PERFORMANCE INVESTIGATION OF 4 STROKES DIESEL ENGINE WITH COMBINED CORN BIO DIESEL AND CERIUM OXIDE NANOPOWDER

Nomula Kondayya[1], Kankati Muralidhar[2], R V Manikanta[3]

[1]M.Tech Student, Department of Mechanical Engineering, AKRG College of Engineering & Technology, Nallajerla – 534112
[2]Department of Mechanical Engineering, AKRG College of Engineering & Technology, Nallajerla – 534112
[3]Department of Mechanical Engineering, Swarnandhra Institute of Engineering & Technology, Narsapur – 534280

---***---

Abstract— *Bio diesel is one of the promising substitute sources of energy fuel in the transportation sector due to rapid depletion of petroleum reserves on one facet and elevated power call for in addition to environmental pollutants risks on the opposite facet. Edible oils are receiving a lot of attention as an alternative fuel for engines, as they are renewable and can be used in engines without any major modification. Their properties are closer to those of diesel, except viscosity. It is very clear those non-edible oil based bio diesels are one of the best sources of energy.*

The main problems of using corn oil in diesel engines are higher emission level and lower thermal efficiency due to higher viscosity and carbon residue compared to diesel. Transesterification of corn oil into biodiesel is the best method to overcome this problem. The addition of nano-metal components to the bio diesel through numerous bureaucracies extensively improves the residences, and it contributes to superior overall performance with decreased emissions. The examples of nano-metallic additives are Al2O3, CNT, CeO3, ZnO2, TiO2, CoO2, CuO, FeO2, and others.

In the present study we are using corn biodiesel in different blends such as COME10, COME20, COME30, &COME100 are taken for the experiment from these blends COME20 gives good results and for these blend cerium oxide Nano particles is added as fuel additive with concentration of 25ppm, and 50ppm. The Performance was improved and emissions were reduced by using COME20+Ceo2 50ppm.

Introduction (Heading 1)

DIESEL ENGINE Developed withinside the 1890s through inventor Rudolph diesel, the diesel engine has end up the engine of preference for strength, reliability, and excessive gasoline economy, worldwide. Early experiments vegetable oil fuels covered the French authorities and Dr.Diesel himself, who estimated that pure vegetable oils should strength early diesel engines for agriculture in far flung regions of the world, in which petroleum became now no longer to be had on the time. Modern biodiesel fuel, that's made through changing vegetable oils into compounds known as fatty acid methyl esters, has its roots in studies performed withinside the 1930s in Belgium; however these days's biodiesel enterprise became now no longer installed in Europe till the overdue 1980s.

EARLY WORK*: The early diesel engines had complicated had complicated injection structures and has been designed to run on many one of kind fuels, from kerosene to coal dust. It became simplest a depend of time earlier than a person identified that, due to their excessive electricity content, vegetable oils could make amazing fuel. The first public demonstration of vegetable oil primarily based totally diesel fuel became at the 1990 world's fair, whilst the French authorities became interested by vegetable oils as a domestic fuel for his or her African colonies. Rudolph diesel later did substantial paintings on vegetable oil fuels and has become a main proponent of any such concept, believing that farmers should gain from offering their personal fuel. However, it might take nearly a century earlier than such concepts have become a extensive reality. Shortly after Dr. Diesel death in 1913 petroleum end up broadly to be had in quite a few forms, such as the magnificence of fuels we recognize these days as "diesel fuel".*

MODREN WORK*: Due to the extensive availability and occasional value of petroleum diesel fuel, vegetable oil- primarily based totally fuels received little attention, besides in instances of excessive oil expenses and shortage. World War II and the oil crises of the 1970's noticed quick hobby in the usage of vegetable oils to fuels diesel engines. Unfortunately, the more moderen diesel engine designs couldn't run on conventional vegetable oils, because of the an awful lot better viscosity of vegetable oil as compared to petroleum diesel fuel. A manner became had to decrease the viscosity of vegetable oils to a factor in which they may be burned well with inside the diesel engine. Many techniques were proposed to carry out this task, which includes pyrolysis, mixing with solvents, and even emulsifying the fuel with water or alcohols, none of that have furnished a suitable solution. It became a Belgian inventor in 1937 who first proposed the usage of transesterification to* *transform vegetable oils into fatty acid alky1 esters and use them as a diesel fuel replacement. The system of transesterification converts vegetable oil into three smaller molecules which can be a lot much less viscous and easy to burn in a diesel engine. The transesterification reaction is the premise for the manufacturing of contemporary-day biodiesel, that's the exchange call for fatty acid methyl esters. In the early 1980s concerns over the environment, electricity security, and agricultural overproduction yet again introduced using vegetable oils to the forefront, this time with transesterification because the favored approach of manufacturing such fuel replacements. Recently the Indian railway began out that bio- diesel is used as a fuel in locomotives.*

Fig. 1.1Train running on bio diesel.

