Study and Experiment on Performance Characteristics of Modified Exhaust Gas Calorimeter with the CI Engine

Raja.K [1]
[1]Assistant Professor,
Department of Mechanical Engineering,
Veltech Rangarajan Dr Sagunthala R&D Institute of Science and Technology, Chennai, India

Venkata Madhu Sudhan K[2], Soma Shashidhar [3], NiteshKumar Y [4]
[2, 3, 4]UG Students, Department of Mechanical Engineering,
Veltech Rangarajan Dr Sagunthala R&D Institute of Science and Technology, Chennai, India

***Abstract*:- The four stroke diesel engine in which water and diesel coolant are used for case study. The experiment is conducted with the purpose of increasing the efficiency of cooling using a modified calorimeter. The modified calorimeter system components such as water pipes for water flow on to the exhaust gas flow pipes. It is important for IC engine to maintain temperature at a required level without damaging the engine. In such a way for achieving a better cool efficiency we modified a calorimeter. The flow of water in the pipes is opposite direction to the flow of exhaust gas. Due to the arrangement of water flow pipes on the exhaust gas pipes due to radiation heat transfer the rate of cooling the exhaust gas will be more. Consequently, as the cooling efficiency increases means the life of an engine will also increases.**

Keywords: Diesel engine, Exhaust calorimeter, Water pipe.

1. INTRODUCTION

Calorimeter is a device used to decrease the temperature of exhaust gas in a four-stroke diesel engine. A pipe on pipe method we are used in modified calorimeter in order to increase the cooling efficiency of an engine. In order to cool the exhaust gas which is coming out from the engine we are sending the water in opposite direction due to the radiation heat transfer the maximum heat which is present in exhaust gas will be cooled to the maximum level.

2. LITERATURE REVIEW

Raja. K [1] Modern automotive diesel engines are so energy efficient that they are heating up slowly and tend to run rather cold at subzero temperatures. The problem is especially severe in mail delivery operations where the average speed is low and the drive cycle includes plenty of idling. The problem is typically solved by adding a diesel fuelled additional engine heater which is used for the preheating of the engine during cold start and additional heating of the engine if the coolant temperature falls below a thermostat set point during the drive cycle.

Venkata Madhu Sudhan. K [2] A new-type corrugation Plate Heat Exchanger (PHE) was designed. Results from both numerical simulations and experiments showed that the flow resistance of the working fluid in this new corrugation PHE, compared with the traditional chevron-type one, was decreased by more than 50%, and corresponding heat transfer performance was decreased by about 25%. The flow field of the working fluid in the corrugation PHE was transformed and hence performance difference in both flow resistance and heat transfer was generated.

Soma Shashidhar [3] The performance analysis of spiral tube heat exchanger over the shell and tube type heat exchanger. They found that the cost saving using spiral tube heat exchanger is around 15 to 20 % as compared to shell and tube type heat exchanger and to establish that improvement in overall heat transfer coefficient as compared to shell and tube type heat exchanger from 400 to 650W/m2K. The process at higher velocity was not suitable.

Nitesh Kumar Y [4] The Ohio State University (OSU) apparatus and the cone calorimeter are two devices commonly used to measure the heat release rate (HRR) of materials and products in forced flaming combustion. Each operates on a different principle but is calibrated in the same way. However, HRR results from these two test methods do not agree in most cases. For the present study, the OSU was modified to measure oxygen consumption and sensible enthalpy (temperature rise) of the apparatus in addition to the usual sensible enthalpy of the exhaust gases during the test.

3. EXPERIMENTAL SETUP

A *heat exchanger* is a system used to transfer *heat* between two or more fluids. *Heat exchangers* are used in both cooling and *heating* processes [5]. The fluids may be separated by a solid wall to prevent mixing or they may be in direct contact [6]. As compared to existing heat exchanger the modified heat exchanger has a capability of exchange the maximum amount of heat with the radiation heat transfer mode in order to cool the exhaust gas flow [7].

As we set the water flow pipes on the exhaust gas flow pipes the efficiency of heat exchanging level is more.

i. Set the existing calorimeter for the diesel engine.
ii. Take the readings of all inlet and outlet temperatures and also discharge and effectiveness.
iii. Then take the modified readings of calorimeter with the same load conditions.
iv. Plot the results and graphs.

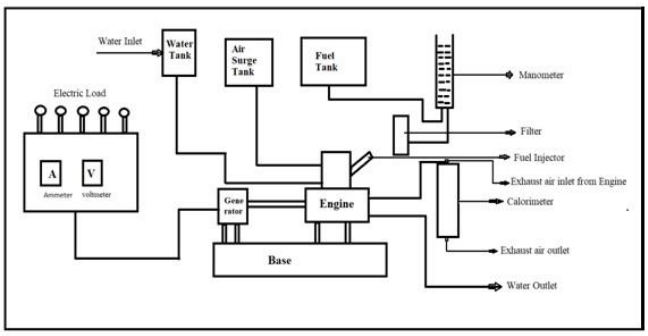

Fig.1 Line diagram of Experimental setup

Fig.2 Modified setup of Calorimeter

Fig.3 Experimental set up with applied electrical load

Fig. 4 Existing Calorimeter

4. RESULT AND DISCUSSION

For the diesel engine calorimeter, we are taking the graph for the Load vs Discharge and for Temperature vs Effectiveness.

