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Design Modifications and Analysis of Two Wheeler Water Cooling System

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ABSTRACT

Engine life and effectiveness of the engine can be improved with effective cooling system. The cooling mechanism of the air cooled engine is mostly dependent on the fin design of the cylinder head and block. The heat is conducted through the engine parts and convected to air through the surfaces of the fins. Insufficient removal of heat from engine will lead to high thermal stresses lower engine efficiency. As the aircooled engine builds heat, the cooling fins allow the wind and air to move the heat away from the engine. Low rate of heat transfer through cooling fins is the main problem in this type of cooling. Heat transfer will be maximum only if the cooling medium with high heat transfer coefficient. In an air cooling system, heat transfer coefficient of air will be remaining same within the specific operating conditions. Hence, increasing of heat transfer coefficient of air is not possible. In order to increase the heat removal rate, it is convenient to change cooling medium to liquid. In this present work an effort is taken to improve the engine life and efficiency by replacing the existing air cooling system with water cooling system. For this work a150 cc four stroke SI has been chosen and suitable modifications are carried out. The heat transfer study of cooling system and engine efficiency are analyzed and compared with air cooling system.
Keywords: Water Cooling System

I. INTRODUCTION

The purpose of cooling system f is to keep the engine at its most efficient operating temperature as high as 220oC may be reached during the engine operation. Although the cylinder wall, cylinder head, valves, piston rings and the pistons absorbs some of this heat. Even though the average temperature in the internal vicinity of the cylinders stands at about 1400oC. If this heat is not dissipated, the surface of the combustion chamber will become red hot, the wall will burn and wrap, and various parts of the engine will expand excessively resulting in seizure of piston and bearings. Cylinder wall temperature must not go as high as 250oC. Temperature higher than this causes the lubricating-oil film to break down and loose its lubricating properties. So the cooling system is preferred to cools the engine rapidly when it is hot. A typical distribution for the fuel energy is given below in Fig.1

Output power available in the crank shaft = 25% Heat carried away by the cooling medium and engine parts = 30% Heat carried away by the exhaust gases = 35%
Un accounted losses = 10%

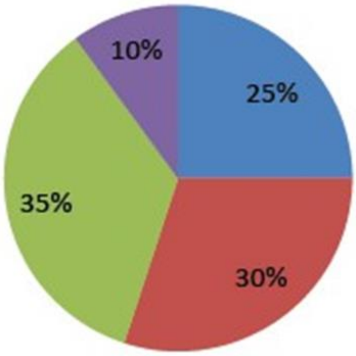

Figure 1. Heat distribution of two wheeler engine

Reasons of overheating of the engine components

- It is not easy to maintain even cooling all around the cylinder so that the distortion of cylinders takes place.
- Coefficient of heat transfer for air is less than that for water With very low speed of vehicle movement so the heat transfer between the fins and atmosphere air is low this will leads the goes to failure.
- Traffic jam: During traffic jams the automobile will have to move very slowly, down to say 10 km/h. this will result in extremely high local temperatures in the engine critical parts and the oil will tend to thin out. Due to high temperature, varnish and carbon will accumulate around the piston rings and combustion will coat the engine valves and spark plugs.
- Highway travel: At very high speeds (beyond 100 km/h), local temperature and pressures between the piston and the cylinder walls may reach extremely.
- Hills travel: During hills riding the load given to the engine is too high.

II. METHODS AND MATERIAL

Effects of overheating of the engine components:

- Evaporation of lubricating oil that lubricates the piston and cylinder wall. This will result in metal to metal contact of the piston and cylinder wall leading to piston scuffing and piston seizure.
- Setting up of thermal stresses in the cylinder, cylinder head and piston. This may lead to cracking of them.
- Sticking of piston rings in the ring grooves, due to carbonization of the oil. Ring sticking will result in inefficient sealing of the cylinder, increased blow by of gases and loss of thermal efficiency. Burning of piston crown.
- Burning and warping of exhaust valves.
- Engine warms up more quickly, and delivers its full power in lesser time than the liquid cooled engines.
- Quick starting of the engine is possible even in frosty weather.
- Rate of coolant frost (ice) damage of the engine (jackets) is not there.

