AIJREAS VOLUME 2, ISSUE 12 (2017, DEC) (ISSN-2455-6300) ONLINE
ANVESHANA'S INTERNATIONAL JOURNAL OF RESEARCH IN ENGINEERING AND APPLIED SCIENCES

TRANSIENT THERMAL ANALYSIS OF ENGINE EXHAUST VALVE BY USING ANSYS

DASARI VENKATESH
M. Tech (THERMAL) Department of Mechanical Engineering,
Kakinada Institute of Technological Sciences
A.Agraharam- Ramachandrapuram East Godavari District

MR.D.VIJAYA PRASAD
Associate Professor, Department of Mechanical Engineering,
Kakinada Institute of Technological Sciences
A.Agraharam- Ramachandrapuram East Godavari District

ABSTRACT:
The aim of this paper is to design an exhaust valve for a four wheeler petrol engine using theoretical calculations. Manufacturing process that is 2D drawings is drafted from the calculations and 3D model and transient thermal analysis is to be done on the exhaust valve when valve is open and closed. Analysis is done in ANSYS. Analysis will be conduct when the study state condition is attained. Study state condition is attained at 5000 cycles at the time of when valve is closed is 127.651 sec valve is opened 127.659 sec. The material used for exhaust valve is EN52 steel. We are doing material optimization by doing analysis on both materials EN52 and EN59.Static Modal analysis the exhaust valve to determine mode shapes of the valve for number of modes.

INTRODUCTION:

With depletion of conventional fuel source at tremendous rate and increasing environment pollution has motivated extensive research in alternative fuel and engine design. Experimental works aimed at good fuel economy and lower tailpipe emissions frequently changes the operating parameters which is a time and money consuming method. Alternatively computer simulation of engine with a mathematical model can be done easily to estimate the effects of design and changes in the operating parameters in short period of time and are cheap. Modeling is the simple representation of complex real world problem. The theoretical models used in the case of internal combustion engines can be classified into two main groups: thermodynamic models and fluid dynamic models. Thermodynamic models are mainly based on the first law of thermodynamics and are used to analyze the performance characteristics of engines. Biodiesel is defined as mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats. It was observed from the literature that the use of biodiesel in diesel engine results in a slight reduction in brake power and a slight increase in fuel consumption. However, the lubricant properties of the biodiesel are better than diesel, which can help to increase the engine life. Also the exhaust emission of the biodiesel is lower than the neat diesel operation due to the presence of oxygen in the molecular structure of the biodiesel. Moreover, the biodiesel fuel is environment friendly, because biodiesel does not produce SO_x and also there is no increase in CO_2 emission at global level.

LITERATURE REVIEW

Balat, M et al Biodiesel blends reduce levels of global warming gases such as CO_2. Its additional advantages include outstanding lubricity, excellent biodegradability, higher combustion efficiency and low toxicity as compared to other fuels.

Heywood et al The combustion process in diesel engine is extremely complex due to transient and heterogeneous nature of combustion which is mainly controlled by turbulent mixing of fuel and air. High speed photography studies and in- cylinder sample collection have revealed some interesting characteristic of combustion phenomena.

Later Assanis et al developed an ignition delay correlation for predicting the delay period in a heavy-duty turbocharged direct injection diesel engine running under both steady state and transient operation.

Lyn et al analyzed the effects of injection timing, injection velocity and fuelling rate on the delay period.

Watson et al developed an ID correlation using a diesel engine under steady state conditions which is still widely used.

Sahoo, P. K et al Biodiesel have a relatively low flash point, a high heating value, high density and high viscosity comparable to those of petroleum derived diesel. Many studies show that unburned hydrocarbons (HC), carbon monoxide (CO) and sulfur levels are significantly less in the exhaust gas while using biodiesel as fuel. However, a noticeable increase in the oxides of nitrogen (NO_x) levels is reported with biodiesel.

OBJECTIVES:

The objective of the present work is to develop a two zone model for a direct injection diesel engine fuelled with diesel and biodiesel blend. It gives a detailed description of model which consists of various sub-models. Moreover, the present work validated the model with experimental investigation.

RESEARCH METHODOLOGY:

The main calculation procedure is based on the integration of the first law of thermodynamics and the perfect gas state equation combined with the various sub-models. The following assumptions were made for the analysis:

(i) The cylinder contain are present in two zones: one zone consists of pure air called non burning zone and other zone consist of fuel and combustion products called burning zone.

(ii) Pressure and temperature in each zone inside the cylinder are uniform and vary

(iii) with crank angle.

(iv) It ontains of each zone obeys the perfect gas state law.

Finite element formulation of heat Transfer equations

In the theory of finite element analysis, first the proper variation principle is selected and then the function involved is expressed in terms of approximate assumed displacements, which satisfy the given boundary conditions. Then by minimizing the approximate function a set of governing equations is developed. In this heat transfer equations are formulated by using finite element method for conduction, convection and for contact boundaries.

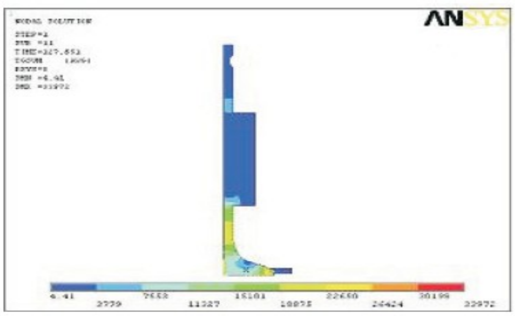
Table 2. Comparison of fuel properties of WPO, JME and JOE15 with diesel [24]

Properties	ASTM method	Diesel	WPO	JME	JOE15
Specific gravity at 15 °C	ASTM D 4052	0.83	1.15	0.88	0.9267
Net calorific value (MJ/kg)	ASTM D 4809	43.8	20.58	39.1	36.32
Flash point (°C)	ASTM D 93	50	98	118	156
Fire point (^{o} C)	ASTM D 93	56	108	126	-
Pour point (°C)	ASTM D 97	-6	2	-1	-
Cloud point (^{o}C)	ASTM D 2500	-	10	4-10	-
Carbon residue (%)	ASTM D4530	0.1	12.85	-	-
Kinematic viscosity at 40 °C (cSt)	ASTM D 445	2.58	25.3	4.6	7.28
Cetane number	ASTM D 613	50	25	51	-
Moisture content (wt %)	ASTM D4442	0.025	15-30	0.03	-
Final boiling point (^{o}C)	ASTM D 86	344	250-280	342	-
Empirical formula	ASTM D3239	C12H26	C1.13H2.92 N0.01 S0.01O1.62	C7.56H 13.89 N0.01O 0.81	C2.08H4.1 3N0.01 S0.01O1.17
Molecular weight	ASTM D5296	170	42.86	117.6	48.27
Stoichiometric A/F ratio	-	15	3.39	12.4	7.26

The fuels considered are diesel ($C_{12}H_{26}$), ester ($C_{7.56}.H_{13.89}N_{0.01}O_{0.81}$) and JOE15 ($C_{2.08}H_{4.13}N_{0.01}S_{0.01}O_{1.17}$). The volumetric composition of JOE15 fuel used in this investigation is 15% WPO, 83% JME and 2% surfactant Span 80.

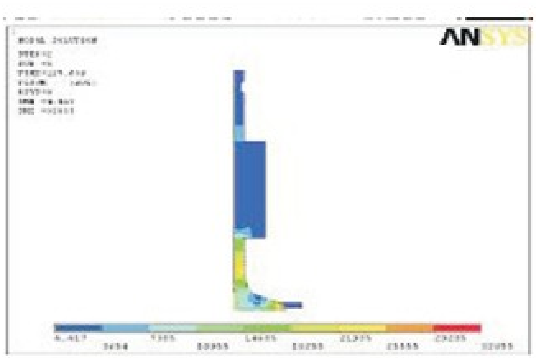
ANALYSIS RESULTS AND DISCUSSION

Figure : Contour Plot Thermal Stresses



Transient Thermal Analysis of rectangular fin body using magnesium alloy

Figure : Contour Plot Thermal Stresses



Pressure-crank angle diagram

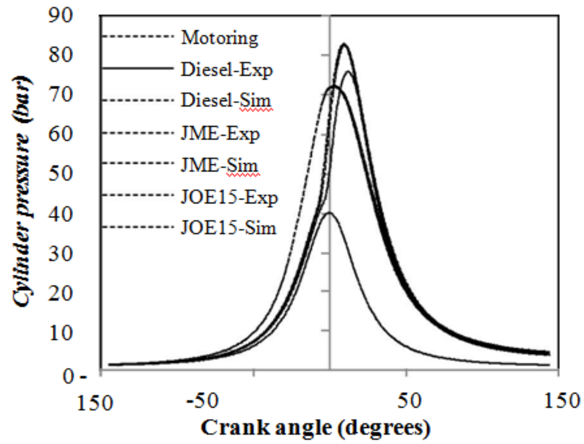


Figure shows Variation of cylinder pressure with crank angle at full load

It is observed from the experimental results that the peak pressure for diesel, JME and JOE15 are 75.72, 82.61 and 82.40 bar respectively. For the simulated conditions the peak pressure values are 71.76, 71.99 and 71.85 bar respectively. In both the cases the combustion of JME and JOE15 starts earlier than that of diesel fuel. Also the peak cylinder pressure of JME and JOE15 is marginally higher than that of diesel, as a result of high viscosity and low volatility.

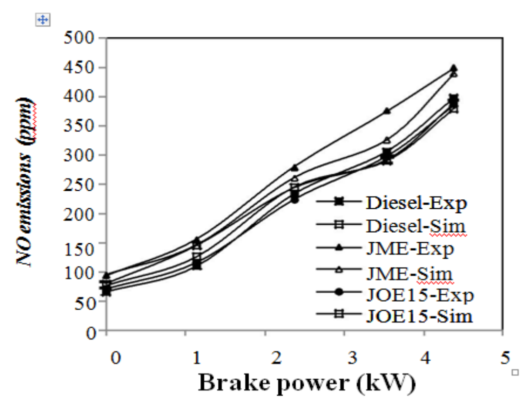


Figure shows Variation of NO emissions with brake power

Figure depicts the comparison of NO emissions for the tested fuels in both experimental and simulated conditions. The experimental results of NO emissions at full load condition for diesel, JME and JOE15 are 398 ppm, 449 ppm and 386 ppm. In case of simulated conditions the NO values are 388 ppm, 440 ppm and 380 ppm respectively for the above said fuels. It can be observed from the figure that the NO emissions of the JME operation are higher compared to JME-WPO emulsions as well as diesel operation.

CONCLUSIONS

1. The experimental results of the peak cylinder pressure of JME and JOE15 is marginally higher than that of diesel, and similar results are obtained with simulated conditions.

2. The maximum heat release rate of JME and JOE15 are lower than that of diesel fuel in both experimental and simulated conditions.
3. The NO emissions of diesel fuel are increased with load both in experimental and simulated conditions. Similar trends have been obtained with JME and JOE15. The NO emissions of JOE15 are increased and soot density is decreased with advancing of injection timing and the values are in vice versa in retarded conditions.
4. Improper bonding may take place leading to the reduced strength of the component and as a result the component will tend to fail.

REFERENCES

1. *Balat, M., and Balat, H, "Progress in biodiesel processing", Applied Energy 87,(2017), 1815-1835.*
2. *Heywood J. Internal combustion engines fundamentals. McGraw Hill book company; 2014.*
3. *Assanis, D.N., Z.S. Filipi, S.B. Fiveland, et al., A predictive ignition delay correlation under steady-state and transient operation of a direct injection diesel engine. J. Eng. Gas Turbines Power, 125,(2003): p. 450.*
4. *Lyn WT, Valdamanis. Effects of physical factors on ignition delay, SAE 680102, 1968.*
5. *Watson N., Pilley A. D., and Marzouk M., A combustion correlation for diesel engine simulation, SAE paper 800029, 1980.*
6. *Sahoo, P. K., Das, L. M., Babu, M. K., Arora, P, Singh, V. P, Kumar, N. R, and Varyani. T. S, "Comparative evaluation of performance and emission characteristics of jatropha , karanja and polanga based biodiesel as fuel in a tractor engine", Fuel 88,(2009), 1698-1707.*