Journal of Advances in Science and Technology
Vol. 12, Issue No. 24, November-2016, ISSN 2230-9659

An In-Depth Analysis on Compression Engines and Its Exploitation with Non-Polluting Oils

Arvindkumar Ganeshaiah Sringeri[1]* Dr. Sanjay S. Chaudhary[2]

[1]Ph.D. Research Student, MUIT, Lucknow

[2]Research Guide, MUIT, Lucknow

Abstract – This paper is on the adjustment design of oil engine for elective fuelling using Compressed Natural Gas (CNG). It gives a consistent establishment in the change setup process. An oil engine Honda CR-V 2.0 auto which has a weight extent of 9.8 was picked as logical examination. All together for this oil engine to continue running on CNG, its weight must be extended. A perfect weight extent of 11.97 was figured using the standard temperature-specific volume relationship for an isentropic weight process. This computation of weight extent relies upon a bay air temperature of 30oC (illustrative of tropical encompassing condition) and pre-consuming temperature of 540oC (contrasting with the auto-begin temperature of CNG). Using this estimation of weight extent, a dimensional change Quantity =1.803mm was gotten using fundamental geometric associations. This estimation of 1.803mm is required to extend the length of the partner bar, the weight stature of the barrel or diminishing the settling plate's thickness. After the change technique, a CNG engine of air standard efficiency 62.7% (this addresses a 4.67% extension over the oil engine), prepared for a biggest vitality of 83.6kW at 6500rpm, was gotten.

Keywords: Non-Polluting Oils, Compression Engines, Combustion Engines

---------------------------♦-----------------------------

1. INTRODUCTION

Inside ignition motors are gadgets that create work utilizing the results of burning as the working liquid as opposed to as a warmth exchange medium. To create work, the burning is completed in a way that produces high-weight ignition items that can be extended through a turbine or cylinder. The building of these highpressure frameworks presents various highlights that significantly impact the arrangement of toxins. There are three noteworthy sorts of inward burning motors being used today: (1) the start motor, which is utilized basically in autos; (2) the diesel motor, which is utilized as a part of huge vehicles and modern frameworks where the enhancements in cycle productivity make it worthwhile over the more conservative and lighter-weight start motor; and (3) the gas turbine, which is utilized as a part of airplane because of its powerful/weight proportion and furthermore is utilized for stationary power age. Each of these motors is an essential wellspring of barometrical contaminations. Vehicles are real wellsprings of carbon monoxide, unburned hydrocarbons, and nitrogen oxides. Presumably more than some other ignition framework, the plan of car motors has been guided by the necessities to lessen emanations of these contaminations. While generous advance has been made in outflow diminishment, vehicles stay imperative wellsprings of air contaminations. Diesel motors are infamous for the dark smoke they produce. Gas turbines emanate ash also. These frameworks likewise discharge unburned hydrocarbons, carbon monoxide, and nitrogen oxides in substantial amounts. In this part we analyze the air toxin emanations from motors. To comprehend the outflows and the uncommon issues in emanation control, it is first important that we comprehend the working standards of every motor sort. We start our discourse with a framework that has been the subject of serious investigation and debate the start motor.

2. REVIEW OF LITERATUERE:

In the early years of the change of internal start engines hydrogen was not the "unprecedented" fuel that it is today. Water part by electrolysis was an exceptional lab ponders. Otto, in the mid-1870s, considered a collection of invigorates for his inside consuming engine, including hydrogen. He rejected gas as being too much hazardous. Later progressions in consuming advancement made fuel more secure. Most early engine examinations were expected for expending a grouping of gasses, including oil gas and propane. Right when hydrogen was used as a piece of these engines it would turn around release. Since hydrogen devours speedier than various forces, the fuel-air mix would touch off in the affirmation complex before the confirmation valve could close. Implanted water controlled the turnaround releases. Hydrogen gave less power than gas with or without the water. In the midst of World War I hydrogen and unadulterated oxygen were considered for submarine use in light of the fact that the group could get drinkable water from the vapor. Hydrogen was similarly considered for use in filling bearer engines. The gas used for softness could similarly be used for fuel. Notwithstanding the likelihood that helium were used to give lift, hydrogen gas could be used to supply additional gentility if set away at low weight in a light compartment. It was Rudolf A. Erren who at first made sensible the hydrogen-filled engine in the 1920s and changed more than 1,000 engines. His endeavors included trucks and transports. After World War II the accomplices found a submarine changed over by Erren to hydrogen control. Without a doubt, even the torpedoes were hydrogen controlled. In 1924 Ricardo coordinated the essential deliberate engine execution tests on hydrogen. He used a one barrel engine and endeavored distinctive weight extents. At a weight extent of 7:1, the engine achieved a zenith profitability of 43%. At weight extent of 9.9:1, Burnstall got a viability of 41.3% with an equivalency extent of 0.58-0.80.