A. Methodology

The methodology adopted for carrying out project work is described in this section.

1. Removal of fin
   The aluminium fins are removed from the 4-stroke SI engine cylinder block by using the necessary cutting tools and good surface finish obtained using grinding tools.
2. Development of water cooling system
   The aluminum sheets are wound around the cylinder block and then they're both ends are welded. Then the holes are provided for water circulations. The radiators are fitted below the bottom of the head light chassis. The non-displacement pump or centrifugal pump shaft are attached with the magnetic clutch shaft. When the engine is started the pump is actuated by the rotation of magnetic clutch. The flexible hose are provided for the transferring of water to the desired section.

B. Analysis

The following parameters are analyzed

- Engine performance test
- Discuss about the temperature distribution while in air cooling and water cooling system.

i. Experimental Setup

The radiator is attached in front of the bike which is below the head light. The pump is connected with the crank shaft. The thermostat is placed near the radiator in left. The water jackets are wound around the cylinder block. Hence the hose are used to transfer the coolants. Fig.2 water cooling system in two wheeler 4-stroke SI engine.

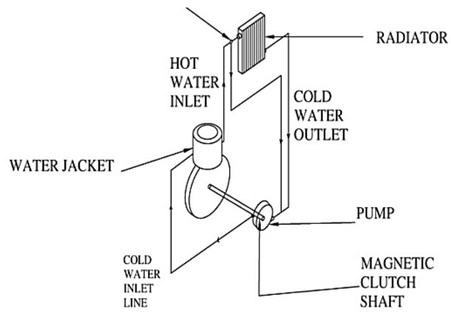

Figure 2. Water cooling system in two wheeler 4-stroke SI engine

ii. Experimental Procedure

a. The cooling medium is charged in the radiator till fill the radiator.
b. b) After that the engine is start the pump is actuate by magnetic crank shaft due to the centrifugal force the water is received from the radiator and discharged to the inlet of cylinder block via the thermostat.
c. Thermostat
Thermostat is a device which is used to maintain the temperature of the engine. The cooling medium from reservoir and outlet water from cylinder block all are sucked by pump and pass through via thermostat to the inlet of the cylinder block . This process is cyclic process. While at same time the temperature of the cooling medium is too high so the thermostat begins to open from 65 0C so the hot water leaving from bottom of the thermostat to the radiator for cooling purpose. The thermostat valve is fully open at 82 0C.
d. Air cooling system

The observations taken are given in table 1

S. No	Speed (rpm)	Time for 10cc fuel consumption (s)	Manometer reading Cm		
	Crank		h_1	h_2	h_m
1	4500	40	12.5	13.8	1.3
2	5500	34	12.7	14.5	1.8
3	6500	29	12.9	15.2	2.3
4	7100	25	13.2	15.9	2.7
5	8000	22	13.6	16.7	3.1

e. Water cooling system

The observations taken are given in table 2

S. No	Speed (rpm)	Time for 10cc fuel consumption (s)	Manometer reading Cm		
	Crank		h_1	h_2	h_m
1	4500	38	12.7	14	1.4
2	5500	31	13	14.8	1.9
3	6500	27	13.5	15.5	2.5
4	7000	24	14	16.8	2.8
5	8000	21	14.5	17.8	3.3

f. Generation of Temperature In Air Cooling system And Water Cooling System

The generation of temperature in the air cooling system with respect to the following condition,
i. The wind velocity of air
ii. The moisture content of the air
iii. Time of exposing

From the above conditions the temperature generation varies with respect to the time at various atmospheric condition at 4500 rpm

Time (min)	10	20	30	40	50	60	70	80
Temperature (^{0}C)	47	53	60	68	78	82	84	85

g. Water Cooling System
For continuous riding with efficient operating temperature water cooling systems are used. The Generation of temperature in the water cooling system with respect to the time

