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INVESTIGATION ON PERFORMANCE AND EMISSION PARAMETERS OF DISC TYPE FUEL INJECTOR NOZZLE IN 4-STROKE SINGLE CYLINDER DIESEL ENGINE

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Abstract — *In this dissertation we are going to analyse performance of disc type fuel injector nozzle to compare the existing injector. We are going to analyse spray characteristics, fuel consumption, penetration, energy output and engine emission parameters of the 4-stroke single cylinder diesel engine.*

Keywords-*disc type injector; single-cylinder diesel engine; spray characteristic; new design of injector; emission parameters*

I. INTRODUCTION

As we All know that world is suffering from air pollution. The air pollution is created major by industries & automobiles vehicles especially by Diesel engine. Several research are done to control air pollution and going on till today various system have been developed, designed & employed to control the automobile air pollution in this project one of the new & innovative design of injector is developed to improve in this project new design of injector is developed in this type the injector nozzle is of disc type operated mechanism holes are made on disc to spray & inject in wide area disc will rotate at the time of injection to produce the swirl mixture fuel will be injected in such a way that it spreads in whole combustion chamber it is assumed that it spray far better than single hole & multi hole nozzle.

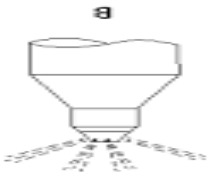
II. OBJECTIVE AND METHODOLOGY

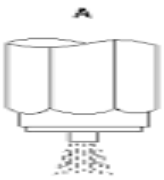
Objective

- To use the fabricated disc type fuel injector nozzle in to diesel engine.
- To analyse spray characteristics of fuel by disc type nozzle.
- To analyse penetration of fuel
- To investigate performance parameters of engine
- To investigate theemissions & combustion

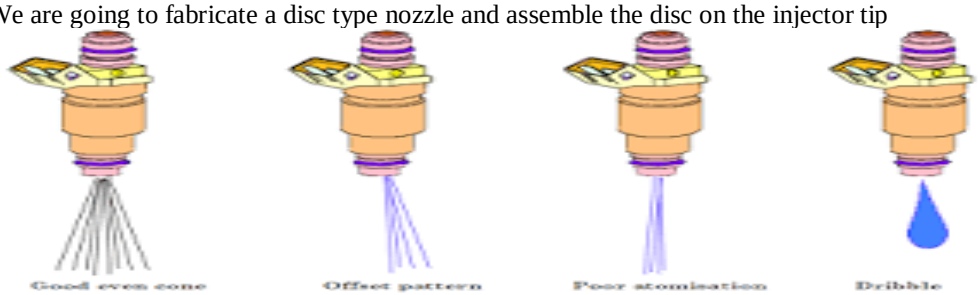
Methodology

- In this project we are going to design a new injector operated directly by disc consisting a number of holes to flow a fuel in atomized form



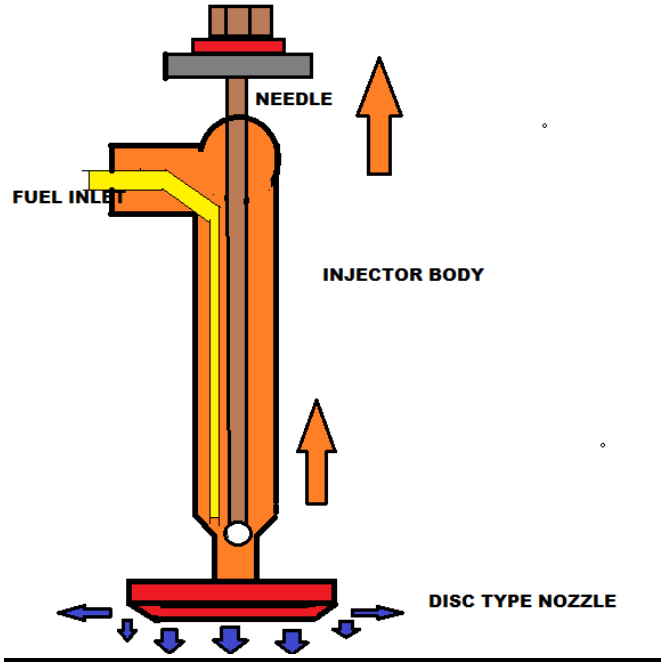


- We are going to fabricate a disc type nozzle and assemble the disc on the injector tip



- To install the disc type injector in engine to check the performance of engine
- To compare the results of disc type injector with Multi hole nozzle, pintle nozzle & pintaux nozzle.

