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REVIEW PAPER ON FOUR CYLINDER FOUR STROKE PETROLENGINE

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ABSTRACT

How to do a four-cylinder, four-stroke engine analysis is the subject of this thesis. As is common knowledge, dynamometers are quite expensive, hence a method must be developed to do engine performance analysis based on dynamometer functionality. So, the fabrication process for the engine test rig that was previously developed can begin. To plan out the shape of the engine test rig, tools such as AutoCAD and SolidWork was employed. The design process also includes the choice of materials. In order to determine if engine performance will improve or worsen, variable loads will be applied while the engine runs at a constant speed. Here, we may examine the engine speed that will yield the most performance from this little engine. Thus, some losses like those from fuel and power can be reduced. The author will follow the best practice to adjust the fuel quality by blending an approach and practically minimize emissions in order to increase engine performance.

Keywords– Energy, Design, Combustion chamber, engine performance.

1. INTRODUCTION

A heat engine is any device that produces heat via the burning of fuel and uses some of that heat to produce mechanical work. These heat engines are primarily divided into two groups, which are Internal combustion engines and External combustion engines. In an internal combustion engine, the fuel is burned while there is air in the cylinder, and the combustion products directly affect the piston to provide power. According to the type of fuel they use, internal combustion engines are further divided into petrol, diesel, and gas engines. They are divided into Spark ignition engines and Compression ignition engines based on how they are ignited.

2. LITERATURE REVIEW

Abdul Khurshid, Purushotham Anil Kumar, Tadala akhil, K. Naresh, (2016) The COUPLED field analysis by finite element method (FEM) had depicted the temperature and the stress distribution of the piston, which is initially made of four distinct materials. The temperature as a thermal conditional, the force or pressure exerted on the piston crown, and the piston's material characteristics are the variables employed in the simulation. The piston's specifications are from a single-cylinder, four-stroke Hero-Honda motorbike. Due to their low thickness, high quality, and excellent structural unbending nature, aluminum metal composites are becoming more widely accepted for use in cars, current technology, and aviation applications. The piston is modeled in the current work using CATIA V5 modeling, and structural and thermal analyses are performed on the same model using ANSYS software for aluminum (pure), aluminum alloy (A6061), al-GHS 1300, and al-Sic graphite. The results were discussed. The findings of utilizing FEA to simulate the different aluminum alloy pistons predict the maximum stress and the critical region. Finding the main location of intense stress is crucial for making the necessary adjustments.

Savita U. Shinde, Anand R. Nadgire, and Nilesh T. Dhokane (2016) [2] engine performance factors had been depicted with the addition of H2 or O2 and with a turbocharger and a supercharger. I have experimented with SI engine intake side development. Research shouldn't be done on using pure oxygen to introduce oxygen-rich air into the intake manifold. Therefore, this study aims to enhance SI engine performance while lowering fuel consumption and, thanks to complete combustion, lowering SI engine emissions. Therefore, research on oxygen-rich air for fuel combustion in SI engines may be conducted. Here, I have calculated the system's brake thermal efficiency and estimated the fuel consumption for brakes both with and without oxyrich air energizers. Additionally, I looked at the SI engine's emission data both with and without an oxyrich air energizer. I discovered engine volumetric and mechanical efficiency with and without oxygen blending. I used a computerized MPFI 4 stroke petrol engine test apparatus to create the experimental setup for an oxyrich air energizer.

John Koszewnik, Gerhard Regner, Suramya Naik, and Fabien Redon (2015) [3] Many Indian manufacturers are looking at new technologies in order to comply with upcoming fuel economy and emissions regulations, such as the newly passed Corporate Average Fuel Consumption (CAFC) guidelines for light-duty cars. However, these technologies must boost efficiency without raising cost if they are to offer a sustainable economic answer. The opposed-piston engine is a potential option for meeting both present and future standards. The opposed-piston engine was frequently employed for on-road applications in the early 20th century, but it was gradually phased out due to problems with oil control and pollution. Achates Power, however, has created a modern opposed-piston diesel engine architecture that is clean, significantly more fuel efficient, and less expensive to produce than the four-stroke engines used today thanks to advancements in computer-aided engineering tools and cutting-edge engineering techniques.

