iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: CAAA-2018 Issue: onference Month of publication: April 2018

DOI:

Experimental Investigations On Single Cylinder 4-Stroke Diesel Engine Using Nanofuels

R.L.Krupakaran[1] , D.Raghurami Reddy[2], G.Vidyasagar Reddy[3]
[1, 2, 3] Department of Mechanical Engineering, Sree Vidyanikethan Engineering College, Tirupati, India

Abstract: An experimental investigation is carried out to establish the performance and heat balance using Aluminum oxide (Al_2O_3) and Copper oxide (CuO) as nanoadditives in diesel,blended with 0.5 wt% proportions per unit litre diesel.These nanoparticles are synthesized by high energy ball milling method and characterized by using characterization techniques such as SEM, EDAX and XRD. The nanoparticles are blended by means of an ultrasonicator to achieve stable suspension. It is observed that the blends are stable which are suitable for the performance test on the compression ignition engine.The fuel properties of Diesel, Diesel + Al_2O_3 Nanoadditive and Diesel + CuO Nanoadditive have been studied and compared according to ASTM standard test methods for biodiesel.The whole investigation is carried out in a single cylinder CI diesel engine using diesel,diesel + Al_2O_3 nanoadditive, and diesel + CuO nanoadditive. The present work mainly focuses on comparing the different nano particles with diesel to improve the performance of compression ignition engine. The acquired data are studied for various parameters to determine the performance and heat balance of the CI engine. The result shows a considerable enhancement in performance and heat balance due to the influence of Al_2O_3 nanoadditive and CuO nanoadditive addition in diesel fuel.
Keywords-diesel; nanoparticle; charactarization: performance; heat balance.

I. INTRODUCTION

Depleting fossil fuels day by day, made a need to find out an alternative fuel to fulfill the energy demand of the world. Biodiesel is one of the best available sources to meet the requirement. The petroleum fuels play a very important role in the development of industrial growth, transportation, agricultural sector and to meet many other basic human needs. However, these fuels are limited and reduce as the consumption is increasing very rapidly. Moreover, their use is alarming the environmental problems to society. Hence, the scientists are looking for alternative fuels.

Anita Šalić et al., [1] fallowed a Microreactor technology, Main problems of the traditional approach in biodiesel production are long residence time, high operation costs and energy consumption and low efficiency.To overcome these issues they introduced Microreactor technology for production of bio diesel in macrolevel .Using this approach sunflower oil was completely converted to biodiesel even in the residence time as short as 112 s at a reaction temperature of 60 °C in a system composed of a micromixer (T-type) and microreactor tube (inner diameter = 1 mm; length = 160 mm).R. Ghanei1, A. Heydarinasab, Moradi et al.,[2] an optimization study was performed by the authors using response surface methodology. biodiesel derived from waste frying oil by using lime as catalyzing material Hossain et al., [3]had studied the feasibility of the transesterification of waste canola cooking oil using lower alcohol to oil molar ratios Some important variables such as volumetric ratio, types of reactants and shaking time were selected to obtain a high quality biodiesel fuel and examine the considerable difference of biodiesel yield produced by methanol, ethanol and 1-butanol.Alemayehu Gashaw et al.,[4] had reviewed the Production of biodiesel from waste cooking oil by Transesterification, Micro-Emulsion Process, Pyrolysis and identified the various factors affecting its formation Charles Mbohwa et al. [5] discussed the status of biodiesel production derived from used oil in South African by using traserificaion process. J. Sadhik Basha,et al.,[6]investigated the variation in cylinder gas pressure and the heat release rate with respect to crank angle for the Jatropha Methyl Esters with 2% surfactant and 5% water with and without addition of Carbon Nano tube by varying ppm levels to the fuels at the full load condition in Single cylinder, four stroke, naturally aspirated, air cooled, constant speed,direct injection.JME, JME2S5W, The addition of CNT to the JME emulsion fuel (25, 50 and 100 ppm) has exhibited a gradual decrement in the cylinder pressure on the account of shortened premixed burning phase. Wail M et al.,[7] studied the combustion characteristics and emissions of compression ignition diesel engine were measured using a biodiesel as an alternative fuel. The waste vegetable oil (cocking oil) used in this investigation. The testing results show without any modification to diesel engine, under all conditions dynamical performance kept normal, and the B20, B5 blend fuels (include 20%, 5% biodiesel respectively) led to satisfactory emissions at variable load. The experimental results compared with standard diesel show that biodiesel provided significant reductions in CO, and unburned HC, but the NOx was increased. Biodiesel has a 5.95 % increasing in brake-specific fuel consumption due to its lower heating value. However, using B20 and B5 diesel fuel gave better emission results, NOx and brake specific fuel consumption. Pushparajet al.,[8]experimental investigation was conducted to evaluate the effects of using ethanol and diethyl ether as additives to biodiesel/diesel blends on the emission and performance of direct injection unmodified diesel engine. Biodiesel was made by pyrolysis process. Cashew nut shell liquid (CNSL) was selected for biodiesel production. The fuel containing 20% biodiesel and 80% Number 2 diesel fuel, is called here as B20, 90% B20 and 10% ethanol by volume is called B20+E10 and 90% B20 and 10% diethyl ether by volume is called B20+D10. The effect of test fuels on engine torque, power, brake specific fuel consumption, brake thermal efficiency, exhaust gas temperature, were ascertained by performance tests. The influence of blends on CO, CO_2, HC, NO and smoke opacity were investigated by emission tests. The experimental results showed that the exhaust emissions for 10% diethyl ether with B20 were fairly reduced, especially the NO is reduced remarkably by 51% while comparing diesel. B20+D10 blend reflect better engine performance and lower emissions than B20+E10and B20 blends. Nantha Gopal et al., they prepared pongamia (PME 100) oil and tested on a diesel engine for different blends such as PME 20, PME 40, PME60 and PME 80. The comparison is made with diesel operation. Test reveals the effect of bio-diesel on a DI engine when compared to diesel and evolves conclusions with respect to performance and emissions.

