

EXPERIMENTAL INVESTIGATION OF EMISSION REDUCTION BY CATALYTIC CONVERTER

Submitted in partial fulfillment of the requirements for the award of Bachelor of
Engineering degree in Mechanical Engineering

by

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DEPARTMENT OF MECHANICAL ENGINEERING

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SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade “A” by NAAC | 12B Status by UGC | Approved by AICTE

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BONAFIDE CERTIFICATE

This is to certify that this project report is the bonafide work of **ABINASH J (37150002), BHARATHWAJ RR (37150030)** who carried out the project entitled **“EXPERIMENTAL INVESTIGATION OF EMISSION REDUCTION BY CATALYTIC CONVERTER”** under our supervision from December 2020 to April 2021.

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We, **ABINASH J (37150002)** and **BHARATHWAJ RR (37150030)** hereby declare that the Project Report entitled “**EXPERIMENTAL INVESTIGATION OF EMISSION REDUCTION BY CATALYTIC CONVERTER**” done by us under the guidance of **Mr. J. SENTHILKUMAR., M.E., (Ph.D).**, is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Mechanical Engineering.

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ABSTRACT

Primary conveyance engines fashionable the world for long period of time momentary is engine motors. Moreover, the decrease in fuel supplies, current environmental concerns, increased fuel prices and have prioritized alternative fuel pursuit. Automobile plays an influential part in gift to the dirtiness. Conventional diesel engines emit gases like CO, NOX and they are produced under this framework combustion of the fuel at Maximum temperature. High release of NOx causes different problem to the organisms in the environment and life. Researchers were very interested in assessing various plant and vegetable oils as diesel substitutes. The present paper discusses efforts to reduce NOx emissions through the development of a catalytic converter for a diesel engine powered by biodiesel and pumpkin seed oil.

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LIST OF ABBREVIATIONS

NO _x	Nitrogen Oxide
HC	Hydro Carbon
CNG DI	Compressed Natural Gas Direct Injection
ECR	Exhaust gas recirculation
CO	Carbon monoxide
PM	Diesel particulate matter emissions
BSFC	Brake specific fuel consumption
CI	Compression Ignition
WVO	Waste Cooking Oil
KSOME	Koroch seed oil Methyl Ester
KME	Kapok Oil Methyl Ester
ASTM	American Society for Testing and Materials
RPM	Revolutions per minute
TC CNSL	Thermal cracked cashew nut shell liquid
GC MS	Gas chromatography mass spectrum
FTIR	Fourier transformed infrared
DI	Direct injects
CNT	Carbon Nano tubes
CeO ₂	Cerium Oxide
EACS	Electro chemically activated cells
BaO	Barium Oxide

NO₂ Nitrogen dioxide

MgO Magnesium oxide

PPM Parts per million

BTHE Brake Thermal Efficiency

SFC Specific Fuel consumption

CO₂ Carbon dioxide

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CHAPTER 1

1.INTRODUCTION

Undesirable combustion emissions are produced by Diesel engines. Fuel capacity toxins are global warming, smog, rainy acids and airborne hazards. Incomplete combustion, nitrogen separation and fuel impurities when mixes with air they form these emissions. Nitrogen oxides (NO_x) and hydrocarbons (HC) carbohydrates and soot-oxides are the main emissions. These pollutants can be treated differently. During the combustion process, internal combustion engines produce unwanted emissions and contaminants used by internal combustibles and affect the global warming and form smog, acid rain and airborne risks. Incomplete combustion, nitrogen separation and fuel impurities are the main reason for these emissions. The main emissions are nitrogen oxides and hydrocarbons (HC) and carbohydrates. These pollutants are different to treat.

An internal combustion engine catalytic convertor is a tool for reducing the car pollutants. By catalyzing oxidation 90% of harmful gases produced by automobile motors gets converted to lower toxic. The author stated that a new catalytic converter has its own characteristics for natural gas motors. The substrate has been developed using the metal oxides TiO₂ and cobalt oxide-composite catalyst substances. The new CNG-DI Engine has a low-cost three-catalytic converter. Authors tried to produce and assess a new electrical reactor in a multiple layer catalytic cathode in addition with NO_x layer of adsorption examined by the method of cell operation to obtain low temperature.

It suggested that the examining the basic features of the ECR system and an electrical cell evaluated as a record. In addition to it a dynamometric chassis test cycle for JC08 mode evaluated an electric chemical honeycomb cell (long term regulations in Japan). Further research is currently needed to produce the

honeycomb cell. Overall results shows that the ECR system reduces both diesels generated NO_x and PM by more than 90% at the same time. The author examined the efficiency and emission of a diesel engine of organic oil diesel combinations. The diesel emissions were all tested for CO, HC, NO_x, PM etc. and conduct parameters reasoning. For the impact of a cerium additive on kinetics of oxidation and size distribution, a high-temperature tandem mobility analysis for the temperature ranging from 300–700° C. It was concluded that biofuels with a high and low viscosity may affect engine performance and leads to inadequate mixing and longer ignition in motors times. So, they concluded that the magnetic field is used to increase the atomization of fuel and air fusion to improve the fuel efficiency and degrade of hydrocarbon fuel molecules. The tests show that CuO nano fuel has increased efficiency and emissions. It has been reported. Motor fuel test results showed that CuO nano fuel mechanically is higher than 7 percent, BSFC reduces by 6 percent and CO₂ and NO_x emissions by 13 and 19 percent when compared to Diesel fuel. The author has produced biodiesel from papaya and watermelon oil and a new biodiesel (WP), which is a 1:1 mixture of papaya oil and watermelon seed esterification reaction system in biofuels using methanol and KOH (catalytic). The WP (B0, B20, B30, B40 and B100) and all diesel and water melon and Papaya is used 100 percent as test mixtures to supplement the testing. The results states that B20's superior Single cylinder 4-stroke diesel engine oxidation and emission testing using different biodiesel mixtures are superior to other biodiesel mixtures. Clean diesel and 20% Mahua petroleum biodiesel based on experiments amended and NHD, whereas the NO_x emissions problem was also tackled by various EGR rates, i.e., 10%, 20% and 30 percent. Combustion functionality was recorded in different Combined Diameter, Type and EGR Speeds using the basic data for clean diesel.

1.1 BIODIESEL

Methyl or ethyl esters acquire by transesterification of animal overweight or edible part of plant oils happen known as Biodiesel. It can be blended by Petrol or diesel. In the case of mixtures, the respective proportion of biodiesel in Petrol and diesel should be indicated. B100 is a pure biodiesel. B20, it is a mixture of 20% biodiesel and 80% petroleum diesel. Two main groups of raw materials for production of biodiesel are vegetable oil and waste cooking oil. The used cooking oil is the most important waste and it can be used for biodiesel production. However, the actual tendency is the utilization of pure vegetable oils cultivated for energetic use.

1.1.1 PRODUCTION

Method used for production of biodiesel is called transesterification process. The transesterification is a reaction of oils or fats with an alcohol of low molecular weight (usually ethanol or methanol) with the presence of an alkaline catalyst (usually NaOH or KOH) to produce esters and glycerin. Normally the reaction takes place at atmospheric pressure and 65°C of temperature. The process uses constant agitation, during an interval of time between one or twelve hours. The transesterification process consists of three consecutive and reversible reactions. The stoichiometric ratio for the transesterification reaction is three moles of alcohol and one mole of triglyceride.



An extra amount of alcohol is added in order to move the reaction to the methyl esters formation. Glycerin is also formed in the reaction.

1.1.2 ADVANTAGES

- Clean and environmentally friendly when compared with other alternative fuel.
- It can be made from renewable oilseed crops such as soybeans, rapeseed, cottonseed and mustard seed and non-edible oilseeds.
- It contains no Sulphur.
- According to Ames Mutagenicity tests it provides a 90% reduction in cancer risks.
- It can be used alone or mixed in any ratio with petroleum diesel fuel.
- It maybe stored unspecified area that petroleum fuel is stocked.
- It is safe to handle and transport as it is biodegradable as sugar, 10 times less toxic than table salt.

1.2 BIOFUELS

Biofuels happen produced from biomass. Biodiesel happen a first-creation biofuel. Other first-generation biofuels are bioethanol, biogas and straight vegetable oils. Second generation biofuels are produced from lignocellulosic materials. The biofuels are in the form of solid (vegetables wastes, and a fraction of the urban and industrial wastes), liquid (bio alcohols and biodiesel) or gaseous (biogas and hydrogen). The first-generation biofuels are produced from cereal

crops (e.g., grain, maize), oil crops (such as, rape, touch oil) and sweet substance crops.

