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Study of Diesel Engine Performance and Emission Run on Dual Fuel Mode

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ABSTRACT:

As the world winds up in the midst of general energy inadequacy, compounded by an equivalent need to decrease poisons, taking everything into account; We should take a certified look at the novel wellsprings of abundant oil and its use policy. With its critical starting properties, C_2H_2 gas gives the idea that it is validated as the right fuel for potential internal engines in the event that it is used properly. Considering inborn difficulties in managing C2H2 development has complemented the utilization of C_2H_2 by implantation methodology to fight blowback in internal consuming engines. On a lone chamber, air-cooled, DI diesel engine, a preliminary evaluation was conducted to yield 4.4 kW at 1500 rpm. C2H2 was blended as a helper fuel into the validation port and biodiesel was specifically pumped into the chamber. The gas stream rate was set at 1 lpm, 2 lpm, 3 lpm and so on, and as a common diesel process, biodiesel was infused. By fluctuating the stack from low weight to maximum load, the intake, execution and radiation limits were tested for the above stream speeds. Results indicate that, due to slimmer operation, NOx, HC and CO surges decreased when diverged from biodiesel activity. A slight smoke escape extension was seen and BTE was similar to the flow of diesel. All things considering, it is believed that in an arranged port mixture system, safe passage of C_2H_2 is possible without a BTE catastrophe. Decreased levels of NOx, HC and CO spread were refined with insignificant growth in the level of smoke surge.

Keyword: Acetylene; Compression Ignition Engine;Dual Fuel Mode Operation; Diesel Engine

1. Introduction

The world is facing crude oil crisis and emission issue due to combustion of fossil fuel which lead to find some substitute of these fossil-based fuel. Many research works have been carriedout and identified different alternative fuels for petrol and diesel engine applications[1–3]. Acetylene (C_2H_2) based twofold fuel technique in CI engines offer surprising benefits including high warm efficiency (BTE), high consuming usefulness, genuine degree of consistent volume start, less start irreversibility, and just about zero carbon-based spreads HC, CO and smoke and so forth. Regardless, these twofold fuel engines persevere through a critical hindrance of confined C_2H_2 energy swap for their convincing utilization in future energy structures. The most outrageous C_2H_2 energy share in a twofold fuel engine is normally restricted by start of pounding. Pounding could be portrayed as atypical copying wonder which necessities the improvement in engine execution. Pounding copying could be distinguished in one or two ways, for instance, in-chamber pressure-based disclosure, chamber block vibration assessment, acoustic wave assessment examination, heat move based assessment, etc. Both speed of weight rise, and warmth release rate together can be used for an assessment of the bang tendency in a CI motor. In a test it was maintained how the pounding consuming in a CI motor is clearly comparative with its most outrageous speed of weight rise. A thermodynamic model was made for pound area in a SI (shimmer start) engine worked with different vaporous fills. Many researchers are trying to replace the fossil fuel by some renewable alternative fuels[4, 5].Even some investigations have been carried out when fuel derived from waste have been used as replacement of diesel fuel[6–8].

Low temperature burning is a vital method for limitingoutflows of greenhouse gas, specifically NO_x discharges,furthermore, further develop motor effectiveness[9]. In lateryears, Premixed Charge Compression Ignition (PCCI),Homogenous Charge Compression Ignition (HCCI), andReactivity Controlled Compression Ignition (RCCI) motorsunder low temperature burning (LTC) methods havebeen utilized to lessen discharges and further develop proficiency[10, 11]. TheHCCI and PCCI have a few significant disadvantages in ignitiontiming controllability and making the unnecessary tensionin the ignition chamber. The technique of the RCCI in thefield of exploration is here to

annihilate this issue. RCCI is ablend of double fuel mode and a fractional PCCI idea,first proposed by many researchers [12]. Yang et al. researched the double fuel mode (Diesel and Methane) CImotor by changing the circumstance of diesel infusion in the RCCIburning motor[13].