Sadhik Basha et al.,[10] investigated the use of Carbon Nanotubes (CNT) with the Jatropha Methyl Esters(JME) emulsion fuel and blended with the JME emulsion fuel in the various dosages systematically. An experimental investigation was conducted in a single cylinder constant speed diesel engine. Subsequently the JME emulsion fuel was prepared in the proportion of 93% of JME, 5% of water and 2% of surfactants (by volume) with a hydrophilic–lipophilic balance of 10. Result revealed that at full load, the brake thermal efficiency for the JME fuel observed was 24.80%, whereas it was 26.34% and28.45% for the JME2S5W and JME2S5W100CNT fuels respectively. Tayfun Ozgur etbal., [11] studied effects of addition of oxygen containing nanoparticle additives to biodiesel on fuel properties and effects on diesel engine performance and exhaust emissions were investigated. Two different nanoparticle additives, namely MgO and SiO_2, were added to biodiesel at the addition dosage of 25 and 50 ppm. Fuel properties, engine performance, and exhaust emission characteristics of obtained modified fuels were examined. As a result of this study, engine emission values NOx and CO were decreased and engine performance values slightly increased with the addition of nanoparticle additives.

Ajin et al.,[12]presented the investigations the effect of cerium oxide nanoparticles on performance and emissions of diesel engine. Cerium oxide nanoparticles were synthesized by chemical method and techniques such as TEM, EDS, and XRD have been used for the characterization. Cerium oxide was mixed in diesel by means of standard ultrasonic shaker to obtain stable suspension, in a two-step process. The influence of nanoparticles on various physicochemical properties of diesel fuel has also been investigated through extensive experimentation by means of ASTM standard testing methods. Load test was done in the diesel engine to investigate the effect of nanoparticles on the efficiency and the emissions from the engine. Comparisons of fuel properties with and without additives are also presented.

II. MATERIAL METHODS

A. Synthesis and characterization of nanoparticle

The nanoparticles are procured commertially having less than 50 nano meter size.Two surfactants are used for to stay stable and not to settle after sonication process.

1) Triton X-100 for Al2O3 Nanoparticles.
2) Nonidet P-40 for CuO Nanoparticles.

