CFD analysis of modified fuel injector in splash area

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Abstract. The proposed concept is about designing a multi-hole fuel injector nozzle design by using a CFD flow analysis. The concept is to show the internal flow of the fuel inside the fuel injector through a modified venture design to increase the splash characteristics and increased efficiency. The proposed geometry of the gasoline fuel injection nozzle and fuel flow characteristics in the nozzle significantly increases the process of fuel atomization. To acquire a desired result in the flow analysis in nose region different types of cone angles were used and the better is selected for greater result. In existing fuel injector, the fuel flow or consumption in splash area is less, so that we implementing the new nozzle or venturi type design in this concept. This work was carried out to obtain a broad picture on electronic fuel injector nozzle; several designs were conducted on fuel injector nozzle to increase the flow characteristics and to decrease the emission level.

INTRODUCTION

The ignition procedure in diesel motors is essentially constrained by the elements of the fuel splash. In this manner exact demonstrating of shower process is fundamental to precisely display the ignition procedure in diesel motors. The result were looked at based on fluid length, splash entrance and shower pictures. The model was additionally approved beside the motor burning attributes information like in-chamber weight and warmth discharge rate. The new shower model very well catches both splash qualities and burning attributes [1, 2, 5, and 7]. Meeting stringent outflow guidelines while keeping up or improving diesel motor effectiveness is a troublesome test. Splash infusion upgrades shower atomization since little beads permit total ignition, which lessens the measure of toxins and expands the enthalpy of the response. Past investigations have given bits of knowledge into new parts of spout/splash communications [3, 4, 6, 8 and 9]. Specifically, it has been shown that the spout arrangement is absolutely critical for the shower's structure, where direct infusion (DI) diesel infusion has demonstrated its proficiency in numerous applications in the car business and different regions of building since it can improve the force. Latest investigations in the injector/shower region have concentrated on the spout structure to permit planners to get the best injector layout. Any alteration to the spout structure effectively affects liquid stream, cavitation, and disturbance improvement [10, 11, 12, 15 and 16]. The association between the spout stream and splash attributes was first found by Ranz in 1958. In 1959, Bergwerk[14,17] recognized the impact of cavitation as the key parameter that influences the spout during shower advancement. The little spout measurement (ordinarily parts of a millimeter) just as the profoundly fierce and transient nature of the stream inside the spout request the examination of diesel injectors either numerically or scaled up in size.

MATERIALS AND METHODS THEORETICAL BACKGROUND

There are two systems that cause cavitation in diesel fuel infusion hardware. As indicated by the age systems, the cavitation can be explained into progressively initiated and geometry-instigated cavitation dynamically actuated cavitation is the one all the more ordinarily perceived in the diesel fuel infusion hardware. It happens just in transient stream and is normally brought about by pressure wave action or valve development. Geometry-incited cavitation can happen in consistent state just as in transient [18,19].

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It is started by neighborhood high speeds inside the isolated limit layers. Limit layer partition happens downstream of unexpected changes in the stream way geometry, and it can exist with or without cavitation.Fig.1shows a basic chart of the stream division in the limit layer. It makes a district of high speed re-coursing streams. These high speeds can bring about adequately enormous decreases in nearby strain to cause the development of fume bubbles [20, 21].

INVESTIGATION METHOD

The current fuel injector configuration is thought about and required changes were done so as to expand the fuel sprinkle attributes on required zone of ignition chamber. The proposed plan is investigated utilizing ansys programming. The spout model for recreation is same with the test spout model. The three-dimensional auxiliary computational network shaped by the space subdividing and coordinating technique is appeared in. The liquid space is portrayed by 538520 cells with 491264 hubs for tube shaped opening spout, 552149 cells with 526221 hubs for different gap spout, 551810 cells with 524561 hubs for joined gap spout. All above absolute cells have been resolved through investigation of work affectability. A district, comparing to the computational region outside the spout gap was given at the opening way out in order to decrease the impacts of gap leave limit conditions on the stream inside the gap. The limit conditions for the reenactment are recorded. At gulf and outlet segments, pressure limit conditions were applied. For the divider, the limit conditions were characterized as the impermeability and no slip for the speed. The fig:1 represents the modified fuel injector design. The nozzle part of the multihole EFI fuel injector is designed and analyzed and expected outcome are shown as results in the following work.