1.3 TRANSESTERIFICATION

Transesterification backlash happen often catalyzed apiece adding of an acid or base. For the transesterification process, mainly the alcohols intoxicating and flammable liquid are secondhand. Theoretically, transesterification maybe in addition to processed accompanying taller or secondary alcohols. Considering wide variety of oils and fats that can be used to produce biodiesel, there is a greater range in the characteristics of biodiesel fuels than for ethanol fuel. Ethanol is actually one very specific molecule, whereas biodiesel is a mix of molecules that varies somewhat, depending on the initial oil or fat source used to produce the fuel.

1.4 PUMPKIN SEED AND OIL

It is also known as pepita. The seeds are flat and oval and have a white husk on it and light green after the husk is removed. The oil of pumpkin seeds is culinary specialty in and important export commodity of central Europe. Oil from pumpkin seeds is extracted by solvent extraction or by supercritical carbon dioxide methods. Once the oil is obtained, further specific extractions may be done, such as for carotenoids.

CHAPTER - 2

LITERATURE SURVEY

2.1 GENERAL

Vegetable oils are blended with diesel as gas in CI engine. The fundamental trouble with uncooked vegetable oil is, it has excessive viscosity and terrible volatility. This trouble is rectified with the assist of transesterification technique. In this technique the best of biodiesel may be modified as comparable as diesel.

2.2 BIODIESEL, TRANSESTERIFICATION PROCESS AND PROPERTIES

R. Alcantara et al (2000), took 3 fatty substances consisting of, soy bean oil, used frying oil and tallow. And it became converted into extraordinary sorts of biodiesel, the usage of transesterification technique and changed with methanol and diethylamide. The ignition homes of the biodiesel had been finalized calculating the cetane index of the transesterification technique and the mixing cetane quantity of the amide biodiesel combined with convectional diesel.

Edward Crabbe et al (2001), learnt 3 predominant variables consisting of Molar ratio of methanol to oil, quantity of catalyst, and response temperature, affecting the yield of acid catalyst manufacturing of methyl ester (biodiesel) from crude palm oil. And they had been investigated.

M.P. Dorado and others (2003), studied the use up diffusion of an instantaneous engine introduction into bloodstream Perkins's engine fueled with waste olive oil methyl ester at numerous constant kingdoms running conditions. Emissions had

been ordered with neat biodiesel the usage of olive oil and convectional diesel gas.

Sanjib Kumar Karmee and Anju Chadha (2005), Prepared biodiesel from non-fit to be eaten oil of *Pongamia pinnata* with the aid of using the usage of transesterification of crude oil with methanol in presence of potassium oxide (KOH) as catalyst.

Laureano Canoira (2006), the writer defined the technique changing the Jojoba oil wax to biodiesel with the aid of using the usage of transesterification technique with methanol and catalyst as sodium methoxide (1 wt.% of the oil).

AmonratSamniang et al (2014), in comparison the manufacturing of biodiesel from extraordinary non fit to be eaten oils with excessive rather acid values i.e., *Jatropha* oil, Krating oil. Non catalytic methanol transesterification technique. The product best from crude krating oil attained the biodiesel standard. Preprocessing steps consisting of degumming and oil purification aren't required.

Zahoor Ullah et al (2015), writer made a manufacturing of biodiesel from waste palm cooking oil the usage of acidic ionic liquid as catalyst and it became investigated. Most possibly alkaline primarily based totally catalyst is used to catalyze the transesterification technique, however in waste cooking oil it includes excessive loose fatty acids, direct utilization isn't viable because of separation of layers and saponification technique. In the study, a -step technique i.e., esterification and transesterification has been performed.

Hadis Bashiri and NastaranPourbeiram (2016), writer did biodiesel manufacturing and became investigated via transesterification technique of soybean oil and with addition of methanol in presence of NaOH with the aid of using kinetic Monte Carlo simulation.

Ngoya Tshizanga et al (2017), The creator investigated the producing of biodiesel from waste vegetable oil (WVO) with excessive loose fatty acid (FFA) as feedstock alongside heterogeneous catalyst with transesterification response.

Virginia Cordero Ravelo et al (2018), the writer studied how does waste cooking oil (WCO) have an effect on the best of the biodiesel obtained. Four sorts of WCO (Sunflower, Maize, Olive and a mix of Soybean, Palm and Sunflower) with extraordinary stages of decay are used to supply biodiesel. The WCO are subjected to a transesterification technique, the usage of NaOH and methanol as reagents and response temperatures among 50 - 67.5 °C and a 60 min response time and magnetic stirring.

Asokan M.A et al, the writer has produced bio diesel from papaya and watermelon seed oil with the aid of using transesterification technique the usage of methanol and KOH (catalyst) and a brandnew biodiesel i.e., WP is produced that is a combination of papaya seed oil biodiesel and watermelon seed oil biodiesel in 1:1 ratio is prepared. The blends (B0, B20, B30, B40, and B100) of WP with diesel and watermelon 100% and papaya 100% are used for in addition testing. The performance, combustion and emission take a look at had been performed on unmarried cylinder 4-stroke diesel engine the usage of extraordinary blends of those biodiesels and the outcomes confirmed that B20 is advanced mixture amongst different biodiesel blends.

2.3DIESEL ENGINE - PERFORMANCE, EMISSION AND COMBUSTION

A.S. Huzayyin et al (2004), the writer studied the experimental assessment of the usage of jojoba oil as an exchange diesel engine gasoline and it's been carried out withinside the measurements of engine overall performance parameters at one of a kind loads situation over the engine velocity variety and feature indicated negligible lack of engine energy and a moderate growth in brake particular gasoline intake and discount in engine NOx. The discount in engine soot emission has been targeted to growth with the growth of jojoba oil percent withinside the gasoline mixture.

Makame Mbarawa (2010), investigated to assess clove stem oil (CSO) as an opportunity gasoline for diesel engines. Finally, an experimental research become achieved on a four-stroke, four-cylinder water-cooled direct injection diesel engine to observe the overall performance and emissions of an engine operated the usage of the CSO diesel mixed fuels.

T.K. Gogoi et al (2011), carried an experimental research on a small direct injection (DI) diesel engine, fueling the engine with 10% - B10, 20% - B20, 30% - B30 and 40% - B40 mixing of Koroch seed oil methyl ester (KSOME) with diesel. The overall performance and combustion traits of the engine at diverse hundreds are analyzed and as compared.

Asep Kadarohman et al (2012), analyzed the gasoline mixture combustion traits on an engine and the achieved studies confirmed terpene compounds content material of clove oil acted as mediator agent among bio-additive and base

gasoline ensuing an excellent solution. Finally, it improved the method of blending among clove oil gasoline mixture and air, reduced ignition put off and promoted speedy combustion.

R. Vallinayagam et al (2013), used Pinebiofuel and their blends of 25%, 50%, and 75% with diesel and tested in a single cylinder, four-stroke, direct injection diesel engine and the combustion, emissions and performance results were compared with diesel.

S. Vedharaj et al (2013), Experimentally investigated and explored the opportunity of the usage of kapok oil as a supply for biodiesel manufacturing, KME (kapok oil methyl ester), as a diesel engine gasoline. KME is synthesized with the aid of using transesterification method, and the residences of it, evaluated with the aid of using ASTM preferred methods, are in concordance with biodiesel standards. Having ensured the feasibility of its use in diesel engine, KME is examined in a unmarried cylinder diesel engine to appraise the overall performance, combustion and emission traits of the engine.

Avinash Kumar Agarwal and Atul Dhar (2013), the writer studied the overall performance, emission and combustion traits of Karanja oil blends (K10, K20, K50 and K100) with mineral diesel and that they have been investigated in unheated situations in an instantaneous injection CI engine at one of a kind engine hundreds and consistent engine velocity (1500 rpm) in terms of baseline information from mineral diesel.

A. Velmurugan et al (2014), carried out experiments with blends of biofuel and diesel to observe the overall performance, emission and combustion traits of an instantaneous injection (DI) diesel engine. In this observe, the chemical composition of thermal cracked - cashew nut shell liquid (TC-CNSL) become decided the usage of fuel line chromatography - mass spectrum (GC–MS) and Fourier converted infrared (FTIR) spectroscopic techniques.

J. Sathik Basha and R.B. Anand (2014), an experimental research become carried out in a unmarried cylinder consistent velocity diesel engine to set up the outcomes of Carbon Nanotubes (CNT) with the Jatropha Methyl Esters (JME) emulsion gasoline. At the overall load, the brake thermal performance for the JME gasoline determined as 24.80%, while it become 26.34% and 28.45% for the JME2S5W and JME2S5W100CNT fuels respectively.