B. Preparation of blends

The dosing level of Al2O3 and CuO nanoparticles samples is 0.5 wt%. In order to obtain a uniform suspension of nanoparticles in diesel, a standard ultrasonicator has been used for mixing the nanoparticles corresponding to the dosing level. The catalytic nanoparticle added diesel was agitated for about 30 minutes in an ultrasonicator to obtain a stable nanofluid. The modified fuel was used in the experiments immediately after preparation, so that considerable time is not allowed for sedimentation to set in.

Blend of Alumina (Al_2O_3): Surfactant: Triton X-100

Blend of Copper oxide (CuO): Surfactant : Nonidet P-40

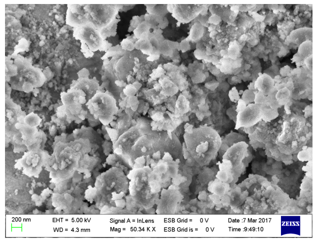


Figure 1. SEM Results of Al_2O_3 Nanoparticles.

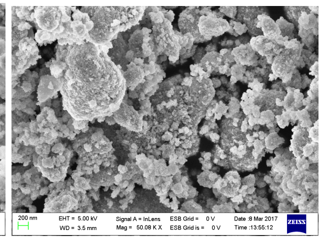


Figure 2 SEM Results of CuO Nanoparticles

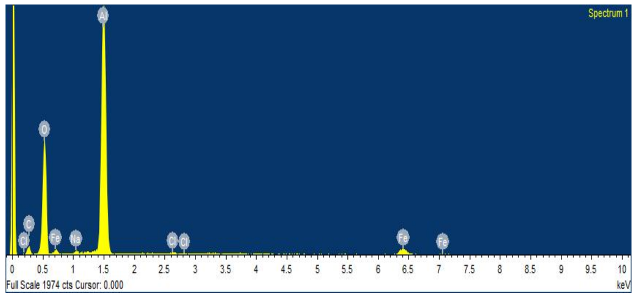


Figure 3. EDAX Results of Al_2O_3 Nanoparticles.

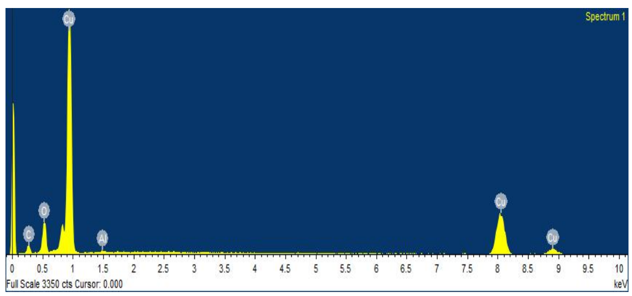


Figure 4. EDAX Results of CuO Nanoparticles

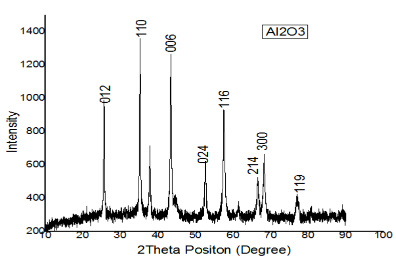


Fig ure 5. XRD Results of Al_2O_3 Nanoparticles.

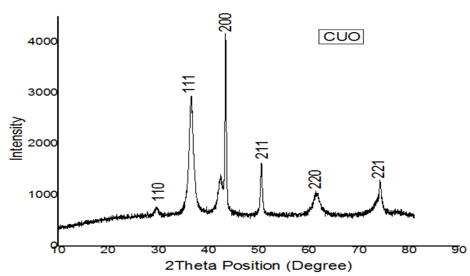


Figure 6. XRD Results of CuO Nanoparticles.