***LITERATURE REVIEW**:*

The main purpose of this literature review is to provide background information on the issues to be considered in this work and to emphasize the relevance of the present study. An intensive literature survey has been carried out from bio-diesel and its blends in diesel engine. The chapter contains the information we have got from different papers

*2.1 **BIO-DIESEL**:-*

In the present years edible oils are easily obtained because of the availability. In the paper stated that potential corn oil as a most promising feed stock for biodiesel production In this paper, several aspects such as physical and chemical properties of corn oil methyl ester, fatty acid composition, Transesterification blending and engine performance and emissions of Corn oil methyl ester were studied. Overall, corn oil appears to be an acceptable feedstock for future biodiesel production.

Sahid at el studied the use of biodiesel in CI engine by using edible oils such as soybean oil, sunflower oil, cotton seed oil. It can reduce the emission reduced in the engine but it has one limitation for the use edible oil as biodiesel i.e. edible oils are used as the food crops in daily life due to its unavailability non edible oils are used as biodiesel.

Nagaraja.s, K. Sooorya prakash,R.sudhakaran, M.sathish kumar from this paper studied the investigation on the emission quality, performance and combustion characteristics of compression ignition engine fuelled with environmental friendly corn oil methyl ester diesel blends from the paper we studied the characteristics of corn biodiesel with various blendes such as (20,40,60,80,100). The results stated that increase in brake thermal efficiency for B100 and reduced emission in part load and full load.

R. Senthi kumar at studied the performance and emission characteristic of biodiesel engine with preheating corn oil methyl ester from thus paper we studied the performance & emission characteristics of corn biodiesel by using different preheating temperatures such as (50,70,and 900c). Increase in brake thermal efficiency at 700c and reduced emission at 700c.

V.A. Markov at studied the optimization of diesel fuel and corn oil mixture composition from this paper we studied the mixing corn oil with diesel fuel in different percentages from this result optimised composition of bio fuel mixture is calculated.

U Santhan kumar at studied the performance combustion and emission characteristics of corn oil blended with diesel from this paper we studied the characteristics of corn biodiesel blends.

*2.2 **BIODIESEL ADDITIVES***

Nithin Samuel, Muhammed Shefeek K: Specific fuel consumption is decreased by 0.5 kg/kw.hr for diesel mixed with cerium oxide at 30 ppm. Mechanical efficiency of the engine is enhanced by 20% while using fuel added with 30 ppm cerium oxide. However thermal efficiencies are higher for neat diesel than the fuel mixed with nanoparticle. There is a significant improvement in the exhaust emissions while using diesel mixed with cerium oxide nanoparticle.

Abbas alli taghipoor bafghi, hosein bakhoda, fateme khodaei chegeni: An experimental research is finished to set up the overall performance traits of a compression ignition engine at the same time as the use of cerium oxide nanoparticles as additive in neat diesel and diesel-biodiesel blends. In the primary section of the experiments, balance of neat diesel and diesel-biodiesel fuel blends with the addition of cerium oxide nanoparticles is analyzed. After collection of *experiments, it's far observed that the blends subjected to excessive pace mixing observed with the aid of using ultrasonic bath stabilization improves the balance. In the second one section, overall performance traits are studied the use of the strong gas blends in a unmarried cylinder four stroke engine coupled with an electrical dynamometer and a information acquisition system. The cerium oxide acts as an oxygen donating catalyst and presents oxygen for combustion. The activation power of cerium oxide acts to burn off carbon deposits inside the engine cylinder on the wall temperature and forestalls the deposition of non-polar compounds at the cylinder wall outcomes discount in HC emissions. The assessments found out that cerium oxide nanoparticles may be used as additive in diesel and diesel-biodiesel blends to improve complete combustion of the fuel significantly.*

Shiva Kumar, P. Dinesha & Ijas Bran: In this paper, the benefits of using nano additives in diesel/biodiesel engines were explained. Addition of nanoparticles of metal and metal oxides in biodiesel blends resulted in improvement of engine performance characteristics and at the same time reduction in exhaust.