After World War II, King watched the purpose behind preignition to be issue regions in the start chamber from the high temperature slag, the store from devoured oil and clean. He took after switch release to high fire speed at high equivalency extents. M.R. Swain and R.R. Adt at the University of Miami made modified mixture techniques with a 1,600 cm3 Toyota engine with a weight extent of 9:1. The Illinois Institute of Technology changed over a 1972 Vega using a propane carburetor. Changing over to propane fuel utilizes similar development as hydrogen. Roger Billings, in a joint exertion with Brigham Young University, entered a hydrogen-changed over Volkswagen in the 1972 Urban Vehicle Competition. The vehicle won before whatever remains of the opposition in the releases order more than 60 distinct vehicles notwithstanding the way that the apex outpourings were more significant than for other hydrogen filled vehicles elsewhere. Nitrous oxides outperformed levels got by various experimenters using direct mixture. Robert Zweig changed over a pickup truck to hydrogen control in 1975. It has been running starting there ahead. He handled the switch releases issue by using an extra confirmation valve to surrender hydrogen freely from air. It is an essential, rich vehicle that uses compacted hydrogen. The American Hydrogen Association demonstrates the Zweig hydrogen pickup trucks out in the open showcases. The Brookhaven National Laboratory changed over a Wankel (turning) engine to hydrogen. It worked favored with hydrogen over conventional engines since its copying chamber updates the release of hydrocarbon poisons. Mazda has changed more than one of their rotational engine automobiles to continue running on hydrogen. The uncommon arrangement of the rotational engine keeps the hydrogen and air detach until the point that they are participated in the consuming chamber. The Indian Institute of Technology attempted begin engines changed once again to hydrogen and has achieved the going with conclusions: Hydrogen permits a broad assortment of fuel-air mixes. No throttling is required. The fuel-air extent and the measure of fuel are varied. Change requires higher weight extents like up to 11:1. Hydrogen is 30 to half more beneficial than gas. The Indian authorities similarly accomplished a couple of conclusions concerning the usage of hydrogen despite diesel fuel in diesel engines. They diminished the weight extents from 16.5:1 to 14.5:1. In perspective of hydrogen's high rate of start only a little aggregate should be used mixed with diesel fuel. A high begin temperature is essential: 585 °C. The more hydrogen is added to the fuel mix the lower is the level of toxic radiations.

The Billings Energy Corporation in Independence, Missouri, changed over a U.S. postal Jeep to hydrogen hydride. On fuel it got 3.9 km/liter. The hydrogen fuel use is 4.9 km/liter per gas essentialness proportionate. This was a difference in 24%. An uncommon vaporous carburetor was used. High fire speed and low begin imperativeness required narrowing the begin gap. Issues of rusting and setting on the sparkplug tip made. Billings supplanted the fittings with Champion stainless steel connections to discard the issue. Rusted fitting tips can cause preignition through the valves (invert release). Since the ending rate was speedier, they expected to change the begin timing on the inline six-chamber engine. The investigators added a dilute mixture system to bring the start temperature and nitrous oxide creation. The extent was 4:1, by weight, of water to hydrogen. Step by step fuel usage was 1.4 kg of hydrogen and 5.4 kg of water. Water was mixed as a fine mist clearly into the complex of the engine. This reduced detonated in reverse into the complex and helped control. In tests in 1980 with a diesel engine changed over to continue running on 100% hydrogen, the U.S. Specialist of Mines, as a group with EIMCO Mining Machinery, found that the nitrous oxide releases for hydrogen is one-tenth of the entirety for a comparative vehicle on diesel. With hydrogen, the primary other spread was water vapor. This is basic for vehicles working in mines and other limited spaces. They mounted a 63.4 kW (85 hp) engine on a 4,500 kg truck. The diesel engine required the development of begin. Weight alone would not light the hydrogen at the decreased weight extent. They added a turbocharger to manufacture the thickness of the moving toward fuel. The fuel acknowledgment structure gives two affirmation routes; one for hydrogen and one for air. The fuel and air are kept separate until the point that entering the barrel to envision turn around releases (Peavey M. A.