Table.1Properties of tested fuel

Sl No	Type Of Blends	Flash Point (°C)	Fire Point (°C)	Kinematic Viscosity (cSt)	Specific Gravity	Calorific Value (kJ/kgK)
1	Diesel	45	55	3.05×10^{-6}	0.814	42000
2	Diesel + Al_2O_3 Nanoadditive	50	59	3.33×10^{-6}	0.826	42726
3	Diesel + CuO Nanoadditive	47	57	4.37×10^{-6}	0.825	42227

III. RESULT AND DISCUSSION

From the Figure 7 the graph it is observed that, the Brake Specific Fuel Consumption Decreases with Increase in the Brake Power.It is observed from graph that, initially the Brake Specific Fuel Consumption for Diesel + Al_2O_3 nanoadditive is low; then gradually decreases with respect to Increase in Brake power as compared with Diesel.Similarly, For Diesel + CuO Nanoadditive, Brake Specific Fuel Consumption is high, then decreases gradually with respect to increase in Brake Power as compared to Diesel.

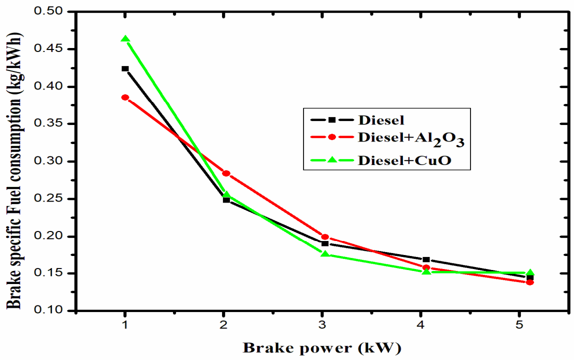


Figure 7. Graph Showing Brake Specific Fuel Consumption Vs Brake Power

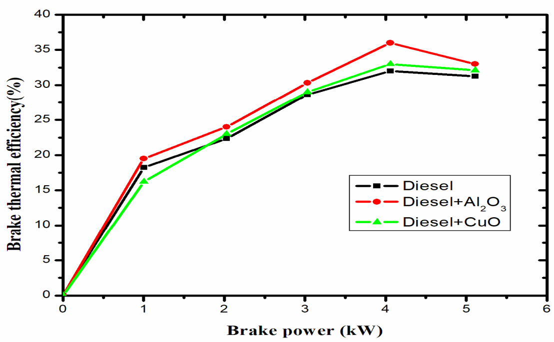


Figure 8. Graph Showing Brake Thermal Efficiency Vs Brake Power

From Figure 8 the graph it is observed that, the Brake Thermal Efficiency Increased with Increase in the Brake Power.It is observed from the graph that, for diesel + Al_2O_3 Nanoadditive, the Brake Thermal Efficiency is less initially, then increases gradually and finally it is high with respect to Increase in Brake Power as compared to Diesel.Similarly, for Diesel + CuO Nanoadditive, initially the Brake Thermal Efficiency is same, then increases with respect to increase in Brake Power as compared to Diesel

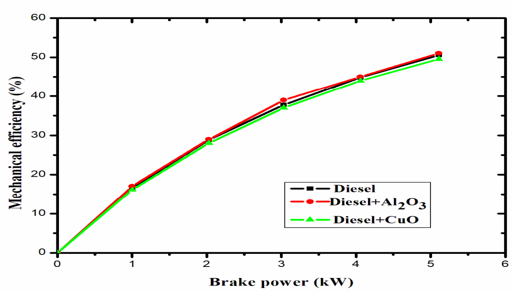


Figure 9: Graph Showing Mechanical Efficiency Vs Brake Power

From Figure 9 the graph it is observed that, the Mechanical Efficiency Increases with Increase in the Brake Power.For Diesel + Al2O3 Nanoadditive and Diesel + CuO Nanoadditive, the Mechanical Efficiency is slightly increases with Increase in the Brake Power as compared to the Diesel.