V.Arul Mozhi Selvan, R.B.Anand, M. Udaya kumar: In this experimental work Cerium Oxide Nanoparticles (CERIA) and Carbon Nano tubes (CNT) was used in Diesel-Castor oil biodiesel-Ethanol blend. The compression ratio was kept 19:1. The added CNT acted as catalyst and helped to accelerate the fuel burning rate, leading to decreased ignition

In the measuring of cloud and pour point initially 10 ml of bio-diesel is taken in a measuring jar, *A beaker of 1000 ml is taken and filled with ice cubes and pour the Cacl2on ice to reduce the formation of water. After waiting some time the formation of fog will occur from this stage the temperature is measured in certain intervals. The*

temperature at which solidification will occur that is cloud point and the temperature at which the bio-diesel is completely solidified.

Cloud point =18°C

Pour point = -8°C

| Fig. 4.2 cloud &pour point checking

Density:

Specific gravity of liquids can be measured with instruments like hydrometer, specific gravity bottle. In the present work specific gravity bottle has been used for the measurement of specific gravity of fuel oil.

Apparatus required:

Weighing machine

Beaker of 100 ml.

Hydrometer is used for testing density. Due unviability of hydrometer we have used weighing procedure. In this process initially water is taken in 100 ml beaker of quantity and weigh that beaker and check the weight to know the error of weighing machine. The reading is 100 gm its good. Now take 100ml of bio-diesel in the beaker and weigh, the reading is 836gm so this is the density of the present bio-diesel.

Fig.4.3 density testing.

DENSITY = 836 kg/mc.

Viscosity: (ASTM D 445)

Viscosity is a measure of the resistance of a fluid which is being deformed by shear stress. It is the resistance of a liquid to flow and describes a fluid's internal resistance. Dynamic viscosity is measured with various types of viscometers viz. Red Wood Viscometer, Saybolt Viscometer and Engler Viscometer.

Apparatus required:

Redwood viscometer.

Beaker of 100 ml.

Thermometer.

Procedure:

Initially the Corn oil bio-diesel is taken a quantity of 100 ml in a beaker. The diesel is poured in a oil cylinder available in viscometer. Now the heating bath is filled with water to the height corresponding to the tip of the indicator. Place the gravity bottle just below the jet of the valve. Note down the time taken for 50ml collection of given oil sample at room temperature. Heat the water by giving electric supply, the temperature is controlled by means of a regulator. After attaining a steady state temperature by continuous stirring determine the time taken for 50ml of oil sample by lifting up the ball valve. Repeat the experiment by different temperatures and note down at least 5 readings.

CALCULATIONS:

$$\text{Kinematic viscosity } (\nu) = At - \frac{B}{t} \text{centistoke}$$

Absolute viscosity (μ) = $\nu \times \rho$ centipoise

Fig. 4.4 viscosity testing

2 COMPARING THE PROPERTI ES OF BIO-DIESEL WITH BASELINE VALUES:

SL.NO	PROPERTY	DIESEL PROPERTIES	CORN BIO-DIESEL
1	CALORIFIC VALUE	42,000 KJ/Kg	39912 KJ/Kg
2	FLASH POINT	$52-96^0$ C	143°c
3	FIRE POINT	$62-106^0$C	149°c
4	CLOUD POINT	(-6)-12°c	18°c
5	POUR POINT	(3)-20°c	-8°c
6	ACID VALUE	0.36 mg/KOH	--
7	DENSITY	0.824	0.836 kg/m3
8	VISCOCITY	1.2 to 2(4.56)	4.363 mm2/sec
9	CETANE NUMBER	40(48-50)	55.4

Tab 4.1 properties of prepared bio-diesel & comparing with base line values

EXPERIMENTAL SETUP

The analysis is carried out at the computerized variable compression ratio multi fuel direct injection water cooled (MFVCR) engine. The experiment is done at constant compression ratio (16.5) of the engine. Initially we have done the base line test with diesel, then diesel with LPG, and then corn oil a bio diesel with blending such as Corn10, Corn20, Corn30, and Corn100 after that we compare the obtained combustion, performance, emission values with base line values.

5.1 Details of test rig and its specifications:

The MFVCR engine test rig is a computer based analysis engine by using different sensors and thermocouples. The sensors are used in the present test rig that are used to find the speed, torque, fuel consumption etc... 6 thermocouples are used in the test rig to measure the temperature at various points.