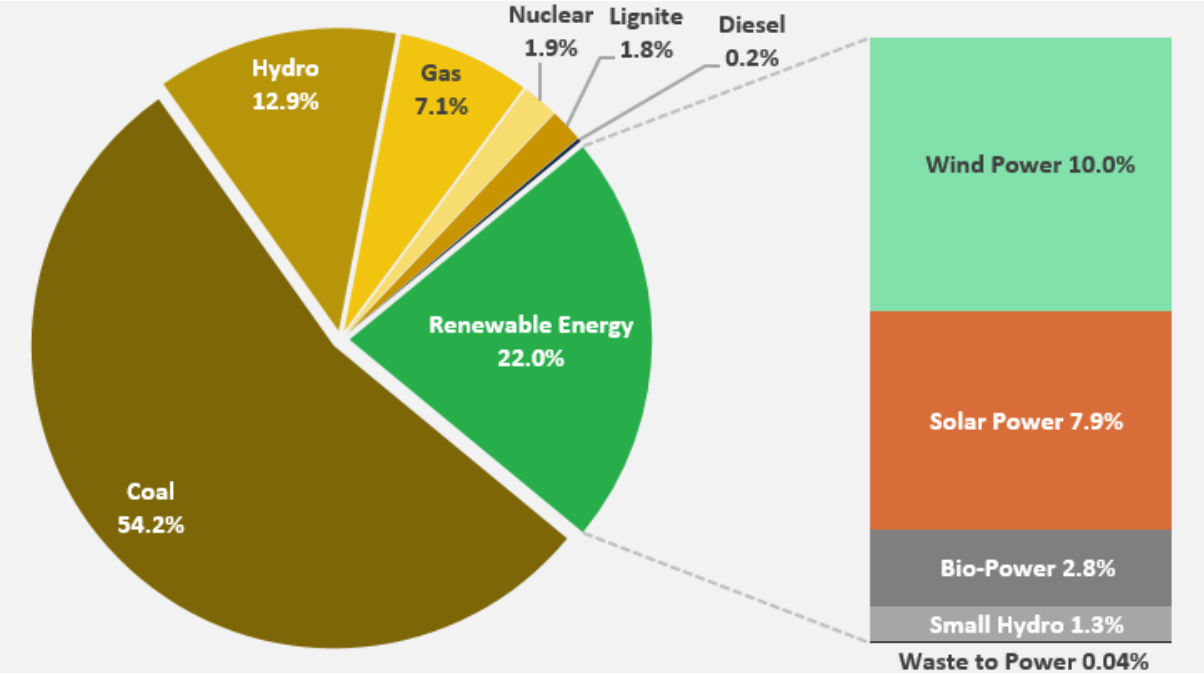

Fig.1 Installed capacity of renewable energy in India [14]

Inferable from colossal expansion in the auto populace, customary petrol powers for gas powered motors will be usable just for a couple of years. Additionally, by delivering harmful discharges into the air at more elevated levels these powers make extreme natural issues. As a rule, Carbon-monoxide (CO), Unburnt hydrocarbons (UHC), and smoke are outflows discharged by motors are recorded when fossil fuels burnt [15]. The contamination of the climate can be constrained by supplanting petrol fuel with the utilization of elective fills like acetylene gas, hydrogen, CNG, LPG and so on. In this flow research, an exploratory examination was done in Compression Ignition motor utilizing acetylene fuel, further upgrading the exhibition and discharge properties by utilizing diethyl ether (DEE) and ethanol as oxygenated fuel. Taking into account the presentation and surge (emanation) boundaries enhancing valve of acetylene gas as 12 lpm with oxygenated powers, the exhibition and outpouring qualities were moved along. The discoveries show an upgrade in brake warm productivity of up to 3 to 4%, a lessening in exhaust temperature and emanations like CO, UHC and smoke of up to 40%, 20%-30% and 10%-35% individually, there is decline in fuel utilization of 10%-30%[16]. It was observed that ethanol is better compared to diethyl ether and diesel powers when utilized as an oxygenated fuel with acetylene gas. Considering the exhibition and emanation boundaries, the best oxygenated fuel is ethanol and the enhance mix for diesel motor is E15+A12. Many research investigations have also been carried out when some nano particles were added in the base fuel [17–19].