A. Heat Balance

Pie Chart: Heat Balance for Diesel:

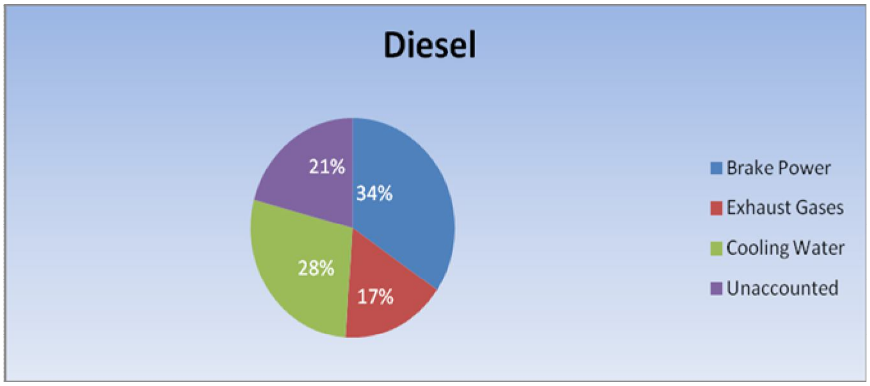


Figure 10 : Pie Chart Showing Heat Distribution for Diesel

From Figure.10 the pie chart, we can notice that the large amount of heat utilized for Brake Power, and then Heat carried away by cooling water.

Pie Chart: Heat Balance for Diesel + Al_2O_3 Nanoadditive:

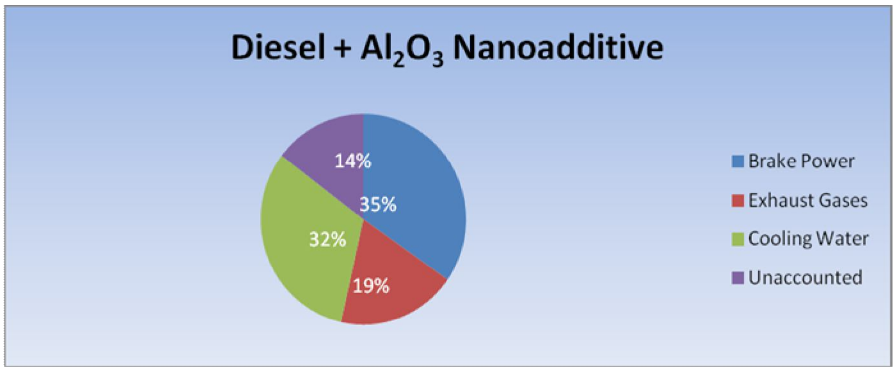


Figure 11 : Pie Chart Showing Heat Distribution for Diesel + Al2O3 Nano Additive

The Figure 11 Pie Chart shows the Heat Distribution of Diesel + Al_2O_3 Nanoadditive fuel.From the Pie Chart, it is observed that, the large amount of heat is utilized by Brake Power and Carried away by Cooling Water.As compared with Diesel, the heat carried away by cooling water is increased by 4% and the unaccounted heat is reduced by 7%.There is slightly increase in the heat utilized by Brake Power by 1% and Heat carried away by exhaust gases by 2% as compared with diesel fuel.

Pie Chart: Heat Balance for Diesel + CuO Nanoadditive:

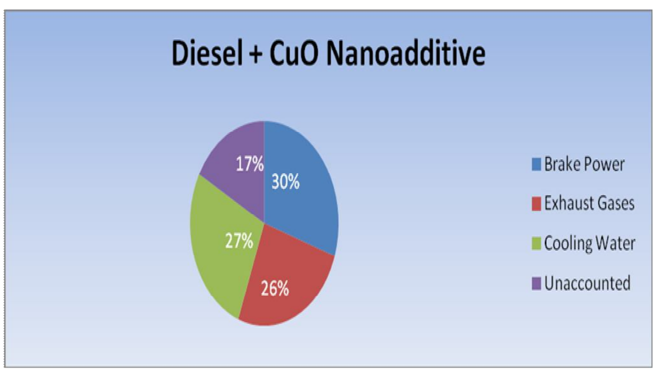


Figure 12: Pie Chart Showing Heat Distribution for Diesel + CuO Nanoadditive

The Figure 12 Pie Chart shows the Heat Distribution of Diesel + CuO Nanoadditive fuel.From the Pie Chart, it is observed that the Heat carried away by Exhaust gases and cooling water is almost same.The Heat carried away by exhaust gases is increased largely by 9% as compared with the Diesel Fuel.There is an Increase in the heat utilized by Brake Power by 4% and decrease in the unaccounted heat by 4% as compared with Diesel Fuel.