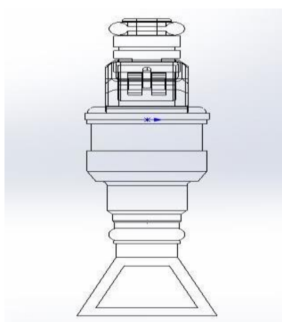

FIGURE 1. 2D design

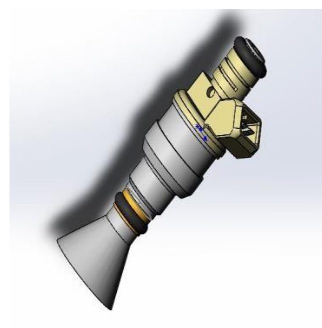

FIGURE 2. 3D design

FUEL INJECTOR SPECIFICATIONS

TABLE 1. Fuel Injector Dimension

Internal Diameter	8 mm
Outer Diameter	13.5 mm
Length Of Cone	14 mm

ANALYZING METHOD

The designed prototype is analyzed using ansys. Both exisiting and proposed EFI fuel injector design were analyzed and the results were differentiated for both and solution is founded with increased pressure in the proposed concept than exisisting design. This concept is designed to achieve the maximum pressure at end of the nozzle to increase the efficiency of the engine. Various angle inclination structures are studied and the best angle is taken for the desired results of the work undertook.

TABLE 2. Fuel Injector Specification

Inlet pressure	100 bar
Fuel type	standard gasoline & ethanol flex fuels
Static flow rate	n-Heptane: 7.64g/sec, (61 lb/hr,668cc)
Dynamic flow rate	n-Heptane: mg/pulse (15.7mg/pulse 2.5ms PW,20 ms period)
Spray pattern	26 deg

RESULT AND DISCUSSION

Analysis of existing design

The existing design of MHFC is taken into consideration and analyzed with ANSYS and the initial results have taken from process.

Geometry

The step file in IGS format saved in solid works should be imported in geometry file in ansys workbench. The part was designed in solidworks and later imported as step file in ansys. The geometry of MHFI is shown in fig 3.

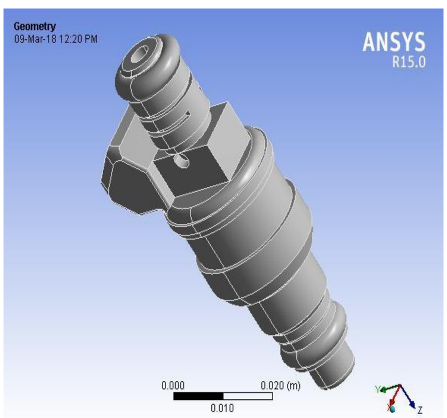

FIGURE 3. Geometry in ansys

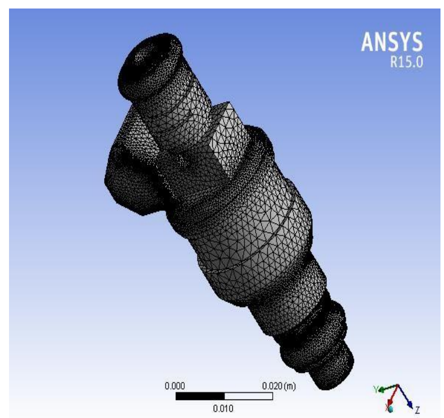

FIGURE 4. Fine meshing of design

MESHING

The Geometrical parts should be given its name of boundaries such as inlet, outlet, wall for the process of fluid flow and should be finely meshed for the process of solution. The geometry of design is finely meshed and further processed fig 4 shows the meshed element.

