EFFECT OF MEAN GAS TEMPERATURE OF A VARIABLE COMPRESSION RATIO DIESEL ENGINE OPERATING WITH PONGAMIA PINNATA OIL BLENDS UNDER DIFFERENT CRANK ANGLES

[1]R.Girimurugan, [2]A.S.Nithiya guru

[1]*Assistant Professor,* [2]*UG Scholar-Pre Final Year, Department of Mechanical Engineering, Nandha College of Technology, Erode-638052, Tamilnadu, India.*

ABSTRACT

In this experimental study mean gas temperature of a variable compression ratio (VCR) Diesel engine operating with diesel and Honge oil blends were studied under different crank angle (-360˚to +359˚), five different percentage loading conditions (0%, 25%, 50%, 75%&100%), two compression ratio (17:01 & 18:01) and three different Honge oil blends (B10, B15 & B20)which are blended with diesel by volumetric basis (100 ml Honge oil: 900 ml pure Diesel, 150 ml Honge oil: 850 ml pure Diesel, 200 ml Honge oil: 800 ml pure Diesel) respectively. For comparative purpose initially the engine was run by pure Diesel. This study shows that the mean gas temperature is maximum when the engine operates with Honge oil (B10 blend) which was blended with pure Diesel on 75%loading conditions at a crank angle of 23˚and compression ratio 17:01. This study shows that the mean gas temperature is minimum when the engine operates with Honge oil (B10 blend) which was blended with pure Diesel on 0% loading conditions at a crank angle of 26˚and compression ratio 17:01.

Keywords: *- VCR Diesel engine, mean gas temperature, Honge oil blends, crank angles.*

1. INTRODUCTION

The preservation of energy is decreasing now a days and it alleged that it leads to energy demand. In the last two decades, alternative fuels have obtained and identified as essential. A potential biodiesel substitutes diesel oil, consisting of ethyl ester of fatty acids produced by the transesterification reaction of triglycerides of vegetable oils and ethanol with the help of a catalyst. In addition, biodiesel is better than diesel fuel in terms of very low sulfur content and it is also having higher flash and fire point temperatures than in diesel fuel. A lot of research work pointed out that biodiesel has received a significant attention and it is a possible alternative fuel. Biodiesel and its blends with diesel were employed as a fuel for diesel engine without any modifications in the existing engine [1]. The research on the production of biodiesel has increased significantly in recent years becaus e of the need for an alternative fuel which endows with biodegradability, low toxicity and renewability [2].The biodiesel produced by transesterification showed similar properties to the standard biodiesel [3]. The process of transesterification is found to be an effective method of reducing viscosity of vegetable oil [4].The lower blends of biodiesel increased the brake thermal efficiency and reduced the fuel consumption. In addition to this, biodiesel blends produce lower engine emissions than diesel [5].The new fuel Die sterol (combination of diesel fuel, bio ethanol and sunflower methyl ester) as a fuel for diesel engines. The authors revealed that, as the percentage of bio ethanol in the blends is increased, the percentage of CO concentration in the emission is reduced. This trend is due to the fact that bio ethanol has less carbon than diesel [6]. The diesel engine runs with waste plastic oil as fuel. The authors concluded that, the smoke was reduced by 40% than diesel [7].The new type of biodiesel is prepared from non-edible pongamia pinnata oil by transesterification and used as a fuel in C.I engine. The authors reported that blend B5 exhibits lower engine emissions of unburnt hydrocarbon, carbon monoxide, oxides of nitrogen and carbon dioxide at full load [8]. The experiments were performed in a single cylinder DI diesel engine fueled with a blend of pungam methyl ester for the proportion of PME10, PME20and PME30 by volume with diesel fuel for validation of simulated results. The authors observed that there is a good agreement between simulated and experimental results [9].From the review of literatures; numerous works in the utilization of biodiesel as well as its blends in engines have been done. However, most of the literatures focused on single biodiesel and its blends. From previous studies, it is evident that single biodiesel offers acceptable engine performance and emissions for diesel engine operation.

2. EXPERIMENTAL PLANS

The biodiesel (pongamia pinnata oil and pure diesel) are prepared by the transesterification process. The biodiesel blends were prepared in three different proportions as: Diesel 90%, pongamia pinnata oil 10%; Diesel 85%, pongamia pinnata oil 15%; Diesel 80%, PPEE 10% by volume basis. The various properties like kinematic viscosity, specific gravity, calorific value, flash point temperature and fire point temperature of baseline fuel, raw oils and biodiesel mixed blends were determined by using ASTM methods and compared with diesel properties. The experiments were conducted on a stationary, single cylinder, vertical, four stroke, water cooled, variable compression ratio, diesel engine with electrical loading and the mean gas temperatures were compared with baseline data of diesel fuel.

Table-1 Test engine specifications

Sl.No.	Items	Specifications
1	Type	Vertical, four stroke, single cylinder, VCR engine.
2	Made	Kirloskar oil engines Ltd, Pune, India.
3	Loading device	Eddy current dynamo meter
4	Type of cooling	Water cooled
5	Speed	1500 rpm
6	Power	3.5 Kw
7	Bore	87.5mm
8	Compression ratio	12:1to 20:1
9	Stroke	110mm
10	Fuel	Diesel

Tests were conducted at a constant speed and at varying loads for all biodiesel blends. Engine speed was maintained at 1500 rpm (rated speed) during all experiments. The mean gas temperatures of the exhaust gases were measured by the AVL make smoke meter. The exhaust emissions were measured by the Crypton make five gas analyzer. The experimental set up is shown in Fig. 1 and the detailed engine specifications are also given in Table 1.

Figure 1 Experimental setup

3. RESULTS AND DISCUSSIONS

The following results were obtained from this experimental study which was carried out to evaluate the mean gas temperature of a Variable Compression Ratio (VCR) Diesel engine operating with Diesel and three Honge oil blends (B10, B15 & B20) under different crank angle (-360° to +359°), five different percentage loading conditions (0%, 25%, 50%, 75% & 100%) and two compression ratio (17:01 & 18:01) respectively.

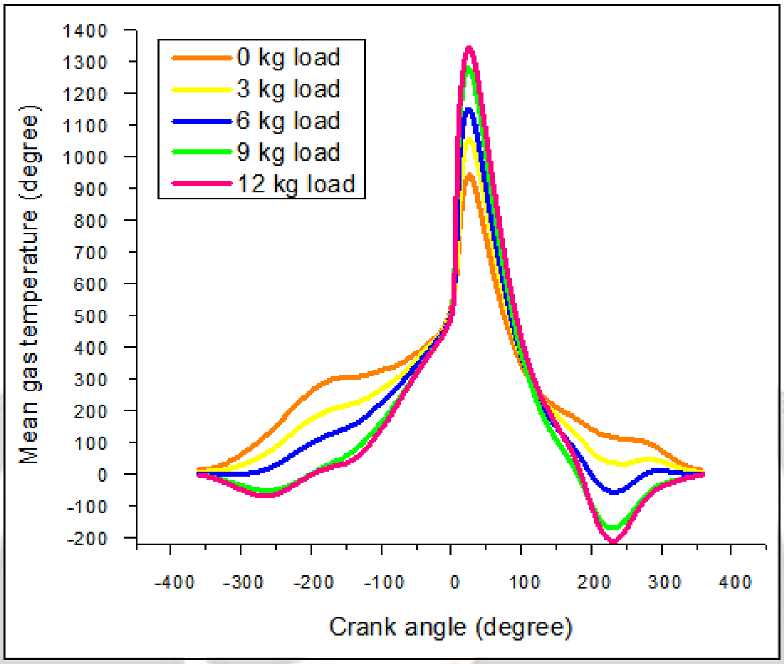

Figure 2 Effect of mean gas temperature of the VCR engine operating with diesel and compression ratio 17:01

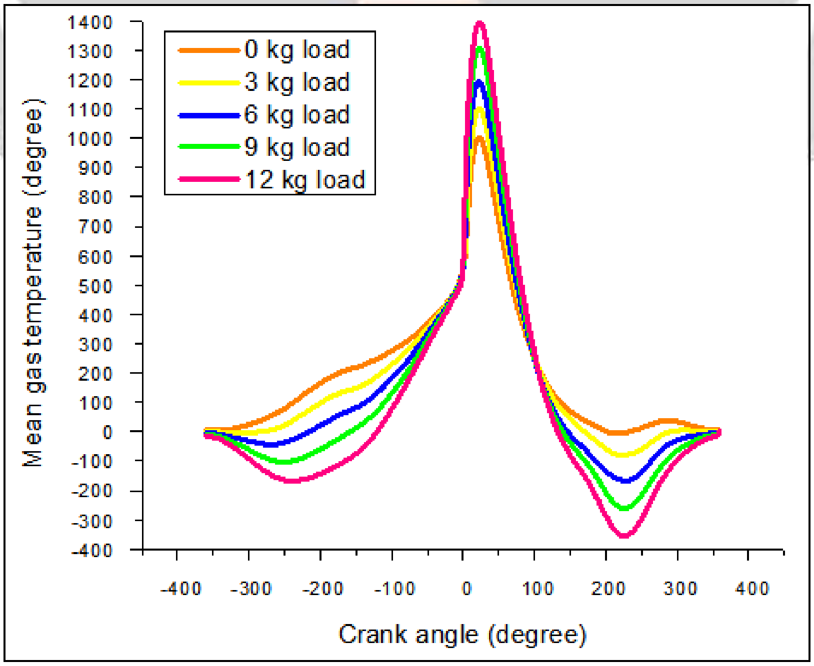

Figure 3 Effect of mean gas temperature of the VCR engine operating with diesel and compression ratio 18:01

3.1 Effect of engine mean gas temperature operating by pure diesel at a compression ratio of 17:01 under different loading conditions

Effect of mean gas temperature of the engine operating by diesel and compression ratio 17:01 for various crank angles were sown in figure.2. It shows that the mean gas temperature is maximum when crank angle is 25˚. The minimum and maximum mean gas temperature obtained in this case is 939.38 and1339.94˚C at a crank angle of 26˚&25˚ respectively. At full load condition and no load conditions the engine cylinder exhibits a maximum and minimum mean gas temperature at a compression ratio of 17:01.

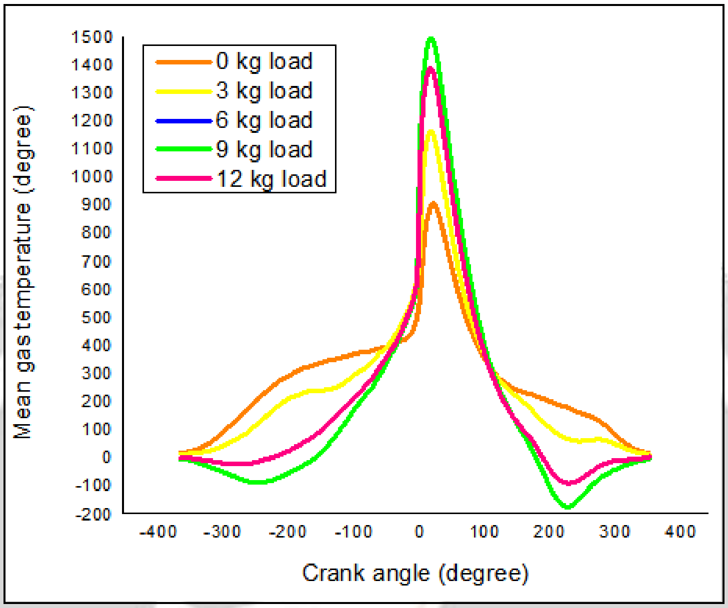

Figure 4 Effect of mean gas temperature of the VCR engine operating with Honge oil blend (B10) and compression ratio 17:01

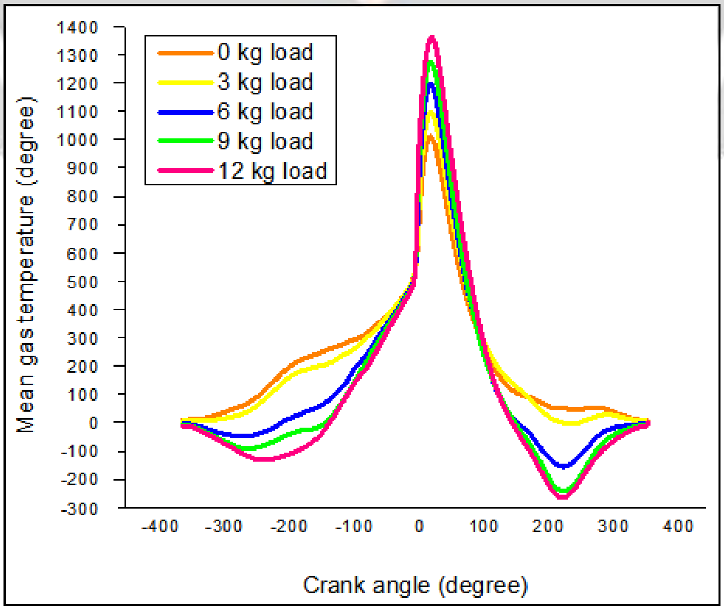

Figure 5 Effect of mean gas temperature of the VCR engine operating with Honge oil blend (B10) and compression ratio 18:01

3.2 Effect of engine mean gas temperature operating by pure diesel at a compression ratio of 18:01 under various loading conditions

Effect of mean gas temperature of the engine operating by Diesel and compression ratio 18:01 for various crank angles were sown in figure.3. It shows that the mean gas temperature is maximum when the crank angle is 23˚. The minimum and maximum mean gas temperature obtained in this case is 1000.79 and 1395.27˚C at a crank angle of 23˚ respectively. At full load condition and no load conditions the engine cylinder exhibits a maximum and minimum mean gas temperature at a compression ratio of 18:01.

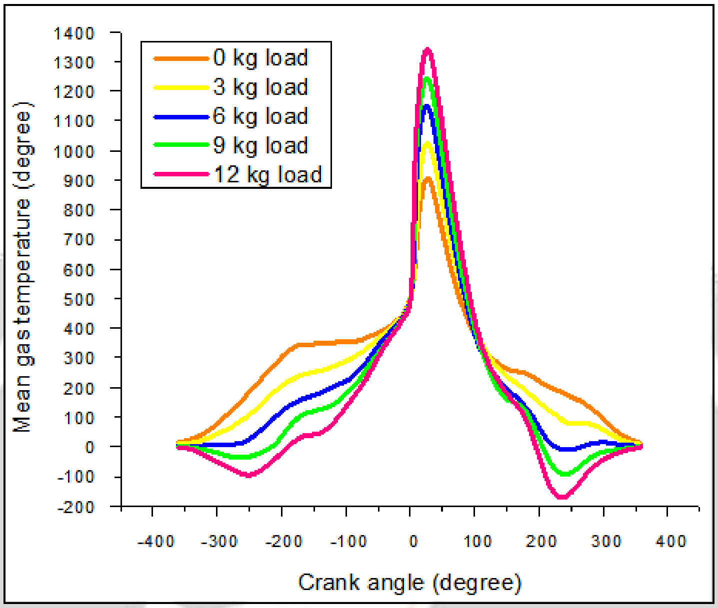

Figure 6 Effect of mean gas temperature of the VCR engine operating with Honge oil blend (B15) and compression ratio 17:01

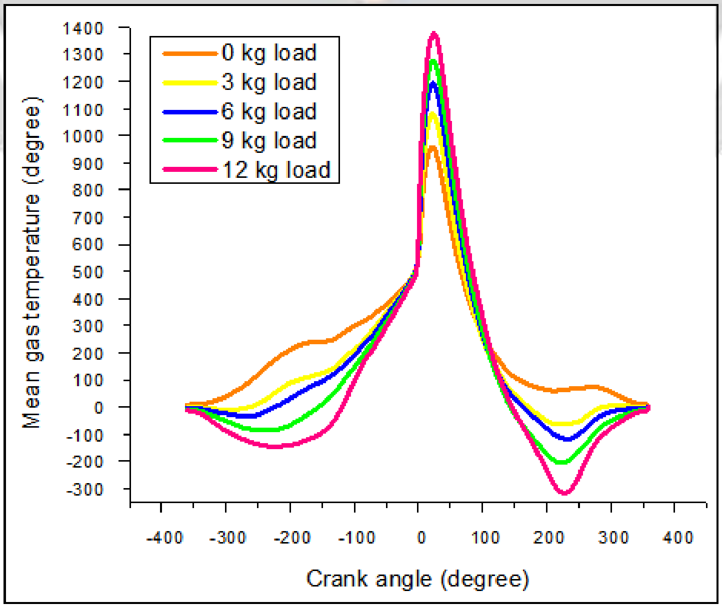

Figure 7 Effect of mean gas temperature of the VCR engine operating with Honge oil blend (B15) and compression ratio 18:01

3.3 Effect of engine mean gas temperature operating by Honge oil (B10) blended with Diesel at a compression ratio of 17:01 under various loading conditions

Effect of mean gas temperature of the engine operating by Honge oil (B10) blended with Diesel and compression ratio 17:01 for various crank angles were sown in figure.4. It shows that the mean gas temperature is maximum when the crank angle is 23˚. The minimum and maximum mean gas temperature obtained in this case is 899.98 and 1486.43˚C at a crank angle of 23˚respectively. At 75% load condition and no load conditions the engine cylinder exhibits a maximum and minimum mean gas temperature at a compression ratio of 17:01.

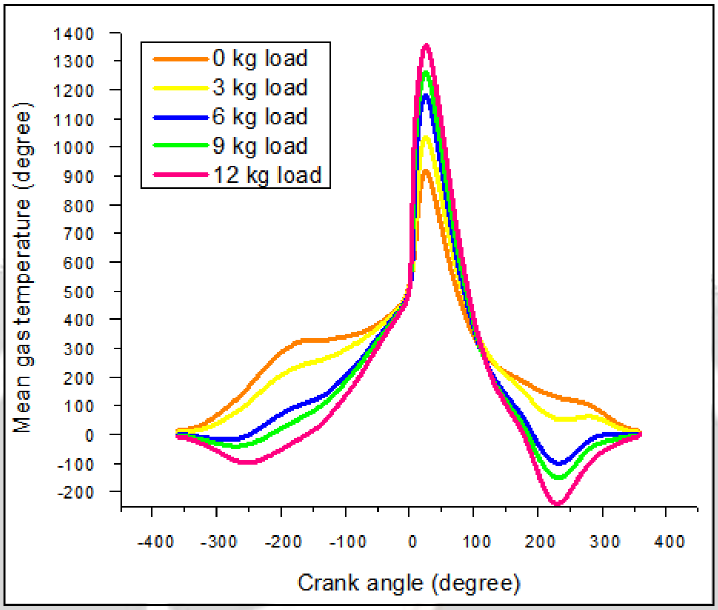

Figure 8 Effect of mean gas temperature of the VCR engine operating with Honge oil blend (B20) and compression ratio 17:01

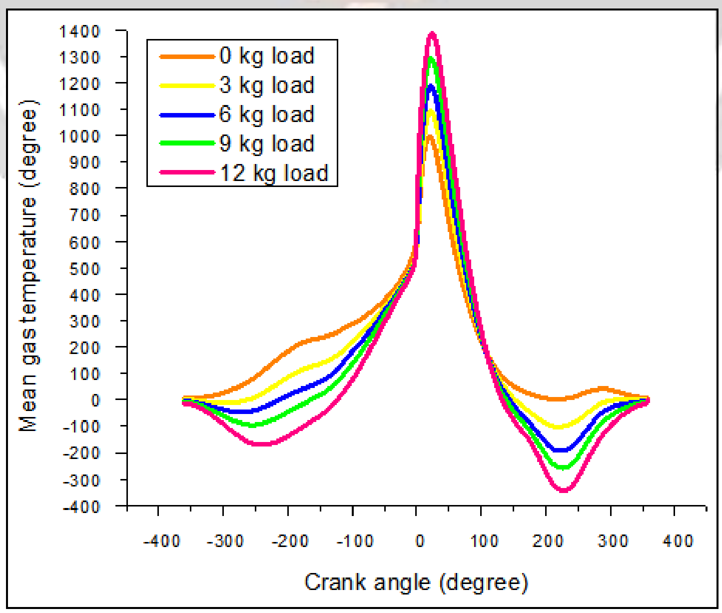

Figure 9 Effect of mean gas temperature of the VCR engine operating with Honge oil blend (B20) and compression ratio 18:01

3.4 Effect of engine mean gas temperature operating by Honge oil (B10) blended with Diesel at a compression ratio of 18:01 under various loading conditions

Effect of mean gas temperature of the engine operating by Honge oil (B10) blended with Diesel and compression ratio 18:01 for various crank angles were sown in figure.5. It shows that the mean gas temperature is maximum when the crank angle is 24˚. The minimum and maximum mean gas temperature obtained in this case is 1009.5 and 1361˚C at a crank angle of 23˚& 24˚ respectively. At full load condition and no load conditions the engine cylinder exhibits a maximum and minimum mean gas temperature at a compression ratio of 18:01.

3.5 Effect of engine mean gas temperature operating by Honge oil (B15) blended with Diesel at a compression ratio of 17:01 under various loading conditions

Effect of mean gas temperature of the engine operating by Honge oil (B15) blended with Diesel and compression ratio 17:01 for various crank angles were sown in figure.6. It shows that the mean gas temperature is maximum when the crank angle is 27˚. The minimum and maximum mean gas temperature obtained in this case is 906.26 and 1340.53˚C at a crank angle of 27˚ respectively. At full load condition and no load conditions the engine cylinder exhibits a maximum and minimum mean gas temperature at a compression ratio of 17:01.

3.6 Effect of engine mean gas temperature operating by Honge oil (B15) blended with Diesel at a compression ratio of 18:01 under various loading conditions

Effect of mean gas temperature of the engine operating by Honge oil (B15) blended with Diesel and compression ratio 18:01 for various crank angles were sown in figure.7. It shows that the mean gas temperature is maximum when crank angle is 24˚. The minimum and maximum mean gas temperature obtained in this case is 956.68 and 1373.62˚C at a crank angle of 22˚ and 24˚respectively.At full load condition and no load conditions the engine cylinder exhibits a maximum and minimum mean gas temperature at a compression ratio of 18:01.

3.7 Effect of engine mean gas temperature operating by Honge oil (B20) blended with Diesel at a compression ratio of 17:01 under various loading conditions

Effect of mean gas temperature of the engine operating by Honge oil (B20) blended with Diesel and compression ratio 17:01 for various crank angles were sown in figure.8. It shows that the mean gas temperature is maximum when crank angle is 26˚.The minimum and maximum mean gas temperature obtained in this case is 915.98 and 1354.64˚C at a crank angle of 26˚ respectively. At full load condition and no load conditions the engine cylinder exhibits a maximum and minimum mean gas temperature at a compression ratio of 17:01.

3.8 Effect of engine mean gas temperature operating by Honge oil (B20) blended with Diesel at a compression ratio of 18:01 under various loading conditions

Effect of mean gas temperature of the engine operating by Honge oil (B20) blended with Diesel and compression ratio 18:01 for various crank angles were sown in figure.9. It shows that the mean gas temperature is maximum at the crank angle is 24˚. The minimum and maximum mean gas temperature obtained in this case is 996.97 and 1385.23˚C at a crank angle of 20˚ and 24˚ respectively. At full load condition and no load conditions the engine cylinder exhibits a maximum and minimum mean gas temperature at a compression ratio of 18:01.

4. SUMMARY

The following conclusions were made from this experimental study which was carried out to evaluate the effect of Honge oil blends for mean gas temperature of a Variable Compression Ratio (VCR) Diesel engine operating with Diesel and three Honge oil blends (B10, B15 & B20) under different crank angle (-360˚ to +359˚), five different percentage loading conditions (0%, 25%, 50%, 75% & 100%), and two compression ratio (17:01 & 18:01) respectively.

- In all cases engine mean gas temperature is maximum at full load condition and minimum at no load conditions.

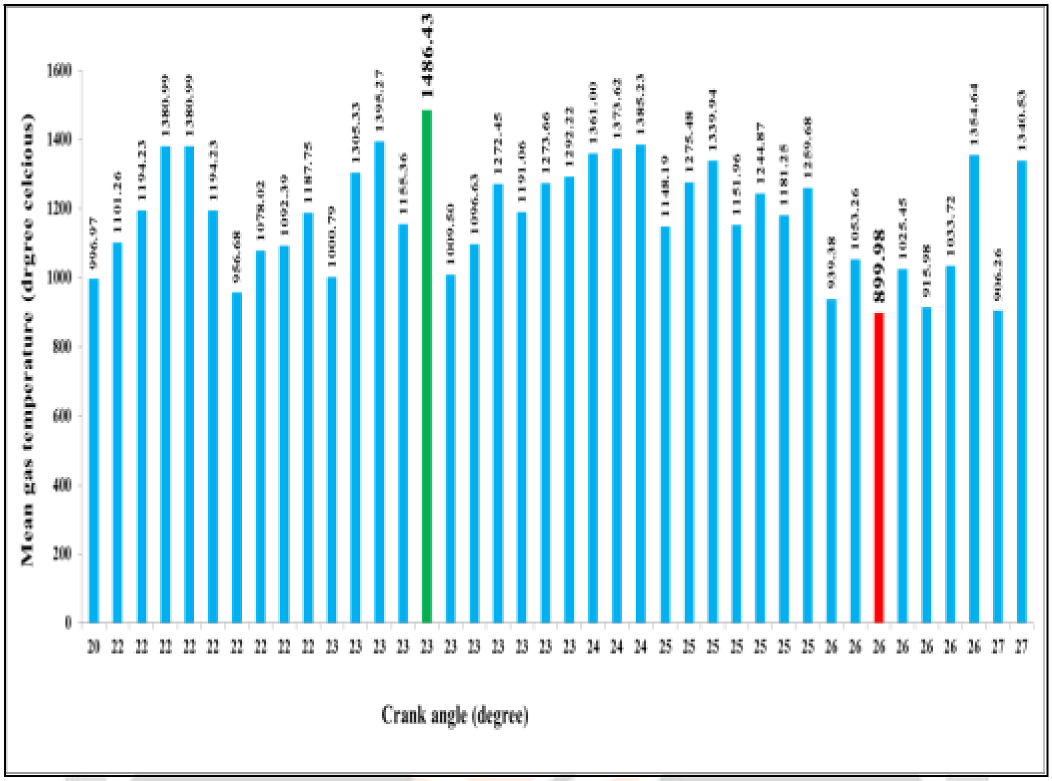

Figure 10 Maximum mean gas temperature for different crank angle

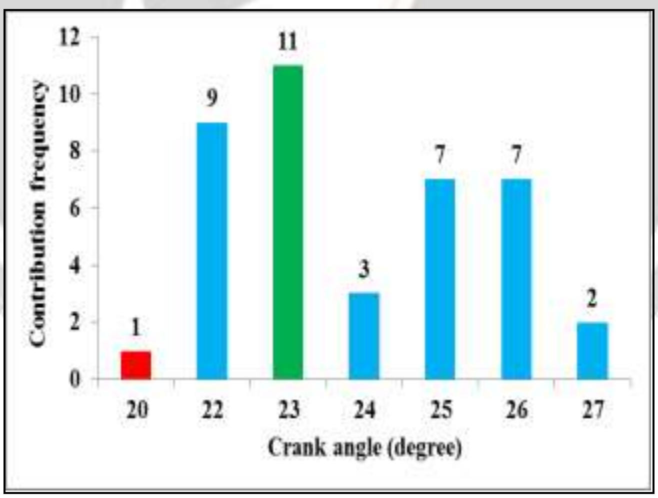

Figure 11 Contribution of crank angles for better mean gas temperature

- At a crank angle of 23˚ the engine exhibits a better mean gas temperature compared than other crank angles.
- In all cases the engine mean gas temperature is maximum when the engine operates at a compression ratio of 17:01.
- In all cases the engine cylinder mean gas temperature is maximum at particular crank angles (22˚ to 23˚).
- The engine cylinder mean gas temperature is gradually increases with the increasing Honge oil blends.

- The maximum engine mean gas temperature obtained from this experimental study is 1486.43˚C when the engine operates with pure Honge oil blend (B10) on full load conditions at a crank angle of 23˚ and a compression ratio of 17:01.
- The minimum cylinder mean gas temperature obtained from this experimental study is 899.98˚C when the engine operates with pure Honge oil blend (B20) on 75% load conditions at a crank angle of 26˚ and compression ratio 17:01.

6. REFERENCES

[1]. K. Srithar, K. Arun Balasubramanian, V. Pavendan and B. Ashok Kumar, 'Experimental investigations on mixing of two biodiesels blended with diesel as alternative fuel for diesel engines'. Journal of King Saud University – Engineering Sciences, 2014.

[2]. A.E Ghaly, D. Dave and M. Brooks, 'Production of biodiesel by enzymatic transesterification: review. American journal of biochemical and biotechnology, 2010, Vol.6, pp.54–76.

[3]. W. Theansuwan, and K. Triratanasirichai, 'The biodiesel production from roast Thai sausage oil by transesterification reaction'. American journal of engineering applications and science, 2011, Vol.4, pp.130–132.

[4]. D. Agarwal, L. Kumar and A.K. Agarwal, 'Performance evaluation of a vegetable oil fuelled compression ignition engine'. Renewable Energy, 2008, Vol. 33, pp.1147–1156.

[5]. B. Deepanraj, C. Dhanesh and R. Senthil, 'Use of palm oil biodiesel blends as a fuel for compression ignition engine'. American journal of applied science, Vol.8, pp.1154–1158.

[6]. H. Rahimi, B. Ghobadian and T. Yusuf, 'Die sterol: an environment-friendly IC engine fuel'. Renewable Energy, 2009, Vol. 34, pp.335–342.

[7]. M. Mani, C. Subash and G. Nagarajan, 'Performance, emission and combustion characteristics of a DI diesel engine using waste plastic oil'. Application of thermal engineering, 2009, Vol.29, pp.2738–2744.

[8]. K. Muralidharan, and P. Govindarajan, 'The effect of bio-fuel blends and fuel injection pressure on diesel engine emission for sustainable environment'. 2011, American journal of environmental science, Vol.7, pp.377–382.

[9]. M.Venkatraman, and G. Devaradjane, 'Computer modeling of a CI engine for optimization of operating parameters such as compression ratio, injection timing and injection pressure for better performance and emission using diesel-diesel biodiesel blends'. American journal of applied science, 2011, Vol.8, pp.897–902.

BIOGRAPHIES

	**Mr.R.Girimurugan** is currently working as an Assistant Professor in Mechanical Engineering Department at Nandha College of Technology, Erode, Tamilnadu, India. He has completed his B.E degree (First Class with Distinction) in Thanthai Periyar Government Institute of Technology in the year of 2010, Vellore, Tamilnadu, India and also he has completed his M.E degree in Engineering Design specialization (First Class) at Nandha Engineering College (Erode, Tamilnadu, India) in the year of 2014. He is pursuing Ph.D in the area of composites at Anna University Chennai. He has published more than 30 international journals in the field of PEM Fuel Cell, Mechanical Fabrication, Bio-Fuels, and Computational Fluid Dynamics. He is also a life member in Association for Machines and Mechanisms (AMM), National Society of Fluid Mechanics and Fluid Power (NSFPFM).
	**Mr.A.S.Nithiya guru** is currently studying in (Pre Final Year) Mechanical Engineering Department at Nandha College of Technology, Erode, Tamilnadu, India. He has completed his Higher Secondary in S.S.M Lakshmi Ammal Matriculation Higher Secondary School in the year of 2014, Kumarapalayam, Tamilnadu, India. He has attended International Conference at Nandha College of Technology and also he has attended one day workshop at Karpagam College of Technology, Coimbatore. He is pursuing Diploma in French at PSG Institute of Management.