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# Investigating the Effect of Blending Kerosene and Palm Oil with Diesel Fuel

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**Abstract**— Burning of petroleum based fuels results in severe air pollution. To minimize this environmental impact mankind try to identify a new alternative source of fuel. A lot of experimentation has been done to identify a good source of alternative.The existing studies have discovered that vegetable oils can be a good substitute for diesel fuel.But using vegetable oils directly in an engine is not feasible due to their high viscosity and low volatility. As a result blends of vegetable oils are used in engines as an alternative of diesel.Here in this investigation the effect of blending kerosene and palm oil with diesel fuel is shown. Investigations are conducted using various blends of kerosene and palm oil with diesel. At first kerosene alone is blended with diesel in various ratios and the effect of blending was identified.After that the effect of blending palm oil alone with diesel in various ratio was determined. At last palm oil and kerosene together blended with diesel fuel in equal portion and the change in various fuel properties was determined. The effect of blending palm oil and kerosene alone with diesel is compared with the effect of blending palm oil and kerosene together with diesel. In order to compare the effects various fuel properties were measured. This study mainly concentrate on lower heating value (LHV) or lower calorific value (LCV) and density for various comparison purposes.

**Index Terms**— Biodiesel, Blends, Density, Diesel, Kerosene, Lower Calorific Value (LCV), Palm oil.

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## 1 Introduction

ONE of the major causes of environmental pollution is burning of petroleum based fossil fuels. Besides their environmental impact they have limited resources also. As a result because of their limited availability and hazardous impact on environment scientists look for alternate energy sources. A good alternative of diesel fuel is biodiesels. Biodiesels produced by transesterification processes. Palm oil is one kind of biodiesel. Kerosene is one of the hydrocarbon compound derived as liquid from refined petroleum. Kerosene has high calorific value. Kerosene can be used as jet fuel. Researchers around the world performed a lot of studies to identify the effect of blending of palm oil and kerosene with diesel. The following review will show some of their efforts.

Hasan Bayındır (2007) performs his study using various ratios of cotton oil blended with kerosene.He determines torque, brake specific fuel consumption, engine power using these blended mixture in a four stroke diesel engine.He found that engine torque, engine power and brake specific fuel consumption slightly differ than that of pure diesel.He indicates that using these blends in diesel engine without modification may cause injection system faults [1].

Pedro Benjumea et al. (2008) perform experiment to determine various properties of palm oil biodiesel–diesel blends.They perform their tests according to corresponding ASTM standards.They show a graph which shows the variation of blends viscosity with temperature.They also show the same kind ofgraph for kinematic viscosity [2].

M. Matouq et al. (2009) in their study reviewed the proper combining proportion of kerosene and diesel. The mixing up ratio ranged from 0 to 50% in volume level. The results show significant decrease in pollutant gas emissions while kerosene was blended with diesel. The efficiency for diesel engine hasbeen advanced after kerosene blending, so that it comes to 73% when 50% kerosene was added or blended with diesel [3].

O. Obodeh and F. O. Isaac (2011) perform their study using different blends of kerosene and diesel in a stationary LD 20-D !issan diesel engine.They compared various engine performance parameters such as brake power,emission temperature etc for different mixtures of kerosene and diesel.They concluded that using a mixture of 30% kerosene and 70% diesel will reduce 10% of fuel cost [4].

Mohammad Nazri Mohd Ja'afar et al. (2014) perform experiments on combustion performance using palm oil bio diesel blends.They measure density, viscosity and surface tension for various blends of palm oil biodiesel.They also examine the flame propagation and temperature profile for those palm oil biodiesel blends.They found that 10% blends of palm oil biodiesel shows high potential to replace diesel due to its high energy content considering the emission problems is ignored [5].

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Naseer Salman Kadhim (2015) performs a study where he created two different mixture of kerosene and diesel.One mixture contain 10% kerosene and 90% diesel and another one contains 20% kerosene and 80% diesel.In his experiments he determined brake thermal efficiency,brake specific fuel consumption,emission of different gases using a 4 stroke diesel engine by those mixute of 10% and 20% kerosene.He identified that both blends of kerosene and diesel shows lower specific fuel consumption than the pure diesel but the problem is that emission gases increases in case of blended mixture.He proposed that kerosene diesel blends can be used in diesel engine without modification of engine assembly [6].

