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CALORIC DELINEATION OF BOTH GASOLINE AND DIESEL BLENDS USING DSC

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ABSTRACT

Today, one of the most serious issues associated with the use of internal combustion engines is the emission of harmful gases. In researching alternative sources of energy, there has been an increase in concern about the need for energy resources and the environmental and demand impacts of fuel sources. To meet this criterion, biodiesels will play an important role as an alternative to diesel oil because they are renewable and have similar properties. Petroleum products are currently being consumed at a rate that will lead to depletion in the coming decades. Ethanol usage in transportation is one of the sectors that can meet the requirement while also helping to reduce vehicle greenhouse gas emissions. The application of thermo gravimetric analysis to renewable energy sources is a novel study that has gained popularity among researchers in recent years. In this mainly focus on differential scanning calorimeter(DSC) of various blends to investigate the (TG-DSC) thermal behavior of Petrol, Diesel, Ethanol blends(E5,E10,E20),J atropha oil and waste cooking oil blends all the thermo grams of heat flow is exhibited at 35ºC -300ºC temperature range at air atmosphere ,The main aim of the study to observe the combustion behavior of both petrol and diesel blends, the origin of biodiesel blends have been analyzed to observe the transesterification reaction effect on biodiesel. Therefore, the petrol and biodiesel blends at different percentages are exposed to isothermal heating rates under nitrogen and air atmosphere with a constant heat rate by using DSC.

KEYWORDS: *Differential Scanning Calorimeter, Combustion, Thermo Gravimetric, Bio-Diesel Blends, Thermo Grams.*

1. INTRODUCTION

Due to the increasing scarcity of petroleum resources around the world, we are compelled to look for alternative fuels to meet the demand for fuels. Among the various alternative fuels such as LPG, biodiesel, hydrogen, ethanol, battery, and so on, biodiesel occupies a notable and significant position. Many research experts now believe that the world's supply of petroleum products will be depleted within the next 40 to 60 years. As a result, there is an increase in research into effective petroleum substitutes. According to a report, produced in India only 30 to 40% of its total petroleum requirements for consumption, with the remaining 70% imported from other countries at a cost of approximately Rs.10,00000 million per year. It is certain that blending 5% bio - diesel with current diesel will save Rs.40,000 million per year.**[1]**

Biodiesel was introduced in the 1990s as a result of global warming, greenhouse gas emissions from vehicles, and its advantages over regular diesel, such as non-sulfur emissions, low toxicity, biodegradability, and Eco friendliness. Biodiesel is made from renewable sources such as fresh or used vegetable oils, animal fats, and so on. In terms of Cetane number, flashpoint, lubricity, and exhaust emissions, it outperforms diesel fuels. It can be blended with conventional diesel in certain proportions and used to power any existing conventional CI engine with no engine modifications required.**[2-3]**

Transesterification is the process of converting vegetable oil into biodiesel fuel, and it is fortunately less complicated than it sounds. Chemically, transesterification is the process of using an alcohol (e.g., methanol, ethanol, or butanol) in the presence of a catalyst, such as sodium hydroxide or potassium hydroxide, to chemically break the molecule of raw renewable oil into methyl or ethyl esters of the renewable oil, with glycerol as a byproduct. If the reaction's reagent is methanol, the biodiesel is referred to as methanol route biodiesel; if the alcohol agent is ethanol, the biodiesel is referred to as ethanol route biodiesel. **[4]**

A lot of research has been carried out by many researchers worldwide to investigate the possibility of biodiesel instead of diesel. Among the studies, using thermogravimetric methods to investigate the thermal behavior of biodiesel and its blends with diesel is a novel and unexplored topic. Although the use of thermogravimetry (TGA/DTG) and differential scanning calorimeters (DSC) in petroleum derivatives has grown in popularity among researchers, its application to biodiesel is a relatively new and promising technology.**[5]**TGA/DTG and DSC were used in this study to perform thermogravimetric analysis on diesel, biodiesel, canola oil, and biodieseldiesel blends. Experiments are conducted in nitrogen and air atmospheres at some heating rate to investigate the pyrolysis and combustion properties of the fuels.**[6-7]**

Calorimetric measurements yield a DSC curve, which represents the temperature/time dependence on heat flux. Endo- and exothermic peaks are recorded on these curves as a result of temperature differences between a tested sample and a reference sample, indicating negative or positive deviations from the so-called "baseline," which is recorded when no transformations/reactions occur in the sample. The variations are caused by phase transformations and chemical reactions that occur in the material. Heat is absorbed when the temperature of a tested sample during the phase transformation/chemical reaction falls below the reference temperature. The heat has been absorbed; this is referred to as the endothermic peak. When the sample temperature rises and heat separates, this is indicated by the exothermic effect on the DSC curve.**[8-9]**

2.Experimental procedure:

T-zero calibration, or temperature check, is performed in two steps. The first step is to obtain the baseline using no pans or samples. The second operation is performed with the sapphire material alumina with pan placing on both reference positions. The cell is preheated in both operations, and the initial equilibrium temperature remains isothermal for 5 minutes. Since the samples are liquids and volatile, temperature zero mass aluminum pans are appropriate. Temperature and sensitivity tests had been performed on Al 2O3.

