International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347 - 6435 (Online)) Volume 4, Issue 6, June 2015)

Experimental Investigation Improvement of Charge Swirl in CI Engine

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***Abstract*— In a diesel engines the Air fuel mixture is very important this air fuel mixture will be introduced with the help of injector this injection Analysis of fuel spray with various injection orientations has high importance on the engine performance as well as exhaust gas emissions measure. The fuel injector orientation plays very important role in fuel air mixing. Fuel injector having single ,two and multi hole nozzle injector is considered for analysis. The fuel atomization ,combustion, injecting, spray pressure and formation of pollutant emission in a diesel engines due to the shapes of the nozzle . the main objective of this research was to find the proper model and get the effective results. Several models of the nozzles were made to increase further fine atomization and break down of fuels droplets in to fine small Molecules. Some of the models are (Normal straight Retrofit, "Z" or curved shape Retrofit, straight Retrofit with considering holes , "Z" shape or curved Retrofit with holes) .these results were compared with standard nozzle used in engine for air fuel mixing purpose . in this experiment it has been investigated the effect of injector nozzle holes and models created such as Retrofit for fuel spray on the performance of diesel engine such as fuel consumption and fuel in engine cylinder the analysis of a swirl diesel engine research also reveals the effects of this atomized droplets though the passage ,effects of the pressure ,heat release HC, No and CO concentration.**

***Keywords*—HC, NO and CO, Emission analysis, Nozzle hole, Swirl, turbulence.**

I. Introduction

This The use of Diesel engines today depends on lowering the toxic emission components to the human and surrounding ,such emission components like HC,NO,CO and PM .we came to know that these will also pollute the atmosphere and also reduces the efficiency of the engine and in the engine the unburnt fuel will develop these toxic gases so to reduce the effects of these gases purifying is required from the exhaust gas and this must be still reduce.

Automotive engines will exits many no of gases which will be produced from the different fuels like petrol ,diesel , gas ,air fuel mixture, ethanol, propane etc these pollutes the atmosphere which issignifintially contributes to air pollution .

Where as petrol and diesel burn in an engine the main toxic substance present in the exhaust gases are incomplete combustion oxides of hydrocarbon containing CO, HC, NOx, and other particulates .

CO is the emission that is the most toxic product found in the exhaust gases that is colorless,tasteless,odorless and mass also constintentioly poor .HC and CO emissions are primarily products combustion fine particles are usually invisible although in certain operating conditions where as the diesel products will produce visible particles appearing as smoke . CO2 emission is unlike one these pollutants is not directly linked to the fuel consumption .the pollutants level are more dependent on the vehicle technology ,maintenance, inspection of the same other factors also includes like ambient temperatures ,driving, and conditions also effects emission of pollutants .the vehicle exhaust emission are typically measured using the five gas analyzer and that is reported in Parts per million (PPM) and volume.

In the Engine we know that fuel injection system is the heart it very important aspect, the pressure required must be good enough to atomize the air fuel mixture ,the components of the fuel injectors require accurate dimensions and proper design, proper selection of material from which those components are prepared ,with the conventional pump line nozzle systems new components need such as distributor pump system, common rail system, accumulator system, unit pumps etc

The combustion process in DI engines is heterogeneous in nature it increases the emissions dissociate the nitrogen ,impurities in the fuel and air are the other region ,liquid fuel injected through nozzle by the fuel injection pump system in to the cylinder though the jet passage end of the compression stroke .when leaves the nozzle the fuel it becomes laminar to turbulence and it will be scatter from the holes provided in the nozzle in to the cylinder that broke in to the fine fuel droplets then mass of fuel will evaporates in the cylinder the impinging on the wall then becomes cylinder un movable due to high impact of DI engines.

IJRDET
International Journal of Recent Development in Engineering and Technology
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The dimensions of the nozzle channel flow even 210 bar under this condition measurements and observations of the nozzle flow coefficients at steady state conditions this measures of the flow in the scaled up transparent models .