2003). The Laboratory of Transport technology (University of Gent, Belgium) has invested huge energy in elective invigorates as far back as 10 years or close. Combustible gas, LPG, hythane and hydrogen have been the subject of extended research. In a first stage, a Valmet 420D engine, a trademark suctioned diesel engine with organize mixture was changed over to a begin touched off engine for the usage of hydrogen. This engine was used generally for the change of a multipoint arranged mixture structure and the examination of different sorts of electromagnetic gas injectors (Sierens R, Rosseel E. 1995). The tests exhibited a couple

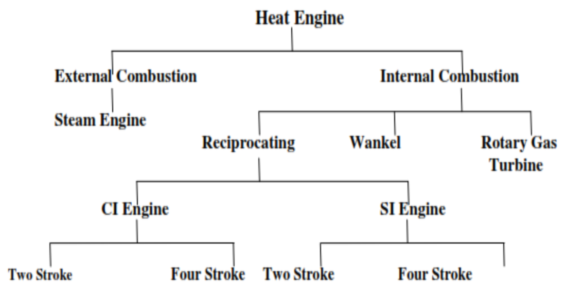
Short comings of the then available gas injectors: spillage, unequal response time (opening deferral) and low quality. In the meantime regardless, the examination on vaporous mixture structures (vaporous oil, LPG, et cetera.) has been extended enormously by the specific associations and these issues are, all things considered, settled now. A minute engine, a GM-Crusader V8, was then changed over for hydrogen use. The essential tests were done with a gas carburetor, which allowed testing with hydrogen, combustible gas and hydrogen-oil gas mixes (hythane), (Sierens R, Rosseel E. 1998).

Remembering the ultimate objective to gain an unrivaled power of the consuming methodology, the engine was then equipped with a progressive composed multipoint imbuement system. Such an imbuement system, as associated with liquid invigorates (gas, liquid LPG, et cetera.) has a couple of purposes of enthusiasm including the probability to tune the air-fuel extent of each chamber to an especially described regard, extended power yield and reduced cyclic assortment of the start method in the barrels. Arranged implantation similarly has an additional favorable position for a hydrogen invigorated engine, as it construes an unrivaled assurance from switch release (impact of the air-fuel mix in the narrows complex). In about all cases, invert release safe operation gathers a repression of the operation range of the air-fuel mix on the "rich" side, along these lines for high load conditions. This impediment is reduced by the use of a multi-point progressive imbuement structure.

Arrange implantation in the start chamber, cryogenic limit (liquid hydrogen tank) and pump is far superior, yet not in certainty available for huge scale fabricating (Furuhama S. 1995). Each one of these purposes of intrigue are remarkable (Sorusbay C, Veziroglu TN. 1988, Kondo T, Hiruma M, Furuhama S. 1996, Lee ST, Yi HS, Kim ES. 1995, Guo LS, Lu HB, Li JD. 1999). The drawback of low weight progressive gas implantation is the low thickness of the gas. For humbler engines running at high speeds (balance application), the injectors need to pass on a high volume of gas in a concise traverse. Distinctive issues may rise with the durability of the injectors and possible breaks. The German Aerospace Research Establishment (DLR) used cryogenic hydrogen with cross breed mix game plan on a BMW 745i vehicle in a joint effort with BMW.

3. ENGINE AND WORKING PRINCIPLES

A warmth motor is a machine, which changes over warmth vitality into mechanical vitality. The burning of fuel, for example, coal, oil, diesel creates warm. This warmth is provided to a working substance at high temperature. By the extension of this substance in appropriate machines, warm vitality is changed over into helpful work. Warmth motors can be additionally partitioned into two sorts: (I) External ignition and (ii) Internal burning. In a steam motor the ignition of fuel happens outside the motor and the steam in this manner shaped is utilized to run the motor. Along these lines, it is known as outer burning motor. On account of inner ignition motor, the burning of fuel happens inside the motor barrel itself. The IC motor can be additionally named: (I) stationary or portable, (ii) flat or vertical and (iii) low, medium or rapid. The two particular sorts of IC motors utilized for either versatile or stationary operations are: (I) diesel and (ii) carburettor.



Types of Heat Engines

Spark Ignition (Carburettor Type) IC Engine

In this engine liquid fuel is atomised, vaporized and mixed with air in correct proportion before being taken to the engine cylinder through the ingestion manifolds. The ignition of the mixture is caused by an electric spark and is known as spark ignition. Compression Ignition (Diesel Type) IC Engine In this only the liquid fuel is injected in the cylinder under high pressure.

4. CONSTRUCTIONAL FEATURES OF IC ENGINE:

The cross segment of IC motor is appeared in Fig. 1. A short portrayal of these parts is given underneath. Barrel: The chamber of an IC motor constitutes the fundamental and supporting bit of the motor power unit. Its significant capacity is to give space in which the cylinder can work to attract the fuel blend or air (contingent on start or pressure start), pack it, enable it to grow and in this manner produce control. The chamber is generally made of high-review cast press. Sometimes, to give more noteworthy quality and wear protection with less weight, chromium, nickel and molybdenum are added to the solid metal.

Cylinder: The cylinder of a motor is the initial segment to start development and to transmit energy to the crankshaft because of the weight and vitality produced by the burning of the fuel. The cylinder is shut down toward one side and opens on the flip side to allow coordinate connection of the interfacing pole and its free activity.

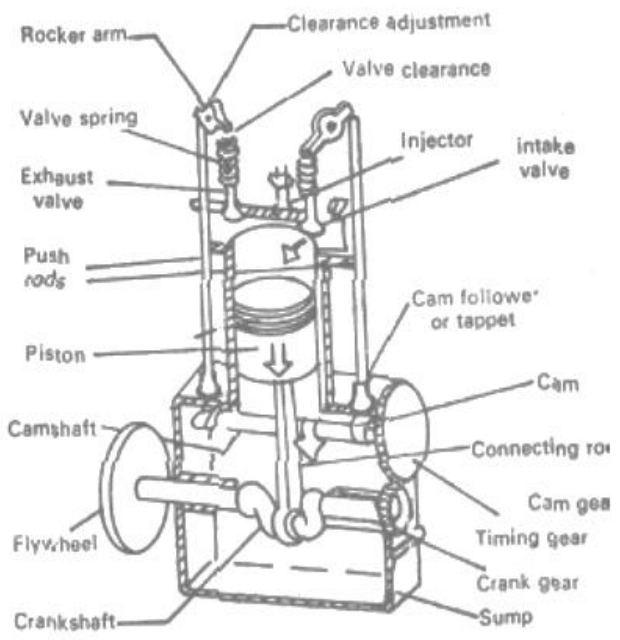


Fig 1: Cross-section of a diesel engine

The materials utilized for cylinders are dark solid metal, cast steel and aluminum composite. Be that as it may, the advanced pattern is to utilize just aluminum combination cylinders in the tractor motor. Cylinder Rings: These are made of solid metal by virtue of their capacity to hold bearing qualities and flexibility inconclusively. The essential capacity of the cylinder rings is to hold pressure and in the meantime diminish the barrel divider and cylinder divider contact zone to a base, in this manner decreasing erosion misfortunes and over the top wear. The other vital elements of cylinder rings are the control of the greasing up oil, chamber oil, and transmission of warmth far from the cylinder and from the barrel dividers. Cylinder rings are classed as pressure rings and oil rings relying upon their capacity and area on the cylinder. Pressure rings are generally plain one-piece rings and are constantly set in the notches closest the cylinder head. Oil rings are notched or opened and are found either in the most minimal furrow over the cylinder stick or in a section close to the cylinder skirt. Their capacity is to control the conveyance of the greasing up oil to the barrel and cylinder surface keeping in mind the end goal to avoid superfluous or over the top oil utilization particle.

