International Journal For Advanced Research In Science & Technology
A peer reviewed international journal www.ijarst.in
ISSN: 2457-0362

STUDY ON CERAMIC COATINGS AFFECT ON IC ENGINE WITH BIO DIESEL BLEND

[1]PROF .P.USHASRI, [2]MR. B T NAIK
[1]Professor Mechanical Engg Dept, UCE OU Hyd
[2]Associate Professor Mechanical Engg Dept St.Martin's Engg College Dhulapally Secunderabad TS Pin : 500100
MailID : btnaik96@gmail.com

Abstract: One of the serious issues taken by the researchers in present times in internal combustion engine is combustion chamber. The combustion chamber configuration varies according to the engine speed. The name of the hemispherical combustion chamber stands for the concept of a combustion chamber at the head or top of a cylinder. Designs of combustion chamber and other accessories have taken from kirloskar engine to run the CFD analysis. The results compare with the practical outputs taken from the review to validate the simulation. Fine mesh used to segregate the temperature and velocity distributions. Ansys work bench used to simulate the CFD processes and CATIA used to design the combustion chamber.
Key words: Combustion chamber, C.I engine, CFD.

Introduction

An I.C engine is one of the most powerful energy sources used in farming. The key issue with diesel engine output is compounded by a good combustion chamber design. Flow and combustion chemistry, with an impact on pollutant emissions of a single cylinders diesel engine, caused by the repenetrating piston crown has been investigated. High carbon formation is needed in order to be more effective in combustion, less pollution and soot.The literature includes many kinds of studies and methods recorded for increasing engine performance, such as injection pressure, injection timing, exhaust gas recirculation, swirl ratio, multi-injection angle spray, nozzle diameter etc. In this analysis, the main advantages for proper combustion timing and increasing engine volumetric efficiencies are the chamber area for single cylindrical diesel engines specified for 4,4 kW, 1500 rpm. By using piston coronation in the top part of piston. With a standard piston fair agreement between CFD (using Ansys Fluent) and Experimental results, the CFD analysis and the CFX analysis of the C.I engine was carried out.

CFD and CFX study expansion stroke and exhaust fuel injections, airflow path inlets, chemical reactions and 4-S diesel cycle pollutant controls. Combustion takes place in the unburnt reactants as a blazing hand. With modern software computing power and CAD systems technology, it became successful for analysts to conduct a CfD analysis of an inner-combined engine output. In the non-premixed combustion, which is affected by swirl and turbulence.

Objectives

- To validate simulation results of combustion chamber with practical results.
- To check the performance of engine with various chamber designs.

- To check the variation of using coated and non-coated pistons.

Need of combustion chamber analysis

Diesel vehicles are common for heavy-duty vehicles because their fuel efficiency is higher than the fuel efficiency of gasoline vehicles. Even though diesel engines have everyday conveniences, they emit emissions of foul-smelling, which include various forms of toxic contaminants such as hydrocarbons, carbon monoxides, nitrogen oxides, sulfur oxides, organic volatility, organic semi-volatile compounds and soot. Diesel engines therefore fall under strict emission regulations to improve air quality. Such international regulations also limited the production of diesel engines[1-3]. Oxide of nitrogen (NOx) and diesel (PM) emissions are seen as sources of air pollution and, in early years of the 21st century, a global trend towards stricter regulation of these components of the extraction gas started. The excellent thermal performance of the diesel engines, on the other hand, is a welcome feature in terms of energy conservation and global warming[4]. The mixture training and the full combustion should be reduced to simultaneously reduce the harmful emissions and improve the consumption of fuel in the diesel-type swirl chamber. An ideal combustion chamber must therefore first be configured to accomplish these tasks. For the design of a swirl type combustion chamber, theoretical and semi-experimental methods exist, but aberrations are too great.The design method currently used is mainly to optimize the process by using an accumulated knowledge based test and error method[5-7]. A powerful swirl is created in the swirl chamber during the compression stroke upstream of the combustion chamber in the swirl chamber form of diesel engine. The engine can achieve excellent combustion even at high velocities by spraying the fuel into this chamber and making a good mixture.The diesel-type Swirl chamber engines are ideal for high-speed operations and are frequently used for small high-speed diesel-engine applications, although small in size they can produce high power[8-9]. In modern motors with quickburn chambers, NOx generation is reduced. The amount of NOx emitted also depends on where the combustion chamber is located. As these are typically more compression-effective, as well as higher temperatures and pressure, the divided combustion chamber and indirect injection (IDI) compression ignition motors tend to produce higher NOx levels[10]. Computer analyses using computational fluid dynamics can quickly provide accurate information and complement existing research by rapidly advancing computer hardware and creating effective numerical modelling tools.[11].