The main aim of this experiment to find the simplified model of some exist one like multinozzel holes will be used for fast analysis and we made the retrofit. By this pollutatents emissions were controlled by the turbulent air fuel mixing and combustion process.

II. Methodology

The experiment is done on existing fuel injector with minor modifications in design of nozzle. Firstly the dimensions of nozzle are measured. A model is created such that it covers the nozzle tip like a cap it is also called as mask and provide as an obstacle for the fuel spray. For this a hollow pipe of Stainless Steel material of internal l dia 6 mm and outer dia 8 mm with a thickness of 1 mm and length 28 mm and a step of 2 mm to the same model of 8 mm outer dia is created with the help of lathe machine or by using the CNC machine for reducing the diameter to make concentric with the nozzle this is made for above required dimensions achieve accurately. 4 no's pieces of same dimensions are created.

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Table no 1
Shows the different types of Retrofit

Slno	Retrofit type	No of projections	Remarks
1	Straight projected	14	
2	Straight projected with holes	14	Hole dia 0.3mm
3	Z type projected	7	
4	Ztype projected with holes	14	Hole dia 0.3mm

Where The straight cut and Z type cut is made with the help of the wire cut machine where as the wire diameter is 3mm, but holes on the retrofits made with the help of laser cut machine.

The nozzles with 3, 4 and 5 holes are reduced in diameter from 8 mm to 6 mm with lathe machine and both the surfaces of nozzles and models are polished with fine emery paper and buffing for smooth finishing. Now the fuel injector is re-assembled with modified nozzle and model.

The fuel pressure injecting is fixed to 210 bars pressure and tested the same with the fuel tester equipment, the fuel injecting from nozzle is restricted by the model called retrofit and this will help to reduce fuel droplets to further fine particles. This helps for better mixing of air fuel inside the combustion chamber because the provided retrofit having finest shape than the conventional one this arrangement makes the particles of fuel in to more smaller than conventional nozzle spraying . This reduces delay in mixing of fuel and air with more turbulence because of its smaller size particles and readily burn with very less amount of unburnt fuel left to exhaust, thus this in turn reduces the emissions caused due to incomplete combustion of diesel fuel. Various nozzles with different hole combination assemblies are tested to obtain the better results.