K. Nantha Gopal et al (2014), took bio-diesel from pongamia oil and organized (PME 100), examined on a diesel engine for one-of-a-kind blends inclusive of PME 20, PME 40, PME 60 and PME 80. Comparison is made with diesel operation and the overall performance reduces barely while the engine is fueled with biodiesel and good sized adjustments withinside the combustion parameters determined in case of biodiesel blends are good sized to note. On the opposite hand, discount in CO, HC and smoke is determined.

Swarup Kumar Nayak et al (2014), Investigated approximately the manufacturing of biodiesel from neat Mahua oil through base catalyzed transesterification method and combining of biodiesel with a appropriate additive (Dimethyl carbonate) in various quantity proportions as a way to put together some of check fuels for engine application. The consequences of research display the

growth in brake energy and brake thermal performance with load for all organized check fuels. It is likewise observed that brake thermal performance will increase with the proportion of additive in all of the check fuels. The brake particular gasoline intake decreases with growth in additive percent. Exhaust fuel line temperature will increase nearly linearly with load for all check fuels and reduces with growth in additive percent. The consequences that each CO and HC emissions have a tendency to lower with growth in additive percent in biodiesel. The smoke and NOx emissions additionally lower with growth in additive percent withinside the biodiesel gasoline.

Senthil Ramalingam et al (2015), studied the overall performance and emission become completed for one-of-a-kind values of compression ratio along side injection timing to discover feasible mixture for running engine with A20 and located that the mixed growth of compression ratio and injection timing will increase the BTE and decreases SFC even as having decrease emissions.

T. Shaafi and R. Velraj (2015), achieved an experimental research to observe the combustion, engine overall performance and emission traits of a unmarried cylinder, clearly aspirated, air cooled, consistent velocity compression ignition engine, fueled with changed gasoline blends, B20 (Diesel soybean biodiesel) and diesel soybean biodiesel ethanol blends, with alumina as a nano additive (D80SBD15E4S1 p alumina), and the consequences are as compared with the ones of neat diesel.

Nidal H et al (2015), the writer investigated the diverse overall performance parameters and emissions of a unmarried cylinder diesel engine running on almond biodiesel and as compared them to the overall performance and

emissions whilst the engine is operated on palm oil biodiesel and baseline diesel fuel thru laboratory measurements.

K. Nanthagopal et al (2016), studied effect of Calophyllum methyl ester on diesel engine usual overall performance, emission and combustion trends are at certainly considered one among a type Experimental investigations with certainly considered one among a type injection pressures of hundred bar, 220 bar and 240 bar were carried out to investigate the parameters like precise fuel intake, warm temperature release rate, brake thermal overall performance, and engine emissions of direct injection diesel engine fueled with 100% biodiesel and it's Annamalai et al (2016), experimentally investigated the effect of the use of cerium oxide (CeO_2) nanoparticle as additive in Lemongrass Oil (LGO) emulsion gas in a unmarried cylinder, steady velocity diesel The engine overall performance may also be multiplied because of the addition of CeO_2 nanoparticle.

M. Senthil et al (2016), Biodiesel productions from Mahua oil the use of distinctive catalysts, consisting of KOH and activated purple dust with the aid of using catalytic cracking (waste from aluminum industry) had been as in comparison in exceptional blends of diesel gas distinctive blends of biodiesel (B25, B50, B75, and B100) had been tested Furthermore, the distinctive blends had been subjected to a four-stroke diesel engine to have a look at its engine overall performance.

Ajin et al (2016), targeted at the synthesis of strong suspension of cerium zirconium blended oxide nanoparticles in diesel and additionally at the impact of

those nanoparticles on gas homes, diesel engine overall performance and exhaust smoke.

JenorisMuthiya. S et al, NO_x emission is produced at some stage in combustion of fuels at excessive temperature. Excessive launch of NO_x reasons numerous consequences on residing organisms and environment. In this painting, the efforts to lessen NO_x emission with the aid of using growing electrochemically activated cells (EACs) for a diesel engine fueled with diesel and biodiesel gas are discussed. EAC approach is critical after remedy generation tried on this painting to simultaneous manage of NO_x, HC, and PM emissions.

Peter Broqvist et al, Authors reviewed the NO₂ interplay with BaO. It advanced from calculations the use of the density useful theory, reactor measurements and vibrational spectroscopy of floor species at some stage in NO₂ garage on a BaO/Al₂O₃ catalyst and BaO powder. The DFT calculations are expecting nitrite formation at the BaO (100) floor upon NO₂ adsorption.

Rashmi, et al, they've concluded that with the impact of magnetic field, ionization takes vicinity and delustering the hydrocarbon gas molecules for higher atomization of the gas and combining the gas-air aggregate to beautify the combustion, which improves the gas financial system the experimental evaluation found out that CuO nano gas has progressed overall performance and emission The engine check consequences with magnetic gas conditioning confirmed that, the CuO nano gas has higher mechanical performance of 7%, discount in BSFC with the aid of using 6% and discount in 13% and 19% for CO₂ and NO_x emissions respectively, as in four

2.4 NANOCATALYSTS ON ENGINE PERFORMANCE

Sunyong Park et al. (2009), investigated the conversion performance of heat up catalytic converter. The emission traits of HC, CO, NO_x and nano sized PM in step with the engine running condition, with and without EGR with BD20. They have a look at found out the conversion performance of THC and CO in WCC below D100 and BD20 is 50% and 80% withinside the ECE R49 cycle respectively. Also, the debris quantity and mass quantity for each BD20 and D100 fuels became decreased with the aid of using 43% with EGR in comparison to with out EGR and decreased with the aid of using 24% and 16% while going from D100 to BD20, while EGR became implemented to the engine device.

Arul MozhiSekvanV (2009), labored with cerium oxide nano particle addition with diesel. In first section the stableness of neat diesel and diesel-biodiesel-ethanol gas blends with addition of cerium oxide nanoparticle had been analyzed. After collection of experiment, it became located that the blends subjected to excessive-velocity mixing accompanied with the aid of using ultrasonic bathing stabilization improves the Phase separation among diesel and ethanol became averted the use of methyl ester (biodiesel) with the aid of using transesterification process. It became concluded that the precise gas intake is better for a diesel-biodiesel-ethanol bends than neat diesel. With addition of cerium oxide with diesel ethanol blends make development in intake.

Sajith V et al. (2010), studied the physico-chemical homes and the impact of the nanoparticle as an additive at the character gas homes and the engine overall performance and emission. The consequences found out forty-seven that the

flash factor of the biodiesel will increase with the inclusion of the additive. Viscosity of biodiesel became multiplied with the addition of CeO₂ nano-particle. The biodiesel at distinctive dosing degree (20-89ppm) of the additive multiplied the engine performance and decreased the emission of hydrocarbons and NO_x.

Mathew Jones et al. (2011), had accomplished experimental have a look at and performed the combustion of nano scale steel and steel oxide components in bio gas. The warmness of combustion became studied the use of changed static bomb calorimeter device and the end result indicated that the quantity of warmth launched from ethanol combustion growth nearly linearly with n-al Small extent fraction of 1% and 3% didn't display enhancement in common volumetric HOC, however better extent of 5%, 7% & It states that the quantity of warmth launched from ethanol combustion growth nearly linearly with n-al concentration. Nano aluminum oxide displayed lively ethanol gas and energetic aluminum content material and it can characteristic as an expansion barrier.

Ajin C. Sajeevan et al. (2013), investigated the impact of cerium oxide nanoparticle at the overall performance, performance and cargo check on diesel engine and numerous physico-chemical homes of Diesel gasoline. The outcomes on load take a look at discovered that performance turned into multiplied as much as 5% and HC and NO_x emission turned into decreased through 45% and 30% respectively at better load. The hearthplace factor and flash factor multiplied with the dosing degree of cerium oxide nano-particle in diesel.

Varatharajan K. et al. (2013) labored and investigated experimentally at the impact of antioxidants additive on NO_x emission in a Jatropha methyl ester fueled direct injection diesel and in comparison the antioxidant additive L-

ascorbic acid, alpha tocopherol acetate butylated hydroxytoluene, p-phenyl diamine and ethylene literature, the reason of biodiesel NO_x and HC emission in a Jatropha forty three methyl ester gasoline DI-diesel at one-of-a-kind load have been studied as antioxidants had been pretty faulty however regarded to have greater CO and HC emissions and it suggests best NO_x discount at a degree of 0.025.