Engine specifications:

Engine: 4 stroke computerized variable compression ratio multi fuel direct injection water cooled engine

a) • Make: TECH-ED

b) • Basic engine: Kirloskar

c) • Rated power: 5 HP (DIESEL)

d) • Bore diameter: 80mm

e) • Stroke length: 110mm

f) • Connecting rod length: 234mm

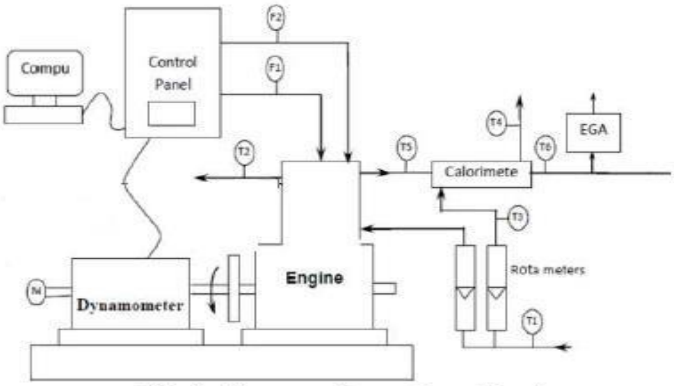
g) • Swept volume: 551cc

h) • Compression ratio: 5:1 to 20:1

i) • Rated speed: 1500 rpm

j) During the running of the engine the performance analysis is done with different flow rates at various loads. The emission analysis is done by using INDUS SIX GAS SMOKE ANALYZER & SMOKE METER. The six gas smoke analyser gives the percentage of CO (carbon monoxide), NOx (nitrogen oxide), SOx (sulphur oxide), oxygen (O2), carbon dioxide (CO2), HC(hydro carbons) and smoke meter will gives the amount of smoke coming from the engine.

Fig5.1. experimental setup



Block diagram of experimental set up

In the present project we have used Multi Fuel Variable Compression (MFVCR) Engine. The total test rig is accumulated with sensors to know the required values from the experiment. The test is integrated with sensors to know the properties like Temperature, Fuel consumption, Pressure, Heat release, Water flow, Air flow etc

RESULTS&ANALYSIS

8.1 PERFORMANCE ANALYSIS:

8.1.1 BP v/s LOAD:

Brake power of an I.C engine is the power available at the crankshaft. For different fuel blends of corn biodiesel were compared conventional biodiesel.