Engine and combustion chamber specifications

Diesel engine 4.4 kw, speed 1500 RPM

Combustion chamber type-spherical-with ϕ 40mm

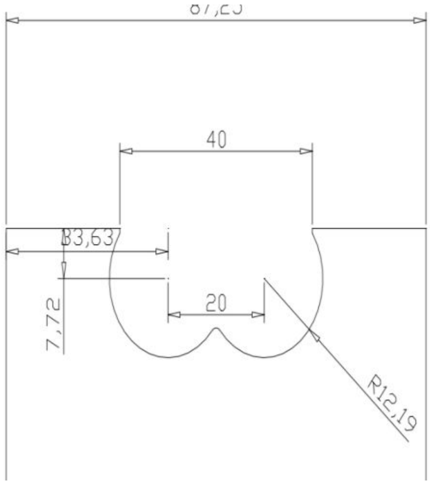
Bore -87.5mm, stroke- 110mm

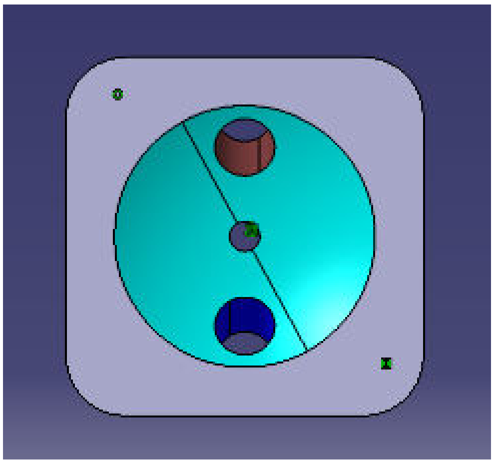
Crank radius= s/2= 55mm

International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
ISSN: 2457-0362

Connecting rod length- 220mm
Compression ratio- 17.5:1
Operating pressure- 200 bar
Start of injection-23.4^{0}θ TDC
Input fluid- diesel temperature-75^{0}c
Maximum over load-300 bar
Torque = 1.5 NM
Cubic capacity= 0.66 Lts

Design of combustion chamber

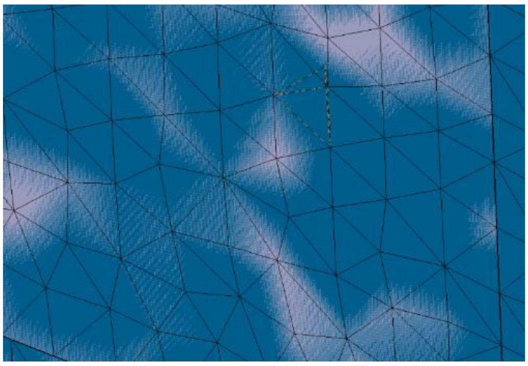


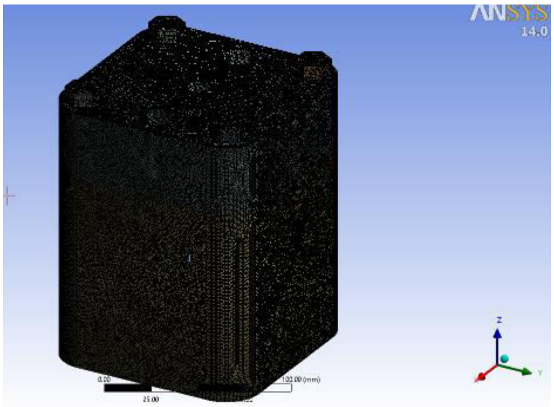


Spherical combustion chamber design in catia

Meshing

The spherical combustion chamber meshed by using tetra hydra mesh in Ansys the mesh elements are as follows





Domain	Nodes	Elements
Fluid chamber bottom	470376	450294
Fluid chamber top	13536	9789
Fluid piston	72870	66006
All domains	556782	526089

