Review Paper on Four Cylinder Four Stroke Petrol Engine

[1]Sagar P Mistry,[2]Prof. Roshni R. Kapadia,[3] Prof. Tejal A. Raval
[1]ME Student,[23]Assistant Professor
[123]Mechanical Engineering Department,
[12]Silver Oak College of Engineering and Technology, Ahmedabad,
[3]Gandhinagar Institute of Technology, Gandhinagar

***Abstract* – This thesis is about how to perform an analysis of four cylinder four stroke engine. As we know, dynamometer is very expensive in the market and some way need to be build to perform engine performance analysis based on functionality of dynamometer. So, engine test rig had been designed before can proceed to fabrication process. Some sketches software had used like autocad and solidwork to draft out the shape of engine test rig. Materials selection also included in this designed process. Variable loads will be given at constant engine speed to see whether performance of engine will decrease or increase. Here, we can analyze at which engine speed is the optimum of performance from this small engine. So, some losses like power and fuel can be decrease. Author will be taking ideal procedure for improve performance of engine to change fuel quality by blending approach and reduced emission practically.**

***Index Terms* – Energy, Design, Combustion chamber, engine performance.**

I. INTRODUCTION

Any machine which derives heat energy from the consumption of fuel and converts part of this energy in to mechanical work is known as heat engine. These heat engines are mainly classified as two categories that are

(1) Internal combustion engines
(2) External combustion engines

In case of internal combustion engine, the combustion of fuel takes place in presence of air in the cylinder and products of combustion directly act on piston to develop power. The internal combustion engines are further classified in to petrol engines, diesel engines and the gas engines according to their type of fuel used. According to their method of ignition they are classified as Spark ignition Engines, and Compression ignition Engines

Literature Review

Tadala akhil, K.naresh, Abdul khurshid, Purushotham anil kumar (2016) [1] had represented, the thermal and the stress distribution of the piston which is initialized with four different materials by using the COUPLED field analysis by finite element method (FEM). The parameters used for the simulation are the temperature as thermal conditional and the force or the pressure applying on the piston crown and the material properties of the piston. The specifications used for the piston belong to four stroke single
cylinder Hero-Honda motorcycle. Aluminum metal composites are increasing across the broad acknowledgement for vehicles, modern, aviation applications in view of their low thickness, high quality and great structural unbending nature. In present work the Piston is modeled using CATIA V5 modeling and Finite Element analysis (COUPLE FIELD analysis) by using the modules of both structural and thermal analysis are done for same
model utilizing ANSYS software for Aluminum (pure) , Aluminum alloy (A6061), Al-GHS 1300 and Al-Sic graphite and the results were discussed. The results predict the maximum stress and the critical region on the different aluminum alloys piston using FEA. It is important to locate the critical area of concentrated stress for appropriate modifications.

Nilesh T. Dhokane, Anand R. Nadgire and Savita U. Shinde (2016) [2] had represented engine performance parameters with addition of H_2 or O_2 and with turbocharger & supercharger. I have done experimentation on intake side development of SI engine. No any research should be done on injecting the oxyrich air into intake manifold by using pure oxygen. So this research to improve the performance of SI engine & reduces the amount of fuel consumption & due to complete combustion the pollution of SI engine is also reduced. Therefore the research may be done on oxyrich air for combustion of fuel in SI engine. Here I have found brake specific fuel consumption with and without oxyrich air energizer, determined brake thermal efficiency of the system. Also I have checked all emission parameters of SI engine with and without oxyrich air energizer. I could find Mechanical & Volumetric efficiency of engine with and without oxygen blending. For developing the experimental set up for oxyrich air energizer, I used computerized MPFI 4 stroke petrol engine test rig.