Geometry and Meshing of proposed fuel injector

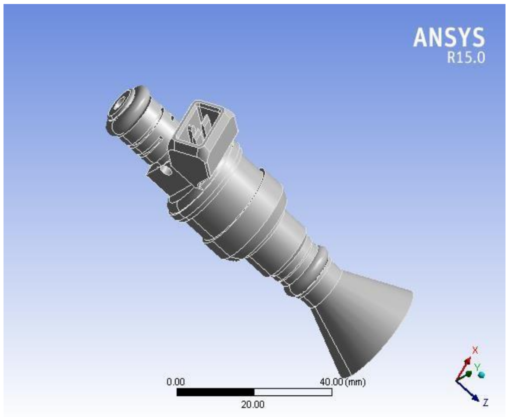

FIGURE 5. Geometric design of proposed design

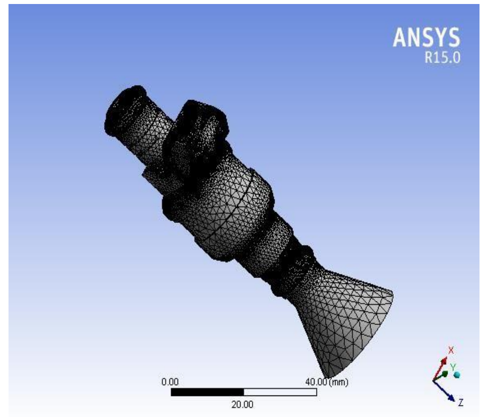

FIGURE 6. Meshing in ansys

Pressure and Velocity of existing fuel injector

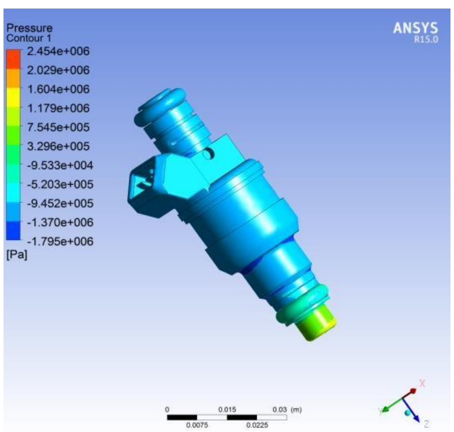

FIGURE 7. Pressure contour

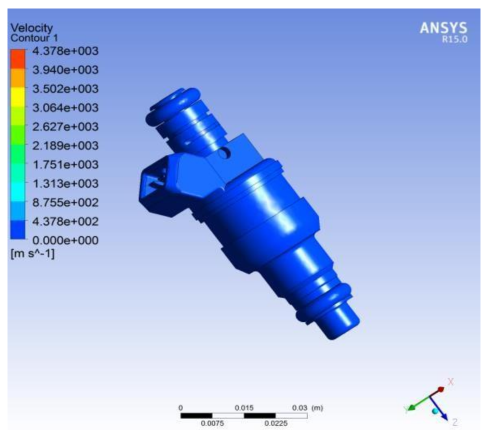

FIGURE 8. Velocity contour

Pressure and Velocity contour for proposed design

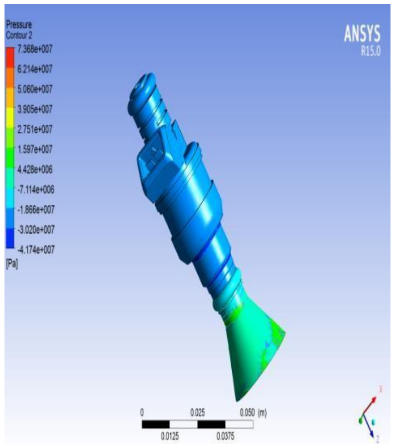

FIGURE 9. Pressure contour for proposed design

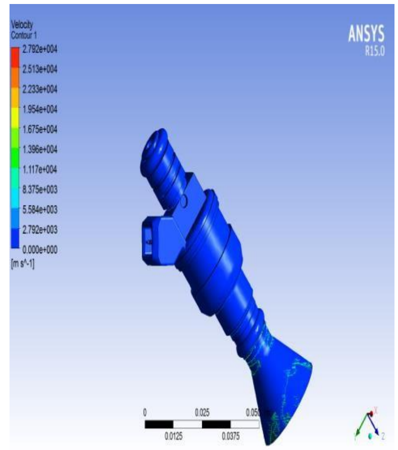

FIGURE 10. Velocity contour for proposed design

TABLE 3. Tabulated Results

Contours	Exisisting	Proposed
Pressure	2.454e +006	7.368e+007
Velocity	4.378e+003	6.850e+003

CONCLUSION

The injector spout geometry assumes a significant job in diesel spout splash and fuel infusion shower arrangement. From the present examination, a few significant ends can be built up:

The main concern of this study is to increase the splash properties in the combustion chamber and the hence the following studies are done from the references to do the above process. Main problems such as cavitation, lean mixtures, and rich mixtures are reduced and increased pressure results in overall engine performance and splash characteristics. The designed part of the fuel injector is within 26 deg which is safe for correct mixture of air and fuel to be atomized and the required the amount of varied pressure and velocity is obtained.

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