Injector Mechanism



III. INJECTOR PERFORMANCE

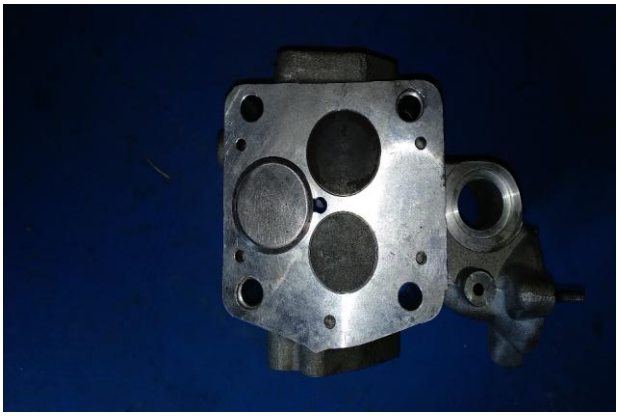
3.1. Disc injector

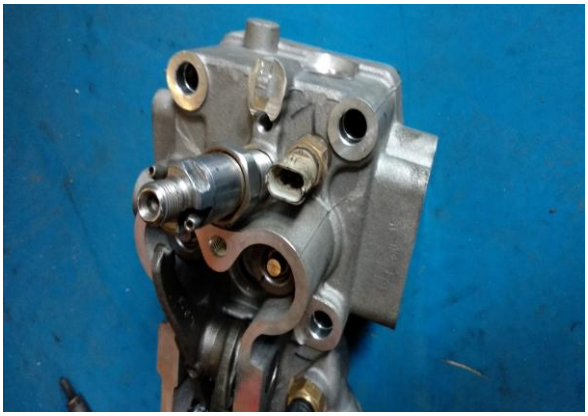
DISC THICKNESS	20 MM
DISC DIAMETER	40 MM
NO OF HOLES	9
SHAPE	CYLINDRICAL & CONICAL AT EDGE
MATERIAL	STAINLESS STEEL
CAVITY	10 MM

3.2 Injector Spray Tester

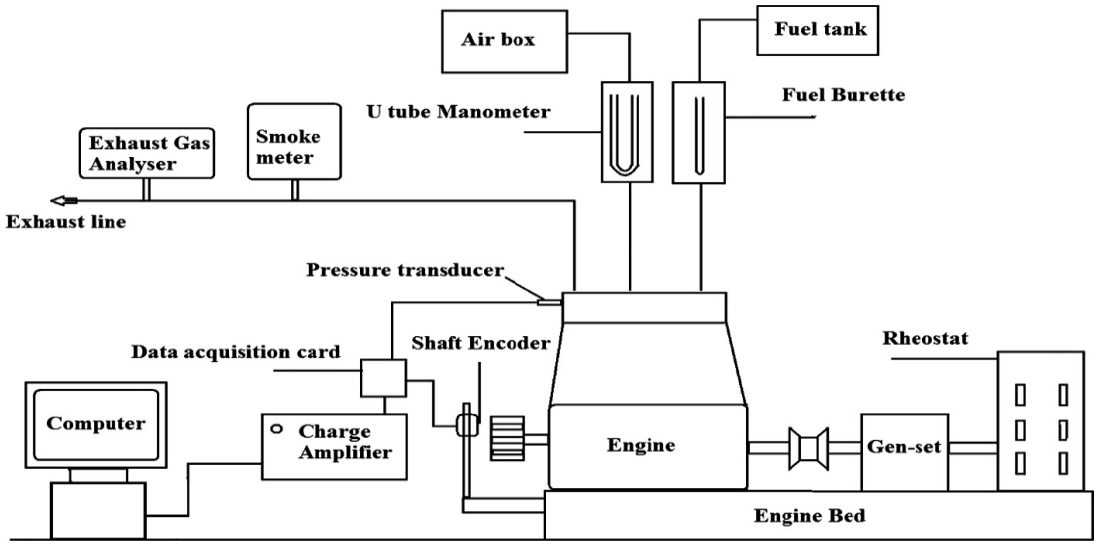
	MULTI HOLE INJECTOR	DISC TYPE INJECTOR
DISCHARGE	10 ml	12 ml
PRESSURE	1.5 BAR	1.5 BAR
RPM	1050	1050
BOOST PRESSURE	1.0	1.2
DIRECTION OF ROTATION	CLOCK WISE	CLOCK WISE
PRE- STROKE IN MM	2.85-2.95	2.85-2.95
CONTROL RACK POSITION IN MM	13.5-16.5	13.5-14.5
CAM SEQUENCE	1-4-2-6-3-5	
CAM DISPLACE MENT	0-60-120-180-240-300	
SPRAY TYPE	CYLINDRICAL	CYLINDRICAL AS WELL AS CONICAL
SPRAY ANGLE	15-85	15-165
BENT ANGLE	0-15	----