Suramya Naik, Fabien Redon, Gerhard Regner, and John Koszewnik (2015) [3] had represented, Indian manufacturers to meet future fuel economy and emissions mandates-including the recently passed Corporate Average Fuel Consumption (CAFC) standards for light-duty vehicles-many are evaluating new technologies. However, to provide an economically sustainable solution, these technologies must increase efficiency without increasing cost. One promising solution to meet both current, and future, standards is the opposed-piston engine. Widely used in the early 20th century for on-road

applications, use of the opposed-piston engine was eventually discontinued due to challenges with emissions and oil control. But advancements in computer-aided engineering tools, combined with state-of-the-art engineering practices, has enabled Achates Power to develop a modern opposed-piston diesel engine architecture that is clean, significantly more fuel efficient and less expensive to manufacture than today's four-stroke engines.

Khalaf I. Hamada, M.K.Mohammed and M.M. Rahman (2014) [4] had represented experimental activities that have been performed in the Automotive Engineering Centre laboratories in University Malaysia Pahang for developing a test-rig based on a modern motorcycle engine. The experimental engine test-rig was developed based on an eddy current dynamometer which was coupled to a four-stroke single cylinder SI motorcycle engine. Moreover, the test-rig consists of all the measurement equipment, sensors and auxiliaries kits for carrying out engine testing in a sufficient way. The results of these activities have been used for validation of a one-dimensional model developed based on that single cylinder engine. Both the in-cylinder pressure trace and brake torque were used to validate the engine model. There was good agreement between the simulation and experimental results. The constructed test-rig can be utilized for further research and development programs.

P.T.Aravindhan, P.T.Anandhan (2014) [5] had represented performance evaluation of two stroke, single cylinder S park Ignition engine (copper of thickness 300 µ is coated on piston crown and inner side of cylinder head) with HHO blended fuel. In this study hydroxy gas was produced by electrolysis using potassium hydroxide (KOH) catalyst. Electrolysis is performed in a leak proof chamber. Utilizing an on board generation of the gas reduces the risk of storage. The effect of doping hydroxy gas to gasoline fuel on the performance characteristics of a spark ignition engine is studied Brake thermal efficiency, indicated thermal efficiency, mechanical efficiency and specific fuel consumption are all calculated for different load conditions. At mid and higher engine speeds the HHO system with petrol fuel yields higher engine efficiency compared to pure petrol fuelled engine operation. High burning velocity and low ignition energy of hydro-oxy air mixture leads to increased performance of the engine. Copper-coated engine showed improved performance when compared to con ventional engine with both different test fuels.

M.A.Bote, H.M.Dange (2014) [6] investigates Petroleum based fuels have important role in rapid depletion of fossil fuels as with demand is increasing .For production of biodiesel Thumba oil is used. Biodiesel can be recognised as eco friendly fuel so considering this through the experiment an attempt has been made of Thumba biodiesel blended on SI engine in laboratory and found its properties and characteristics. Various blends of Thumba biodiesel were prepared and its performance was evaluated with single cylinder four stroke petrol engine.

Pareshkumar D. Chavada, Raghuvir S. Khanna, Prof. V. G. Trivedi (2013) [7] had represented petroleum Engine efficiency improvement efforts via constructional modifications are increased today; for instance, parallel to development of advanced technology ceramics, ceramic coating applications in internal combustion engines grow rapidly. To improve engine performance, fuel energy must be converted to mechanical energy at the most possible rate. Coating combustion chamber with low heat conducting ceramic materials leads to increasing temperature and pressure in internal combustion engine cylinders. Hence, an increase in engine efficiency should be observed. Methanol burn at lower temperature than petrol. Using methanol as blends with petrol in spark ignition engines can offer an increased thermal efficiency and increased power output due to high octane rating and high heat of vaporization. Initiation of the engine can be easier like shortened ignition delay in ceramic coated IC engines due to increased temperature after compression because of low heat rejection. More silent engine operation can be obtained considering less detonation and noise causing from uncontrolled combustion. Engine can be operated at lower compression ratios due to shortened ignition delay. Thus better mechanical efficiency can be obtained and fuel economy can be improved.

Gayatri Kushwah (2013) [8] had represented the assessment of environmental impact of four stroke petrol engine. The assessment is done by using the Eco indicator 99 method & Eco it software. The assessment of environmental impact of whole life cycle of engine includes the impact assessment of Production phase, Processing phase, transport and packaging phase, use phase, disposal phase of whole life of engine. For assessment, data are collected and then analyzed, during analysis the indicator point obtained from eco it software for particular material and process is taken. After the analysis the impact shows as indicator scores in milli-points, which phase have more indicator score have more impact on environment.