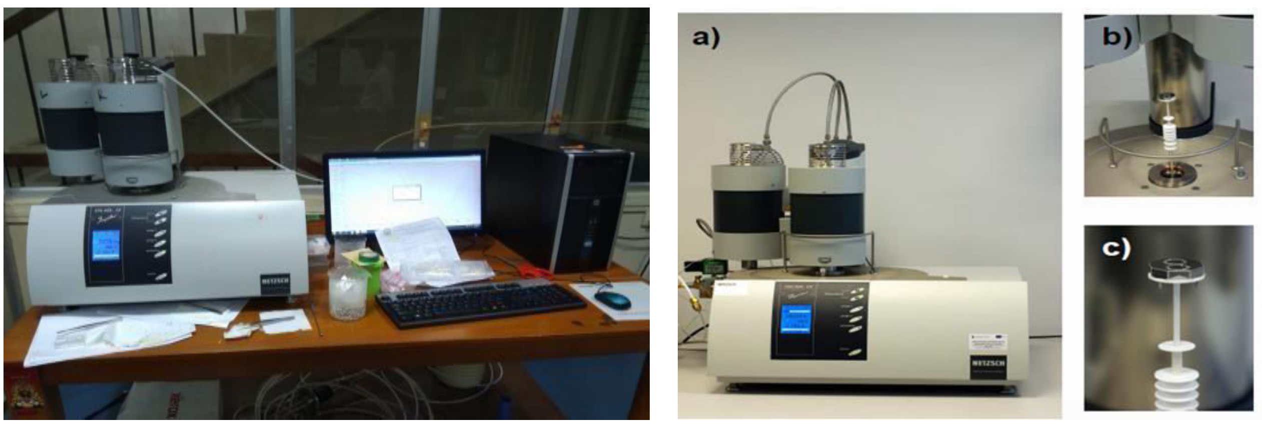


Fig: TG-DSC INSTRUMENT NETZSCHSTA 449F3

The investigation of samples bioethanol, bio diesel, and its blends are exhibits one reaction zone, indicating that the apparatuses constituting the samples are similar in nature and the response interval zone is nearly identical for all samples. DSC combustion is performed using STA 449F3, an aluminum pan with a heating rate of 100C/min, and the curve is evaluated in terms of peak temperature, reaction intervals, and heat flow of the reactions. Some materials meet with partial combustion in air, forming char, which can affect results; however, in an oxygen environment, most organic materials will go through the entire combustion process, which is why the experiment is carried out in oxygen(O2).To run experiments on the DSC Analyzer, a test procedure must be specified. Depending on the experiment type, a temperature range of 25-600 C is used, with a constant heating rate of 5, 10, or 15 C/min. Also, nitrogen is chosen as the purge gas for pyrolysis experiments, while air is chosen for combustion experiments. Furthermore, some signals must be saved in order to analyses the experiment after it is completed. Time (min), temperature (C), heating flow (W/mg), sample purge gas, and flow rates (ml/min) were chosen as the signals.

3.Differential scanning calorimeter:

Calorimeter measures the heat into or out of the sample. A differential calorimeter measures the heat of sample relative to a reference. Differential scanning calorimeter does all the above and heats the sample with a linear temperature. Endothermic means Heat flows into the sample.

Exothermic means Heat flows out of the sample. DSc measures differences in the amount of heat required to increase the temperature of a sample and reference as a function of temperature.

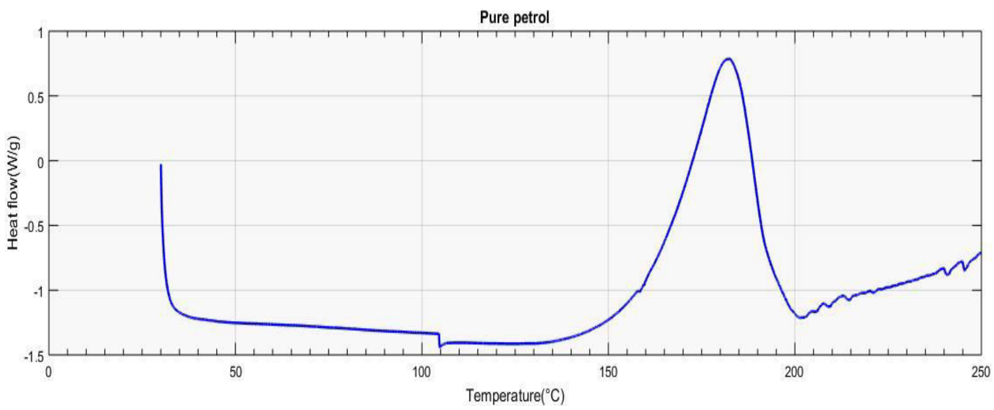
Heat flow α C_p (Heat capacity of material for a given temperature).

Enthalpy: A thermodynamic quantity equivalent to the total heat content of system. It is equal to the internal energy of the system plus the product of pressure and volume.

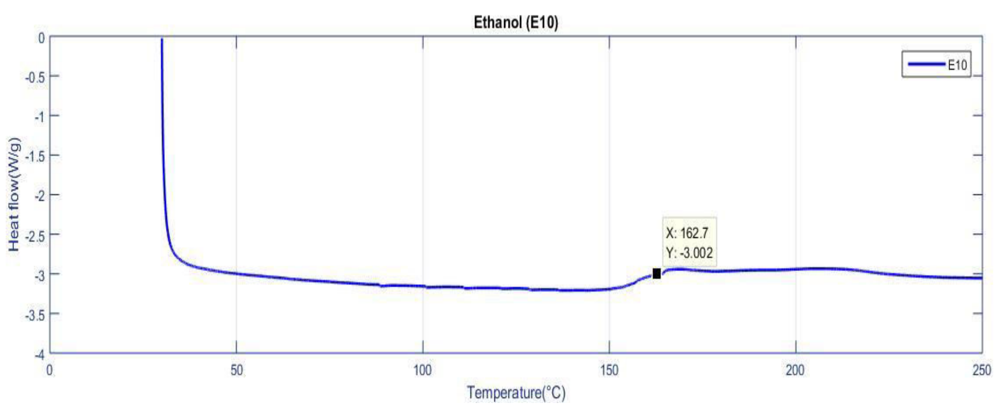
4. Results and Discussions:

Gasoline results:

1)



From the above figure Temp vs Heat Flow shows that the heating rate at 10c/min, the peak temperature of pure petrol is around 180ºc. The DSC curve starts and remains constant at 40ºc and drastically varies from 200ºc from the temperature nearly 150ºc to 180ºc is endo -thermic reaction (+ve) reaction the DSC curve shifts to endo to exo thermic reaction from 180ºc onwards the curve slightly comes to downward, and it is exothermic reaction.



2)

From the above fig Temp vs Heat flow shows that the peak temperature take place is around 162ºc, the DSC curve represents purely exo-thermic reaction compared to petrol it as high heating rate and boosting power and gave less emissions the curve starts at nearly 40ºc and drastically varies through 250ºc, therefore, the combustion becomes better by increasing the thermal efficiency.

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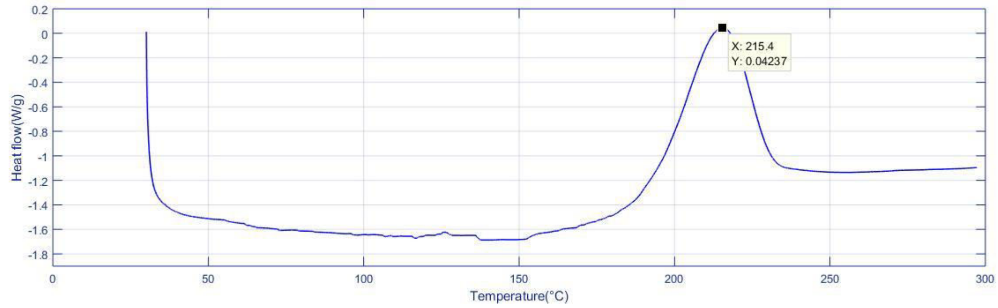
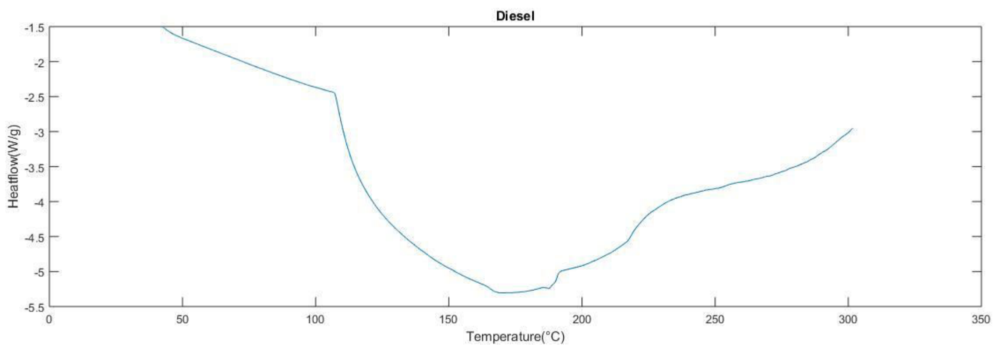


3)

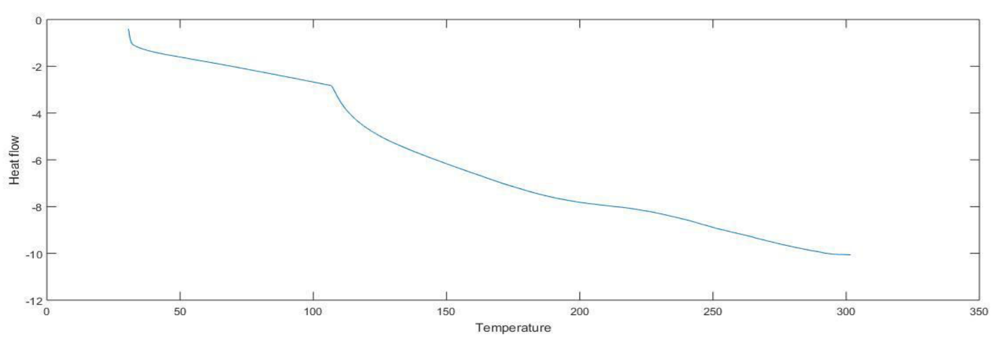
From the above fig Temp vs Heat Flow, shows that the peak temperature take place is around 215ºc, The DSC curve represents exothermic reaction (negative) take place, it can be constant at certain temperature of both exo-endo thermic reaction the curve starts at 35ºc ends at 300ºc nearly in between it E10 blend it has high octane number.*During above analysis we say that we add the petrol into the ethanol it exhibits high octane rating and high thermal efficiency, low emissions, but the lifetime of engine should be reduced.



4)

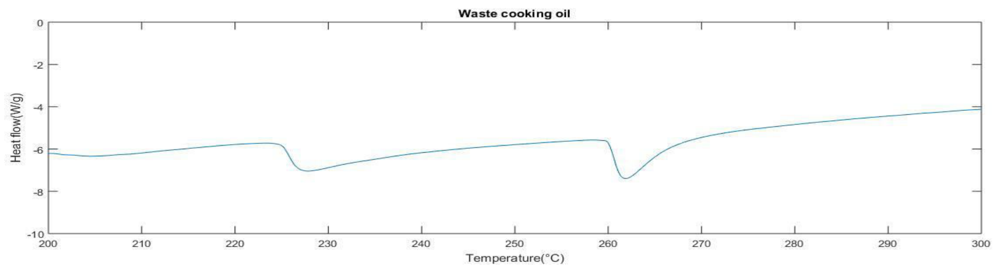
From the above graph temp V Heat flow of diesel shows that the peak temperature is nearly 150◦ to 180ºc the DSC curve completely Exo -thermic and it is negative reaction take place the curve starts at nearly 50ºc and ends at 250ºc in between peak temp exhibits compare to petrol, the curve completely exothermic. In petrol it should changes the peak at certain temperature.

5)



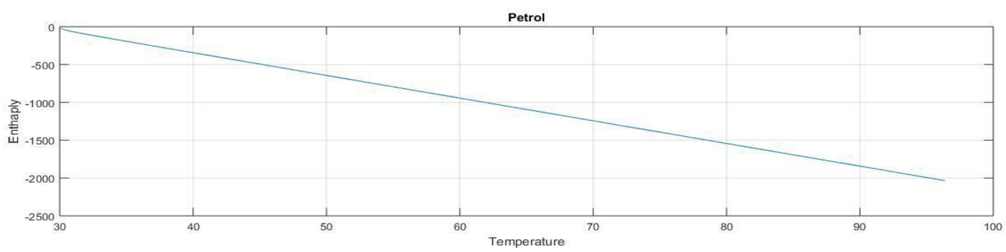
From the above graph temp vs Heat flow show that the peak temperature is nearly 100ºc to 120ºc the DSC curve downwards from the zero to negative it is completely exothermic reaction take place compare the diesel during the curve was at constant after 120ºc is end point .100% of jatropha oil is not used for combustion process, the heat flow or heat rate is constant at higher temperatures.

6)Waste cooking oil:



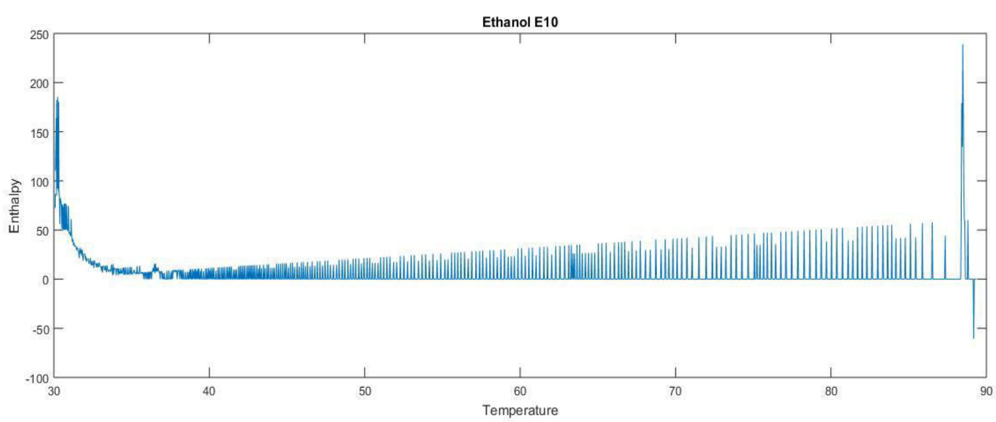
From the above graph temp vs heat flow shows that the peak temperatures exhibit two one is at 225ºc and another one is at 265ºc, at 265ºc temp gets actual peak the DSC curve start at nearly 190ºc and ends at 300ºc here it was completely exothermic reaction (negative) take place compare the diesel it has high heat flow rate and high thermal efficiency etc.

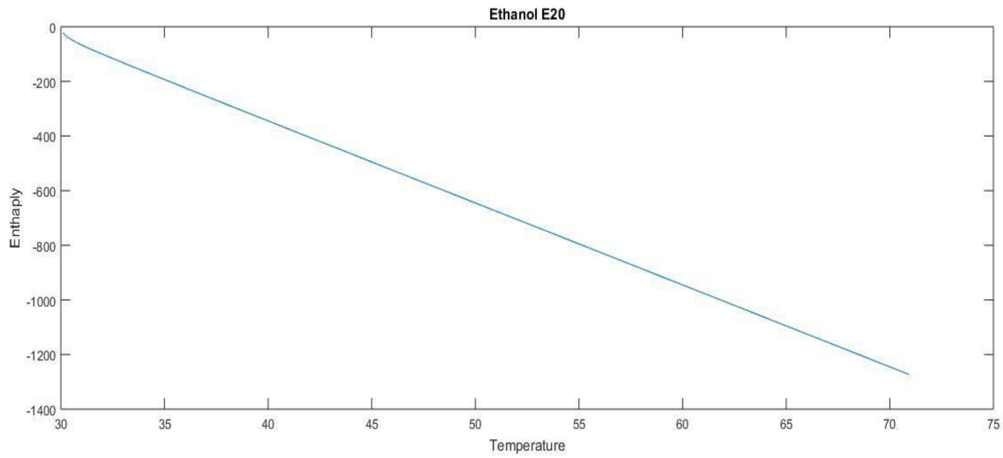
7.Petrol enthalpy:



The above graph indicates that temp vs enthalpy of petrol w.k.t enthalpy is a function of temp, when the temp increases the enthalpy will be decreased, during the mass of fuel is corresponding to the temp increases than we calculate enthalpy change in reaction. Enthalpy reaction was completely exothermic reaction, and it should be negative. For enthalpy mainly products and reactants can be change it should be removed. The heat energy is given out when one mole of substance burns completely in oxygen.

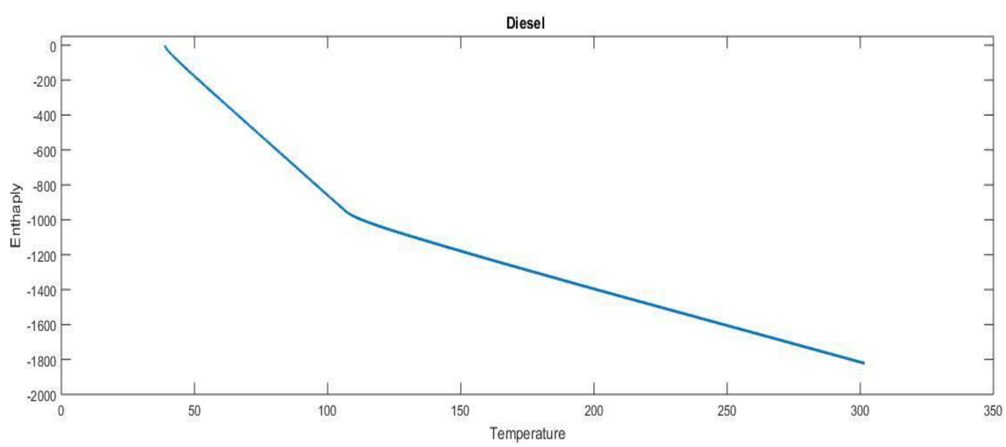
8. Ethanol E10, E20:





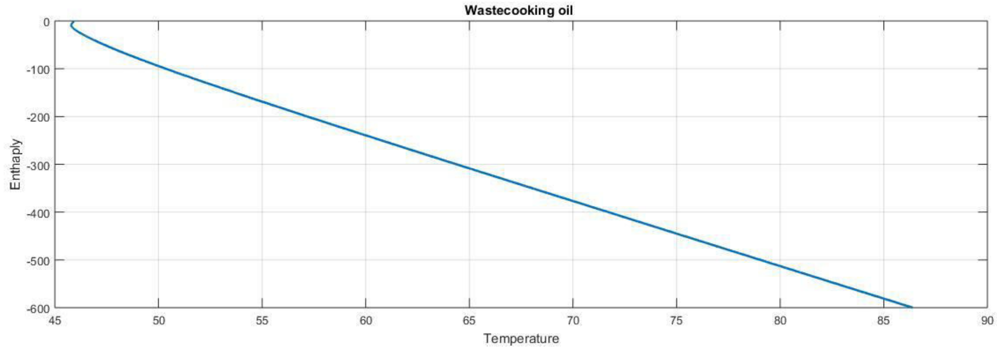
- From the above two graphs Ethanol E10, E20 temp vs enthalpy say that the temp increases enthalpy was decreases.
- For the ethanol boosting power is high and exhibits less emissions.
- In the Ethanol alcohol content is more when it is combines with petrol, the carbon and the oxygen content of air is easily taken and gave more heat to the combustion and gave less emissions.
- The bonds of C=O are double and stronger it should be giving enthalpy change. The products and reactants were more it gives actual enthalpy. Exothermic reaction (purely) and negative reaction formed.

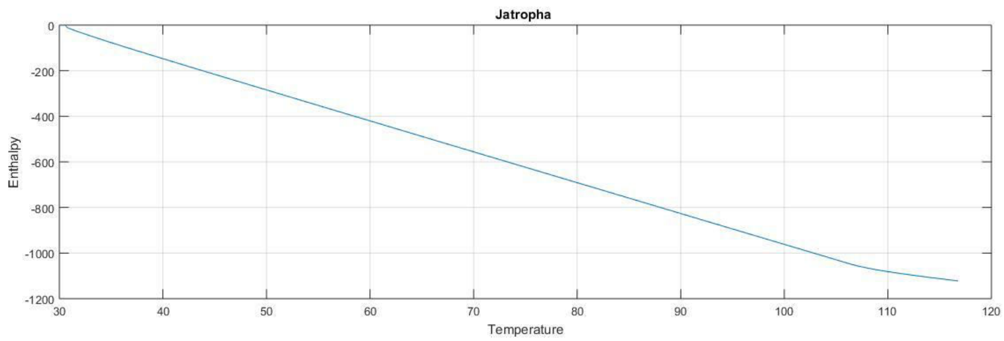
9.Diesel enthalpy:



The above graph show that Temp vs enthalpy diesel is constant at 100ºc after it can be changes it should be curved, the temperature increases the enthalpy was changes on its way. It is should exothermic reaction, negative reaction can be formed its means If 'ΔH' is negative enthalpy of the system increases and the heat flow to the surroundings.