Table 4 Water cooling system temperature with respect to time

Time (min)	10	20	30	40	50	60	70	80
Temperature (^{0}C)	40	48	51	59	62	65	68	70

III. RESULTS AND DISCUSSION

1. From the performance calculation the volumetric efficiency little bit changed after the alteration of water cooling system. This is not affecting the engine performance and pulling power.
2. The temperature rising while driving at traffic and travelling at below 20 km speed is not possible
3. The water is discharged from the pump to the engine while running the engine. The velocity of the coolant is directly proportional to engine speed because the pump shaft is connecting with the crank shaft.

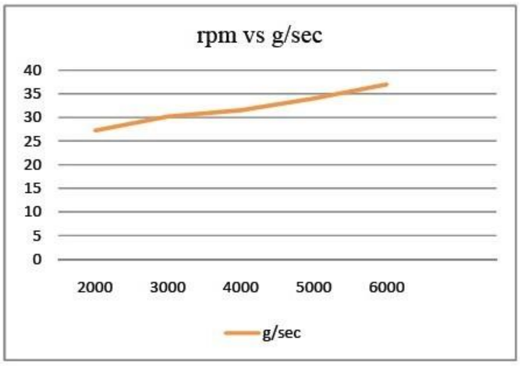

Figure 3. Mass flow rate Vs speed

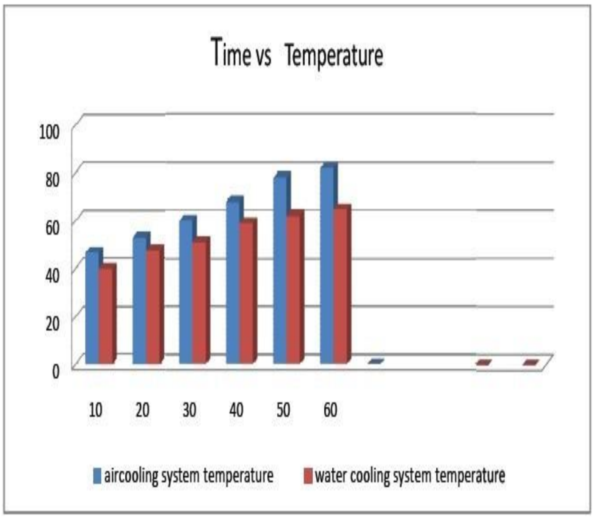

Figure 4. Time Vs temperature

From the bar chat we can understand the advantage of water cooling system is established.

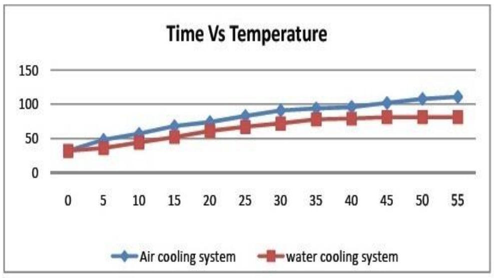

Figure 5. Time Vs Temperature

From the above discussion the temperature generation of water cooling system is worked under efficient operating temperature so the life time of the oil is increased. The internal thermal stress is reduced by using water cooling system so the life of the engine cylinder piston and valves were increased.

IV. CONCLUSION

The water cooling system is used instead of air cooling system and analyzed with water as a working fluid. Higher heat transfer coefficient of water may attained in the two wheeler 4-stroke engine performance and it reduces the evaporation of lubricating oil that lubricates the piston and cylinder wall. The constant circulation of the coolant constantly cools the engine and can maintain high speeds for a long time as well as the performance is not hampered. The liquid engine has a longer life when compared with an air cooled engine. The volumetric efficiency of liquid cooled engine in any day is found to be better than its air cooled counterpart. It is suggested that to improve in cooling system for the continuous riding by continuous circulation and thereby prevent the overheat of the engine and reduction of the evaporation of lubricating oil.

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