IV. CONCLUSION

The performance and heat balance of CI diesel engine with diesel, diesel + Al_2O_3 nanoadditive, and diesel + CuO nanoadditive were investigated. The following conclusions are drawn Compared with diesel:

1) The brake specific fuel consumption is gradually decreased for both diesel + Al2O3 nanoadditive and diesel + CuO Nanoadditive with respect to increase in brake power.
2) The brake thermal efficiency is gradually increased for both diesel + Al2O3 nanoadditive and diesel + CuO Nanoadditive with respect to increase in brake power.
3) The brake mean effective pressure is slightly increased for both diesel + Al2O3 nanoadditive and diesel + CuO Nanoadditive with respect to increase in brake power.
4) There is slightly increased in heat utilized by brake power by 1% for diesel + Al2O3 nanoadditive by 1% and decreased for diesel + CuO Nanoadditive by 4%.
5) The heat carried away by exhaust gases slightly increased for both diesel + Al2O3 nanoadditive by 2% and for diesel + CuO Nanoadditive by 9%.
6) The heat carried away by cooling water increased for diesel + Al2O3 nanoadditive by 4% and decreased slightly for diesel + CuO nanoadditive by 1%.

REFERENCES

[1] [Anita Šalić, Bruno Zelić, Microreactors - Portable factories for Biodiesel fuel production. Goriva i Maziva, 2011.50, 2 : 85-110,

[2] R. Ghanei1, A. Heydarinasab, G.R. Moradi, V. Falahati1 Process optimization for biodiesel production from waste frying oil with constructional lime. International Journal of Biosciences. 2014,Vol. 4, No. 8, p. 36-45, , ISSN: 2220-6655.

[3] A. B. M. S. Hossain, A. N. Boyce, A. Salleh and S. Chandran. Impacts of alcohol type, ratio and stirring time on the biodiesel production from waste canola oil. African Journal of Agricultural Research 18 July, 2010,Vol. 5(14), pp. 1851-1859,

[4] Alemayehu Gashaw1, Abile Teshita2. International Journal of Renewable and Sustainable Energy 2014; 3(5): 92-98, ISSN: 2326-9723.

[5] Charles Mbohwa and Alexander Mudiwakure.The Status of Used Vegetable Oil (UVO) Biodiesel Production in South Africa. Proceedings of the World Congress on Engineering 2013 Vol I, WCE 2013, July 3 - 5, 2013, London, U.K.

[6] J. Sadhik Basha a, R.B. Anand b, Performance, emission and combustion characteristics of a diesel engine using Carbon Nanotubes blended Jatropha Methyl Ester Emulsions. Alexandria Engineering Journal (2014) 53, 259–273. Production and hosting by Elsevier.

[7] Wail M. Adaileh and Khaled S. AlQdah . Performance of Diesel Engine Fuelled by a Biodiesel Extracted From A Waste Cocking Oil. ELSEVIER, Energy Procedia 18 (2012) 1317 – 1334