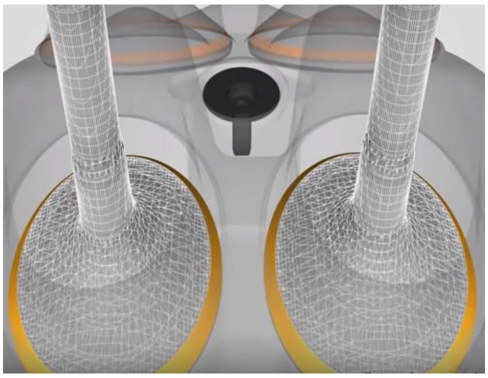


Figure represents porous medium mesh for advanced CFD simulation

International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
ISSN: 2457-0362

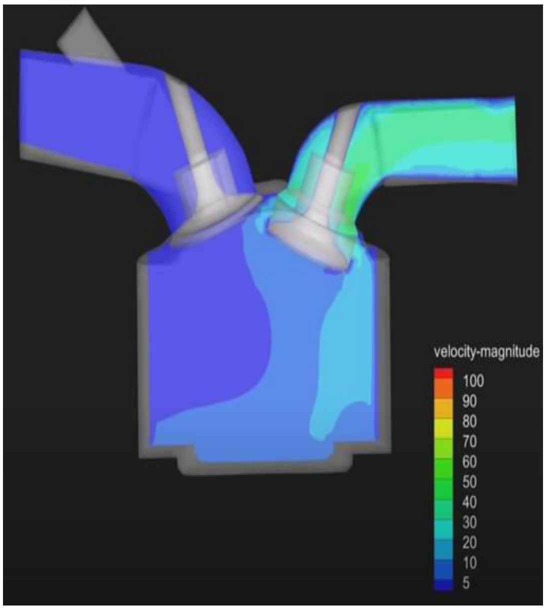
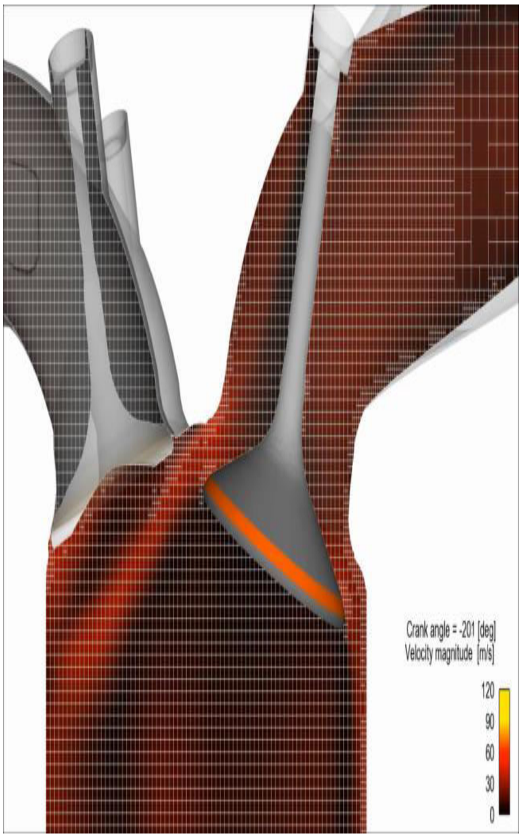


Figure represents velocity magnitude with assembly



Combustion flow at crank angle 201^0

Results and discussions

The following are the results for ceramic coated piston for diesel

Heat release – crank angle:

		Crank angle								
		-20	-15	-10	-5	0	5	10	15	-20
Heat release	Q1(practical)	10	20	85	55	50	45	43	35	40

Break power - ignition delay:

		Break power								
		0	1.4	2.4	3.4	4.4				
ignition delay	II(practical)	17	16.5	15	14.2	13.4				

THERMAL EFFICIENCY- BREAK POWER:

		Break power (kw)								
		0	1.4	2.4	3.4	4.4				
Thermal efficiency (%)	η (practical)	5	8	15	14	16				

CARBON MONOXIDE (%)- BREAK POWER:

		Break power (kw)								
		0	1.4	2.4	3.4	4.4				
Carbon monoxide (%)	co (practical)	0	0.5	1.5	2.0	2.5				

Hydro carbons break power:

		Break power (kw)								
		0	1.4	2.4	3.4	4.4				
Hydro carbons (%)	HC (practical)	0	10	15	20	25				

NO_X break power:

		Break power (kw)								
		0	20 %	40%	60%	80%	100 %	120 %	140 %	160 %
NO_X (%)	NO_X (practical)	100	200	300	400	500	600	700	800	900
	NO_X (simulation)	120	220	330	390	540	610	720	810	905