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FIG-1. MODEL OF THE STRAIGHT CUT RETROFIT-14 PROJECTIONS

FIG-2.MODEL OF THE STRAIGHT CUT WITH HOLES RETROFIT - 14PROJECTIONS

FIG-3. MODEL OF THE Z TYPE CUT RETROFIT- 7 PROJECTIONS

FIG-4. MODEL OF THE Z TYPE CUT WITH HOLES RETROFIT-14 PROJECTIONS

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III. EXPERIMENTAL SET UP

FIG -5.EXERIMENTAL SET UP OF

1) Connect the fuel injector body with the different nozzle holes and different retrofit (any one combination which you want to conduct)
2) Switch on the water pump to collect the water in the sump and then to the over head tank and on the valve by that it will flow through the water flow meter to the engine head.
3) Switch on the CO ,HC & N% analyzer by connecting the switches to the junction box and supplying the power to the respective ones.
4) Maintain the standard as given below before starting the experiment
   CO = 0.00
   HC = 0.000
   N% = o.o
5) On the valve to make flow water in water flow meter(check the needle)
6) Switch on the panel board which contains the fallowing things on the board (experimental set up)
   a) Loads in KW
   b) Time consume in 10cc of fuel indicator tube
   c) Main power supply on / off
   d) Water flow meter
   e) Fuel supply control knob
7) Switch on the fuel supply
8) By using the handle rotate by keep it in engine crank shaft and start the engine
9) Maintain the fuel oil above the indicated for 10cc of fuel consumption (you can see the marks in the fuel indicator tube)
10) Absorbed that spring load and load should be zero before starting the engine
11) After maintaining the water level and fuel level in the water level and fuel level indicator
12) First we have to take the reading without and load by setting only spring load
13) then we have to note the spring value which we set in to the tabular column ,we have to fix the wheel and tighten the nut on top of the wheel and noted the spring reading in the dial
14) Then we have to take the fuel consumption for 10cc of fuel noted in the tabular by using stop watch, when spring load is set we have to close the fuel supply knob kept close and when it reaches the first mark in the fuel level indicator (upper level) then switch on the stop watch and when it reaches the second mark then we have to stop the stop watch noted the values in the tabular column. Then switch on the fuel supply knob for fuel supply and to maintain above the upper level mark for next reading .
15) Then keep the probe (HC & CO which is common one only one it is two in one in same machine we can measure both HC & CO), after keeping probe leave some period about few minutes and note the reading (till it stand up to some value and then goes back or it reduces take the maximum one) both HC & CO values and tabulated.
16) Then keep the N% measuring probe by that measured N% leave some few minutes and notes it by keeping in test mode.
17) After that repeat the experiment for different nozzle holes and for different Retrofit ,and also changing the different spring load and load in kw for different combinations repeat for no of readings which required (the maximum load is 2.5 KW load),note down all the HC,CO,N% values .

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18) Then remove the loads in decreasing order, remove the spring load, and then switch off the fuel supply knob and then engine ,by that time HC,N,CO values will come to zero and you can switch off too and then switch off the main panel board and close the water supply valve.
19) Repeat the step 1 to step 18 for every combination
20) Clean all the probes and disconnect all the probes and pipes and keep all the things were where their and to their regular places for feature use and to maintain 5S and keep clean and neat in the lab.

IV. Results And Discussion

A. HC Comparisons

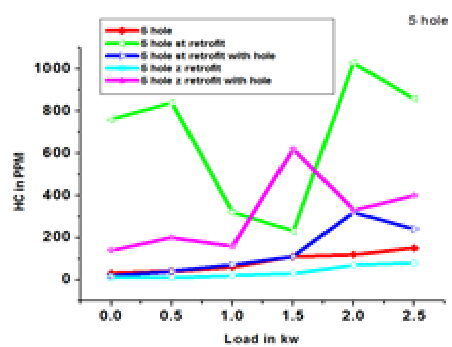

Fig -6. Shows HC comparison for 5 holes nozzle and 5hole nozzle with different retrofit

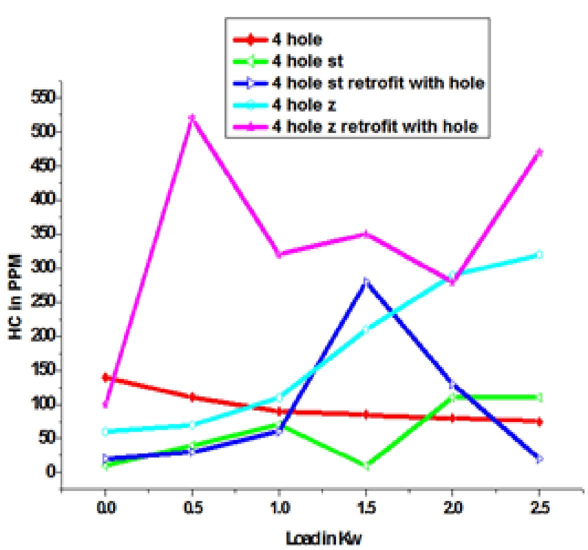

Fig 7: Shows HC comparison for 4 holes nozzle and 4 hole nozzle with different retrofit.