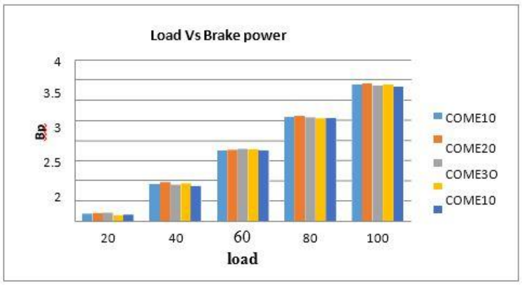


Fig. 8.1 LOAD v/s BP diagram

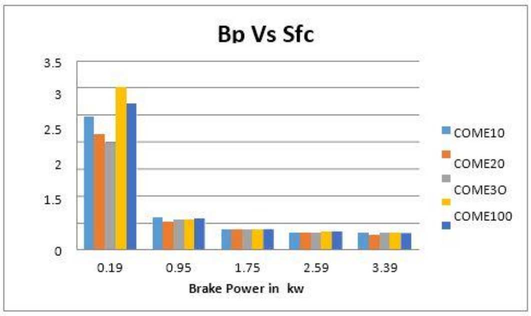


Fig. 8.2 LOAD v/s SFC diagram

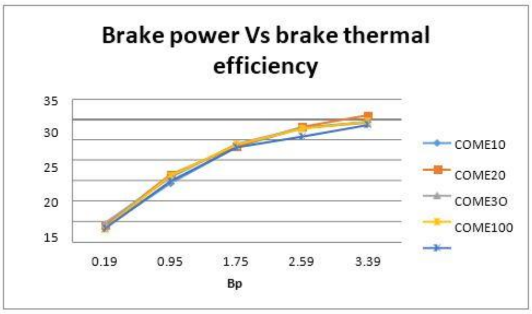


Fig. 8.3 BP v/s BTHE diagram

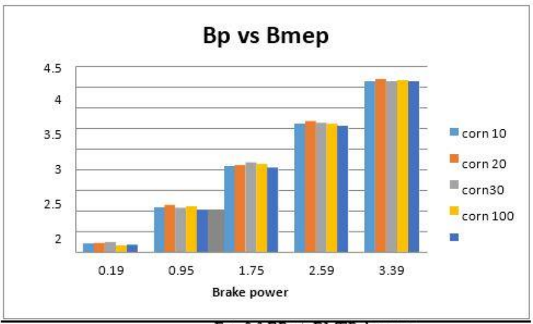


Fig. 8.3 BP v/s BMEP diagram

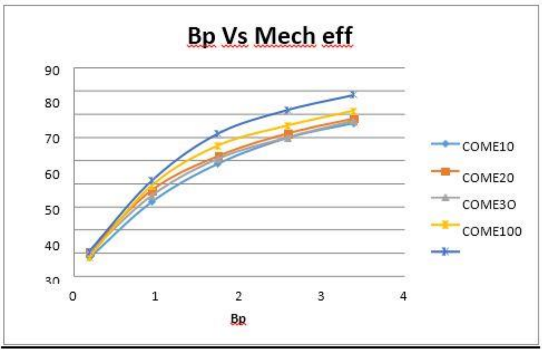


Fig 8.4 BP v/s Mech Eff diagram.