M.K. Mohammed, M.M. Rahman, and Khalaf I. Hamada (2014) [4] for building a test-rig based on a modern motorbike engine, had represented experimental operations that had been carried out in the Automotive Engineering Centre laboratories in University Malaysia Pahang. An eddy current dynamometer that was connected to a four-stroke single cylinder SI motorcycle engine served as the foundation for the development of the experimental engine test rig. Additionally, the test rig includes all of the measurement tools, sensors, and accessory kits required to conduct adequate engine testing. A one-dimensional model built around that single cylinder engine has been validated using the findings of these operations. The engine model was validated using both the in-cylinder pressure trace and the braking torque. The results of the simulation and the experiments were in good accord. The built-in test-rig can be put to use in other research and development projects.

P.T. Aravindhan and P.T. Anandhan (2014) [5] represented a performance evaluation of a two-stroke, single-cylinder S park Ignition engine (the piston crown and inner side of the cylinder head are coated in copper with a thickness of 300). In this study, a potassium hydroxide (KOH) catalyst was used to electrolyze water to create hydroxy gas. In a leak-proof chamber, electrolysis is carried out. Utilizing on-board gas generation lowers the danger of storage. Studying how adding hydroxy gas to gasoline fuel affects a spark ignition engine's performance characteristics. For various load conditions, it is possible to compute brake thermal efficiency, indicated thermal efficiency, mechanical efficiency, and specific fuel consumption. In comparison to pure petrol powered engine running, the HHO system with petrol fuel produces improved engine efficiency at mid and higher engine speeds. Engine performance is improved by the hydro-oxy air mixture's high burning velocity and low ignition energy. When using two separate test fuels, the performance of the copper-coated engine outperformed that of the conventional engine.

M.A. Bote and H.M. Dange (2014) [6] look into As demand rises, petroleum-based fuels play a significant part in the quick depletion of fossil fuels.Thumba oil is used to create biodiesel. As a fuel that can be recognized as being environmentally benign, biodiesel was blended with a SI engine in a laboratory setting to find its qualities and characteristics. Thumba biodiesel was made in a variety of blends, and its performance was assessed with a single-cylinder, four-stroke petrol engine.

Professor V. G. Trivedi, Pareshkumar D. Chavada, and Raghuvir S. Khanna (2013) [7] had acted as petroleum Today, there are more attempts being made to optimize engine efficiency by constructional modifications; for instance, ceramic coating applications in internal combustion engines are expanding quickly in tandem with the development of advanced technology ceramics. Fuel energy must be transformed into mechanical energy as quickly as feasible to improve engine performance. Internal combustion engine cylinder temperatures and pressure rise as a result of coating the combustion chamber with low heat-conducting ceramic materials. Consequently, an improvement in engine efficiency should be seen. Methanol burns at temperatures lower than gasoline. Due to its high octane rating and high heat of vaporization, methanol can be blended with gasoline in spark ignition engines to boost thermal efficiency and power output. Because of increased temperature during compression and poor heat rejection in ceramic coated IC engines, starting the engine can be made simpler. Less explosion and noise from uncontrolled combustion can result in more silent engine running. Because of the shorter ignition delay, the engine can be run at lower compression ratios. Thus, higher mechanical efficiency and fuel efficiency are possible.

Gayatri Kushwah (2013) [8] provided an evaluation of the four-stroke petrol engine's environmental impact. The Eco indicator 99 method and Eco it software are used to conduct the assessment. The evaluation of the engine's entire life cycle's environmental impact takes into account the effects of the production, processing, shipping and packing, use, and disposal phases. Data are gathered, then evaluated for assessment; during analysis, an indicator point produced from eco-IT software for a specific material and procedure is used. Following analysis, the impact is represented by indicator scores in millipoints, with the phase with the highest indicator score having the greatest environmental impact.