2. Experimental Analysis

Trial investigations of acetylene in gas powered motorshave acquired energy lately as acetylene has higher firespeed and energy thickness than gas and diesel. Aside from this,numerous analysts attempted to further develop the burning system in a dieselmotor, which is a heterogeneous ignition process. They utilized thevaporous energizes to get homogeneously charged CI and premixed charge CIstrategies in diesel motors. Utilizing vaporous energizes like maker gas,CNG, LPG, and acetylene will assist with further developing the ignition cycleby giving the homogenous charge to the motor. Utilizing vaporousenergizesin double fuel innovation as researched in this paper, where homogeneity of charge in the ignition chamber will serve todiminish the thump and contamination from the motor.

This study aims to investigate the performance of an engine bylowering the CR from 18 to 13 when operating the engine in dual fuelmode

with different flow rates of acetylene as 2 LPM to 5 LPM. Thisinvestigation was carried out on a four-stroke, single-cylinder, constantspeed,variable CR diesel engine. A similar trend found in this studyabout better performance results of the engine using gaseous fuels indual-fuel technology at medium and high loads than running the engineat low loads was investigated. At low loads, thecylinder pick pressure was low, which leads to an increase in pollutionand decrease the overall performance of the engine. As, the use ofacetylene, a clean source of alternative energy for diesel engines.

Likewise, as of one more elective fuel utilized, expanded emanation of nitrogenoxides found with acetylene.The decrease in CR will bring down the chamber pressure, which lessensthe warm and mechanical anxieties in the motor. The review will helpthe motor assembling tochoose lighter materials for motor square thanto utilize the conventional weighty iron squares. Additionally, vibrations brought about byregular diesel motors at high CR will significantly decrease when itworks at low chamber pressures. Figure 2 represents about the schematic diagram used in this study.

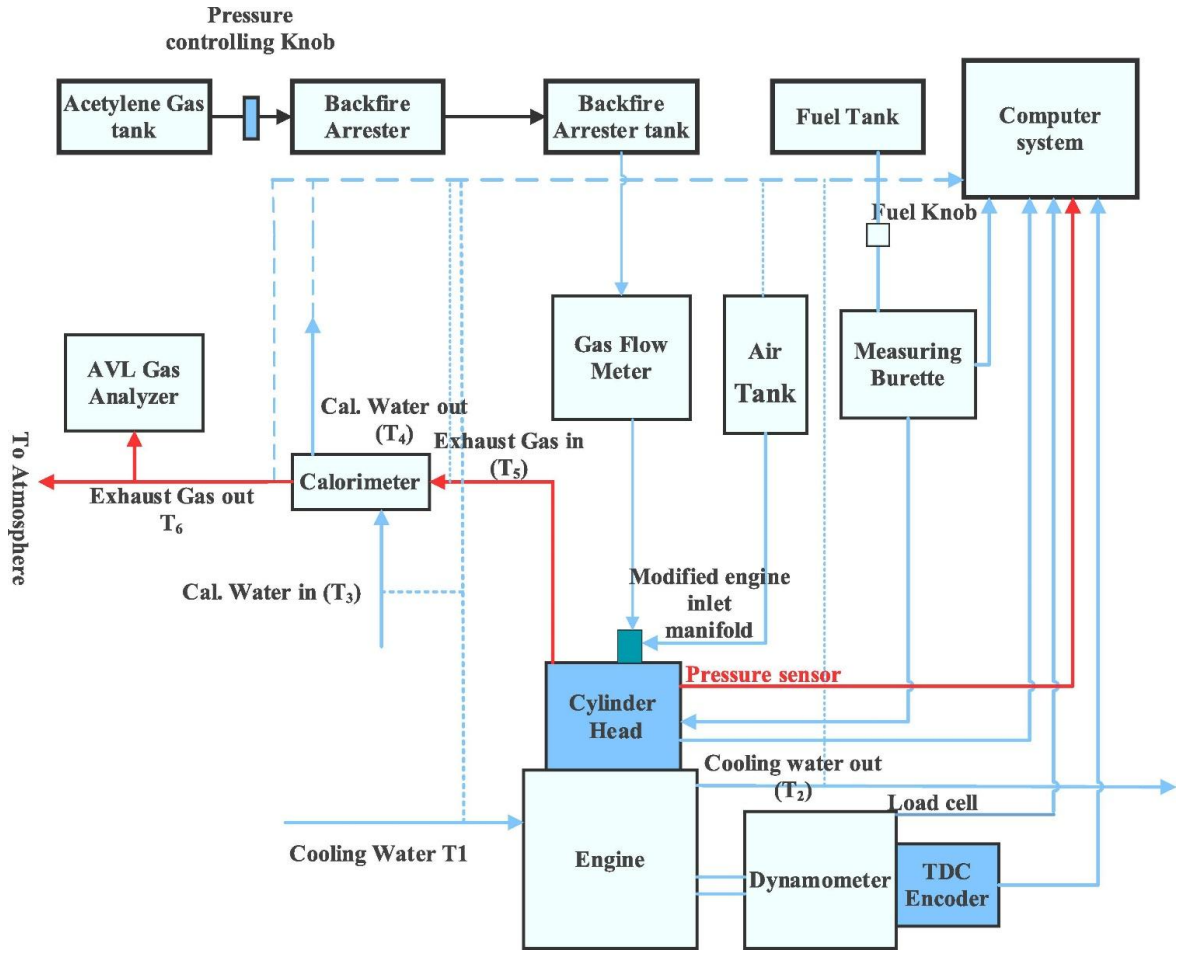

Fig.2 Schematic representation of test setup

The amount of infused biodiesel fuel was consequently differed by the lead representative appended to it, which kept up the motor speed at 1500 rpm all through the try. At that point, by differentiating the heap, the investigation was rehashed for various gas stream rates. By gas adoption, the identicality ratio was changed from no load to full load. The flow rate of acetylene gas and the normal method of biodiesel injection were shifted from 1 lpm, 2 lpm, and 3 lpm. The proportion of the energy share for C_2H_2 and diesel fuel at the most intense flow rate of 3 lpm for different load conditions. A non-dispersive infrared gas (NDIR) theory has been used to quantify CO_2.

Table 1 Uncertainty Analysis of the instruments

S. No	Instruments	Range	Accuracy	Percentage uncertainties
1	Gas analyzer	CO 0–10%,	+0.02% to −0.02%	+0.2 to −0.2
		CO_2 0–20%,	+0.03% to −0.03%	+0.15 to −0.15
		HC 0–10,000 ppm,	+20 ppm to −20 ppm	
		NO_x 0–5000 ppm	+ 10 ppm to −10 ppm	+0.2 to −0.2
2	Smoke level measuring instrument	BSU 0–10	+0.1 to −0.1	+1 to −1
3	Exhaust gas temperature indicator	0–900 °C	+1 °C to −1 °C	+0.15 to −0.15
4	Speed measuring unit	0–10,000 rpm	+10 rpm to −10 rpm	+0.1 to −0.1
5	Burette for fuel measurement		+0.1 cm^3 to −0.1 cm^3	+1 to −1
			+0.6 s to −0.6 s	+0.2 to −0.2
6	Digital stop watch		+1 mm to −1 mm	+1 to −1
7	Manometer	0–110 bar	+0.1 kg to −0.1 kg	+0.1 to −0.1
8	Pressure pickup		+1° to −1°	+0.2 to −0.2
9	Crank angle encoder			

3. Results and Discussions

Figure 3 shows the pattern for BTE with brake power (BP) When acetylene was used in dual fuel mode operation.

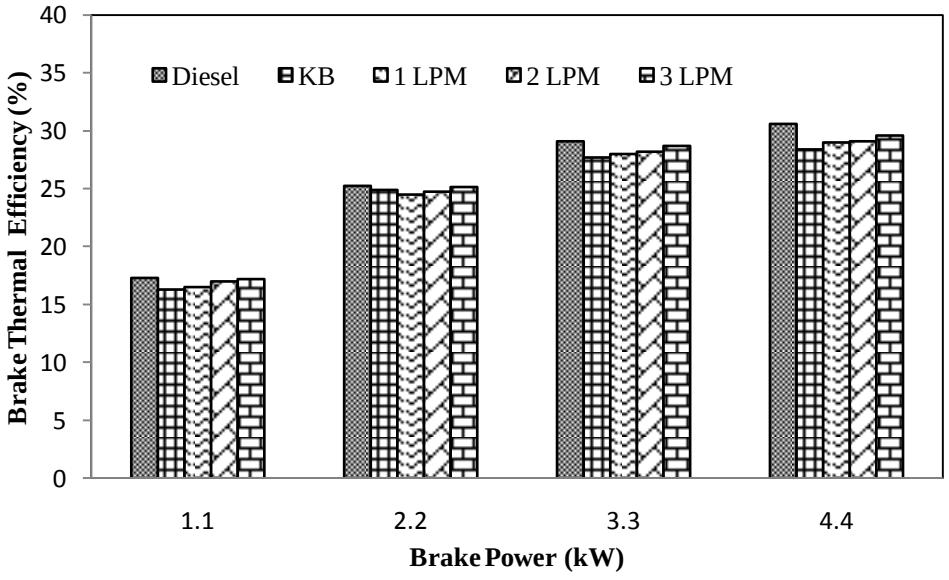

Fig.3 BTE Variations

From thechart, higher BTE is accomplished in 4 LPM acetylene in normal ignition. As the amount of acetylene expansions in the Dual fuel

mode, the BTE additionally increments for all heaps up to 4LPM of acetylene infusion. This is expected to the higher calorificworth of acetylene which improves consuming climatebefore the infusion of B20 biodiesel blend and thatwill lead the rising pattern in BTE[20]. The BTE for infusionof 5 LPM acetylene alongside B20 biodiesel in normal combustion burning is lower than B20 biodieselin CDE activity. The explanation is that the dissolving pace ofacetylene in the admission complex is low contrasted with any remainingcombinations of air and acetylene.

Biodiesel consumption because of the injection of acetylenegas in dual fuel mode. Trends in thegraph show that B20 biodiesel blend with 4 LPM acetylene in normal combustion mode haslower SFC than any other flow rate of acetylene. Althoughacetylene is partially injected with B20 biodiesel blend andthe specific fuel consumption is low due to acetylene havinga higher heating content (calorific value) leading to an efficientcombustion process[21].

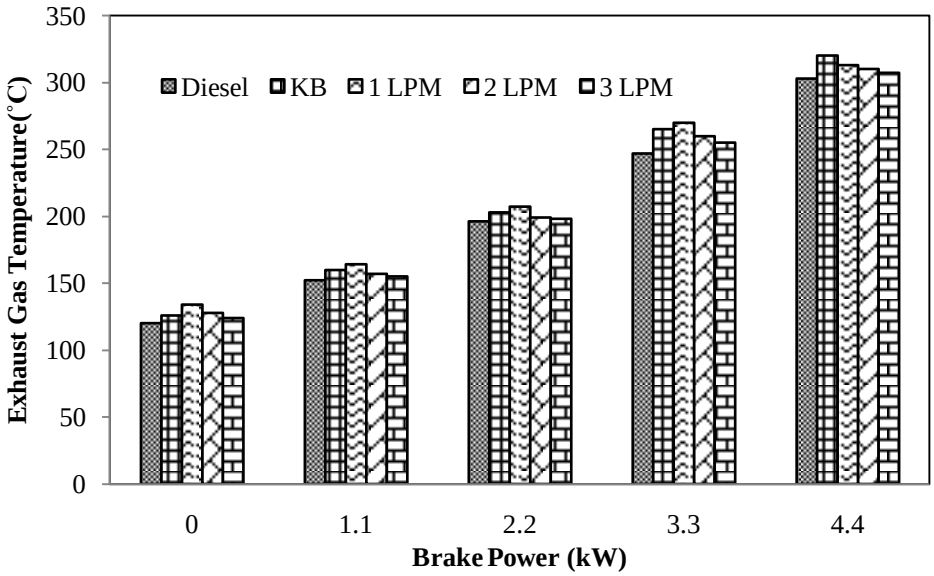

Fig.4 EGT Variations

The fumes gas temperature at full burden is portrayed in Fig. 4. Itis 388 ºC at 110 g/h, 376 ºC at 180 g/h, and 380 ºC at 240 g/h ofacetylene stream rate in port infusion method and 444 ºC on account of benchmark diesel activity. Acetylene port infusion diminishedthe fumes gas temperature at all heaps demonstrating theprogression of energy discharge in the cycle. Chamber pressureoutline affirmed this, in which the most extreme tension happensprior in the cycle when acetylene was presented alongsidethe admission air. Heat misfortune from the gas to the divider expanded due tohigher warm conductivity of gases, prompting higher misfortunes thatmay likewise be the justification behind lower fumes gas temperature.

The development of NO_x from burning relies upon ignitiontemperature, the substance of oxygen, and response time.The exploratory outcomes address that up to 45% of appraised powerthe motor discharged less NO_x in double fuel mode. Further addition inevaluated power from the motor transmitted more NO_x. As addressed before,at high loads in double fuel method of activity, the progression of acetylene isconsistent, however how much diesel fuel goes diminished. The accessibilityof fluid diesel is conveyed the ignition temperature for its vanishing.As fluid diesel amount is less, the production of NO emission increases[22].

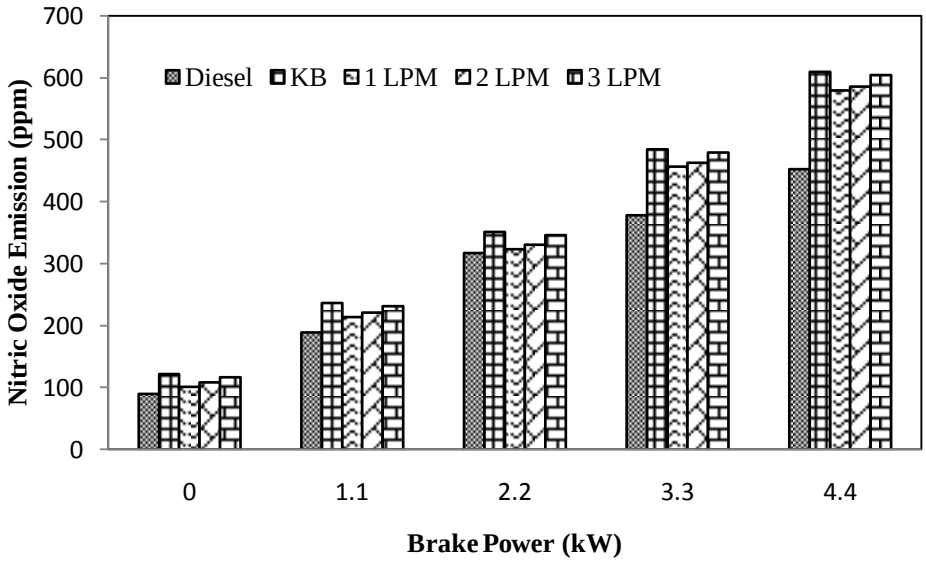

Fig. 5 NO_x variations

The arrangement of carbon dioxide (CO_2) from the ignition interactionof non-renewable energy sources contributes significantly to ozone depleting substances.The test result addressed that in double fuel method of activitywith an expanded stream pace of acetylene and bringing down pressureproportion, CO_2 discharge marginally diminished than diesel mode. Indeed, however the aftereffects of CO and HC addressing less accessibility ofoxygen, the post-ignition temperature assists with lessening the CO_2discharge.