Vinod Yadav, Dr. N. D. Mittal (2013) [9] had represents Piston is the part of engine which convert heat and pressure energy liberated by fuel combustion into mechanical works. Engine piston is the most complex component among the automotives. This paper illustrate design procedure for a piston for 4 stroke petrol engine for hero bike and its analysis by its comparison with original piston dimensions used in bike. The design procedure involves determination of various piston dimensions using analytical method under maximum power condition. In this paper the combined effect of mechanical and thermal load is taken into consideration while determining various dimensions. The basic data of the engine are taken from a located engine type of hero bike.

Mr. Hitesh B. Bisen, Mr. Y. R. Suple (2013) [10] had performed Gaseous fuels such as liquefied petroleum gas (LPG) and liquefied natural gas (LNG) have been widely used in commercial vehicles. In this project the main aim is to evaluate the exhaust emission by running the conventional engine on Liquefied Petroleum Gas (LPG) as an alternative fuel for four-stroke spark ignition engine. The primary objective of the study is to determine the performance and the exhaust emissions of the engine

using LPG as a fuel. The engine used in the study is originally a single cylinder; four-stroke spark ignition engine with certain modifications is to make to permit the experiments to run on LPG fuel. During the running, the engine was coupled to a ropeway dynamometer to measure several engine performance parameters and a 5-gas analyzer is to be inserted into the engine exhaust tailpipe for measuring the exhaust emissions. Experimental investigations have been carried out to emissions of single cylinder four-stroke spark ignition engine at full throttling position of engine and different load conditions is used to different fuels (Gasoline and LPG). Exhausts are the five gasses measured by the latest technology exhaust analysers are: HC, CO, CO2, O2 and NOx.

Vivek Ugare, Nikhil Bhave, Sandeep Lutade (2013) [11] had performed the effect of magnetic field on the performance of Single Cylinder Four Stroke Spark Ignition engine. The study concentrates on the effect of magnetic field the engine performance parameters such as fuel consumption, break thermal efficiency and exhaust emissions and on fuel properties like density and calorific value. The magnetic field is applied along the fuel line immediately before carburetor. The magnetic field is applied with the help of strong permanent magnets of strength 5000 gauss. The experiments are conducted at different engine loading conditions. The exhaust gas emissions such as CO,
CO_2, HC and NO_X are measured by using an exhaust gas analyser. With the application of magnetic field the percentage reduction in fuel consumption is about 12 %, the percentage reduction in HC and CO is about 27% and 11 % respectively. The NOx level in engine increases with the application of magnetic field. The percentage increase in NOx is about 19%. The effect of magnetic field on percentage increase of CO_2 emissions from SI engine is about 7 %.

S. Sunil Kumar Reddy, V. Pandurangadu (2013) [12] had performed in the area of improvement of the engine thermal efficiency. In diesel engines approximately only one-third of the fuel energy is converted into useful work and major part of the energy is lost to cooling water. In an adiabatic engine (or insulated engine), the energy loss through cooling system is avoided by applying a layer of insulating material over the walls of the combustion chamber. The commonly used insulating materials are ceramic coatings such as silicon nitride, silicon carbide, zirconia (zirconium oxide) etc. As per the literature the partially Stabilized Zarconium (PSZ) is quite useful for the adiabatic engine application because of its excellent insulating characteristics, adequate strength and thermal expansion characteristics. Further this improves fuel economy, reduces, emissions and further reduces noise due to a lower rate of pressure rise. In the present investigations an adiabatic engine is developed with air gap insulation over the piston and cylinder liner, PSZ coated cylinder head and valves. With the higher temperatures in the combustion chambers in an adiabatic engine, widely available low cetane fuels like alcohols (which have high latent heat of vaporization) can also be burnt so that the ever-increasing demand for imported diesel can be reduced. In the present investigations a computer program has been developed in C language for an insulated engine and with that the theoretical results are obtained and then the same thing is compared with experimental results of adiabatic engine.

