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**Submission date:** 26-Jan-2021 04:48PM (UTC+0700)

**Submission ID:** 1494617449

**File name:** Akbar\_2018\_IOP\_Conf.\_Ser.\_\_\_\_Mater.\_Sci.\_Eng.\_434\_012179.pdf (633.95K)

**Word count:** 2030

**Character count:** 10410

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To cite this article: A Akbar *et al* 2018 *IOP Conf. Ser.: Mater. Sci. Eng.* **434** 012179

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## The cooling effectiveness of the V-ixion motorcycle radiator using water coolant variation

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**Abstract.** The effectiveness of cooling motorcycle engine will affect its performance, therefore required an effective cooling system so as to produce good performance. The V-IXION motorcycle cooling system uses a radiator without an extra fan with a water cooling medium, therefore effective cooling is required in order to produce maximum motor performance. For that done research by varying water coolant to get influence of this treatment to cooling effectivity. This research uses experimental method, by varying the use of three different types of water coolant that is water coolant of brand A, B, C which each type have different concentrate level and tested on V-IXION motorcycle engine. Further temperature measurements are made on the intake and outside manifold radiator under standard air conditions. The results of this study indicate a significant influence on the use of water coolant variations on the effectiveness of heat discharged by the radiator. Based on this analysis, the effectiveness of heat discharged by water coolant shows that brand A has 30% cooling effectiveness, B 24% brand, C 20% brand. This is strongly influenced by the concentrate content contained in water coolant solution.

### 1. Introduction

The radiator plays a very important role in an internal combustion engine especially diesel engine and gasoline engine. It dissipates the waste heat generated by combustion process. The effectiveness with which waste heat is transferred from the engine walls to the surrounding is crucial in preserving the material integrity of the engine and enhancing the performance of the engine [1]. Cooling system is a series to overcome the overheating of the machine to keep working optimally [2]. Cooling system on the motorcycle radiator V-IXION serves to reduce the temperature on the engine that occurs from the combustion process. If the cooling system is going well then the power generated by the engine will be better.

The cooling system that serves to lower the temperature of the engine usually uses the radiator as an effective heat exchanger, and the way it works by passing cold fluid into the radiator, is then circulated into the block cylinder and the hot fluid will be cooled through the radiator that will remove heat from the engine, for it required an effective cooling system to remove heat by a motorcycle radiator V-IXION.

A coolant is a fluid which flows through a device in order to prevent its overheating, transferring the heat produced by the device to other devices that utilize or dissipate it. An ideal coolant has high thermal capacity, low viscosity, is low-cost, and is chemically inert, neither causing nor promoting corrosion of the cooling system [3].



The cooling effectiveness is the amount of heat discharged by the radiator by using standard water compared to the amount of heat discharged by the radiator by using a predetermined cooling water. The amount of heat is measured by the incoming temperature indicator and the radiator outlet temperature.

There are several different approaches that can be used to optimize heat transfer performance of smaller radiator design [4]. These are; 1) Changing the fin design 2) Increasing the core depth 3) Changing the tube type 4) Changing the flow arrangement 5) Changing the fin material 6) Increasing the surface area to coolant ratio 7) Changing the different types of fluid and mixture concentration.

Various studies have been carried out on engine radiators focusing primarily on optimizing their performance. The use of Computational Fluid Dynamics (CFD) modeling simulation of mass flow rate of air passing across the tubes of an automotive radiator was carried out [5]. The study show the Effect of Mass flow Rate of Air on Heat Transfer Rate in automobile radiator by CFD simulation using CFX. Yiding Cao and Khokiat Kengskool [6] had presented use of heat pipe in automobile engine in this heat pipe work integrated into the automobile radiator of the engine to increase the heat transfer ratio by the use of heat pipe cooling load. The numerical study of the cooling capabilities of an ethylene-glycol (EG)-based nanofluid was carried out [7]. The conclusion of study reveals an increase in magnetic field strength Ha leads to an increase in the skin friction and a decrease in the rate of heat transfer.

## 2. Methodology

This research uses experimental method, that is by varying three types of water coolant A, B and C, each water coolant has different brand and concentrate level. Coolant Brand A has a concentrate content of -1. With such a concentrated content, Coolant Brand A is able to withstand heat before boiling of less than 118° C, Coolant Brand B has a concentration content of -8. With such a concentrated content, Coolant Brand B is able to withstand heat before boiling of 118° C and Coolant Brand C has a concentrate content of -18. With such a concentrated content, Coolant Brand C is able to withstand heat before boiling of 130° C.