Raja M. et al. (2013), investigated the impact of peclet variety and diverse extent concentrations of 0.5%, 1.0%, 1.5% and 2.0% on warmth switch traits and strain drop below laminar go with the drift situation. The outcomes discovered that the warmth switch coefficient multiplied through 20%, 25% and 29% for Al₂O₃ water nanofluids with extent attention of 1%, 1.5% and 2% at $pe=3000$ at complete load. NO_x emission turned into decreased through 12.5% at complete load and 3-5% at no load and component load.

Aline L.N Guarieiro et al. (2014), labored on redox interest and PAH content material in length categorized nanoparticle emitted through a diesel engine fueled with biodiesel and diesel blends. In this the impact of diesel look at blends at the physical, chemical and toxicological houses of diesel engine at low situation thru the examiner of adjustments in length distribution and emission element of PAH related to PM. Nanomaudi impactor turned into used and analyzed for the sixteen precedence PAH through HPLC fluorescence detector. For particle emission it took 4% of soya biodiesel (B4), a diesel combination (B25 and B50) and additionally natural biodiesel (B100) had been measured on a consistent kingdom dynamometer in a take a look at the usage of a diesel engine decrease at low load.

S. Karthikeyan et al. (2014), studied Pomolion Stearin wax oil biodiesel with zinc oxide additive in a unmarried-cylinder, stationary, air cooled and direct injection compression ignition engines in addition to its outcomes on engine overall performance and exhaust emissions.

Santhanamuthu M et al. (2014), labored on overall performance and emission traits of inner combustion engine. Polanga oil diesel gasoline blends had been used. To enhance the engine overall performance, iron oxide nano particle turned into doped with Polanga oil diesel gasoline combination as an additive. The engine turned into loaded at 5 one-of-a-kind destroy powers for every Polanga oil diesel iron oxide nano particle gasoline blends. 10%, 20% and 30% of Polanga oil with neat diesel turned into taken. It turned into concluded that forty six addition of iron oxide nano particle significantly inspired the engine overall performance and emission at excessive POD combination ratio. Performance and emission parameter had been same to that of neat diesel.

Abbas Alli TaghipoorBafghi et al. (2015), An experimental research is accomplished to set up the overall performance traits of a compression ignition engine at the same time as the usage of cerium oxide nanoparticles as additive in neat diesel and diesel-biodiesel blends. In the primary segment of the experiments, balance of neat diesel and diesel-biodiesel gasoline blends with the addition of cerium oxide nanoparticles is analyzed.

Vijayakumar Chandrasekaran et al. (2016), Initially they did unmarried cylinder diesel engine operated with 20MEOM, 40MEOM, 60MEOM, 8MEOM and 100MEOM without components with diesel at one-of-a-kind masses at steady rated speed. From the experimental examine proved that 20MEOM is the great gasoline ratio in comparison to different blends. In 2nd segment primarily based

totally upon first segment outcomes the engine turned into operated 20MEOM combined gasoline with including 50 ppm copper oxide nano components with diesel the usage of solgel process. From the outcomes, the brake thermal performance turned into 2.19% progressed in comparison than 20MEOM combination without additive at complete load situation.

KaroonFangsuwannarak et al. (2016), The goal of this paintings turned into to are seeking for and enhance the palm biodiesel gasoline blends as in all likelihood excessive fraction for offering diesel engine primarily based totally on changed bio-fuels with bio-polymer additive. This research taken into consideration concurrently approximately the engine overall performance, the discount of fueloline exhaust emissions and additionally compliance with the primary law requirements of ASTM and SEA.

Seyyed Hassan Hosseini et al. (2017), performed an experimental research to assess the outcomes of the alumina nanoparticles as additive to B5 (95% diesel+5% biodiesel from waste cooking oil) and B10 gasoline blends at the overall performance and emission of a CI unmarried-cylinder engine. The alumina nanoparticles with dosages of 30, 60, and ninety ppm had been used for every gasoline blends. The outcomes for best gasoline confirmed the torque, power, BTE and EGT boom 5.36%, 5.36%, 10.63% and 5.80%, respectively, while in comparison with the ones of natural diesel gasoline, at the same time as the SFC not like reduces through 14.66%. The CO and UHC exhaust emissions lower through 2.94% and 20.56%, respectively, at the same time as NO emission rises through forty-three.61%.

TaranehMihankhah et al. (2018), evolved an environmentally easy and green system for biodiesel manufacturing from waste olive oil withinside the presence

of a catalytic quantity of TiO₂ nanoparticles at 120°C with a conversion of 91.2% inside the gift technique offers safe and noncorrosive medium, excessive yield of biodiesel, easy reaction, and easy experimental and isolation procedures. The catalyst may be recycled via way of means of easy filtration and reused with none full-size discount in its interest.

Nitin Shrivastava et al. (2018), performed the test on certainly aspired diesel engine with 4 organized check fuels aside from neat diesel and neat biodiesel. The 50 and a hundred and fifty of alumina nanoparticles have been delivered one at a time to the natural diesel and natural Jatropha biodiesel to shape the nano emulsions the usage of the residences of nano emulsion have been evaluated the usage of dynamic mild scattering method the usage of zetasizer. The overall performance and emission traits of multi cylinder diesel engine with those nano emulsions have been in comparison with that of neat fuels. The consequences confirmed that the usage of nanoparticles with diesel and biodiesel can make contributions in a greater green, economical, and ecofriendly engine operation.

Cyril joshua. R et al, A catalytic converter is a easy tool that makes use of to lessen the pollution from the auto engines which comes from an inner combustion engine. It converts almost 90% of the damaging gases produced via way of means of vehicle engines in to fewer poisonous pollution via way of means of catalyzing each oxidation and discount It has a steel housing with ceramic honey comb indoors with insulating layers of skinny wall channels, further on this we're going to attempt with the extraordinary Catalytic converter that's mainly designed, urea and ceramic oxide are used as catalyst withinside the system. This converter makes use of for the oxidation and discount reactions to transform the undesirable gases.

Kalam.M. A et al, the writer stated that this paper affords traits of a brand new catalytic converter (catco) for use for herbal fueloline fueled engine. The catco have been evolved primarily based totally on catalyst substances such as steel oxides together with titanium dioxide (TiO_2) and cobalt oxide (CoO) with cord mesh The purpose of an action of this paper search out extend a low-worth 3 manner catalytic preacher for use accompanying the newly develop CNG-DI engine. Detailed overview on catalytic converter, low-value catalytic converter improvement traits and CNGDI engine check consequences were resented with discussions.

2.5 ELECTROCHEMICAL ACTIVATED CELL

S. Bredikhin et al (2001), investigated and designed a brand-new own circle of relatives of electrochemical cells for decomposition of NO fueloline withinside the presence of extra It became proven that protecting of the Pt cathode via way of means of a aggregate of oxygen ionic conductor YSZ and digital $\checkmark$. conductor NiO results in enhancement of the residences of the electrochemical mobileular for nitrogen monoxide decomposition.

Alexander Aronin et al (2005), discovered and investigated the microstructure and structural evolution withinside the composite NiO - YSZ electrocatalytic electrode at some stage in operation of electrochemical cells for NO decomposition.

Toshiaki Yamaguchi et al (2006), Investigated the catalytic and electric residences of an electrochemical NO_x discount device. A strength above $3.5\text{W}/\text{cm}^2$ decreased greater than 60% of NO_x to N_2 over the $(\text{La}, \text{Sr}) \text{CoO}_{3-\alpha}/\text{Ce}_{0.9}\text{Gd}_{0.1}\text{O}_{1.95}/\text{Pt}$ laminated device in a temperature variety of

450°C to 650°C. O²⁻- transportation eliminated the oxygen across the cathode layer thru the Ce_{0.9}Gd_{0.1} electrolyte layer, then NO became capable of decompose to N₂ on the cathode. This ceria-primarily based totally device exhibited strong NO_x discount with admire to electric strength, irrespective of running temperature.

K. Hamamoto et al (2008), they tried to manufacture and examine a brand new electrochemical reactor with a further NO_x adsorption layer on a multilayer catalytic cathode and investigated a mobileular running technique to gain a low temperature To make clear the functionality of a NO_x adsorption layer, they performed the NO_x decomposition measurements of the mobileular. As a result, NO_x adsorption layers have advanced the NO_x decomposition residences aleven though the contemporary values of every mobileular have been nearly the same.