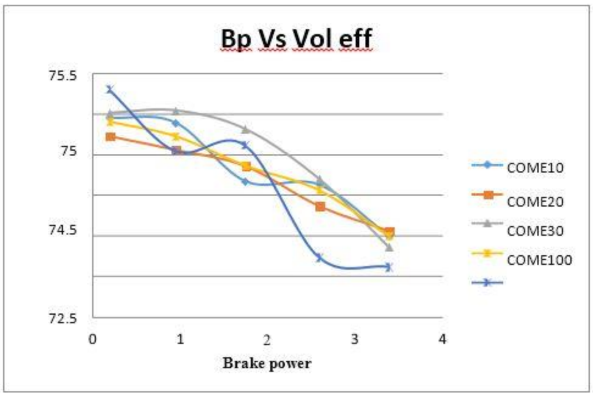


Fig .8.5 BP vs Vol eff

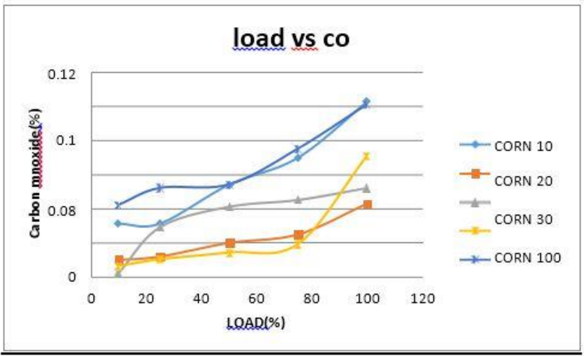


Fig. 8.6 Load vs CO

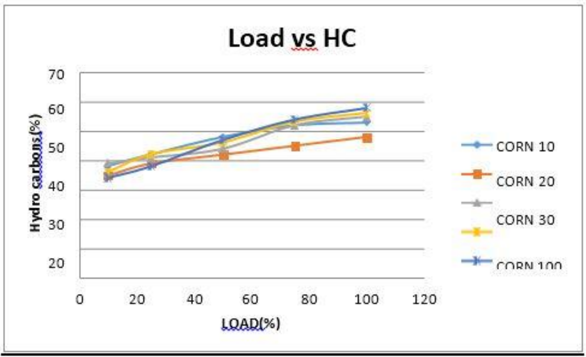


Fig. 8.7 Load v/s HC diagram

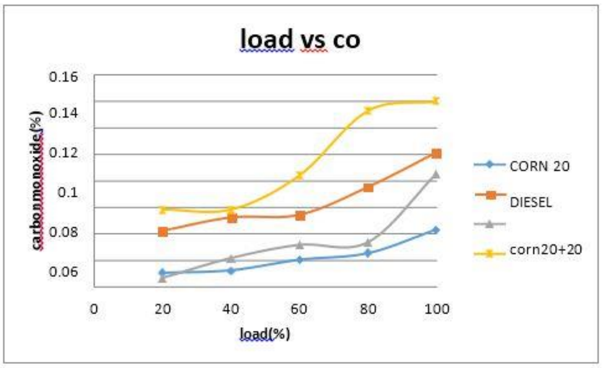


Fig. 8.18 Load vs CO

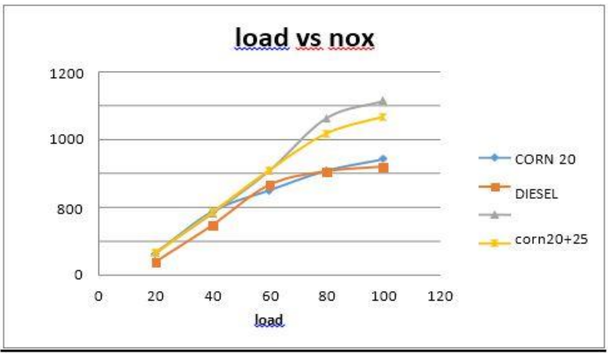


Fig. 8.20 Load v/s NOx diagram

CONCLUSIONS

The main objective of the present study was to use the edible corn oil as pilot fuels in different forms along with isooctane additive added in a single cylinder diesel engine. To reduce the viscosity of neat corn oil, transestrification was done to bring it close to that of conventional diesel. In order to obtain a basis for comparison, the performance& combustion tests were conducted in two parts. In first part, the test was conducted using diesel(baseline test). In the second part, the test was conducted using corn oil along with nano particles additive in the concentration of CeO2 25ppm and 50ppm.

Observations:

COME20 gives the good performance and emission results in single cylinder operation

In COME20has low emission parameters except NOx and smoke emission compared to diesel engine operation.

The performance of all combination of fuels show slightly higher values compared to diesel.

The performance of COME20 is further increased by adding additive.

Finally we conclude that by observing performance, combustion and emission analysis the combination of COME20+Ceo2 50 is acts like a diesel fuel with small deviations. At full load condition the COME20+CeO2 50 will produce maximum

B.P. so, this combination is recommendable for the stationary engines

REFERENCES

1) https://www.ijrer.org/ijrer/index.php/ijrer/article/download/5678/pdf
2) https://iopscience.iop.org/article/10.1088/1757-899X/469/1/012035
3) R.Senthilkumar, M.Loganathan,P.Tamilarasan “Performance and emission characteristics of DI diesel engine with preheating corn oil methyl ester” IJMET VOLUME 5, JANUARY(2014) , PP.79-89.
4) S.Kumar, P.Dinesha and I.Bran, "Experimental investigation of the effects of nanoparticles as an additive in diesel and biodiesel fuelled engines: a review", Biofuels, pp. 1-8, 2017.
5) V.Arul Mozhi Selvan, R.Anand and M.Udayakumar, "Effect of Cerium Oxide Nanoparticles and Carbon Nanotubes as fuel-borne additives in Diesterol blends on the performance, combustion and emission characteristics of a variable compression ratio engine", Fuel, vol. 130, pp. 160-167, 2014.
6) S.Nagaraja,K.Soorya prakash,R.Sudhakaran,M.Sathish kumar“Investigation on emission quality, performance and combustion characteristics of the compression ignition engine fuelled with environmental friendly corn oil methyl ester-Diesel blends” ELSEVIER.
7) U.Santhan kumar, K.Ravi kumar “performance, combustion and emission characteristics of corn oil blends with diesel” International Journal of Engineering Trends and Technology (IJETT) – Volume 4 Issue 9- Sep 2013, Page 3904.
8) Sameet Keshari Pati1, Susant Kumar Sahu published a paper on“Investigation of Bio-Fuel Production and Performance Characteristics of CI Engine”. –IJISET-volume no-2, issue 9, September-2015.
9) G.A Rao, A.V.S. Raju, K.Govinda raju and C.V.Mohana Raopublished a paper on “performance evolution of a dual fuel engine” – IJST- volume no-3 march 2010.
10) V. A. Markov,V.G.Kamaltdinov,S.S.Loboda“optimization of diesel fuel and corn oil mixtures composition” science direct procedia engineering 150(2016)225-

BIOGRAPHIES

Nomula Kondayya
M.Tech Student, Department of Mechanical Engineering, AKRG College of Engineering & Technology, Nallajerla – 534112

Kankati Muralidhar
Department of Mechanical Engineering, AKRG College of Engineering & Technology, Nallajerla – 534112

R V Manikanta
Department of Mechanical Engineering, Swarnandhra Institute of Engineering & Technology, Narsapur – 534280