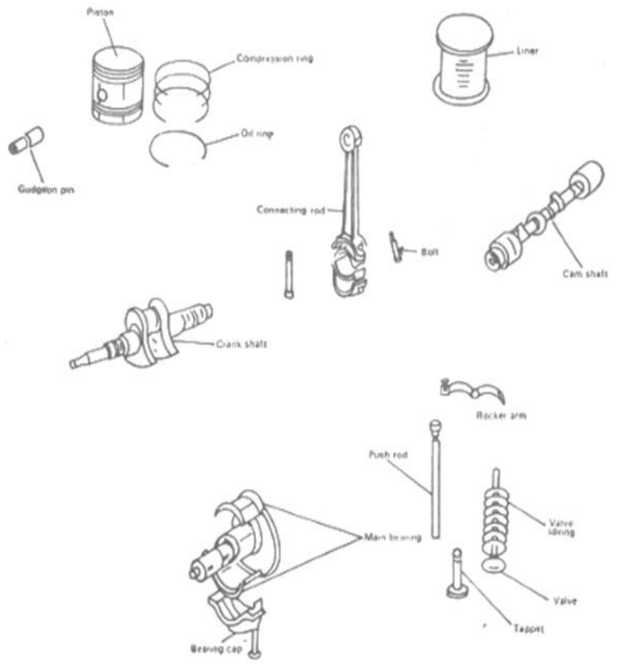
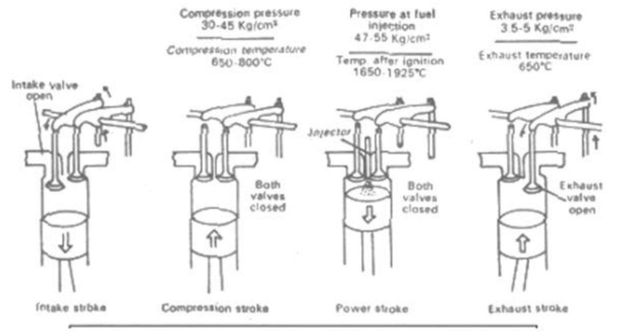


Figure 2: Components of the diesel engine

Cylinder Pin: The associating bar is associated with the cylinder through the cylinder stick. It is put forth of defense solidified composite steel with accuracy wrap up. There are three distinct techniques to interface the cylinder to the associating pole. Associating Rod: This is the association between the cylinder and crankshaft. The end interfacing the cylinder is known as little end and the flip side is known as large end. The huge end has two parts of a course shot together. The interfacing pole is made of drop produced steel and the area is of the I-pillar sort. Crankshaft: This is associated with the cylinder through the interfacing pole and changes over the straight movement of the cylinder into the rotational movement of the flywheel. The diaries of the crankshaft are upheld on fundamental heading, housed in the crankcase. Stabilizers and the flywheel darted to the crankshaft help in the smooth running of the motor. Motor Bearings: The crankshaft and camshaft are bolstered on hostile to erosion direction. These course should be fit for with standing fast, overwhelming burden and high temperatures. Typically, cadmium, silver or copper lead is covered on a steel back to give the above attributes. For single chamber vertical/flat motors, the present pattern is to utilize metal rollers set up of principle heading of the thin shell sort.

5. COMPRESSION ENGINES AND ITS EXPLOITATION WITH NON-POLLUTING OILS

In four-stroke cycle engines there are four strokes completing two unrests of the crankshaft. These are independently, the suction, weight, power and vapor strokes. Simply unadulterated air is drawn into the barrel in the midst of this stroke through the channel valve, while, the vapor valve is closed. These valves can be worked by the cam, push bar and rocker arm. The accompanying stroke is the weight stroke in which the barrel moves with both the valves remaining close. The air, which has been drawn into the barrel in the midst of the suction stroke, is coherently compacted as the chamber climbs. The weight extent as a rule changes from 14:1 to 22:1. The weight toward the complete of the weight stroke ranges from 30 to 45 kg/cm2 . As the air is powerfully compacted in the chamber, its temperature increases, until the point that when near the complete of the weight stroke, it ends up being enough high (650-80O oC) to quickly touch off any fuel that is mixed into the barrel. Right when the barrel is near the most astounding purpose of its weight stroke, a liquid hydrocarbon fuel, for instance, diesel oil, is showered into the start chamber under high weight (140-160 kg/cm2), higher than that current in the barrel itself. This fuel by then lights, being seared with the oxygen of the extremely stuffed air. In the midst of the fuel imbuement period, the chamber accomplishes the complete of its weight stroke and starts to return on its third consecutive stroke, viz., control stroke. In the midst of this stroke the hot consequences of consuming involving dominatingly of carbon dioxide, together with the nitrogen left from the pressed air reach out, along these lines compelling the barrel dropping. This is quite recently the working stroke of the chamber. In the midst of the power stroke the weight tumbles from its most extraordinary start regard (47-55 kg/cm2), which is typically higher than the more unmistakable estimation of the weight (45 kg/cm2), to around 3.5-5 kg/cm2 near the complete of the stroke. The exhaust valve by then opens, generally speaking to some degree sooner than when the barrel accomplishes its most diminished motivation behind travel. The exhaust gasses are gotten out on the going with upward stroke of the barrel. The exhaust valve remains open all through the whole stroke and closes at the most elevated purpose of the stroke. The reacting development of the barrel is changed over into the spinning development of the crankshaft by techniques for an interfacing bar and crankshaft. The crankshaft hands over the central heading, which are set in the crankcase. The flywheel is fitted on the crankshaft remembering the ultimate objective to smoothen out the uneven torque that is delivered in the reacting engine.