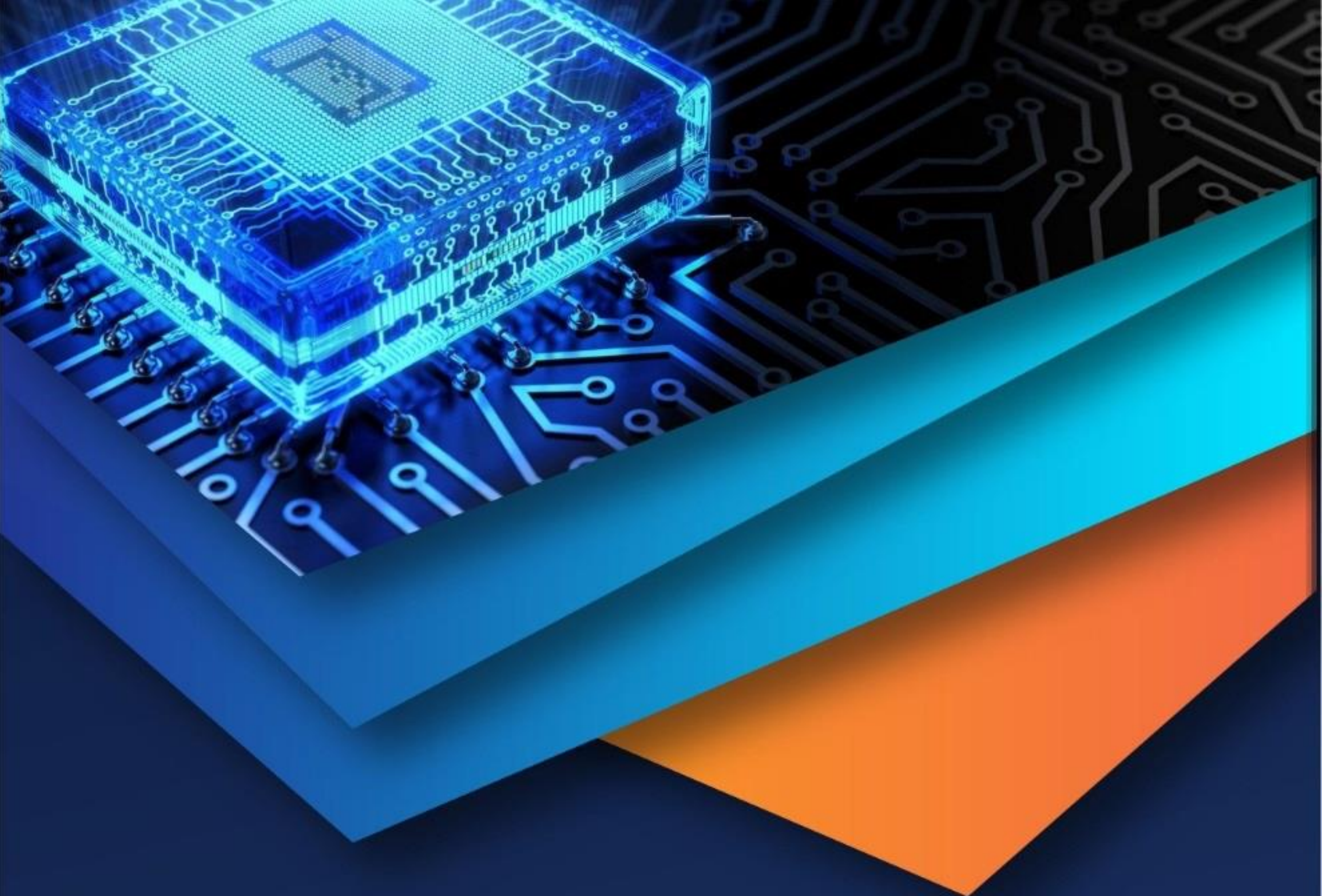
[8] T. Pushparaj, S. Ramabalan. Green fuel design for diesel engine, combustion, performance and emission analysis. ELSEVIER, International Conference on design and manufacturing, IConDM 2013. Procedia Engineering 64 (2013)701–709.

[9] K. Nantha Gopal, R. Thundil Karupparaj. Effect of pongamia biodiesel on emission and combustion characteristics of DI compression ignition engine. Ain Shams Engineering Journal (2015)6, 297–305. Production and hosting by Elsevier

[10] J. Sadhik Basha ,R.B. Anand. Performance, emission and combustioncharacteristics of a diesel engine using CarbonNanotubes blended Jatropha Methyl Ester Emulsions. Alexandria Engineering Journal (2014) 53, 259–273.

[11] Tayfun Ozgur,Musafa ozcanil, Kadir Aydin. Investigation of Nanoparticle Additives to Biodiesel for Improvement of the Performance and Exhaust Emissions in a Compression Ignition Engine. Taylor& Francis, International Journal of Green Energy (2015) 12, 51–56. ISSN: 1543-5075.

[12] Ajin C. Sajeevan and V. Sajith . Diesel Engine Emission Reduction Using Catalytic Nanoparticles: An Experimental Investigation. Hindawi Publishing Corporation Journal of Engineering Volume 2013, Article ID 589382, 9 pages.



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

TOGETHER WE REACH THE GOAL

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY