COMPARISON OF STATIC STRESS ANALYIS RESULTS OF H-SHAPE ENGINE BY APPYING DIFFERENT MATERIALS USING FEM

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ABSTRACT

H-shape engines combustion quality is based on the formation of fuel-air mixture. Enormous efforts have made to reduce the harmful H-shape engine emissions. High engine noise, Particulate matter (PM) and NOx production are the results of improper combustion process and considered as the major constraints. The performance and emission characteristics of H-shape engines depend on many parameters. Precise control over the fuel injection process is one of the most important factors and plays a very important role in combustion to increase the engine performance with minimal exhaust emission. The injection system must satisfy high pressure capability, injection pressure control, flexible timing control, and injection rate control. The purpose of this study is to find the performance and exhaust emission of H-shape engines by implementing high injection pressure. Present paper is more concentrated on the optimization of high pressure injection to reduce particulate matter (PM), NOx and fuel consumption with increased engine power.

Keywords: *H-shape Engine, Emission control, Injection pressure.*

1.0 INTRODUCTION

An H-engine can be viewed as two flat engines, one atop or beside the other. The "two engines" each have their own crankshaft, which are then geared together at one end for power-take-off. The H configuration allows the building of multi-cylinder engines that are shorter than the alternatives, sometimes delivering advantages on aircraft. For race-car applications there is the disadvantage of a higher centre of gravity, not only because one crankshaft is located atop the other, but also because the engine must be high enough off the ground to allow clearance underneath for a row of exhaust pipes.

Although bio H-shape has many advantages over H-shape fuel, there are several problems that need to be addressed such as its higher viscosity, lower calorific value, higher flash point, poor cold flow properties, It is found that the lower concentrations of bio H-shape blends improve the BTE. Reduction in emission and BSFC is also observed while using up to B20. Since the introduction of petroleum fuels, the development of compression ignition (CI) engines is being done keeping the properties of H-shape fuel in front. The present designs and operating parameters of available engines are standardized for H-shape fuel only. For all other fuels, the operating parameters must be optimized to suit the fuel properties. Effect of injection parameters; spray, injection timing and compression ratio have been studied in detail at many places. Most of the research studies concluded that in the existing design of engine and parameters at which engines are operating, a 20% blend of bio H-shape.

Techniques that have been evaluated for concurrent use of H-shape and alcohols in a compression-ignition engine include

(1) Alcohol fumigation,

(2) Dual injection

(3) H-shape fuel emulsions, and

(4) H-shape fuel solutions.

A piston is a component of reciprocating IC engines. It is the moving component with in a cylinder and is made of gas-tight by piston rings. In an engine, piston is used to transfer force from expanding gas in the cylinder to the crankshaft via a piston rod. Piston endures the cyclic gas pressure and the inertial forces at work, and this working condition may cause the fatigue damage of the piston, such as piston side wear, piston head cracks and so on. So there is a need to optimize the design of piston by considering various parameters in this project the parameters selected are analysis of piston by applying pressure force acting at the top of the piston and thermal analysis of piston at various temperatures at the top of the piston in various strokes.

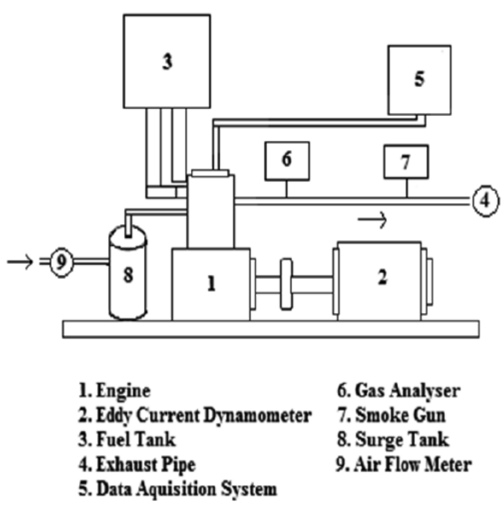

Figure 1: Layout of engine test rig and data acquisition system

Emission Measurement

The exhaust gases were analyzed using an AVL Di Gas 444 gas analyzer. It measures carbon monoxide (CO), carbon dioxide (CO2), hydrocarbons (HC) and nitric oxide (NO). Model 114 smoke meters was used to measure the smoke intensity which works based on the British standard institution testing procedures.