Sergey Bredikhin and others (2008), The electrochemical discount of nitric group of chemical elements withinside the composure of mind of the extra oxygen enhance inspected. It suggests that the selectivity and interest of the cathodes is strongly depending on the composition and at the microstructure of the cathode material. A idea of electrochemical reactor with multilayer electro-catalytic electrode became proposed and efficaciously designed in Advanced Manufacturing Research Institute, National Institute of Advanced Industrial Science and Technology (AIST), Nagoya, Japan.

W.Y. Hernández et al (2013), A NO_x chemisorption look at became completed on yttria-stabilized zirconia (YSZ), an O²⁻ ionically accomplishing ceramic. NO₂

chemisorption on YSZ in addition to NO + O₂ interactions on Pt/YSZ catalyst have been actually correlated to the presence of floor oxygen vacancies.

Jin Goo Lee (2015), the writer studied the impact of a hint of CuO (one hundred ppm) at the overall performance of 8YSZ-primarily based totally SOFCs is investigated. It is discovered that addition of a hint of CuO now no longer simplest promotes a densification of the YSZ electrolyte via way of means of appearing as a sintering useful resource however additionally will increase the quantity of the oxygen emptiness withinside the YSZ electrolyte.

A. Jayanth Joseph et al (2016), delivered a twin layer configuration of CuZ and FeZ catalysts which might be acknowledged to have correct NO_x conversion in my view at low and excessive Using a twin layer configuration lets in us to have the benefits of each the catalysts and improves the NO_x conversion of SCR over a huge temperature variety. At consequences there has been an excellent NO_x conversion of over 84% at mild temperatures. There became a 20% NO_x conversion performance in bloodless begin conditions.

S. JenorisMuthiya et al (2017), tries to lower NO_x emissions via way of means of growing electrochemicalreactor. The electrochemical reactor consists of electrochemical cells placed inside it. The electrochemical cells are fabricated by YSZ as an electrolyte middle layer coated with NiO -YSZ as cathode layer and Ag-YSZ as anode layer. The electrochemical cells are tested with diesel exhaust in a single cylinder diesel engine. By passing the variable voltage to the electrochemical cell, it is observed that up to 80 % NO_x reduction, 75% PM reduction and 75% HC reduction was achieved with electrochemical cell.

JenorisMuthiya Solomon et al (2018), developed two types of EACs. The CuO–YSZ electrolyte and CuO–YSZ electrolyte with BaO coating and tested with diesel and biodiesel exhaust. Comparing with diesel fuel, use of biodiesel fuel increased NO_x emission by 11% and became barely decreased with biodiesel, which became because of the presence of gas bond oxygen content material in biodiesel. The research has tested low-temperature activation of the EACs at 250–350°C which become because of the addition of CuO to YSZ. In this work, most NO_x discount become executed for CuO–YSZ cells with BaO NO_x storage and the simultaneous manage of HC and PM emission additionally changed into determined on this technique.

Yoshihara Yoshinobu (2018), investigated the easy tendencies of the ECR gadget, and a disk-normal electrochemical mobileular have become evaluated. In addition, the chassis dynamometer test cycle for the JC08 mode (put up new long-term regulation in Japan) became performed to assess the practicality of a honeycomb electrochemical. Currently, the fabrication of the honeycomb mobileular calls for in addition investigation. However, the general effects display that the ECR gadget has the capability to concurrently lessen greater than 90% of each NO_x and PM produced with the aid of using diesel engines.

JenorisMuthiya Solomon et al (2019), take a look at have become completed in a single-cylinder diesel engine and found that the electrochemical mobileular indicates immoderate NO_x decompositionprice of 80% on the exhaust temperatures between The HC discount as much as 65% and CO discount as much as 45% become located with this technique. The energy required to function the electrochemical mobileular become low. The electrochemical NO_x discount is notably easy generation with decreased complexity. From the experiment, it's miles located that this idea works effectively withinside the oxygen-wealthy diesel exhaust.

CHAPTER 3

AIM AND SCOPE

3.1 AIM

To compare the performance and emission characteristics of DI engine using Nano additives as a catalyst in biodiesel blends with pure diesel and to determine the best combination of diesel blends for optimum performance and Emission.

3.2 SCOPE OF WORK

To determine the parameters such as Brake Thermal Efficiency and Specific fuel consumption and emission characteristics such as Nitric oxide, Carbon dioxide, Hydro Carbon, Carbon monoxide at different loads and brake power for pure diesel and various combination of pumpkin seed oil mixed separately with and using AVL gas analyzer.

CHAPTER 4

MATERIALS AND EXPERIMENTAL METHOD

4.1 MATERIALS

4.1.1 PUMPKIN SEED OIL

Pumpkin seed oil was collected from a supplier and it was esterified by means of transesterification process. The basis for the catalytic transesterification process is a triglyceride (fat/oil) Sodium or potassium-hydroxide (NaOH) and this is (KOH). This approaches diesel and reduces the viscosity of the fuel. Following esterification, 0.846% of the oil properties were tested with free fatty acid value. Magneto strictive agitation, a common technique, was accompanied during the biodiesel production for mixing fluids.



Fig :4.1 Pumpkin Seed Oil

S.NO	PROPERTIES	RESULTS
1	FFA	0.846%
2	DENSITY	0.925g/cc
3	KINEMATIC VISCOSITY @ 40° C	0.798cSt
4	FLASH POINT BY PMCC METHOD	80 °C
5	FIRE POINT BY PMCC METHOD	91 °C
6	MOISTURE CONTENT	0.011%
7	CALORIFIC VALUE	7884.806 cal/gm

Table: 4.1 Pumpkin Seed Oil Properties

A magnetic mixer is an equipment that uses a revolving magnetic field, which rotates quickly at 40 cells at 1200 rpm and therefore removes an intervertebral bar (also known as "flea" in the liquid). The rotating field produced from a rotating magnet by the liquid below the vessel.

S.NO	PARAMETERS	RESULT
1	FREE FATTY ACID	0.11%
2	CATALYST(NaOH) QUANTITY	5grams
3	OIL TO METHANOL MOLAR RATIO	1:6
4	TEMPERATURE	60°C
5	REACTION TIME	90 min
6	YIELD	97.3%

Table: 4.2 Transesterification Report of Pumpkin Seed oil (Bio Diesel)

4.1.2 NANO CATALYST

4.1.2.1 BARIUM OXIDE (BaO)

MELTING POINT	2240°C
MOLAR MASS	221.81g/mol
DENSITY	5.0 g/cm ³
BOILING POINT	4300 °C

Table: 4.3 BARIUM OXIDE (BaO) PROPERTIES

4.1.2.2 MAGNESIUM OXIDE (MgO)

MELTING POINT	2400°C
MOLAR MASS	172.115g/mol
DENSITY	7.215g/cm ³
BOILING POINT	3500°C

TABLE: 4.4MAGNESIUM OXIDE (MgO) PROPERTIES

4.2 METHODOLOGY

To find the best combination of biodiesel fusion and best performance, compare engine CI efficiency and emission characteristics against various biodiesel fusion combinations with pure diesel and catalytic converter and determine it by the AVL 5 di-gas analyzer for the components. For example, total fuel and brake, heat performance and emission features such as oxide of nitrogen, oxygen, carbon dioxide, carbon monoxide, smoke at different loads and Brake power.

Three samples were finished. They are B10, B20 and B30. B10 contains 90% diesel, 10% biodiesel and 30 ppm cerium oxide additives. B20 contains 80% diesel, 20% biodiesel. B30 contains 70% diesel, 30% biodiesel and 30 ppm cerium oxide nano additives.

S.NO	SAMPLE	DESCRIPTION
1	D100	Pure Diesel
2	B10	10% biodiesel with 90% Diesel Blends
3	B20	20% biodiesel with 80% Diesel Blends
4	B30	30% biodiesel with 70% Diesel Blends
5	B10+NP1	10% biodiesel with 90% Diesel Blends + MgO Catalytic Converter
6	B20+NP1	20% biodiesel with 80% Diesel Blends + MgO Catalytic Converter
7	B30+NP1	30% biodiesel with 70% Diesel Blends + MgO Catalytic Converter
8	B10+NP2	10% biodiesel with 90% Diesel Blends + BaO Catalytic Converter
9	B20+NP2	20% biodiesel with 80% Diesel Blends + BaO Catalytic Converter
10	B30+NP2	30% biodiesel with 70% Diesel Blends + BaO Catalytic Converter

Fig: 4.5 Sample Amount

4.2.1 Engine

It has 4-stroke direct injection cylinder and it is Diesel engine with a maximum output of 7.5KW at 1500 rpm. The cylinder is 17.5 compressed. The engine has a cylinder sweeping volume of 661.45 (cc), an engine boring diameter of 87.50 mm and a punching length of 110.00 mm. During the entire process, injection pressure is maintained at 210 bar. (Fig:4.2).