S. Ghosh, D. Dutta (2012) [13] had to an experimental investigation of various exhaust gas recirculation (EGR) rates on the engine performance like brake thermal efficiency, brake specific fuel consumption and brake power and engine exhaust gas emission parameters like nitrogen oxides(NOx), carbon monoxide (CO), hydrocarbon(HC) and particulate matter (PM) for the fuel used in the engine. Four observations are made for exhaust emission gas analysis 0% EGR, 10% EGR, 20% EGR and 30% EGR. The rotational speed of the engine is taken as constant at 1500 rpm. The experiment was performed on a four cylinder four stroke water cooled spark ignition engine fuelled with commercial grade gasoline of octane number 92 and a hydraulic dynamometer. Exhaust gas emissions were measured by using a Indus exhaust gas analyzer. Lower heating value of the fuel was 43700/kJ/kg and average molecular weight was 93.454. The effect of EGR addition to the fresh air on performance and exhaust gas analysis of the engine is investigated. The substantial reductions in NOx concentration are achieved with 10-30% EGR.

Venkata Ramesh Mamilla, V.Gopinath, C.V.Subba Rao, Dr.G.Lakshmi Narayana Rao (2013) [14] with the study and performance of 4-stroke petrol engine fueled with Bio gas /L.P.G blends. The various blends of L.P.G and Biogas are used and conducted the tests on 4-stroke, single cylinder, air cooled SI engine. The experimental results were analyzed for the selection of better blend of L.P.G and Biogas suitable for SI engine for better performance with reduced pollution.

M. M. Rahman (Member, IAENG), Mohammed K. Mohammed and Rosli A. Bakar (2009) [15] had performed on the effect of air-fuel ratio on the engine performance of single cylinder hydrogen fueled port injection internal combustion engine. GT-Power was utilized to develop the model for port injection engine. One dimensional gas dynamics was represented the flow and heat transfer in the components of the engine model. The governing equations are introduced first, followed by the performance parameters and model description. Air-fuel ratio was varied from stoichiometric limit to a lean limit. The rotational speed of the engine was varied from 2500 to 4500 rpm while the injector location was considered fixed in the midway of the intake port. The acquired results show that the air-fuel ratio is greatly influence on the performance of hydrogen fueled engine. It is shown that the brake mean effective pressure (BMEP) and brake thermal efficiency decreases with increases of the airfuel
ratio however the brake specific fuel consumption (BSFC) increases with increases of the air-fuel ratio. The cylinder temperature decreases with the increase of air-fuel ratio. The
present model emphasizes the ability of retrofitting the traditional engines with hydrogen fuel with minor modifications.

M. S. Shehata and S. M. Abdel Razek (2008) [16] to investigate engine performance parameters and methods of reducing emissions from spark ignition engine. The used engine is four stroke four cylinder naturally aspirated spark ignition engine

with compression ratio of 9, bore diameter of 80 mm and stroke of 90 mm. The engine performance parameters are presented with and without exhaust gases recirculation (EGR). Engine cylinder pressure measurements and engine geometry are used for calculating indicated engine performance parameters. UHC and CO concentrations are measured with EGR, catalyst converter and air injection in the exhaust manifold. UHC and CO concentrations for different methods are compared with the original engine emissions. The investigated parameters are indicated and brake engine performance parameters, air/fuel ratio (AFR) and exhaust gases temperature (Texhaust). Also, engine cycle to cycle variation (CCV) and sound pressure level (SPL) generated from engine are
calculated using cylinder pressure, inlet and exhaust manifold pressure measurements. EGR rate of 5%, 7%, 8%, 10% and air injection rate of 3%, 4%, 5%, 6% are used in the present work.. Catalyst converter and air injection in exhaust manifold are useful methods for reducing UHC and CO concentrations on contrast UHC and CO concentrations increase with the increase of EGR. Air injection in the exhaust manifold represents method for reducing UHC and CO exhausted from spark ignition engine. The present work is useful for improving engine performance parameters, reducing engine emissions and further development of spark ignition engines