Dr. N. D. Mittal and Vinod Yadav (2013) [9] had stands for The piston is the component of an engine that transforms the pressure and heat energy released during fuel combustion into mechanical work. The most intricate part of an automobile is the engine piston. The design process for a piston for a 4-stroke petrol engine used in a hero bike is illustrated in this paper, along with its examination through comparison with the original piston dimensions used in the bike. As part of the design process, different piston size are calculated analytically while operating at maximum power. While determining various dimensions in this study, the combined effect of mechanical and thermal stress is taken into account. The engine's fundamental specifications were drawn from a hero bike's identified engine type.

Mr. Y. R. Suple, Mr. Hitesh B. Bisen (2013) [10] performed had Commercial vehicles have traditionally used gaseous fuels like liquefied petroleum gas (LPG) and liquefied natural gas (LNG). The primary goal of this research is to analyze exhaust emissions when using Liquefied Petroleum Gas (LPG) as a substitute fuel for four-stroke spark ignition engines. Finding out the engine's performance and exhaust emissions while using LPG as fuel is the study's main goal. To enable the tests to run on LPG fuel, adjustments must be made to the study's engine, which was originally a single cylinder, four-stroke spark ignition engine. A 5-gas analyzer will be inserted into the engine exhaust tailpipe to monitor exhaust emissions, and the engine was attached to a ropeway dynamometer to test a number of engine performance metrics while it was running. Experimental studies have been conducted to determine the emissions of a single cylinder, four-stroke, spark ignition engine while it is operated at full throttle and under various load circumstances with different fuels (gasoline and LPG). The five gases that are measured by the most up-to-date exhaust analyzer equipment are: HC, CO, CO2, O2, and NOx.

Sandeep Lutade, Vivek Ugare, and Nikhil Bhave (2013) [11] had studied the impact of a magnetic field on a single-cylinder, four-stroke spark-ignition engine's performance. The study focuses on the influence of magnetic field on fuel qualities like density and calorific value as well as engine performance parameters including fuel consumption, break thermal efficiency, and exhaust emissions. Just before the carburetor, the magnetic field is applied along the gasoline line. Permanent magnets with a 5000 gauss strength are used to apply the magnetic field. The experiments are carried out under various engine loading scenarios. An exhaust gas analyser is used to measure the emissions of exhaust gases such CO, CO2, HC, and NOX. With the use of magnetic fields, fuel consumption is reduced by about 12%, while CO and HC emissions are reduced by around 27% and 11%, respectively. When a magnetic field is applied, the NOx level in the engine rises. NOx levels have increased by roughly 19%. The percentage increase in CO2 emissions from SI engines caused by the magnetic field is roughly 7%.

S. Sunil Kumar Reddy and V. Pandurangadu (2013) [12] had worked on increasing the thermal efficiency of the engine. Only around one-third of the fuel energy in diesel engines is used for work, and the majority of it is lost to cooling water. A coating of insulating material is applied across the combustion chamber walls of an adiabatic engine (also known as an insulated engine) to prevent energy loss through the cooling system. Ceramic coatings like silicon nitride, silicon carbide, zirconia (zirconium oxide), etc. are often used insulating materials. According to the literature, partially stabilized zarconium (PSZ) has good insulating properties, appropriate strength, and minimal thermal expansion characteristics, making it a great material for adiabatic engine applications. Due to a slower rate of pressure rise, this further enhances fuel efficiency, lowers pollutants, and decreases noise. In the current research, an adiabatic engine with a PSZ-coated cylinder head and valves, air gap insulation over the piston and cylinder liner, and other features is developed. The ever-increasing demand for imported diesel can be decreased by burning readily accessible low cetane fuels like alcohols (which have a high latent heat of vaporization) at higher temperatures in the combustion chambers of an adiabatic engine. In the current investigations, an insulated engine-specific computer program written in C language was used to produce theoretical conclusions, which were then compared to adiabatic engine experimental findings.