Fig:4.2 Engine setup

Product	Diesel Engine test setup 1 cylinder, 4 strokes, Diesel with EGR (Comp.)
Engine	Kirloskar, type 1-cylinder, four-stroke diesel engine, water-cooled, 7.5 kW at 1500 rpm, stroke 110 mm, inner diameter 87.5 mm, 661 ccm, CR17.5, modified for VCR engine CR 12-18. With electric start arrangement, battery and charger
Dynamometer	Eddy current
Propeller shaft	Universally used joints
Air box	Attached with orifice meter and manometer
Fuel tank	Capacity 15 lit with glass fuel metering column
Calorimeter	Pipe with a pipe
EGR	Water cooled, Range 0-15%
Piezo sensor	Range 5000 PSI, with low noise cable
Crank attitude sensor	Resolution 1 Degree, Speed 5500 RPM with TDC pulse.
Data acquisition device	NI USB-6210, 16-bit, 250kS/s.
Piezo powering unit	Model AX-409.
Temperature sensor	Type RTD, PT100 and Thermocouple, Type K
Temperature transmitter	RTD PT100, Range 0–100oC, 3 No's; Thermocouple, Range 0-1200oC, 2 No's
Load indicator	Digital, Range 0-50 Kg, Supply 230VAC

Load sensor	Load cell, type strain gauge, range 0-50 Kg
Fuel flow transmitter	DP transmitter, Range 0-500 mm WC

Table 4.6 Engine Specifications

4.2.2 Sonication Process

Thoroughly lift all the dirt for complex parts. The bypass grid can run continuously, isolate the circuit and be waterproof. Durable and strong, warmth resistance chrome steel construction. The sound energy application process is used to dissolve the particles of a sample for various purposes, such as plant compounds, microalgae and algae. Activity of sonic frequencies (>20 kHz) (Fig:4.3), lead to ultrasonic. Use of ultrasonic or an ultrasonic sensor in laboratory is as sonicator.



Fig: 4.3 GT SONIC Ultrasonic Cleaner

4.2.3 AVL Gas Analyzer

AVL gas analyzer is for CO₂ analysis, O₂ gas analyzer, and Lambda gas measurement analyzer. More over a Pollution testing machinery. This can be used for measuring the emission concentrations of HC, CO, O₂, NO_x, CO₂. They are measured with microinfrarouge sensors and O₂ with gas, pressure, speed, electrochemical sensors (Fig:4.4).



Fig:4.4 AVL Gas analyzer

4.2.4 Engine Test

Exhaust (silencer) is attached with Catalytic Converter which is coated with nano particle. Other end is inserted with AVL gas plug to calculate and find how much emission of HC, CO, O₂, NO_x, CO₂ is released by the engine and the results are shown in the AVL Gas analyzer.



Fig:4.5 Exhaust with Catalytic Converter

CHAPTER 5 **RESULTS AND DISCUSSIONS** **EMISSION MEASUREMENT REPORT**

5.1 BRAKE THERMAL EFFICIENCY - BTHE

BP (%)	BP (KW)	D 100	S1 (B10)	S2 (B20)	S3 (B30)	S4 (B10+BaO)	S5 (B20+BaO)	S6 (B30+BaO)	S7 (B10+MgO)	S8 (B20+MgO)	S9 (B30+MgO)
0.03	0%	2.45	3.54	2.92	2.85	3.39	1.49	0.97	1.81	2.19	3.19
0.99	25%	16.49	18.41	16.21	13.97	15.94	15.86	14.02	13.21	15.93	16.3
1.88	50%	22.75	23.82	21.13	25.05	27.38	23.5	22.49	23.1	21.68	22.1
2.78	75%	31.71	32.46	25.42	26.22	29.07	27.53	26.51	26.97	27.72	25.6
3.5	100%	32.59	33.82	28.57	29.06	32.1	32.38	35.55	32.56	31.89	32.8

Table 5.1BTHE

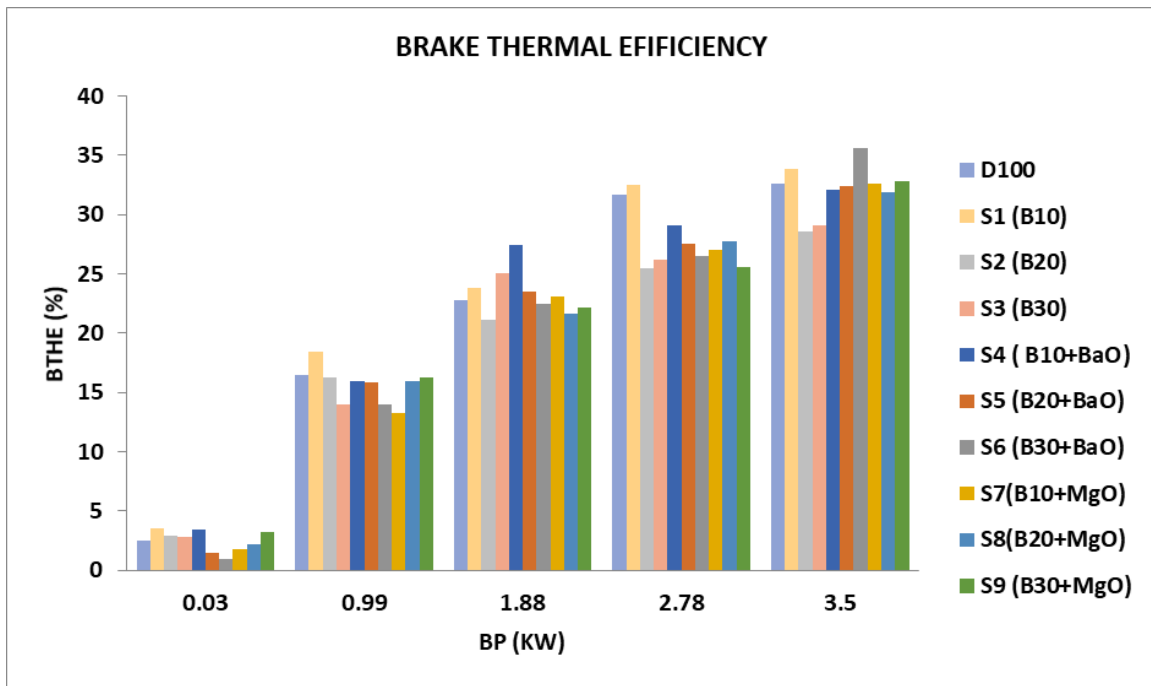


Fig: 5.1 BTHE

The brake thermal efficiency of neat diesel is comparable. Both pure diesel and mixtures have a very low BTHE value at 0% charge (Fig.5.1). On the other hand, the second mixture has a relatively low thermal efficiency. At 25 percent, 50 percent, 75 percent and the full load were highly performant in the same biodiesel combination. The rest of the samples were as good as pure diesel.

5.2 SPECIFIC FUEL CONSUMPTION - SFC

BP (%)	BP (KW)	D100	S1 (B10)	S2 (B20)	S3 (B30)	S4 (B10+BaO)	S5 (B20+BaO)	S6 (B30+BaO)	S7 (B10+MgO)	S8 (B20+MgO)	S9 (B30+MgO)
0.03	0%	2.48	3.42	3.05	3.11	2.62	5.97	3.15	4.9	4.06	4.15
0.99	25%	0.52	0.62	0.55	0.64	0.56	0.56	0.63	0.67	0.56	0.6
1.88	50%	0.38	0.41	0.42	0.35	0.32	0.38	0.4	0.38	0.41	0.48
2.78	75%	0.29	0.35	0.35	0.34	0.28	0.32	0.34	0.33	0.32	0.38
3.5	100%	0.2	0.31	0.31	0.31	0.31	0.13	0.29	0.26	0.26	0.29

Table 5.2 SFC

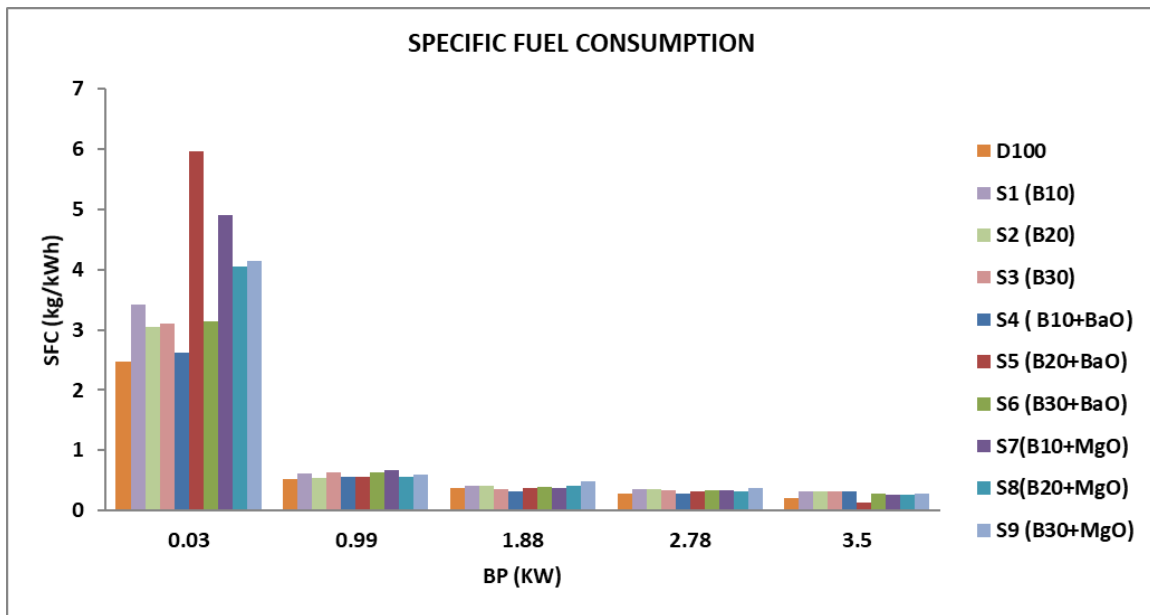


Fig: 5.2SFC

At maximum load, SFC is lowest and nearly equivalent to pure diesel, according to the estimates (Fig:5.2). Despite the high values for biodiesel mixtures from S5 and S7 at zero loads, all other samples showed lower fuel consumption.

5.3 Nitrogen Oxide (NOx)Emissions

BP (%)	BP (KW)	D100	S1 (B10)	S2 (B20)	S3 (B30)	S4 (B10+BaO)	S5 (B20+BaO)	S6 (B30+BaO)	S7 (B10+MgO)	S8 (B20+MgO)	S9 (B30+MgO)
0.03	0%	138	75	62	179	117	70	62	63	92	110
0.99	25%	235	125	125	439	219	189	129	198	190	222
1.88	50%	432	203	228	517	323	354	323	330	396	350
2.78	75%	603	556	666	698	464	466	437	473	594	580
3.5	100%	1151	1118	1150	1080	1082	711	627	739	642	702

Table 5.3 NOx Emissions

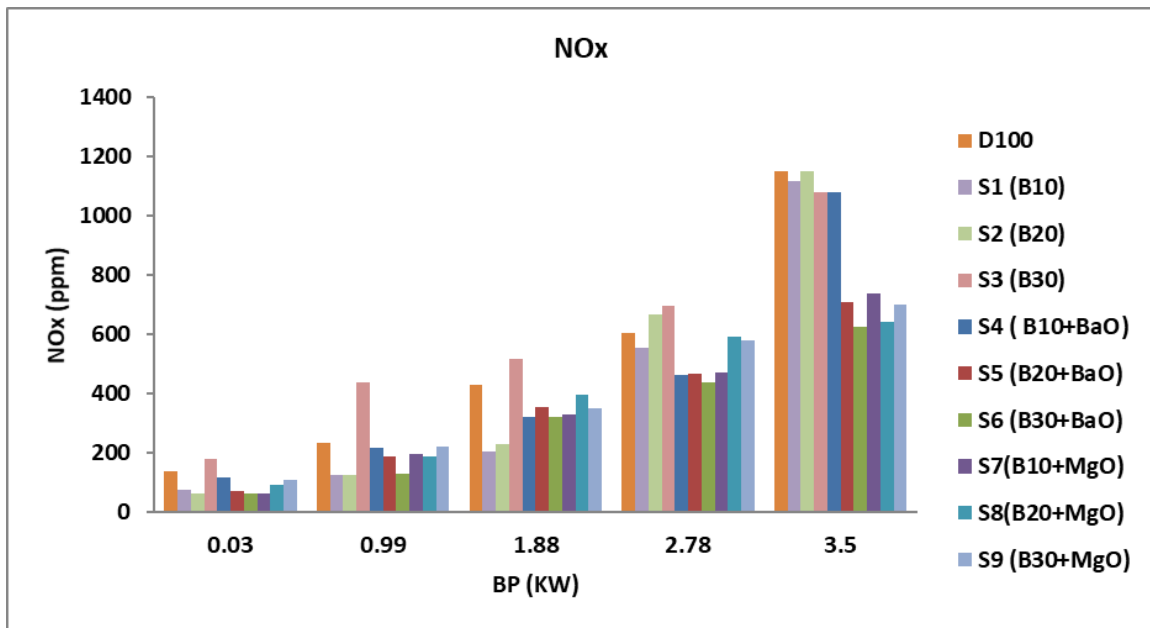


Fig: 5.3NOx Emission

The graph shows NOx emissions as a brake force function (Fig:5.3). 500ppm with 100 percent load (3.5 KW) is a minimum emission of 500ppm, which is significantly less than the same load level achieved from pure diesel. The S6

mixture releases the least NO_x through exhaust of the four blends with 100% load.

5.4 Carbon dioxide (CO₂)Emissions

BP %	BP (KW)	D100	S1 (B10)	S2 (B20)	S3 (B30)	S4 (B10+BaO)	S5 (B20+BaO)	S6 (B30+BaO)	S7 (B10+MgO)	S8 (B20+MgO)	S9 (B30+MgO)
0.03	0%	2.09	0.91	0.87	0.9	1.02	0.94	1.14	1.03	1.05	1.12
0.99	25%	2.73	1.2	1.23	1.55	1.54	1.62	1.74	1.65	1.6	1.7
1.88	50%	3.61	1.25	1.94	1.6	1.87	2.1	2.28	2.04	2.29	3.1
2.78	75%	3.69	1.58	2.34	2	1.98	2.37	2.38	2.37	2.79	4.2
3.5	100%	5.32	2.92	2.53	2.98	2.83	2.58	2.52	2.97	3.13	5.2

Table 5.4 CO₂ Emissions

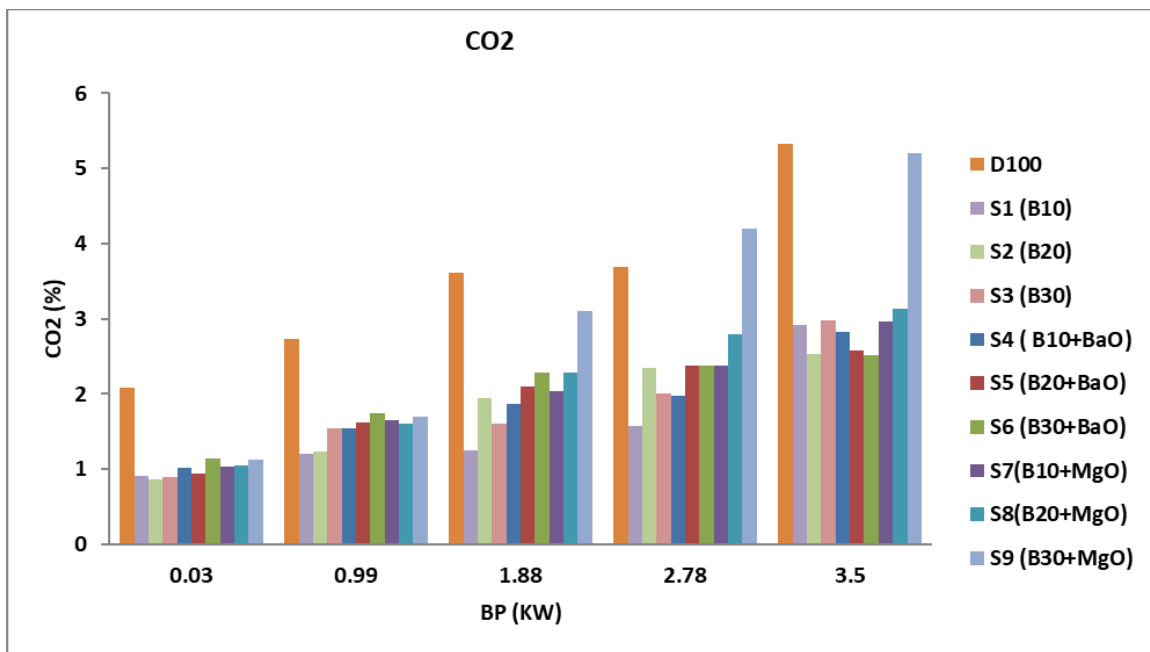


Fig: 5.4CO₂ Emissions

The CO₂ emissions appear to be falling and the measurement results are purely reduced to 100 percent (Fig:5.4). The second sample shows a substantial increase in emissions without charge, whereby the biodiesel mixture produces

CO₂ equal to the pure diesel. In comparison with clean diesel, the third 50 percent biodiesel fusion sample shows lower emissions compared to the same load.