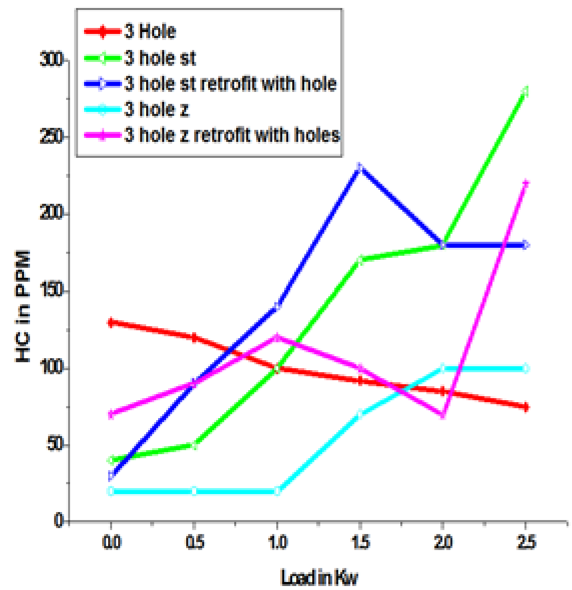

Fig 8: Shows HC comparison for 3 holes nozzle and 3 hole nozzle with different retrofit.

B CO Comparisons

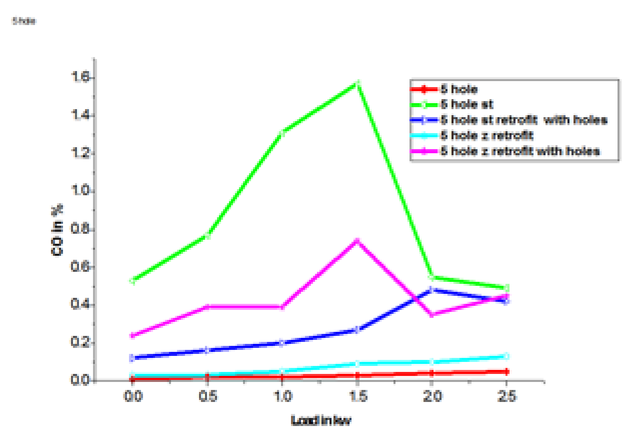

Fig -9.Shows CO comparison for 5 holes nozzel and 5hole nozzle with different retrofit.

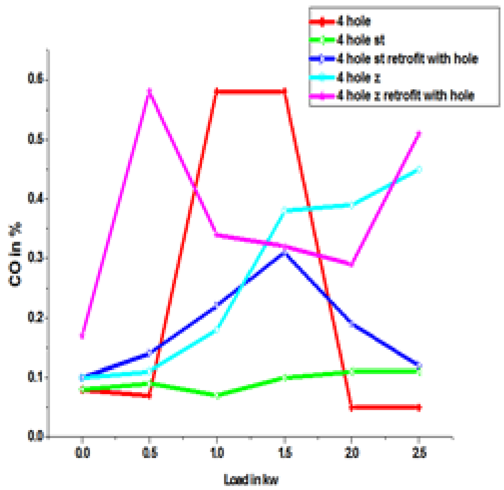

FIG -10.SHOWS CO COMPARISON FOR4 HOLES NOZZLE AND 4 HOLE NOZZLE WITH DIFFERENT RETROFIT.

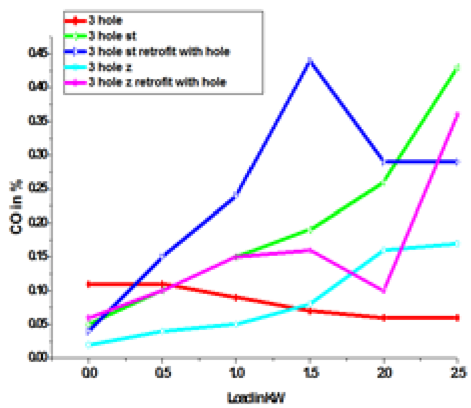

FIG -11.SHOWS CO COMPARISON FOR3 HOLES NOZZLE AND 3 HOLE NOZZLE WITH DIFFERENT RETROFIT.