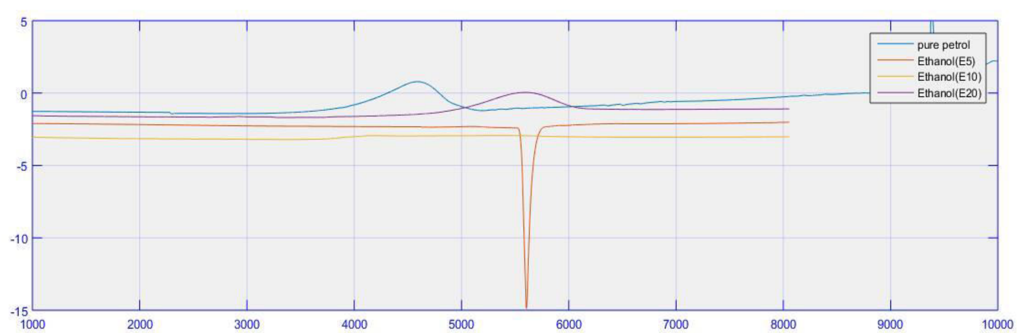
10.Waste cooking oil and jatropha oil:





The above graph shows that the temp vs enthalpy of both waste cooking oil and jatropha oil, Temperature at starting to the ending 30ºc to 120ºc it should be constant and the enthalpy at 1000kJ it should be decreases gradually. The enthalpy change is exothermic reaction the reaction can be formed it means 'ΔH' negative the enthalpy of the system increases and the heat flow to the surroundings. Pure waste cooking oil is heated at high temperatures. If the exothermic reaction, heat is released by the system to its surroundings. Bond making releases energy.

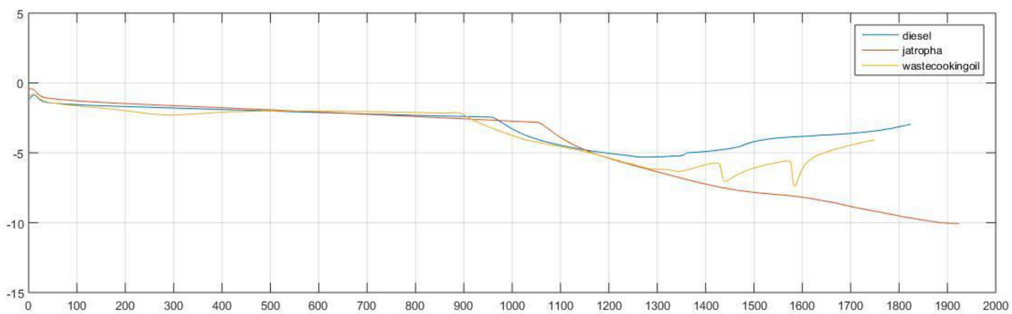
11.Petrol and its blends:



The above graph shows that all thermograms of Petrol and its Ethanol blends. The thermograms of petrol slightly the peak temperature goes to endothermic and afterwards down to exothermic reaction, the remaining Petrol-Ethanol blends are completely exo-thermic reaction the energy is released by the system.

- The Fire point of Ethanol blends are high compare to petrol.
- Heat of combustion is less than Petrol compare to Ethanol blends
- Ethanol blends octane number is increasing more compare to Petrol.

12.Diesel and various blends of seed oils:



The above graph shows that all thermograms of Diesel and its Bio-diesel blends. The thermograms of waste cooking oil gives Exhaust peak compare to Diesel, Waste cooking oil and Jatropha all thermograms are exothermic reactions.1

- Calorific valve of diesel is more compare to Jatropha and Waste cooking oil
- Jatropha seed oil and Waste cooking oil of Kinematic Viscosity is more than the Diesel.
- Jatropha seed oil and Waste cooking oil of Cetane number is increases more compare to Diesel.

Fuel blend	Density @15.6c	API gravity (deg)	Kinematic viscosity mm2/sec @30c	Flash point ©	Fire point ©	Cloud point ©	Head of combustion MJ/L	Octane number
Petrol	0.7400	59.53	0.4872	-	25.0	-22	34.84	93.2
E5	0.7385	58.42	0.4925	-	27	>8	34.12	95.2
E10	0.7396	57.10	0.5383	-	29.0	>8	33.19	97.1
E15	0.7495	57.09	0.5619	-	29.1	>8	32.91	98.6

TABLE:1. FUEL PROPERTIES OF TESTED BLENDS OF PETROL

Fuel blend	Density@15.6c	API gravity(deg)	Kinematic viscosity@40c	Calorific valve	Flashpoint	Cetane number
Diesel	0.82-0.87	39.51	1.3-4.1	42	60-80	40-55
Jatropha	0.91		3.598	38.65	229	23-41
Waste cooking oil	0.893	26.87	3.658	35.56	160	50

TABLE:2. FUEL PROPERTIES OF VARIOUS OILS

5. CONCLUSION:

This Study has been conducted in order to search whether which alternative fuel as renewable energy source ,can be replaced by petrol and diesel fuel and also observe the effect of biodiesel &Ethanol blending on combustion at different percentages to petrol& diesel ,Therefore the Ethanol blending with petrol (E5,E10,E20) and diesel ,Jatropha oil &Waste cooking oil at different percentages are exposed at isothermal heating under nitrogen and air atmosphere with constant heating rate by using Differential Scanning Calorimetry ,Reaction parameters such as peak temperature ,heat flow of reaction, Enthalpy ,Specific heat capacity etc. are determined.