### 2.1. Data analysis

Data processing techniques using descriptive techniques based on experimental results, while the analytical methods used Microsoft Office Excel processing. In the processing will be calculated to get the value of temperature incoming temperature (Tin) and exit temperature (Tout) on the radiator [8]. The cooling effectiveness is defined as follows:

$$\text{Cooling Effectiveness} = \frac{(T_{in} - T_{out})_{coolant}}{(T_{in} - T_{out})_{Standrt Water}} \quad (1)$$

**Table 1.** Tabulation of experiment data.

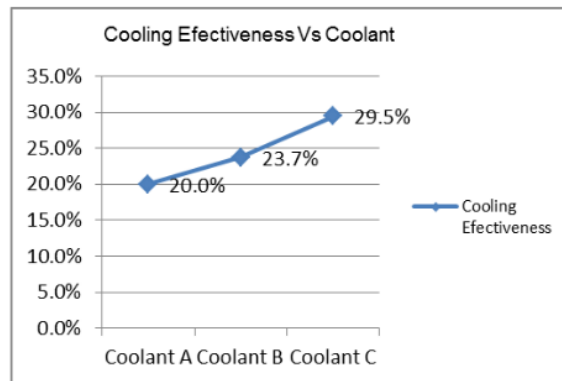
Experiment	Water Coolant Standart		Water Coolant A		Water Coolant B		Water Coolant C	
	T <sub>in</sub> (°C)	T <sub>out</sub> (°C)	T <sub>in</sub> (°C)	T <sub>out</sub> (°C)	T <sub>in</sub> (°C)	T <sub>out</sub> (°C)	T <sub>in</sub> (°C)	T <sub>out</sub> (°C)
1	79,1	73,1	78,2	70,2	78	68,9	77,8	66,2
2	78,9	72,8	77,5	69,5	77,3	69,6	77,1	66,5
3	80,3	73,4	77,1	70,3	76,5	69,8	69	66,6
Avg	79,4	73,1	77,6	70	77,3	69,4	74,6	66,4

## 3. Result and discussion

Based on the experimental results of various brands of coolant at 3000 rpm engine speed can be presented in table form as follows:

**Table 2.** Various brands of coolant data.

Experiment	Water Coolant Standart		Water Coolant A		Water Coolant B		Water Coolant C	
	T <sub>in</sub> (°C)	T <sub>out</sub> (°C)	T <sub>in</sub> (°C)	T <sub>out</sub> (°C)	T <sub>in</sub> (°C)	T <sub>out</sub> (°C)	T <sub>in</sub> (°C)	T <sub>out</sub> (°C)
1	79,1	73,1	78,2	70,2	78	68,9	77,8	66,2
2	78,9	72,8	77,5	69,5	77,3	69,6	77,1	66,5
3	80,3	73,4	77,1	70,3	76,5	69,8	69	66,6
Avrg	79,4	73,1	77,6	70	77,3	69,4	74,6	66,4



**Figure 1.** Relationship Coolant type variation to cooling effectiveness.

From the table and the above graph can be analyzed that there is a significant influence between the uses of water coolant type to the value of cooling effectiveness. Water coolant C has the highest value of effectiveness because it has the highest content of concentrate, concentrate on water coolant is a kind of additive that can increase the conductivity of water coolant fluid. This results in increased heat dissipation. Water coolant C is also able to withstand heat to the point 130°C, this is also one factor that makes this coolant able to throw away the most heat. The more resistant to the heat given the more solid the fluid [9]. Another thing that should also be discussed is about the effect of engine rotation on water coolant resistance to remove heat and effectiveness of heat dissipation that can be removed [10].

This study yields the effectiveness value of several types of water coolant that is tested on V-IXION motorcycle vehicle. From the average data generated, Coolant type a gives effectiveness results of 20 percent, coolant B produces 23.7 percent and coolant C produces cooling effectiveness value of nearly 29.5 percent.

Experimental study is reported to simulate the Toyota Yaris 2007 cooling system (radiator) using Nano fluid with different concentrations and at different loads. Results show that heat transfer by the coolant increases as the nanofluid concentration increases up to  $\phi = 0.01$  by volume where it reaches its optimum value [11]. Nano fluids showed greater heat transfer performance comparing with water. Increase liquid and air reincrease to overall heat transfer coefficient. Increasing the inlet temperature decreases the overall heat transfer coefficient [12].

#### 4. Conclusion

The conclusions drawn from the analysis can be summarized as follows: there is a significant influence between the uses of water coolant type to the value of cooling effectiveness. Water coolant C has the highest effectiveness value.

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