C. Water Testing Snaps

FIG -12. 3HOLE NOZZLE

FIG -13. 3HOLE NOZZEL Z TYPE RETROFIT WITH HOLES

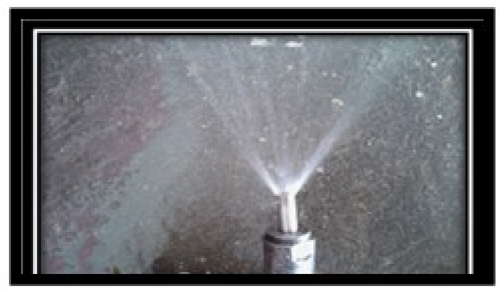

FIG -14. 3HOLE NOZZLE STRAIGHT TYPE RETROFIT WITH HOLES

FIG -15. 3HOLE NOZZLE Z TYPE RETROFIT WITHOUT HOLES

FIG -16. 3HOLE NOZZLE STRAIGHT TYPE RETROFIT WITHOUT HOLES

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FIG -17. 4 HOLE NOZZLE

FIG -18. 4 HOLE NOZZLE STRAIGHT RETROFIT WITHOUT HOLES

FIG -19. 4 HOLE NOZZLE Z TYPE RETROFIT WITHOUT HOLES

FIG -20. 4 HOLE NOZZLE Z TYPE RETROFIT WITH HOLES

FIG -21. 4 HOLE NOZZLE STRAIGHT TYPE RETROFIT WITH HOLES

FIG -22. 5 HOLE NOZZLE

FIG -23. 5 HOLE NOZZLE Z TYPE RETROFIT WITHOUT HOLES

FIG -24. 5 HOLE NOZZEL STRAIGHT RETROFIT WITHOUT HOLES

FIG -25. 5 HOLE NOZZLE STRAIGHT RETROFIT WITH HOLES

FIG -26. 5 HOLE NOZZLE Z TYPE RETROFIT WITH HOLES

D. Break Thermal Efficiency verses Load in Kw

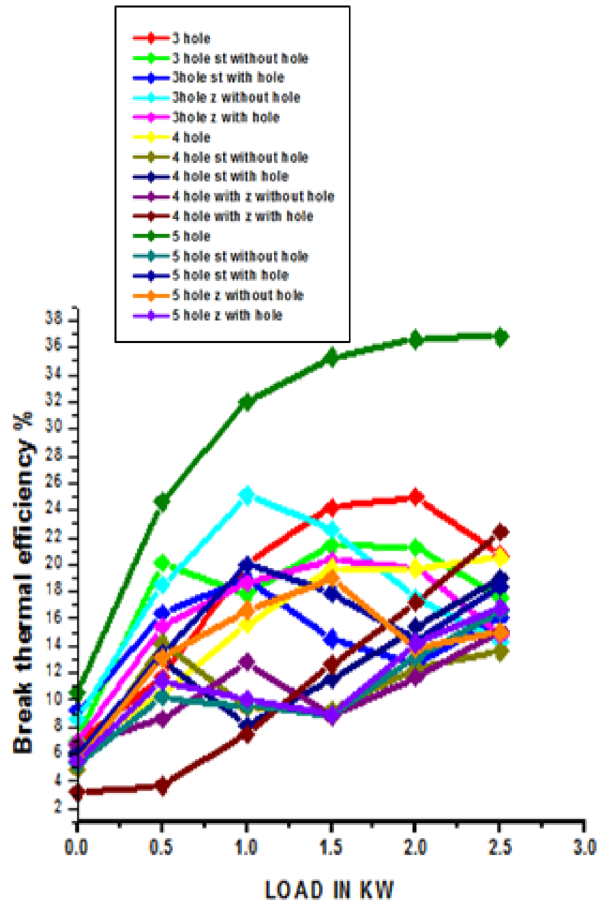

FIG -27. BREAK THERMAL EFFICIENCY VERSES LOAD IN KW

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E. Break Specific fuel verses Load in Kw

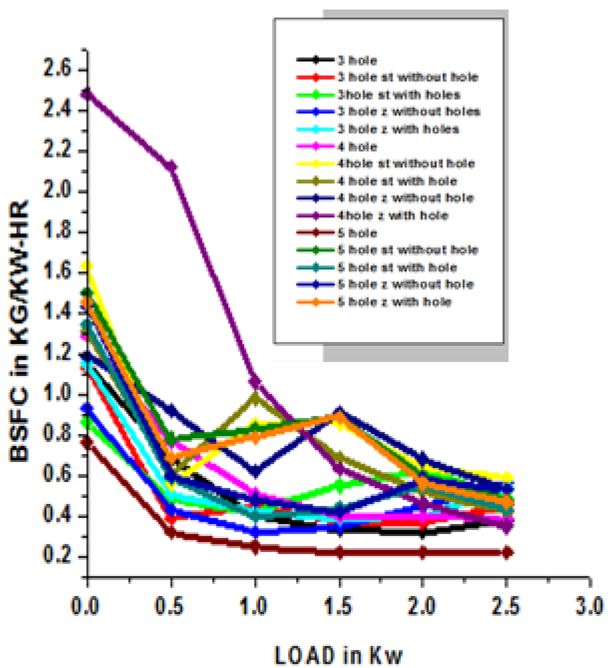

FIG -28. BSFC VERSES LOAD IN KW

When The fuel air mixture enter in to the fuel injector the droplet they will be colloid each other and scatters and make the turbulence on tangential and equally balanced due to the equally partition done on the retrofit projections of the different retrofit so effective fuel utilization.

V. CONCLUSION

From the graphs and figures of water testing we came to conclusion that using Z type retrofit with 7 projection we can get very good result better HC & CO ,and even fine spray.

REFERENCES

[1] M.Kato et al., Flow Analysis in Nozzle Hole in Consideration of Cavitation, SAE 970052.

[2] T. Yoda, T. Tsuda, Influence of Injection Nozzle Improvement on DI Diesel Engine, SAE paper 970356.

[3] J.B. Heywood, "Internal Combustion Engine Fundamentals", McGraw-Hill Book Co, pp 493-494, 1988.

[4] D. Ing. H. Tschöke, "Diesel distributor fuel-injection pumps", Robert Bosch GmbH, pp 12-53, 1999.

[5] B. Challen R. Baranescu, "Diesel Engine Reference Book" Reed Educational and Professional Publishing Ltd., Second Edition, pp.260-301,1999.

[6] A.J.Von Wielligh, "Influence of fuel quality on diesel injector failures", Fifth International Colloquium Fuels, Germany, 2005.

[7] A.Rosland,greenhomegas emission in Norway: inventories and estimation methods oslo:Minsters of environment, 1993.

[8] Baver.H (1999) Diesel engine management Stuttgart :SAE

[9] Herzog.P.(1989) the ideal rate of injection for swirl supported diesel engines. Imech E,Diesel fuel injection systems seminar, Birmingham

[10] Pehen,s.,svoljsalc-jerman,M.Kegl,& Kegl,B.(2009) Biodiesel influence on tribology characteristics of a diesel engine fuel.88,970-979.

[11] H.Khallil,Nonlinear systems,Prentice-hall,inc1992

[12] Thring R.H.(1989) , Homogeneous – change compression ignition (HCCI) engines: SAE Technical paper 892068.

[13] Arcoumanis C. et al., Investigation of Cavitation in a Vertical Multi-Hole Injector, SP-1415, p.181-198, SAE, Warren dale, 1999.

[14] C.Arcoumanis et. al., Analysis of the Flow in the Nozzle of a Vertical Multi Hole Diesel Engine Injector, SAE paper 980811.

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