Following are the results for 20% vegetable oil blend to diesel of ceramic coated piston

Thermal efficiency-n	Break power(KW)				
	0	1.1	2.2	3.3	4.4
N1-normal	0	15	24	28	32.5
N2-scc designed	0	15	24	29	34
N3-scc simulation	0	15	24.2	28.32	33.4

IJARST
International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
ISSN: 2457-0362

CO(%)	Break power(KW)				
	0	1.1	2.2	3.3	4.4
CO1-normal	0.12	0.14	0.18	0.225	0.25
CO2-scc designed	0.12	0.14	0.175	0.225	0.25
CO3-scc simulation	0.11	0.13	0.16	0.21	0.23
HC(PPM)	Break power(KW)				
	0	1.1	2.2	3.3	4.4
HC1-normal	31.5	39.5	41.5	46.5	50
HC2-scc designed	32	39	44	47.5	49
HC3-scc simulation	31.5	38	42	46	48.5

NOX(PPM)	Break power(KW)				
	0	1.1	2.2	3.3	4.4
NOX1-normal	150	210	310	400	500
NOX2-scc designed	155	205	315	420	510
NOX3-scc simulation	148	200	308	410	502

SMOKE DENSITY(MG/M^3)	Break power(KW)				
	0	1.1	2.2	3.3	4.4
SD1-normal	7	19	31	90	142
SD2-scc designed	8	17	30	80	140
SD3-scc simulation	8	16	29	82	138

Conclusions

The 4,4 kW single cylinders are chosen for the evaluation of performance and emission characteristics of the internal-combustion engine powered by 20 percent JTME for the 4-stroke direct injection diesel motor. The performance parameters such as thermal efficiency, heat release and cylinder pressure validate the simulation results with practical output from the literature. The engine emissions for the spherical combustion chamber designs tally with the simulation results. From the experimental results it could be inferred that numerical simulation is one of the strong methods to refine and increase the performance of internal combustion engines rather than designing new designs and to test and evaluate them at all times.

REFERENCES:

[1] S. H. Choi and Y. T. Oh, Experimental study onemission characteristics and analysis by variousoxygenated fuels in a D.I. diesel engine. *Int. J.Automotive Technology* 6 (3) (2005) 197-204.

[2] D. P. Schmidt and M. L. Corradini, The internalflow of diesel fuel injector nozzles: a review, *Int. J.Engine Research,* 2 (1) (2001) 1-22.

[3] M. P. Poonia, A. Ramesh and R. R. Gaur, Experimentalinvestigation of the factors affecting the performanceof a LPG - diesel dual fuel engine. *SAEpaper No.* 1999-01-1123, (1999).

[4] S. Kimura, O. Aoki, H. Ogawa and S. Muranaka,New Combustion Concept for Ultra-Clean andHigh-Efficiency Small DI Diesel Engines. *SAE paper*1999-01-3681, (1999).

[5] J. M. Desantes, J. V. Pastor and A. Doudon, Studyof the steady flow

produced by direct injection dieselengine intake ports. *Proc. Instn Mech. Engrs,Part D: J. Automobile Engineering,* 215 (2001)285-298.

[6] K. Cunningham, R. K. Kee and R. G. Kenny, Reedvalve modelling in a computational fluid dynamicssimulation of the two-stroke engine, *Proc. InstnMech. Engrs, Part A: J. Power and Energy.* 213(1991) 37-45.

[7] J. K. Yeom and H. Fujimoto, A study on the behaviour characteristics of diesel spray by using a highpressure injection system with common rail apparatus.*KSME International Journal,* 17 (2003) 1371-1379.

[8] M. A. Patterson, S. C. Kong, G. J. Hampson and R.D. Reitz, Modelling the effects of fuel injectioncharacteristics on diesel engine soot and NOx emissions.*SAE Paper* 940523 (1994).

[9] M. A. Patterson and R. D. Reitz, Model the effectsof fuel spray characteristics on diesel engine combustionand emission. *SAE Paper* 980131 (1998).

[10] W. W. Pulkrabek, *Engineering Fundamentals ofthe Internal Combustion Engine Fundamentals(Prentice Hall, New Jersey), (1999) 285-286.*

[11] Gyeung Ho Choi1, Jae Cheon Lee2et.al ‘Combustion characteristics of a swirl chamber type diesel engine’ Journal of Mechanical Science and Technology 23 (2009) 3385~3392