5.5 Hydro Carbon (HC) Emissions

BP %	BP (KW)	D100	S1 (B10)	S2 (B20)	S3 (B30)	S4 (B10+BaO)	S5 (B20+BaO)	S6 (B30+BaO)	S7 (B10+MgO)	S8 (B20+MgO)	S9 (B30+MgO)
0.03	0%	32	50	56	58	38	33	40	42	44	52
0.99	25%	36	51	58	63	42	37	42	48	50	58
1.88	50%	39	55	62	65	47	40	51	52	55	64
2.78	75%	43	62	67	69	55	45	58	60	63	68
3.5	100%	49	63	70	75	64	52	67	65	65	69

Table 5.5 HC Emissions

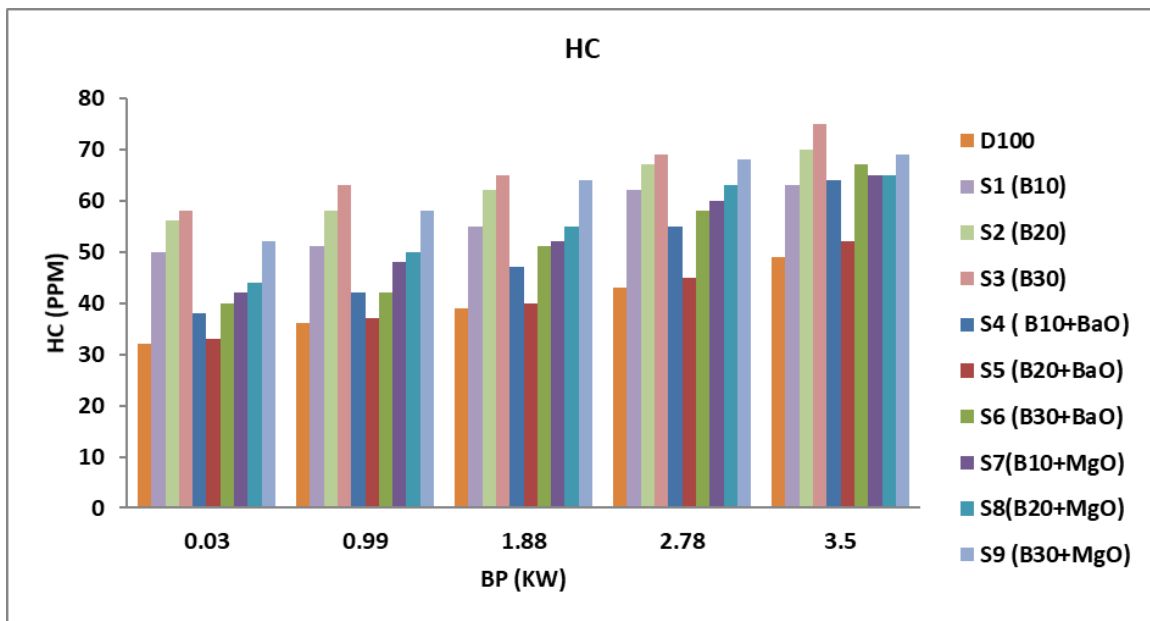


Fig: 5.5

The engine's HC pollution showing dramatic growth in HC content were measured via a smoke meter (Fig:5.5). The readings from clear diesel carbon emissions showed very low values under similar load conditions.

5.6 Carbon monoxide(CO)Emissions

BP %	BP (KW)	D100	S1 (B10)	S2 (B20)	S3 (B30)	S4 (B10+BaO)	S5 (B20+BaO)	S6 (B30+BaO)	S7 (B10+MgO)	S8 (B20+MgO)	S9 (B30+MgO)
0.03	0%	0.073	0.06	0.075	0.077	0.078	0.076	0.07	0.083	0.078	0.09
0.99	25%	0.075	0.057	0.078	0.079	0.075	0.075	0.068	0.08	0.073	0.08
1.88	50%	0.07	0.054	0.082	0.081	0.073	0.073	0.065	0.075	0.071	0.078
2.78	75%	0.067	0.05	0.083	0.084	0.07	0.07	0.062	0.07	0.067	0.066
3.5	100%	0.058	0.049	0.085	0.088	0.069	0.068	0.053	0.069	0.066	0.069

Table 5.6 CO Emissions

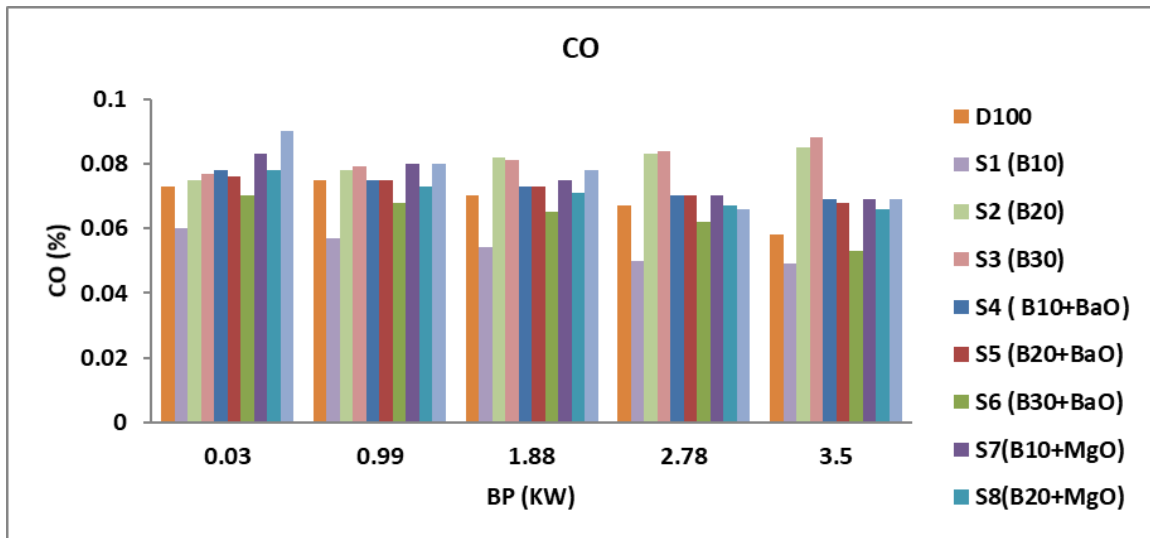


Fig: 5.6CO Emissions

A dramatic rise in diesel fuel CO emissions for different loads, a mean value of 53 percent, is shown in the following chart (Fig:5.6). The emission of CO increases exponentially under load conditions of 100% (3.5 KW), since during the blending procedure the amount of pot seed is increased.

CHAPTER 6

6.0 Conclusion

The experimental test is attempted to examine the potential of alternative fuels by use of pumpkin seed oil and Diesel blends. The flavoring agent kuris seed has not been used in biodiesel but never investigated. It has been also conducted examining the effect on pumpkin seed biodiesel and diesel of metal oxides nano additives and catalytic transducers. During the research work, basic aspects were tested. Braking efficiency and fuel consumption were considered and emission attributes compared to those for NO_x, CO, CO₂ and hydrocarbon emission. The results of the diffusion delay, non-clean and engine emission of 1151ppm accompanying anoverriding value (B10 + D80 + 30ppm CeO₂ + Catalytic Converter) of 684ppm for the fourth sample were positive. The NO_x emissions showed that they were lower than other loads samples. A combination of biodiesel which can reduce NO_x emissions from a diesel engine would have the proper meaning of the S4 (sample 4) diesel mix. In relation to pure diesel, CO and HC levels seemed to be dramatically decreasing. The tests revealed the emissions from the S4 mixture are approximately twice that of all load factors of neat diesel. S4 can therefore be considered helpful in reducing the Engine NO_x emissions (B10 + D90 + catalytic converter). In addition, there were significant results from the B10 diesel mixture.

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