Bilal A. Akash (2015) investigate performaces of diesel fuel and kerosene and their blends using horizontally positioned cylindrical furnace.He analysed the exaust gases and combustion efficiency.He found improved combustion efficiency and emission results in case of blended mixtures.A mixture of 75% kerosene and 25% diesel gives the best result [7].

Abul Hossain et al.(2016) in chemical engineering transactions published their research output.Where they performed experiments to determine kinematic viscosity, higher heating value, density, flash point temperature, sulphur content, ash content etc of glidfuel biofuel - a waste stream from paper industry, palm oil mill effluent which is produced by processing palm oil industrial waste and differet proportion mixture of glidfuel biofuel and palm oil mill effluent biofuel.They found that in optimum proportion blends of these two biofuel results in conformity with pure diesel oil [8].

Azeem Hafiz PA et al. (2016) conduct experimental study using 10%, 20%, 30% kerosene diesel blends.Where they determine the engine performance parameters such as mechanical efficiency, brake thermal efficiency, exhaust temperature and specific fuel consumption using single cylinder-four stroke diesel engine.They showed their experimental finding with the help of various curves plotted in graph [9].

R. El-Araby et al. (2017) perform their investigation with the help of palm oil methyl esters and palm oil methyl esters blends with diesel fuel.These blends of palm oil have been characterised as an alternative fuels for diesel engines. Kinematic viscosity and flash point was predicted.Based on the experimental results different correlations have been developed. Those advanced equations can be used as a guideline for mixing palm oil and diesel in different ratios [10].

Syed Shahbaz Anjum and Dr. Om Prakash perform tests on single cylinder diesel engine using blends of kerosene and diesel in various ratios.They used three different ratio of kerosene blends where the kerosene percentage is 5%, 10% and 15% respectively.They found the test results near similar to that of pure diesel.They also determine various engine performance parameters for their comparasion purpose [11].

The assessment of the literature showed that investigation of various blends using palm oil and kerosene in equal portion together with diesel has not been addressed. This present study will show the effect of kerosene and palm oil blends with diesel when mixed with diesel individually in various ratios. This study will also show the effect of kerosene and palm oil blends with diesel when mixed with diesel together in various mixing ratio.

## 2 MATERIALS USED FOR THE INVESTIGATION

For investigation pure diesel fuel, kerosene and palm oil was purchased from neighboring market. For investigating the effect of palm oil blends with diesel five mixtures of palm oil and diesel having different mixing ratio were prepared with the help of beaker and syringe.The beaker can measure maximum 50 ml of mixture. For lower mixing ratio syringe which can measure maximum 5 ml is used.

Fig.1 Beaker and syringe used for measuring purposes.

Five various ratio mixtures of kerosene and diesel were also prepared.Lastly five more mixture which contain both palm oil and kerosene together blends with diesel in various ratios were prepared.Total fifteen samples of different mixing ratio of palm oil, kerosene and diesel were prepared.

Fig.2 Samples prepared for the investigation.

For preparing various blends ingradients were measured by volume. For example a mixture which contains 5% kerosene, 5% palm oil and 90 % diesel indicates that in a mixture whose total volume is 100 ml contains 5ml kerosene, 5ml palm oil and 90 ml diesel.For each sample the percentage of different ingradients indicate the same as above. For plotting the resultant graph different names were given to each sample. The names assigned to various samples are shown in the following tables.

TABLE 1
LIST OF NAMES ASSIGNED TO BASE ELEMENTS

| Name assigned to the Sample | Percentage of constituents in the prepared sample |
|---|---|
| D | 100% Diesel |
| K | 100% Kerosene |
| P | 100% Palm Oil |

TABLE 2
LIST OF NAMES ASSIGNED TO VARIOUS RATIO BLENDS OF KEROSENE WITH DIESEL

| Name assigned to the Sample | Percentage of constituents in the prepared sample |
|---|---|
| K10 | 10% Kerosene and 90% Diesel |
| K20 | 20% Kerosene and 80% Diesel |
| K30 | 30% Kerosene and 70% Diesel |
| K40 | 40% Kerosene and 60% Diesel |
| K50 | 50% Kerosene and 50% Diesel |

TABLE 3
LIST OF NAMES ASSIGNED TO VARIOUS RATIO BLENDS OF PALM OIL WITH DIESEL

| Name assigned to the Sample | Percentage of constituents in the prepared sample |
|---|---|
| P10 | 10% Palm Oil and 90% Diesel |
| P20 | 20% Palm Oil and 80% Diesel |
| P30 | 30% Palm Oil and 70% Diesel |
| P40 | 40% Palm Oil and 60% Diesel |
| P50 | 50% Palm Oil and 50% Diesel |