Maher A. R. Sadiq AL-BAGHDADI (2006) [17] had performed and concentrated on decreasing fuel consumption by using renewable alternative fuels and on lowering the concentration of toxic components in combustion products. A simulative model for establishing the performance parameters of spark ignition engines fueled with a range of fuels (gasoline, ethanol, or hydrogen) and their mixture is presented. The incidence of pre-ignition and its relative intensity as well as cyclic variations are also accounted for. The 2-zone incorporates a procedure for deriving an estimate of the effective duration of combustion and the associated mass burning rate for various operating conditions and fuels. A system of first-order ordinary differential equations was obtained for the pressure, mass, volume, temperature of the burned and unburned gases, heat transfer from the burned and unburned zone, mass flow into and out of crevices, and the composition of combustion products. The mathematical and simulation model has been developed, tested, and verified against the experimental data to simulate a 4-stroke cycle of a spark ignition engine fueled with gasoline, ethanol, or hydrogen as a single fuel or their mixture. The results obtained from the present study have shown the capability of the model to predict satisfactorily the performance and emissions including the incidence of pre-ignition at various engine-operating conditions. A good agreement was obtained between the results of the present model and the experimental results.

PAULINA S. KUO (1996) [18] had performed on to accurately predict the gas pressure changes within the cylinder of a spark-ignition engine using thermodynamic principles. The model takes into account the intake, compression, combustion, expansion and exhaust processes that occur in the cylinder. Comparisons with actual pressure data show the model to have a high degree of accuracy. The model is further evaluated on its ability to predict the angle of spark firing and burn duration.

II. ACKNOWLEDGMENT

It is indeed a great pleasure for me to express my sincere gratitude to those who have always helped me for this dissertation work. I am extremely thankful to my thesis guide Asst. Prof. Roshni R. Kapadia , Asst. Professor in Mechanical Engineering Department, Silver Oak College of Engineering and Technology and Prof. Dhaval P. Patel, Asst. Professor in Mechanical Engineering Department, Gandhinagar Institute of Technology, Gandhinagar are valuable guidance, motivation, cooperation, constant support with encouraging attitude at all stages of my work. I am highly obliged to him for his constructive criticism and valuable suggestions, which helped me to present the scientific results in an efficient and effective manner in this research.

III. CONCLUSION

From the results obtained in the analysis of different literature survey, the following can be concluded:
The research survey was reflected different types of engine such as single cylinder four stroke petrol engine, 2-stroke multi Cylinder Engine, Modern Motorcycle Engine, 4- Stroke Hero Bike Engine, Four Stroke Adiabatic Di Diesel Engine, Gasoline Engine etc. The research had survey on their design and analysis of each component.
Some research paper indicated about performance of engine by using different types of fuel such as Oxyrich Air, Thumba oil, LPG etc.
Some research paper indicated about development of an electronic fuel injection system, effect of magnetic field on performance etc.
There is possibility of work on four cylinder four stroke petrol engine so with respect to improving performance of engine by applying minimum fuel producing more power.

REFERENCES

PAPERS

[1] Tadala akhil, K.naresh, Abdul khurshid, Purushotham anil kumar, "Analysis on Four Stroke Single Cylinder Engine Piston by using Aluminum Alloys (Al-GHS 1300, Al-Sic- Graphite, A6061, Pure Aluminum)'', SSRG International Journal of Mechanical Engineering (SSRG-IJME) – volume 3 Issue 1 – January 2016.

[2] Nilesh T. Dhokane, Anand R. Nadgire and Savita U. Shinde, " Performance Evaluation of Four Stroke SI Engine with and without Oxyrich Air Energizer at 1000rpm'', International Journal of Current Engineering and Technology, MIT College of Engineering, Pune, India, AMET 2016, INPRESSCO IJCET Special Issue-4 (March 2016).

[3] Suramya Naik, Fabien Redon, Gerhard Regner, and John Koszewnik, "Opposed-Piston 2-Stroke Multi-Cylinder Engine Dynamometer Demonstration'', SAE International, 2015-26-0038 Published 01/14/2015.