3.3 Fabricated Cylinder Head





3.4 Experimental Set-up



3.4.1. Engine Setup Specification

Engine manufacturer	Apex Innovations (Research Engine test set up)
Engine type	Single cylinder four stroke multi fuel research engine
No. of cylinder	1
Type of cooling	Water cooled
Rated power	3.5 kW @ 1500 rpm
Cylinder diameter	87.5 mm
Orifice diameter	20 mm
Stroke length	110 mm
Connecting rod length	234 mm
Dynamometer	Type: eddy current, water cooled, with loading unit

3.5 Observation Table

1) DATA FOR OEM INJECTOR							
Load (kg)	**SPEED (rpm)**	**FC (Kg/hr)**	**CO (%)**	**HC (ppm)**	**CO_2 (%)**	**O_2 (ppm)**	**NO_X (ppm)**
1.00	1510	0.6552	0.04	25	1.8	18.07	92
3.00	1508	0.7056	0.04	27	1.9	17.52	114
5.00	1500	0.8568	0.05	35	2.3	17.15	151
7.00	1495	1.0584	0.05	42	2.9	16.47	219
9.00	1490	1.1592	0.03	47	3.3	15.7	351

Load (Kg)	**Speed (rpm)**	**FC (cc/min)**	**FC (Kg/hr)**	**Torque (Nm)**	**B.P (kW)**	**SFC (Kg/kWh)**	**BTHE (%)**
1.00	1510	13	0.6552	1.81485	0.28683	2.28427198	3.38924
3.00	1508	14	0.7056	5.44455	0.85935	0.8210826	9.42894
5.00	1500	17	0.8568	9.07425	1.42466	0.60140781	12.873
7.00	1495	21	1.0584	12.70395	1.98787	0.53242871	14.5408
9.00	1490	23	1.1592	16.33365	2.54729	0.45507237	17.0125

1) DISC TYPE INJECTOR							
Load (kg)	**SPEED (rpm)**	**FC (cc/min)**	**CO (%)**	**HC (ppm)**	**CO_2 (%)**	**O_2 (ppm)**	**NO_X (ppm)**
1.00	1507	11	0.03	25	1.8	18.2	92
3.00	1503	13	0.04	26	1.85	17.68	129
5.00	1499	16	0.04	32	2.1	17.33	164
7.00	1494	18	0.03	39	2.5	16.96	218
9.00	1491	20	0.03	43	2.9	16.97	247

Load (Kg)	Speed (rpm)	FC (cc/min)	FC (Kg/hr)	Torque (Nm)	B.P (kW)	SFC (Kg/kWh)	BTHE (%)
1.00	1507	11	0.5544	1.81485	0.28626	1.9377	3.98
3.00	1503	13	0.6552	5.44455	0.8565	0.7649	10.09
5.00	1499	16	0.8064	9.07425	1.42371	0.5645	13.60
7.00	1494	18	0.9072	12.70395	1.98654	0.4566	16.86
9.00	1491	20	1.008	16.33365	2.549	0.3954	19.46

IV. CONCLUSION

From the above research it is studied and observed that to increase spray width the disc type nozzle is more suitable as the spray width is twice in multihole nozzle than in single hole.

By using Disc type multi holes injector we can reduce HC (hydro carbon) and CO2 (carbon dioxide) emission. There is very less effect seen on NOx (Nitrogen oxide) and CO (Carbon monoxide)

This process also increases break thermal efficiency at different load, also reduce fuel consumption. Specific fuel consumption is also decrease gradually by increasing load.

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