TABLE 4
LIST OF NAMES ASSIGNED TO VARIOUS RATIO BLENDS OF PALM OIL AND KEROSENE TOGETHER WITH DIESEL

| Name assigned to the Sample | Percentage of constituents in the prepared sample |
|---|---|
| KP10 | 5% Kerosene, 5% Palm oil and 90% Diesel |
| KP20 | 10% Kerosene, 10% Palm oil and 80% Diesel |
| KP30 | 15% Kerosene, 15% Palm oil and 70% Diesel |
| KP40 | 20% Kerosene, 20% Palm oil and 60% Diesel |
| KP50 | 25% Kerosene, 25% Palm oil and 50% Diesel |

## 3 EXPERIMENTAL PROCEDURE

For measuring lower heating values of the prepared samples experimentations were performed using bomb calorimeter.At first 1gm of prepared specimen is measured and placed inside the crucible.Then fuse wire of known length attached to the electrodes.After closing the bomb it was filled with oxygen.Commercial oxygen formed by refinement of liquid air was used directly from the supply cylinder.Thermometer was placed inside the bomb calorimeter in order to determine the temperatures.A stop watch is used to determine the time intervals. After starting the bomb calorimeter temperature reading of the thermometer started to rise and after a certain time the increment of temperature stopped and a fixed reading of temperature is obtained from the thermometer.The time interval required to achive this condition is recorderd. Then the bomb calorimeter is opened and the unburnt length of fuse wire is measured. With the help of proper equations the lower calorific values were measured by using those readings of time interval, temperature and length of burnt fuse wire.

Fig.3 Bomb calorimeter used for the experimentations.

For measuring the densities of the prepared samples a weight scale is used. For measuring density of a sample at first the mass of 60 ml of sample was measured.Then using the mathematical relation between volume and mass density of the sample was measued.

## 4 Results and Discussion

The results of the investigation performed is shown with the help of charts showing below.Among three base elements kerosene has maximum lower calorific value of 45587.13 KJ/Kg. Diesel and palm oil used for the experiments have a lower calorific value of 44885.69 KJ/Kg and 39154.9 KJ/Kg respectively.LCV of base elements is shown in Fig 4.

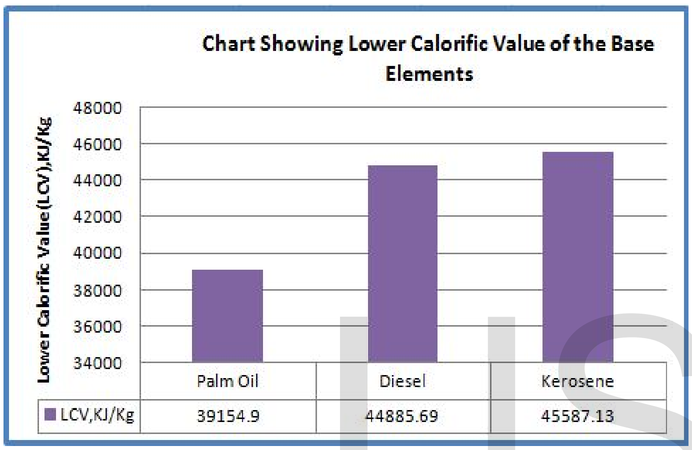


Fig.4 Chart showing lower calorific value of the base elements.

Among three base elements palm oil has maximum density of 909.55 Kg/m³. Diesel and kerosene used for the experiments have a density of 833.27 Kg/m³ and 814.12 Kg/m³ respectively.Density of base elements is shown in Fig 5.From fig 5 it is seen that palm oil has higher density than diesel and kerosene.On the other hand diesel has a higher density than kerosene.

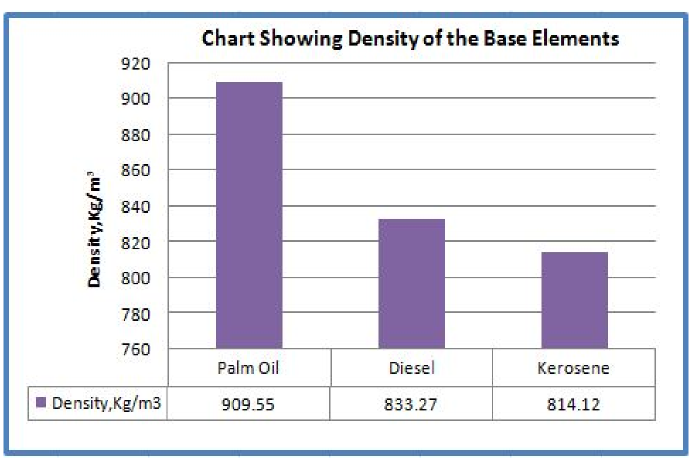


Fig.5 Chart showing Density of the Base Elements.