2.0 LITERATURE SURVEY

1. Basinger et al (2010) reported the design methodology for the modifications and a suite of performance test results are described including fuel consumption, efficiency, pre-combustion chamber pressure, and various emission. The results of the study show how the combination of preheating the high pressure fuel line, advancing the injector timing and increasing the injector valve opening pressure allows the engine to efficiently utilize plant oils as a H-shape fuel substitute, potentially aiding remote rural farmers with a lower cost, sustainable fuel source enabling

2. Hossain et al (2010) reported the regarding engines performance, exhaust emission and engines durability for compression ignition engine. The causes of technical problems arising from the use of various oils were discussed and the modifications to oil and engines employed to alleviate these problems. The review shows that a number of plant oils can be used satisfactorily in C.I engines, without Trans-esterification, by preheating the oil and/or modifying the engines parameters and the maintenance schedule. As regards life-cycle energy and greenhouse gas emission and these reveal considerable advantages of raw plant oils over fossil H-shape and bio H-shape. Typical results show that the life-cycle output-to-input energy ratio of raw plant oil is around 6 times higher than fossil H-shape. Depending on primary energy or fossil energy requirements, the life-cycle energy ratio of raw plant oil is in the range of 2 6 times higher than corresponding bioH-shape.

3. Amba Prasad Rao et al (2011) experimentally studied a mechanically operated simple component, variable timing fuel injection cam, is designed for a 510 cc automotive type naturally aspirated, water-cooled, direct injection H-shape engine. Modifications in the fuel injection cam and gear train are carried out to suit 34 the existing engine configuration. Variable speed tests are carried out for testing the efficiency of component on both engine and chassis dynamometers for performance and emission. It is observed that the engine which is already retarded could further be retarded with variable timing fuel injection cam. Significant reductions in NOx and smoke emission levels are achieved.

4. JinlinXue et al (2011) reported the effect of bio H-shape on engine power, economy, durability and emission including regulated and non-regulated emission, and the corresponding effect factors.

5. Reddy (2006) reported the experimental work on a compression ignition engine fuelled with jatropha oil. They found that when the injection timing is retarded with enhanced injection rate, a significant improvement in performance and emission was noticed. At full output, NOX level and smoke with jatropha oil are 1162.5 ppm and 2 BSU, respectively, while they are 1760 ppm and 2.7 BSU with H-shape. It was found that the brake thermal efficiency increases when the injection rate is lowered with jatropha oil.

3.0 METHODOLOGY

3.0 Measuring Fuel Consumption to Estimate H-shape Engine Efficiency

The cost of farm H-shape for pumping, which had hovered around a dollar per gallon for years, was an accepted part of conducting irrigation business, and in may localities where ground water was shallow, was inconsequential. However, in 2004 energy prices started rising drastically and then the following summer, as it appeared that prices might be starting back down. Hurricane Katrina hit the Gulf Coast sending prices to record levels. At that time irrigators faced H-shape and propane costs four times greater than they had experienced before. This increase in the cost of H-shape led to renewed interest in conducting efficiency evaluations on H-shape pumping plants.

3.2 Evaluating Pumping Plant Efficiency

An efficiency test for a H-shape irrigation pumping plant compares the unit's generated water horsepower (power-out) to the rate that H-shape is being consumed (power-in).

Equation 1 defines water horsepower (WHP).

$$WHP = Q\left(PWL + H_f + [2.31\,OP]\right) / 3960$$

Where,

WHP = Water Horsepower, HP

Q = Flow rate, GPM

PWL = Pumping Water Level, ft

Hf = Sum of all Friction Losses, ft

OP = Operating Pressure, PSI

The next step in evaluating H-shape irrigation pumping plant efficiency is to ascertain power-in, i.e., H-shape use rate (D_R). This pamphlet describes several methods for obtaining D_R.

3.3 Measuring H-shape Rate of Consumption (D_R):

The easiest way to measure the rate of fuel use (D_R) of aH-shape engine occurs in the cases where the engine already has a built-in fuel use meter. These meters provide an immediate answer to the power-in question and thus afford quick solutions to the answers of economic what-if questions: What RPM should I run at to fill up my reservoir. I have four pivots in a network, and always irrigate two at one time.