Petrol and its blends:

- The peak temperature of petrol is exhibits at nearly 180ºc
- Ethanol(E10) the peak temperature is nearly 162.7ºc, and it is exothermic reaction
- Ethanol(E20) the peak temperature is nearly 215ºc and is exothermic reaction, temperature is auto ignition temperature during combustion.

During combustion, the mixing of petrol into the ethanol blend it gives more accurate profiles. The E5 blend gets melting point from the curve accurately, the mixture E10 & E20 gets combustion reaction more efficiently. In DSc analysis at higher temperature interval implying the octane number of ethanol is higher than petrol and results in their no delay in petrol engines during combustion. Ethanol-gasoline blends used as alternative fuel for variable speed is spark-ignition up to 35% blends without engine modification. It concludes that the blending ethanol with petrol blends is economical with reduced harmful pollutions.

Diesel and its blends:

- **The peak** temperature exhibits at nearly 170ºc
- Jatropha seed oil the temperature exhibits at nearly 110ºc it is exothermic reaction it means the energy is released by the system.
- Waste cooking oil the peak temperature is nearly 225ºc and 265ºc is exhibited it is also an exothermic reaction.

6. REFERENCES:

1. Termicznej SAT'98 Materials Analysis Metodes Analizy Thermicznej II, Materły konferenzjne (1998) 31-50 [L] Stoch Stoch Stoz:

2. V. Zielenkiewicz, II Szkoła Analysy SAT'98, Pomiary Effektów Cieplnych.Conferences (1998) 1-17. Conferences.

3. K. Rzyman Towarzyszące tworzeniu faz międzymetalicznych Efekty Energieczne Praca IMIM PAN, Kraków, Habilitacyjna (2002).

4. Candeia Friday: R. A. Souza J. C. O. M. A. F. C. M. Mr Santos Mr President Oh, I. M. G. Souza A. G. and L. E. B. (2007). Warm, rheological behaviour of biodiesel blends of fuel and methanol. Thermo gravimetric diary 87(3) 653-56. Thermal analysis diary.

5. Yu H. Lu C. and Han K. Niu S. Zhou Y. (2017). Examination of warm oleic corruption TG-FTIR is used to convert and manage the corrosive methyl and ethyl esters in the process.149(17923) 495-04. 494.

6. A. Watson: A chromium-nickel, chromium-nickel and silicone thermodynamic study, PhD theses of the University of Manchester University of Victoria (1987).

7. C. Client: Comparison of formation enthalpies and transitional mixing enthalpies Thermochimica Acta 314 (1998) 229-245 metal-based alloys.

8. A Javidialesaadi and S. Raeissi; High-Free Fatty Fatty Acid Content Biodiesel Production Oils: APCBEEEProcesia 5(2013)474–478[4] Experimental investigation in the processing stage

9. Mr. Farooq, Anita Ramlib. Renewable energy 76 (2015) 362e368 Abdul Naeemc;

10. Zhang, Jincheng Ding, Zengdian Zhao, Bioresource Technology 123.

11. R.B. Sharma, Amit Pal, Juhi Sharaf, Biodiesel production from cooking oil waste, J. Eng. Res. Appl. 4(6) (2013)

12. Shahid E.M Shahid Shahid Shah A.N. Jamal, M. Munsha, M. N. Rumzan, M. Cooking oil Effect Used Compression inflammation engine methyl ester, J. Technol Quality. Management. 91–104 (II) (2012)

13. Joana Neiva Correia, Idalina Raposo, Joao Mendes, [3] Pedro Felizardo, M. Joao Moura Bordado, Berkemeier, Biodiesel production from the frying of garbageJ. 26(3) (2006) 487–494. Waste Management.

14. Cellulosic Material Bioethanol: biomass renewable engine fuel. PS. 2005;27:327–337. energy sources.

15. Lin Y, Tanaka S. Biomass resource fermentation ethanol: State and possibilities of today. Biotechnology Appl Microbiol. 2006;69:627-642. February.