In the following portion of the results and discussion the effect of blending on density and lower calorific value will discuss. In every case best fit curve was plotted.For understanding the effect of blending kerosene with diesel on blend density fig 6 has been plotted.From fig 6 it is seen that as the portion of the kerosene in the diesel kerosene blends increases the density of the blends decreases.That is because of with the increase of kerosene in diesel kerosene blends the percentage of diesel which has higher density than kerosene decraeses.

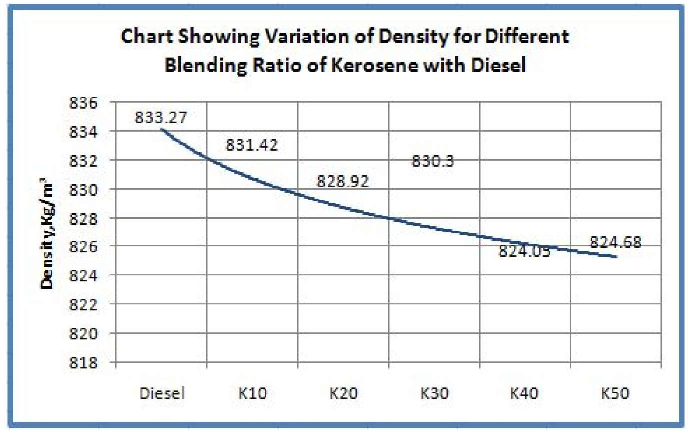


Fig.6 Chart showing variation of density for different blending ratio of kerosene with diesel.

From fig 7 the effect of palm oil blended with diesel on blend density can easily understand. It is seen that as the portion of the palm oil in the diesel palm oil blends increases the density of the blends increases.That is because of palm oil has higher density than diesel.

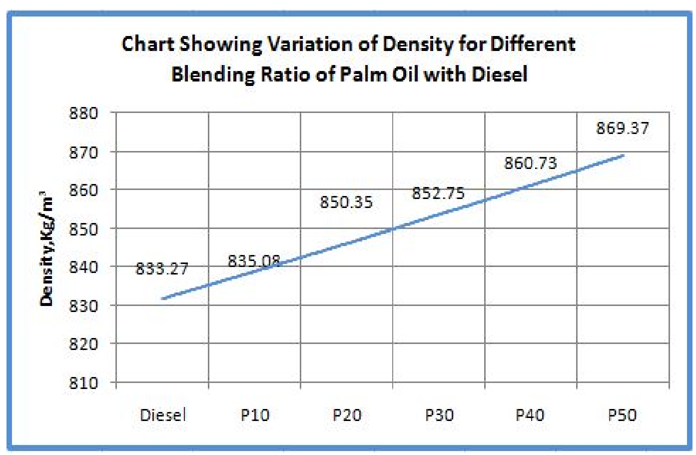


Fig.7 Chart showing variation of density for different blending ratio of palm oil with diesel.

The effect of blending diesel with equal portion of palm oil and kerosene on blend density can be observed from fig 8.It is observed that as the portion of the palm oil and kerosene in the blends increases the density of the blends increases.But kerosene has low density than diesel.Palm oil makes it possible to increase the density of the blends.Higher density of palm oil dominates over the densities of diesel and kerosene and determine the density of the blends.

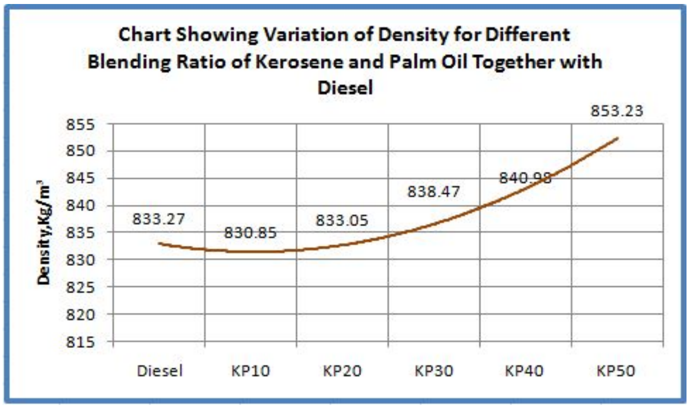


Fig.8 Chart showing variation of density for different blending ratio of equal portion of kerosene and palm oil with diesel.