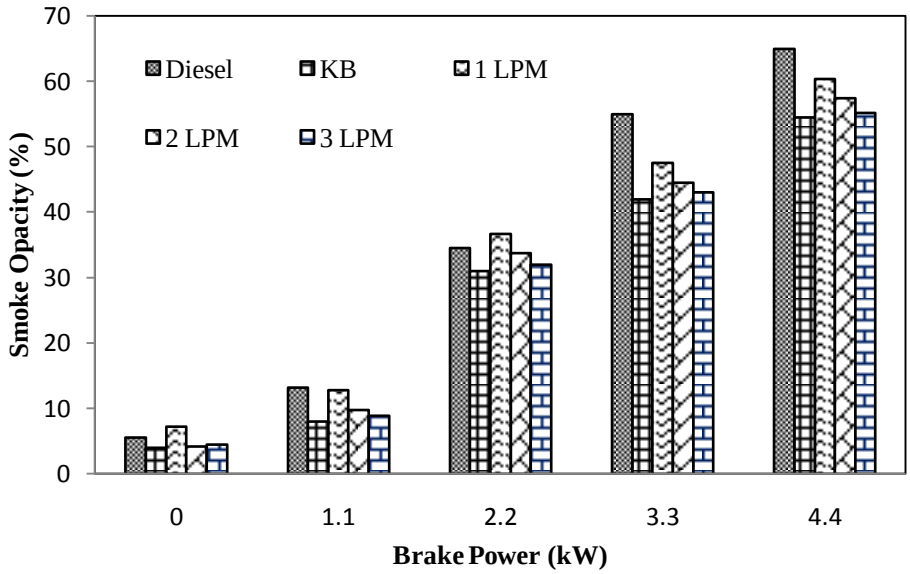

Fig.6 Smoke variations

4.Conclusion

The consequences of present exploration work for motor execution andoutflow with double fuel method of activity of CI motor at decreased CRfurthermore, 2 LPM to 5 LPM ofacetylene stream rates are completed with significantresearch work done in this field. Coming up next are resolutionsfrom the investigated aftereffects of the current review.

- Involving acetylene as a substitute fuel in the diesel motor can empowerto work the diesel motor at a lower pressure proportion withouthampering the brake power yield.

- BTE viewed as expanded for high loads and in double fuel mode by any means decreased CR. Decreased CR of 15 gives increase in BTE at 3 LPM, 4 LPM, and 5 LPM stream paces of acetylene as 23%, 19%, and 23% individually. Further decrease of CR to 14 and 13 gives decrement in BTE for 4 LPM and 5 LPM by 8% and 18% individually.
- Mechanical effectiveness in double fuel mode at all diminished CR found expanded than pattern diesel. At high loads and diminished CR 15, activity of the motor in double fuel for stream paces of 2 LPM to 4 LPM gives increase in mechanical effectiveness by 36% and from that point somewhat decrement for 5 LPM stream rate.