D. Dutta and S. Ghosh (2012) [13] The effects of different exhaust gas recirculation (EGR) rates on engine performance, such as brake thermal efficiency, brake-specific fuel consumption, and brake power, as well as engine exhaust gas emission parameters, such as nitrogen oxides (NOx), carbon monoxide (CO), hydrocarbon (HC), and particulate matter (PM) for the fuel used in the engine, were experimentally investigated. For the analysis of exhaust emission gases, four observations are made: 0% EGR, 10% EGR, 20% EGR, and 30% EGR. The engine's rotational speed is assumed to be constant at 1500 rpm. The experiment was conducted using a hydraulic dynamometer and a four-cylinder, four-stroke, water-cooled spark ignition engine that was fueled with 92-octane commercial grade gasoline. A Indus exhaust gas analyzer was used to measure the emissions of exhaust gases. The fuel's lower heating value was 43700 kJ/kg, and its typical molecular weight was 93.454. On engine performance and exhaust gas analysis, the impact of EGR addition to fresh air is looked into. With 10–30% EGR, significant decreases in NOx concentration can be attained.

Dr. G. Lakshmi Narayana Rao, V. Gopinath, C. V. Subba Rao, and Venkata Ramesh Mamilla (2013) [14] with the analysis and functionality of 4-stroke petrol engines running on biogas/LPG mixtures. On a 4-stroke, single-cylinder, air-cooled SI engine, experiments were done using various LPG and biogas mixtures. The trial findings were examined to determine the best LPG and biogas blend for SI engines, resulting in improved performance and less pollution.

Mohammed K. Mohammed, Rosli A. Bakar, and M. M. Rahman (Member, IAENG) (2009) [15] had investigated how the air-fuel ratio affected the operation of a single-cylinder, port-injection internal combustion engine. The port injection engine model was created using GT-Power. The flow and heat transfer of the engine model's component was depicted in one dimension by gas dynamics. The performance parameters and model description are presented after the governing equations. The air-fuel ratio was adjusted between the stoichiometric and lean limits. While the injector was thought to be stationary in the middle of the intake port, the engine's rotational speed ranged from 2500 to 4500 rpm. The obtained results demonstrate that the performance of a hydrogen-fueled engine is significantly influenced by the air-fuel ratio. It has been demonstrated that while the air-fuel ratio causes a drop in the brake mean effective pressure (BMEP) and brake thermal efficiency, it causes an increase in the brake specific fuel consumption (BSFC). As the air-fuel ratio rises, the cylinder temperature falls. The current model highlights the potential to convert conventional engines to use hydrogen fuel with very minor adjustments.

M. S. Shehata and S. M. Abdel Razek (2008) [16] to look into engine performance factors and strategies for spark ignition engine emissions reduction. The used engine has a nine-to-one compression ratio, an 80-mm bore, and a 90-mm stroke. It is a four-stroke, four-cylinder naturally aspirated spark ignition engine. The exhaust gas recirculation (EGR) parameters for the engine are shown both ways. The specified engine performance metrics are calculated using engine geometry and engine cylinder pressure data. With EGR, a catalytic converter, and air injection in the exhaust manifold, UHC and CO concentrations are measured. Different methods' UHC and CO concentrations are contrasted with the engine's initial emissions. The air/fuel ratio (AFR) and exhaust gas temperature (Texhaust) are the researched characteristics, together with braking engine performance metrics. Additionally, cylinder pressure, inlet and exhaust manifold pressure readings are used to compute engine cycle to cycle variation (CCV) and sound pressure level (SPL) generated from the engine. In the current work, EGR rates of 5%, 7%, 8%, and 10% and air injection rates of 3%, 4%, 5%, and 6% are used. UHC and CO concentrations can be decreased with the employment of a catalyst converter and air injection in the exhaust manifold, however EGR increases UHC and CO concentrations. Using air injection in the exhaust manifold, UHC and CO emissions from spark ignition engines can be reduced. The current research is beneficial for increasing engine performance parameters, decreasing engine emissions, and advancing the development of spark ignition engines.

Al-Baghdadi, Maher A. R. (2006) [17] has worked and focused on minimizing the concentration of hazardous components in combustion products and on reducing fuel consumption by using renewable alternative fuels. The performance parameters of spark ignition engines running on a variety of fuels (gasoline, ethanol, hydrogen, and their mixtures) are established using a simulative model. Pre-ignition frequency, relative intensity, and cyclic changes are also taken into account. The 2-zone includes a method for calculating an estimate of the mass burning rate and effective duration of combustion for various operating conditions and fuels.

