahindra	Ashok Leyand
Type	Pressurized Water Cooling	Pressurized water cooling	Pressurized water cooling
Thermostat	No	Thermostat Controlled	Water cooling
Capacity	7.96 liters	10 liters	25 liters
Fan Blades	4	4	©
Anti-freeze Mixture	Ethylene glycol	Methyl alcohol	Ethylene glycol

Fig:6(a) Data : Cooling System

7. CONCLUSION:

Cars and trucks using under direct air cooling system. Most I.C. Engine, the fluids cooled by direct air cooling or liquid coolant run through a heat exchanger while the hot water is circulated around the radiator and this hot water reached to cool through thermostat valve and circulating again. On the other hand, engine coolant may be run through a heat exchanger that is cooled by the body of water. Most liquid cooled engines use a mixture of water and chemicals such as antifreeze and rust inhibitors, which is called engine coolant.

The over and above discussion, while engine oil mixing in radiator water (coolant) are never cooled by any process and as a result, overheating causes engine damages.

Because, the radiator in the cooling system provides a large cooling surface areas the hot water so that it may get cooled by the air stream. The air stream is induced but the air fan located behind the radiator. However, down flow type radiator consists of three parts:

- [6.1.] Upper tank known as header tank is made of thin steel or brass sheet metal.
- [6.2.] A number of brass or copper tubes connect the upper and lower tanks. These small diameter

tubes are surrounded by fins. And this assembly is known as matrix or core.

[6.3.] Bottom tank.

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