For comparing the above mentioned results fig 9 was plotted where it is seen that with the increase of blend ratio the density of the blends increases in case of palm oil where as it decreases for kerosene.But in case of blending of diesel with equal portion of palm oil and kerosene the density of the blends increases.

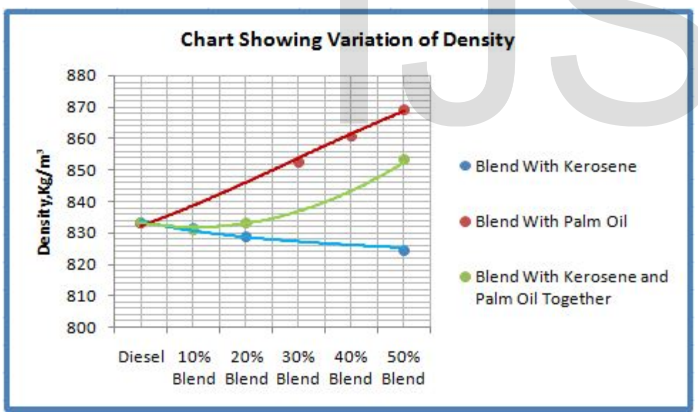


Fig.9 Chart showing variation of density for different blending ratio.

Comparision can also be done with the help of fig 10. Which shows a column chart. From fig 10 it is seen that with the increase of blend ratio the density of the blends increases in case of palm oil. The density of the blends decrease for kerosene. But in case of blending of diesel with equal portion of palm oil and kerosene the density of the blends increases.The height of each column indicates the magnitude of the density in kg/m³.The coulmn shows more height in case of palm oil when compared to diesel and kerosene.This column chart is more convenient to understand the differences in densities.The numerical values of densities can directly obtained from this column chart.

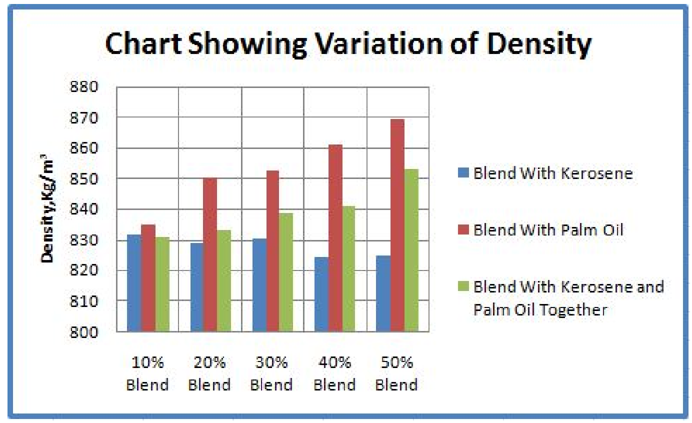


Fig.10 Chart showing variation of density for different blending ratio.

From fig 11 it is observed that lower calorific value of palm oil diesel blends decreases with the increase of blend ratio. Increasing portion of palm oil causes the reduction of lower calorific value.

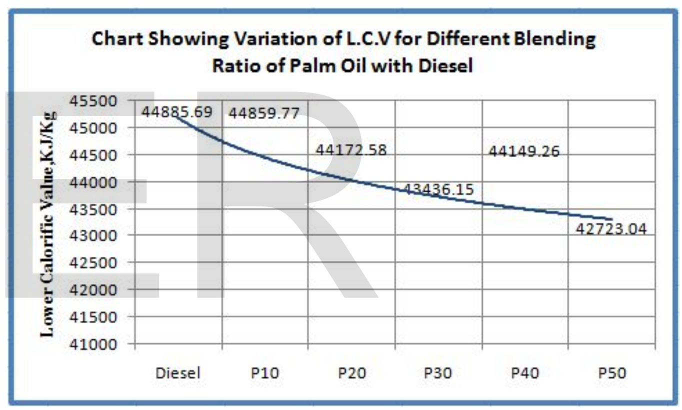


Fig.11 Chart showing variation of L.C.V for different blending ratio of palm oil with diesel.

The effect of blending kerosene with diesel is shown fig 12.