The pressure, mass, volume, temperature, and heat transfer from the burned and unburned zone, as well as the mass flow into and out of fissures and the composition of combustion products, were all calculated using a system of first-order ordinary differential equations. For the purpose of simulating a 4-stroke cycle of a spark-ignition engine powered by gasoline, ethanol, or hydrogen as a single fuel or a mixture of those fuels, a mathematical and simulation model has been created, tested, and verified against experimental data. The findings of the current investigation have demonstrated the model's capacity to accurately forecast engine performance, emissions, and pre-ignition frequency under a variety of operating situations. The results of the current model and the outcomes of the experiments showed a good degree of consistency.

3. CONCLUSION

From the results obtained in the analysis of different literature survey, the following can be concluded:

- The research survey included a variety of engine types, including single-cylinder, four-stroke petrol engines, two-stroke multi-cylinder engines, modern motorcycle engines, four-stroke hero bike engines, gasoline engines, and more. The investigation included a survey on their component design and analysis.
- Some study papers investigated the performance of engines when using various fuels, including oxygenated air, thumba oil, and LPG, among others.
- It is possible to work on four-cylinder, four-stroke petrol engines in order to increase their performance while using less fuel and providing more power.

4. REFERENCES

[1] Deepak, SSK and Thakur, Mukesh, Comparative Analysis of Different Catalysts used in Catalytic Converters for C. I. Engine based Automobiles, Research Journal of Engineering Sciences, Vol. 6, No. 1, pp. 1-5 (2017) .

[2] Deepak, SSK and Thakur, Mukesh, An Innovative Approach for Control of Exhaust Emissions from C. I. Engine based Automobiles using Nano-particles, Rungta International Journal of Mechanical and Automobile Engineering, Vol. 1, No. 1, pp. 10-13 (2016).

[3] Deepak, SSK and Thakur, Mukesh, Analysis based on Atomic Activity of Nano-particles for Exhaust Emissions Reduction from Automobiles using Nano-Coated Catalytic Converter, International Journal of Science & Research, Vol. 1, No. 1, pp. 493-495 (2016).

[4] Deepak, SSK and Thakur, Mukesh, Post pollution control Method for C. I. Engine automobiles using Nano-coated Catalytic converter, Research Journal of Engineering Sciences, Vol. 5, No. 3, pp. 14-16 (2016) .

[5] Deepak, SSK and Thakur, Mukesh, Pollution Prevention from Diesel Engine based Automobiles using Nano-particles, International Journal of Engineering Research & Technology, Vol. 1, No. 1, pp. 370-372 (2015).

[6] Deepak, SSK and Thakur, Mukesh, Methods of Pollution Control using Nano-particles, International Journal of Advanced Engineering Research & Studies, Vol. 4, No. 2, pp. 215-217 (2015).

[7] Deepak, SSK and Thakur, Mukesh, Methods of Pollution Control using Nano-particles, International Journal of Advanced Engineering Research & Studies, Vol. 4, No. 2, pp. 215-217 (2015).

[8] Thakur, Mukesh and Saikhedkar, N.K., Rapid Control of Exhaust Emissions and Enhancement of Retention Time in the Catalytic Converter using Nano-sized Copper Metal Spray for Spark Ignition Engine, Journal of Mechanical Engineering Research & Development, Vol. 3, No. 1, pp. 1-10 (2013).

[9] Thakur, Mukesh and Saikhedkar, N.K., Control of Exhaust Emissions and Enhancement of Retention Time for Four Stroke Engine Using Nano-sized Copper Metal Spray, International Journal of Scientific & Engineering Research, Vol. 4, No. 2, pp. 1-9 (2013).

[10] Thakur, Mukesh and Saikhedkar, N.K., Comparative Analysis for Reduction of Exhaust Emissions for Two Stroke and Four Stroke Spark Ignition Engine with Improved Design for Implementation, International Journal of Scientific and Engineering Research, Vol. 4, No. 9, pp. 2436-2446 (2013).

[11] Thakur, Mukesh and Saikhedkar, N.K., Behavioral Modeling and Simulation of Two Stroke Engine and Designed Catalytic Converter with Improved Design for Implementation, International Journal of Scientific and Engineering Research, Vol. 4, No. 11, pp. 1053-1062 (2013).