Principle of four-stroke engine

FOUR-STROKE SPARK IGNITION ENGINE

In this fuel is mixed with air, isolated into a mist and deficiently vaporized in a carburetor.. The mix is then sucked into the chamber. There it is compacted by the upward improvement of the barrel and is touched off by an electric begin. Right when the mix is seared, the resulting warmth causes the gasses to develop. The expanding gasses apply a weight on the barrel (control stroke). The exhaust gasses escape in the accompanying upward improvement of the barrel. The strokes resemble those discussed under four-stroke diesel engines. The diverse temperatures and weights are showed up in Fig. 17. The weight extent shifts from 4:1 to 8:1 and the air-fuel mix from 10:1 to 20:1.

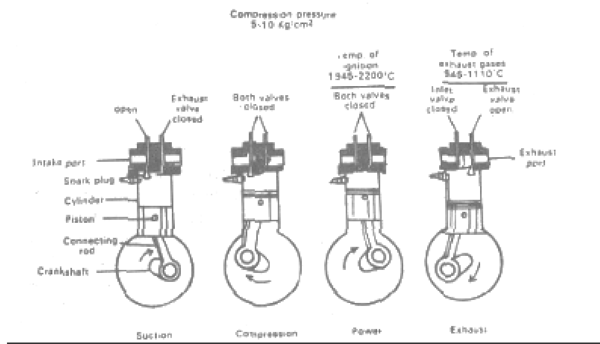


Fig 18. Principle of operation of four-stroke petrol engine

TWO-STROKE CYCLE PETROL ENGINE

The two-cycle carburettor sort engine impacts use of a water/air confirmation crankcase for to a limited extent pressing the air-to fuel mix (Fig. 18). As the barrel goes down, the mix effectively drawn into the crankcase is mostly stuffed. As the barrel nears the base of the stroke, it uncovers the vapor and confirmation ports. The vapor streams out, diminishing the weight in the chamber. Right when the weight in the start chamber is lower than the weight in the crankcase through the port openings to the consuming chamber, the moving toward mix is diverted upward by a befuddle on the barrel. As the barrel climbs, it packs the mix above and draws into the crankcase underneath another air-fuel mix.

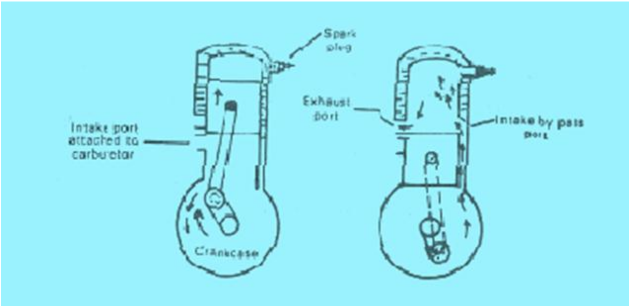


Fig. 19 Principle of operation of two stroke petrol engine

The, two-stroke cycle motor can be effectively distinguished by the air-fuel blend valve joined to the crankcase and the fumes Port situated at the base of the barrel.

EXAMINATION OF CI AND SI ENGINES

The CI engine has the going with purposes of enthusiasm over the SI engine.

1. Enduring nature of the CI engine is considerably higher than that of the SI engine. This is because if there ought to emerge an event of the failure of the battery, begin or carburetor system, the SI engine can't work, however the CI engine, with an alternate fuel injector for each chamber, has less peril of dissatisfaction.

2. The spread of fuel to each chamber is uniform as each of them has an alternate injector, however in the SI engine the apportionment of fuel mix isn't uniform, inferable from the arrangement of the single carburetor and the confirmation complex.

3. Since the upgrading time of the fuel imbuement course of action of CI engine is longer, its help cost isn't as much as that of the SI engine.

4. The expansion extent of the CI engine is higher than that of the SI engine; thusly, the glow incident to the barrel dividers is less in the CI engine than that of the SI engine. Thusly, the cooling plan of the CI engine can be of more diminutive estimations.