References

1. Karthick, M., Logesh, K., Baskar, S., Sharma, A.: Performance and Emission Characteristics of Single-Cylinder Diesel Engine Fueled with Biodiesel Derived from Cashew Nut Shell. In: Advancement in Materials, Manufacturing and Energy Engineering, Vol. II. pp. 521–529. Springer (2022).
2. Logesh, K., Karthick, M., Baskar, S., Sharma, A.: Performance and Emissions Characteristics of Diesel Engine Run on Citrullus Colocynthis Biodiesel with Zinc Oxide Additive. In: Advancement in Materials, Manufacturing and Energy Engineering, Vol. II. pp. 513–520. Springer (2022).
3. Sharma, A., Murugan, S.: Combustion Analysis of a Diesel Engine Run on Non-conventional Fuel at Different Nozzle Injection Pressure. In: Innovations in Energy, Power and Thermal Engineering. pp. 109–118. Springer (2022).
4. Kalam, M.A., Masjuki, H.H.: Biodiesel from palmoil - An analysis of its properties and potential. Biomass and Bioenergy. 23, 471–479 (2002). https://doi.org/10.1016/S0961-9534(02)00085-5.
5. Lee, R.A., Lavoie, J.M.: From first- to third-generation biofuels: Challenges of producing a commodity from a biomass of increasing complexity. Animal Frontiers. 3, 6–11 (2013). https://doi.org/10.2527/af.2013-0010.
6. Sharma, A., Khatri, D., Goyal, R., Agrawal, A., Mishra, V., Hansdah, D.: Environmentally Friendly Fuel Obtained from Pyrolysis of Waste Tyres. In: Energy Systems and Nanotechnology. pp. 185–204. Springer (2021).
7. Sharma, A., Gupta, G., Agrawal, A.: Utilization of Waste Lubricating Oil as a Diesel Engine Fuel. IOP Conference Series: Materials Science and Engineering. 840, (2020). https://doi.org/10.1088/1757-899X/840/1/012015.
8. Arya, S., Sharma, A., Rawat, M., Agrawal, A.: Tyre pyrolysis oil as an alternative fuel: A review. Materials Today: Proceedings. 28, 2481–2484 (2020). https://doi.org/10.1016/j.matpr.2020.04.797.
9. Sharma, A., Murugan, S.: Investigation on the behaviour of a DI diesel engine fueled with Jatropha Methyl Ester (JME) and Tyre Pyrolysis Oil (TPO) blends. Fuel. 108, 699–708 (2013). https://doi.org/10.1016/j.fuel.2012.12.042.
10. Sharma, A., Murugan, S.: Potential for using a tyre pyrolysis oil-biodiesel blend in a diesel engine at different compression ratios. Energy Conversion and Management. 93, 289–297 (2015). https://doi.org/10.1016/j.enconman.2015.01.023.
11. Sharma, A., Murugan, S.: Combustion, performance and emission characteristics of a di diesel engine fuelled with non-petroleum fuel: A study on the role of fuel injection timing. Journal of the Energy Institute. 88, 364–375 (2015). https://doi.org/10.1016/j.joei.2014.11.006.
12. Reitz, R.D., Duraisamy, G.: Review of high efficiency and clean reactivity controlled compression ignition (RCCI) combustion in internal combustion engines. Progress in Energy and Combustion Science. 46, 12–71 (2015).
13. Vallinayagam, R., Vedharaj, S., Yang, W.M., Roberts, W.L., Dibble, R.W.: Feasibility of using less viscous and lower cetane (LVLC) fuels in a diesel engine: A review. Renewable and Sustainable Energy Reviews. 51, 1166–1190 (2015).
14. Sitharthan, R., Swaminathan, J.N., Parthasarathy, T.: Exploration of wind energy in India: A short review. In: 2018 National Power Engineering Conference (NPEC). pp. 1–5. IEEE (2018).
15. Sharma, A., Sivalingam, M.: Impact of Fuel Injection Pressure on Performance and Emission Characteristics of a Diesel Engine Fueled with Jatropha Methyl Ester Tyre Pyrolysis Blend. SAE Technical Papers. 2014-Octob, 2650 (2014). https://doi.org/10.4271/2014-01-2650.
16. Sharma, A., Murugan, S.: Effect of blending waste tyre derived fuel on oxidation stability of biodiesel and performance and emission studies of a diesel engine. Applied Thermal Engineering. 118, 365–374 (2017). https://doi.org/10.1016/j.applthermaleng.2017.03.008.
17. Kumar, S.S., Rajan, K., Mohanavel, V., Ravichandran, M., Rajendran, P., Rashedi, A., Sharma, A., Khan, S.A., Afzal, A.: Combustion, Performance, and Emission Behaviors of Biodiesel Fueled Diesel Engine with the Impact of Alumina Nanoparticle as an Additive. Sustainability. 13, 12103 (2021).
18. Khatri, D., Goyal, R., Sharma, A.: Effects of Silicon Dioxide Nanoparticles on the Combustion Features of Diesel Engine Using

Water Diesel Emulsified Fuel. In: Energy Systems and Nanotechnology. pp. 119–130. Springer (2021).

19. Thamilarasan, J., Kolappan, S., Pushpakumar, R., Sharma, A.: Investigation of plastic Pyrolysis oil performance on CI engine blended with magnesium oxide nanoparticle using Taguchi method. Materials Today: Proceedings. (2021).
20. Sharma, A., Murugan, S.: Durability analysis of a single cylinder DI diesel engine operating with a non-petroleum fuel. Fuel. 191, 393–402 (2017). https://doi.org/10.1016/j.fuel.2016.11.086.
21. Sharma, A., Dhakal, B.: Performance and emission studies of a diesel engine using biodiesel tyre pyrolysis oil blends. SAE Technical Papers. 2, (2013). https://doi.org/10.4271/2013-01-1150.
22. Abhishek Sharma, Murugan, S.: Experimental Evaluation of Combustion Parameters of a DI Diesel Engine Operating with Biodiesel Blend at Varying Injection Timings. 169–177 (2016). https://doi.org/10.1007/978-81-322-2773-1_13.