[4] Khalaf I. Hamada, M.K.Mohammed and M.M. Rahman, "Development Of A Test-Rig For A Modern Motorcycle Engine", International Journal of Automotive and Mechanical Engineering (IJAME), Volume 10, pp. 2034-2041, July-

December 2014.

[5] P.T.Aravindhan, P.T.Anandhan, "Efficiency Analysis of a Copper Coated SI Engine using Normal and HHO blended Gasoline under Various Loads'', International Journal of Innovative Research in Science, Engineering and Technology, Volume 3, Special Issue 3, March 2014.

[6] M.A.Bote, H.M.Dange, "Performance analysis of single cylinder four stroke petrol engine using petrol blended with Thumba oil'', International Journal of Innovative Research in Science, Engineering and Technology, Vol. 3, Issue 2, February 2014.

[7] Pareshkumar D. Chavada, Raghuvir S. Khanna, Prof. V. G. Trivedi, "Comparative Investigation on Performance and Emissions of Single Cylinder Four Stroke Ceramic Coated SI Engine with Blends of Methanol and Petrol-A review paper'', IJSR - International Journal Of Scientific Research, Issue : 5,May 2013.

[8] Gayatri Kushwah, "Analysis of Environmental Impact of 4 Stroke Petrol Engine by Using Eco Indicator 99 Method'', International Journal of Scientific and Research Publications, Volume 3, Issue 2, February 2013.

[9] Vinod Yadav, Dr. N. D. Mittal, "Design and Analysis of Piston Design for 4 Stroke Hero Bike Engine'', International Journal of Engineering Innovation & Research, Volume 2, Issue 2, 2013.

[10] Mr. Hitesh B. Bisen, Mr. Y. R. Suple, " Experimental Investigations of Exhaust Emissions of four Stroke SI Engine by using direct injection of LPG and its analysis'', International Journal of Modern Engineering Research (IJMER), Vol. 3, Issue. 5, Sep - Oct. 2013 pp-2600-2605.

[11] Vivek Ugare, Nikhil Bhave, Sandeep Lutade, "Performance Of Spark Ignition Engine Under The Influence Of Magnetic Field'', International Journal Of Research In Aeronautical And Mechanical Engineering, Vol.1,Issue 3, July 2013, Pages:36-43.

[12] S. Sunil Kumar Reddy, V. Pandurangadu, "Theoretical & Experimental Investigations On The Performance Of A Four Stroke Adiabatic Di Diesel Engine'', International Journal of Advances in Engineering & Technology, July 2013.

[13] S. Ghosh, D. Dutta, "Performance and emission parameters analysis of gasoline engine with EGR'', International Journal of Engineering Research and Development, Volume 4, Issue 10 (November 2012), PP. 08-12.

[14] Venkata Ramesh Mamilla, V.Gopinath, C.V.Subba Rao, Dr.G.Lakshmi Narayana Rao, "Performance And Emission Characteristics Of 4 Stroke Petrol Engine Fueled With Biogas / L.P.G Blends'', International Journal of Advanced Engineering Technology, IJAET, Vol. II, Issue I, January-March 2011/209-213.

[15] M. M. Rahman (Member, IAENG), Mohammed K. Mohammed and Rosli A. Bakar, "Effect of Air Fuel Ratio on Engine Performance of Single Cylinder Port Injection Hydrogen Fueled Engine: A Numerical Study'', Proceedings of the International Multi Conference of Engineers and Computer Scientists 2009 Vol II IMECS 2009, March 18 - 20, 2009, Hong Kong

[16] M. S. Shehata and S. M. Abdel Razek, "Engine Performance Parametres And Emissions Reduction Methods For Spark Ignition Engine'', Engineering Research Journal 120, (December 2008) M32 – M57.

[17] Maher A. R. Sadiq AL-BAGHDADI, "A Simulation Model for a Single Cylinder Four-Stroke Spark Ignition Engine Fueled with Alternative Fuels'',2006.

[18] PAULINA S. KUO, "Cylinder Pressure in a Spark-Ignition Engine: A Computational Model'', Engineering Sciences, J. Undergrad. Sci. 3: 141-145 (Fall 1996).