5. The torque characteristics of the CI engine are more uniform which realizes better best mechanical assembly execution.

6. The CI engine can be changed over from part load to full load not long after resulting to starting from cold, while the SI engine requires warming up.

7. The fuel (diesel) for the CI engine is more affordable than the fuel (oil) for SI engine.

8. The fire chance in the CI engine is restricted due to the nonattendance of the begin system.

9. On part stack, the specific fuel usage of the CI engine is low.

CONCLUSION:

The most fundamental differences are the power made by the engine, the mileage, the fuel tank measure, and the state of headway of the advancement. Jumbling any examination is the enormous weakness inborn in future vehicle progressions, hydrogen ICE included. If the power gadget development is made to its potential, the effectiveness advantage it has over the hydrogen ICE advancement appears to demonstrate a persuading case for FCVs in the whole deal. This is particularly certified in light of the fact that the higher mileage thinks about a humbler fuel tank evaluate for a comparative range, and fuel tank measure is for all intents and purposes beyond any doubt to be a key hindrance for hydrogen vehicles.

Regardless, the issue of vitality may wind up being a thorn in the side of FCVs, particularly for vehicles that need the capacity to perform at high loads, since including more power module stacks can add out and out to cost of the vehicle. Transports and trucks clearly fall into this class, and light commitment vehicles, for instance, light trucks and diversion utility vehicles may in like manner fall into it, dependent upon the conceivable cost of vitality units. This leaves a circumstance for the blueprint of open approach: does a course of action to propel hydrogen ICE vehicles as an advance procedure look good? This examination reveals four essential core interests:

(1) the PDV of a blend approach far outperforms that of a hydrogen ICE or FCV course of action up to 2050,

(2) if policymakers place assets into hydrogen at any rate for the long-run benefits past 2050, by then there may be a place for hydrogen ICE vehicles in the inescapable task force mix as a result of their lower cost and more conspicuous power,

(3) in case we are to propel hydrogen, the fuel save assets and carbon benefits by earlier introduction of hydrogen ICE vehicles may

give adequately broad preferences to pay for the system and R&D costs of a hydrogen ICE procedure, and

(4) these points of interest are needy upon the usage of hydrogen made by central station time non-sustainable power sources (combustible gas or coal with sequestration).

These conclusions must be grasped concerning the assumptions that created them, especially given the noteworthy vulnerabilities enveloping key fragments of the examination. The four most fundamental premises that this examination lays on are, all together: the acknowledged headway and scattering of new vehicle developments, the normal lessening in cost of formation of feedstock progresses (current versus future), the normal cost of crude oil, and the acknowledged estimation of carbon dioxide surge diminishes. Affectability examinations demonstrate that the above conclusions are by and large generous to various other parameter blends. Given the circumstances of vehicle apportionment, the conclusions are most tricky to oil expenses and carbon benefits. Huge changes in the vehicle apportionment circumstances would in like manner change the quantitative results, yet reckless examination demonstrates that movements inside a strong range are not at risk to change the subjective results.

REFERENCES:

Agarwal, A.K. and Das, L.M. (2001). Biodieseldevelopment and characterization for use as a fuelin compression ignition engines, Journal ofEngineering for Gas Turbines and Power, Vol. 123, No. 2, pp. 440-447.

Agarwal, A.K., Bijwe, J. and Das, L.M. (2003). Effect of biodiesel utilization of wear of vital parts in compression ignition engine. Journal of Engineering for Gas Turbine and Power, Transactions of the ASME 125(2003) pp. 604-611.

Altin, R. Cetinkaya, S. and Yucesu, H.S. (2001). The potential of using vegetable oil fuels for diesel engines. Energy conversion and Management 42 (2001) pp. 529-538.

B. De, R. S. Panua (2014). "An experimental study on performance and emission characteristics of vegetable oil blends with diesel in a direct injection variable compression ignition engine". 10th International Conference on Mechanical Engineering, ICME 2013. Procedia Engineering 90.

Bharat Raj Singh (2005). Design & Development of Zero Pollution Air Engine.

Canakci, M. and Van Gerpen, J.H. (2003). Comparison of engine performance and emission for petroleum diesel, yellow grease biodiesel & soybean oil biodiesel. Transaction of ASAE 46 (4): pp. 937-943.

Devlin, C.C., Passut, C.A., Campbell, R.L. and Jao, T.-C. (2008). Biodiesel fuel effect on Diesel enginelubrication, SAE Technical Paper No. 2008-01-2375.