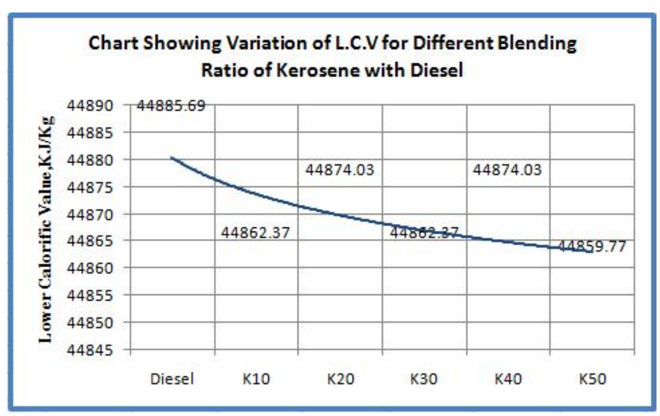


Fig.12 Chart showing variation of L.C.V for different blending ratio of kerosene with diesel.

From fig 12 it can be observed that with the increase of blend ratio the lower calorific value of the blends decreases which stands opposite to theory.The causes of decreasing the lower calorific value is unknown.From fig 13 the effect of blending equal portion of palm oil and kerosene with diesel can be observed.

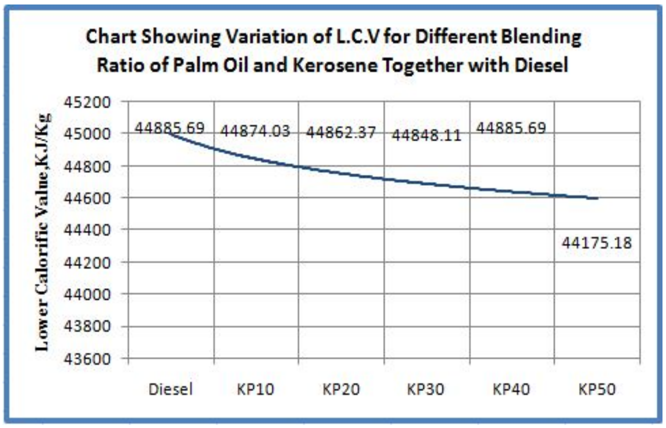


Fig.13 Chart showing variation of L.C.V for different blending ratio of equal portion of kerosene and palm oil with diesel.

From fig 13 it is seen that with the increase of blend ratio the lower calorific value decreases.That is because of in the blends of kerosene and palm oil with diesel palm oil dominates over kerosene. For comparing different blends fig 14 was plotted which also verify the results mention above.



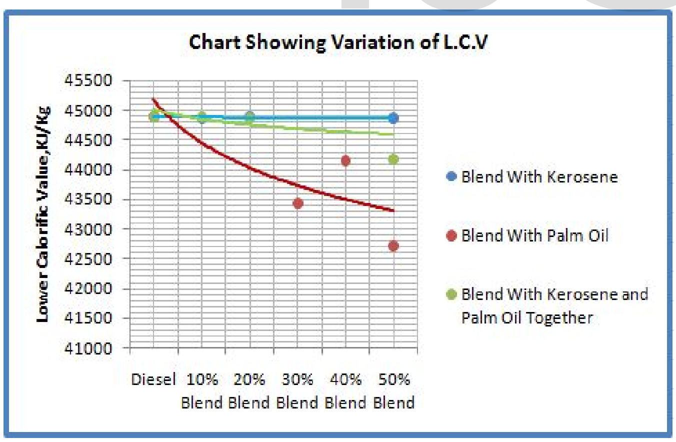


Fig.14 Chart showing variation of L.C.V for different blending ratio.

## 5 Conclusion

In the above investigations the effect of blending kerosene and palm oil with diesel fuel in various ratios were identified.The above mentioned comparision,s were done based on density and lower calorific value. It is possible to perform same kind of investigations using same type of blends in terms of other fuel properties also.This investigation has a lot of future scope for expanding. Interested researchers can perform the same type of experiments based on other fuel properties such as flash point, viscosity, boiling point etc.From the above investigation it is verified that blends of vegetable oils with diesel has higher density than diesel fuel where as it is lower when blends with paraffin is considered.From the above investigation it is also verified that blending of vegetable oils with diesel fuel results in low L.H.V or L.C.V when compared with diesel.These investigations will serve as a guideline for young researchers who wish to study the effect of blending vegetable oils and paraffin with diesel fuel.

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