3.4 Graduated Cylinder Method

Instantaneous measurement of DR can be made with easy to find items. Materials needed include:

1. Graduated cylinder (or other device to measure volume)[2] .

2. A small container (e.g., 5-gal bucket) of H-shape, comparable to that running in the tested engine.
3. A small standby container partially filled with
4. Tools (wrenches) to disconnect the fuel line.

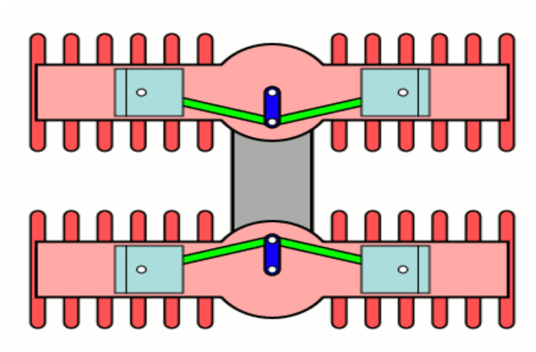

Figure 3.1 H-Engine in line with frame

Figure 3.2 longitudinal straight of h-shape engine at the rear of a Fiat 500

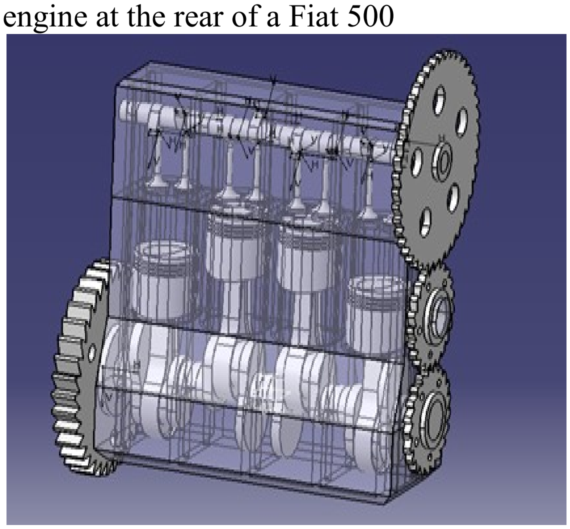

Figure 3.3 design of H-shape engine.

4.0 ANALYSIS

CATIA (Computer Aided Three-Dimensional Interactive Application) is a multi-platform CAD/CAM/CAE commercial software suite developed by French Dassault Company and marked worldwide by IBM.

CATIA V5 is applied in a wide variety of industries such as aerospace, automotive, industrial machinery, electronics, shipbuilding, plant design and customer goods including design things as clothing and jewelry. Some top names of companies using the software are Toyota, Ford, Goodyear, Boeing, Porsche and many others.

CATIA is the only solution capable of addressing the complete product development process, from product concept specifications through product-in-service to a fully integrated and associative manner.

I have chosen CATIA to design my final project, because it is used in every corner of the globe and only by mastering the software will give me the opportunity to succeed, no mater which career path I would take

The finite element method is a powerful tool to obtain the numerical solution of wide range of engineering problem. The method is general enough to handle any complex shape or geometry, for any material under different boundary and loading conditions. The generality of the finite element method fits the analysis requirement of todays complex engineering systems and designs where closed form solutions of governing equilibrium equations are usually not available. In addition, it is an efficient design tool by which designers can perform parametric design studies by considering various design cases, (different shapes, materials, loads, etc.) and analyze them to choose the optimum design. The method originated in the aerospace industry as a tool to study stress in a complex airframe structures. It grows out of what was called the matrix analysis method used in aircraft design. The method has gained increased popularity among both researchers and practitioners. The basic concept of finite element method is that a body or structure may be divided into small elements of finite dimensions called "finite elements". The original body or the structure is then considered, as an assemblage of these elements connected at a finite number of joints called nodes or nodal points.

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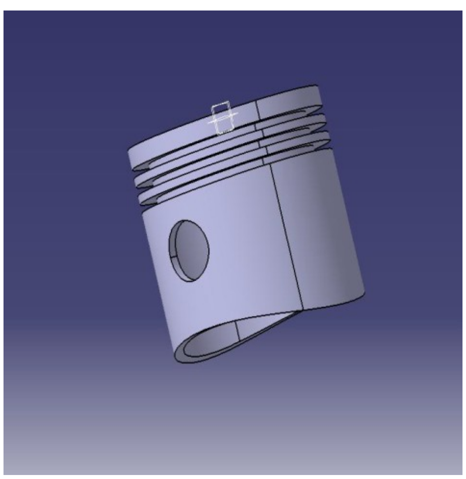
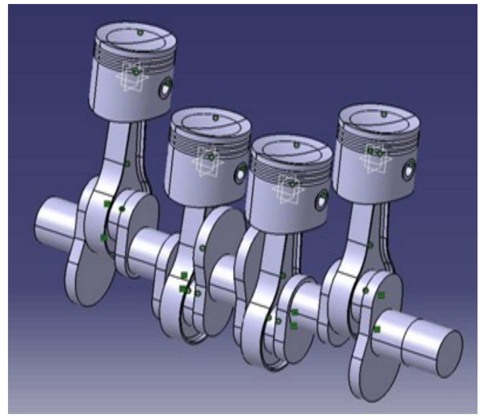
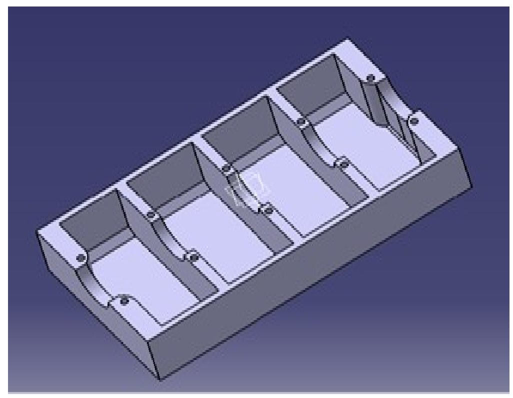


4.1 design of piston



4.2 mechanism of engine



4.3 design of crank case

5.0 DESIGN ANALYSIS

Engine specifications:

Kirloskar TV2

Bore dia - 87.5

Cubic capacity - 1.323 lts

Compression ratio - 17.5: 1

Governor – mechanical centrifugal type

Speed – 1500 rpm

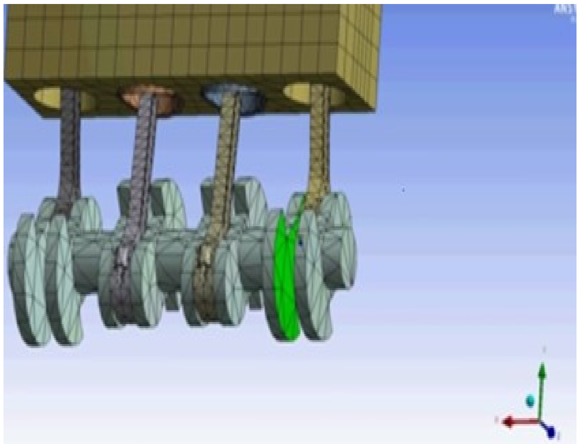
Starting system – by hand cranking

Orifice dia – 18 mm

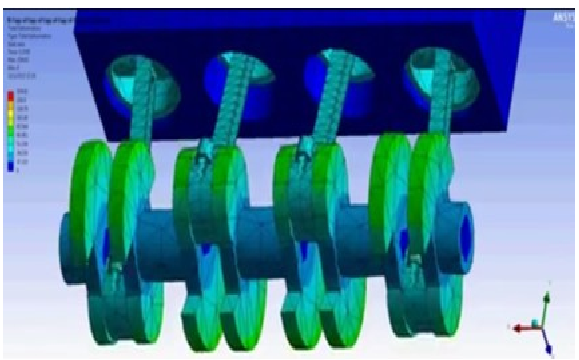
Water density – 1000 Kg/m^3

Coefficient of discharge – 0.65

BMEP at full load at 1500rpm – 633 Kg/cm^2



5.1 Meshing of parts in h-shape engine



5.2 Static stresses of engine

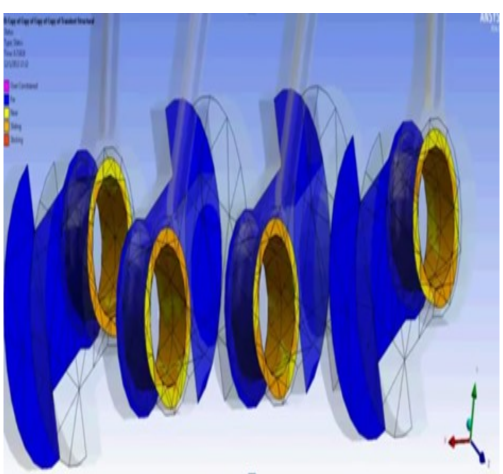


Figure 5.3 von mises stressed element

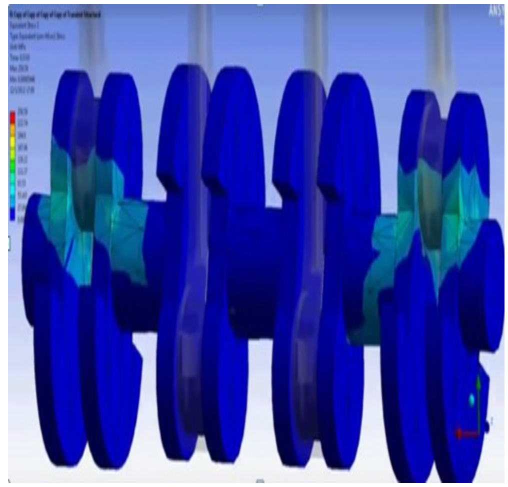


Figure 5.4 deformations along the engine

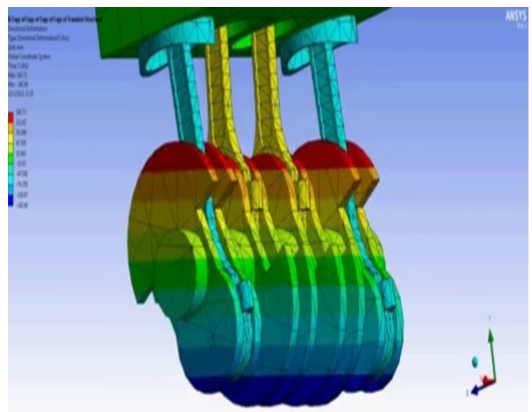
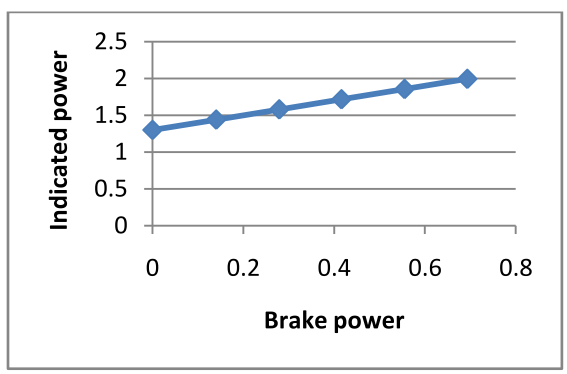


Figure 5.5 stresses along the piston



Graph 5.1 the flow of stresses along the brake power.

6.0 CONCLUSION

In the present study, a series of experimental investigations have been conducted to explore the performance, combustion and emission characteristics with optimization of engine operation using H-shape, thumba oil, thumba bio H-shape and their specified blends with H-shape fuel in direct injection single cylinder variable compression ratio multi fuel H-shape engine. The present effort has contributed mainly in the following aspects:

- A suitable test rig including pressure pickup, charge amplifier and high speed data acquisition system was developed together with emission measuring equipments like smoke meter and exhaust gas analyzer for conducting detailed experimental investigation of performance, combustion and emission characteristics of H-shape engine fuelled with thumba oil, thumba bio H-shape and their specified blends with H-shape.

The experimental results of performance on twin cylinder H-shape engine are above. In that the graphs between

- Indicated power and Brake power
- Mechanical efficiency and Brake power
- Thermal efficiency and Brake power
- The different pressure loads are applied on the H-shape engine and Temperature and Fuel consumption are noted and plotted on graphs

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