Fang, H.L. and Whitacre, S.D. (2007). Biodiesel impact onwear protection of engine oils, SAE TechnicalPaper No. 2007-01-4141.

Fraer, R., Dinh, H., Proc, K., McCormick, R. L., Chandler, K. and Buchholz, B. (2005). Operatingexperience and teardown analysis for enginesoperated on biodiesel blends (B20), SAE Technical Paper No. 2005-01-3641.

Hansen, K.F. and Jensen, M.G. (1997). Chemical andbiological characteristics of exhaust emissions froma DI Diesel engine fuelled with rapeseed oil methylester (RME), SAE Technical Paper No. 971689.

Heywood J.B. (1998). Internal Combustion Engine Fundamentals, edited by A. Duffy, John M. Morris, (McGraw-Hill).

Kalligeros, S., Zannikos, F., Stournas, S., Lois, E., Anastopoulos, G., Teas, C. and Sakellaropoulos, F. (2003). An investigation of using biodiesel/marine diesel blends on the performance of a stationary diesel engine. Biomass and Bioenergy 24, pp. 141 – 149.

Kummer, J.T. (1980). "Catalysts for automobile emission control" Prog. Energy Combust. Sci. 6: pp. 177-199.

Labeckas, G. and Slavinskas, S. (2006). The effect ofrapeseed oil methyl ester on direct injection Dieselengine performance and exhaust emissions, EnergyConversion and Management, Vol. 47, No. 13-14, pp. 1954-1967.

Lapuerta, M., Armas, O. and Rodríguez-Fernández J. (2008). Effect of biodiesel fuels on Diesel engineemissions, Progress in Energy and CombustionScience, Vol. 34, No. 2, pp. 198-223.

Liang, X., Gong, G., Wu, H. and Yang, J. (2009). Highlyefficient procedure for the synthesis of biodieselfrom soybean oil using chloroaluminate ionicliquid as catalyst, Fuel, Vol. 88, No. 4, pp. 613-616.

Lin, L., Ying, D., Chaitep, S. and Vittayapadung S. (2009). Biodiesel production from crude rice bran oiland properties as fuel, Applied Energy, Vol. 86,No. 5, pp. 681-688.

Nwafor, O.M.I. (2004). Emission characteristics of Dieselengine operating on rapeseed methyl ester, Renewable Energy, Vol. 29, No. 1, pp. 119-129.

Rakopoulos, C.D., Antonopoulos, K.A., Rakopoulos, D.C., Hountalas, D.T. and Giakoumis E.G. (2006). Comparative performance and emissionsstudy of a direct injection Diesel engine usingblends of Diesel fuel with vegetable oils or biodiesels of various origins, Energy Conversion andManagement, Vol. 47, No. 18-19, pp. 3272-3287.

Sahoo, P.K., Das, L.M., Babu, M.K.G. and Naik, S.N. (2007). Biodiesel development from high acid value polanga seed oil and performance evaluation in a CI engine. Fuel 86, 448–454.

Saka, S. and Isayama, Y. (2009). A new process forcatalyst-free production of biodiesel usingsupercritical methyl acetate, Fuel, Vol. 88, No. 7,pp. 1307-1313.

Stewart, W. F. (1986). “Hydrogen as a vehicular fuel” In Recent Developments in Hydrogen Technology, Vol.2, eds K. D. Williamson Jr. and F. J. Edeskuty. CRC Press, Cleveland, OH.

Texas Commission of Environmental Quality (TCEQ) (2010). “Barnett Shale Area Special Emissions Inventory: Phase I.”

Tsolakis, A., Megaritis, A., Wyszynski, M.L. andTheinnoi, K. (2007). Engine performance and emissions ofa Diesel engine operating on diesel-RME (rapeseed methyl ester) blends with EGR (exhaust gasrecirculation), Energy, Vol. 32, No. 11, pp. 2072-2080.

World Oil Outlook (2008). Organization of thePetroleum Exporting Countries, Vienna.

Yesica Alvarez, Tejas Shah, Amnon Bar-Ilan, Chris Lindhjem, Sue Kemball, Greg Yarwood (2013). Gas Compressor Engine Study for Northeast Texas ENVIRON.

Corresponding Author

Arvindkumar Ganeshaiah Sringeri*

Ph.D. Research Student, MUIT, Lucknow

E-Mail – aravinda0212@gmail.com