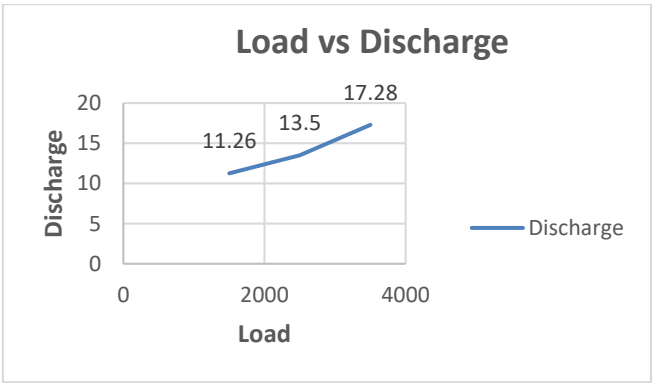

Fig.5 Load vs Discharge for the Existing

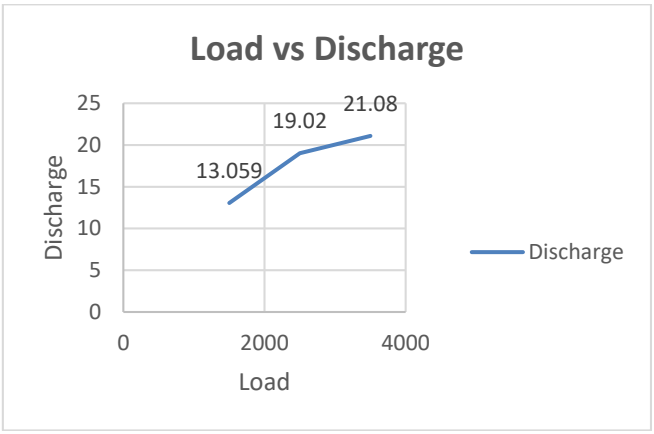

Fig.6 Load vs Discharge for the Modified

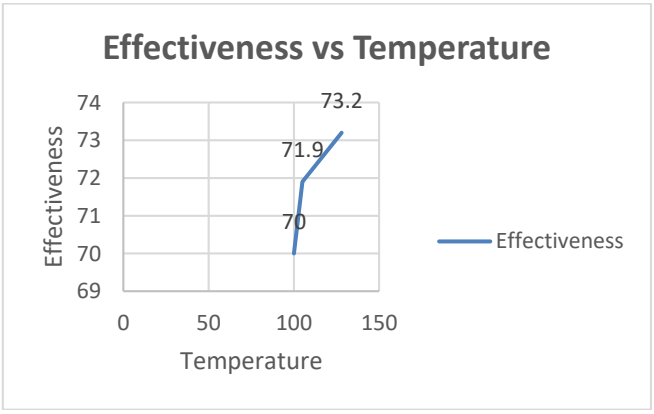

Fig.7 Effectiveness vs Temperature for the Existing

5. CONCLUSION

In case of I.C engine it is important to find heat balance sheet. How much heat goes to exhaust gas as a loss & heat loss in cooling water; Hear effort also made for using cooling media as water for the single cylinder diesel engine.

For the single cylinder diesel engine, the calorimeter is used for the decreasing of exhaust hot air temperatures. In the case of calorimeter for the existing one the temperatures are 100, 105 and 128 having the effectiveness of 70%, 71.9% and 73.2%. For the modified calorimeter of increasing the inner exhaust air flow tubes having the temperatures of 106, 114 and 143 have the effectiveness of 72.02%, 73.06% and 74.2%.

In the both cases of the calorimeter the electric load we are taking as 1500W, 2500W, and 3500W respectively. For

that conditions the existing calorimeter having the discharge of 11.26, 13.50 and 17.28. In case of the modified one the discharge is increased as 13.059, 19.02 and 21.28.

6. REFERENCES

[1] Pertti Kauranen, Tuomo Elonen, Lisa Wikström, Jorma Heikkinen,Juhani Laurikko "Temperature of a diesel engine using exhaust gas heat recovery and thermal energy storage (diesel engine with thermal energy storage)" 15 Nov 2009.

[2] J.R. McBride, K.E. Nietering, K.R. Ellwood "Design considerations for optimizing the of catalytic calorimetric gas sensors: modeling and experimental results" 15 Nov 2005.

[3] LUAN Zhi-jian, ZHANG Guan-min, TIAN Mao-cheng, FAN Ming-xiu "Flow resistance and heat transfer characteristics of a new-type plate heat exchanger" 7 may 2008.

[4] G. E. Kondhalkar & V. N. Kapatkat, "Performance Analysis of Spiral tube heat exchanger used in oil extraction system" International Journal of Modern Engineering Research, Vol.2, Issue.3, 2012, PP – 930 – 936, ISSN No.2249 – 6645

[5] Pertti Kauranen, Tuomo Elonen, Lisa Wikström, Jorma Heikkinen, Juhani Laurikko "Temperature of a diesel engine using exhaust gas heat recovery and thermal energy storage (diesel engine with thermal energy storage)" 15 Nov 2009.

[6] Paisarn Naphon, Somchai Wongwises, "A study of the heat transfer characteristics of a compact spiral coil heat exchanger under wet-surface conditions "Experimental Thermal and Fluid Science 29, 2004, PP – 511 – 521. [15] A. Parlak, H. Yasar, B.Sahin, Performance and exhaust emission characteristics of a lower compression ratio LHR diesel engine, Energy Conversion Management 44(2003) 163-175.

[7] S.Kakas, H. Liu, "Heat Exchangers Selecting, Rating and Thermal Design" Second Edition, New York, CRC Press, 2002, PP – 6 –10. [17] K.S. Rao, "Analysis of Flow Maldistribution in Tubular Heat Exchangers By Fluent" 2007, PP – 20 –26