International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 01 | Jan 2020 www.irjet.net p-ISSN: 2395-0072

Computational Analysis of Group Nozzle for Single Outlet for Constant Discharge

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Abstract - *This paper describes the effects on atomization of fuel in a direct injection diesel engine. Atomization is characterized by orifice configuration. Simulation has been carried on two different configuration of orifice for conventional one hole and clusters of two holes, ANSYS software been used for simulation. Injection pressure and nozzle hole diameter are some of the important parameters which improves the engine performance subsequently pollution levels gets decreased. For an optimum pressure nozzle diameter must be optimized to achieve maximum efficiency. For the same orifice diameter and pressure analysis shows that, configuration of orifice for two holes gives additional benefit of atomization. This helps to reducing pollution levels to some extent in terms of NOx and soot.*

***Key Words*: Configuration of orifice, PPDA, Velocity contours.**

1. INTRODUCTION

In Diesel engine common rail systems was very popular, further the interest in diesel engines for automotive application has been grown rapidly. There has been lots of research in DI Diesel engine for combustion in combustion chamber. In combustion chamber injection of fuel is very important, that causes for fuel burn efficiently. The injection pressure is key factor for atomization. Higher the pressure gives the wall impingement of spray also low pressure causes to less utilization of air, so the pressure should be optimum. Number nozzle holes also one of the important factor, as the number of holes increases for same mass flow rate, there is reduction of hole size. The reduced size of orifice gives finer particles of fuel.

For increase in orifice number leads to optimize their layout on nozzle. The group-hole concept can produce a more homogeneous charge than the conventional hole nozzle without sacrificing spray tip penetration [2]. In recent year the cluster nozzle concept is lead for better fuel combustion with less PM and NOx emission.

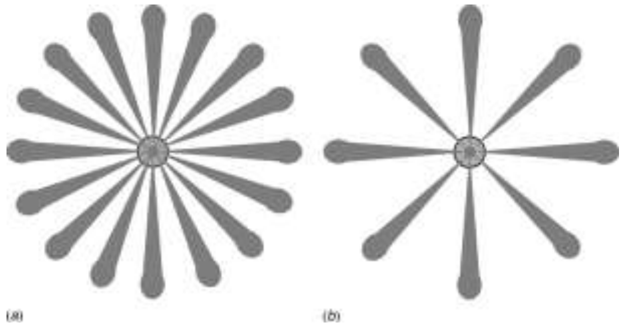
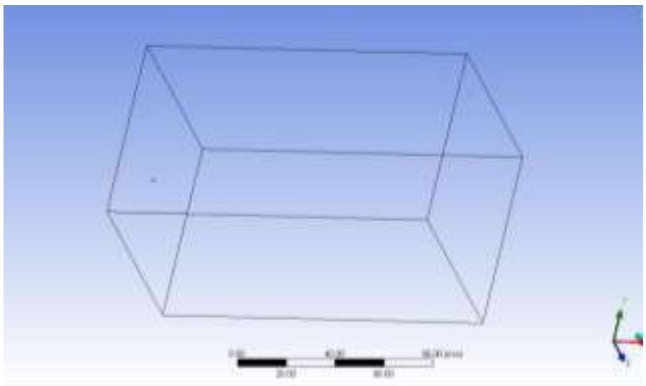


Figure.1 Bottom-view images of group- and multi holes: (a) multi-hole [16 holes] (b) group hole (8 groups of two holes) [2]

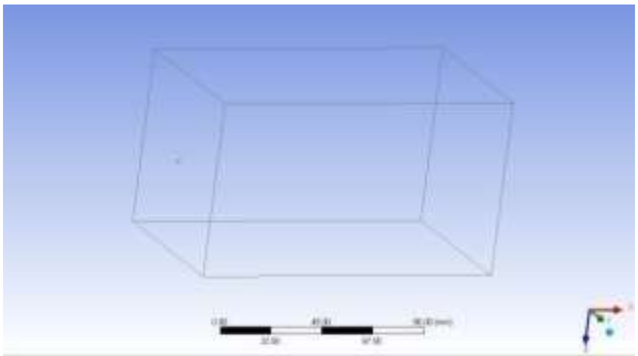
The Group-hole nozzle has a series group of orifices, and each cluster consists of two orifices that are very close and parallel to each other or with a small angle that is diverged or converged configuration of holes. This configuration leads for increase kinetic energy for flow also gives for improved atomization without change in spray diffusion.

2. INITIAL AND BOUNDARY CONDITIONS

Simulations are carried out on a closed system consist of dimension 80*80*140. Figure 2 shows the numerical grid, which is designed to model the geometry of the injector and the flow domain. The present resolution was found to give adequately grid independent results. In that the two configuration is checked one is for single nozzle and second is the cluster nozzle



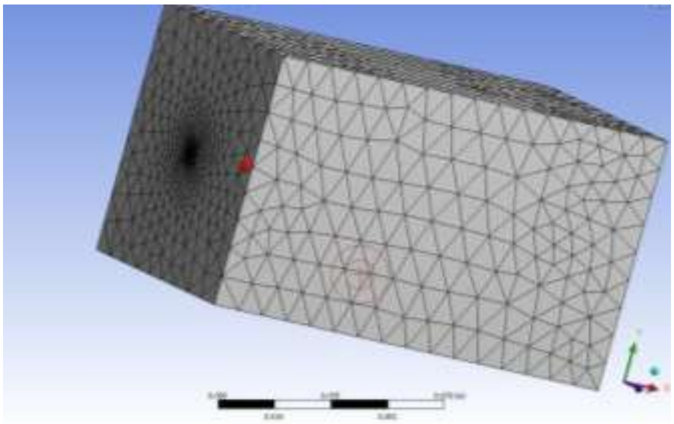
(a)Geometry of the computational domain of single orifice



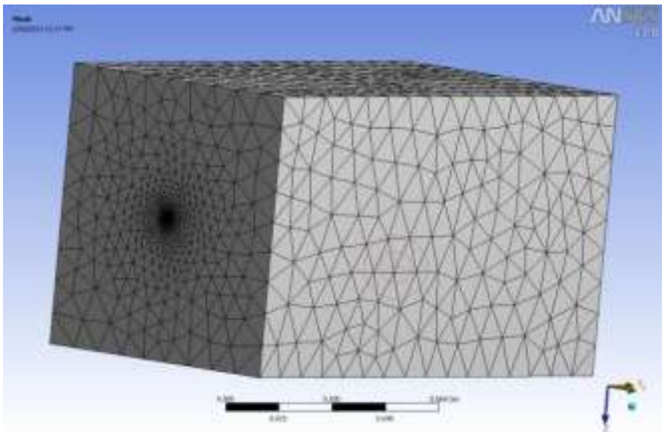
(b) Geometry of the computational domain for clusters

Fig. 2 Computational system for injector nozzle

The fuel is injected via a single hole injector and double hole nozzle. Initial conditions for pressure and velocity in the domain are 101.325 kPa and 30 m/s respectively. Fig.3 shows the mesh with 6949 nodes for single holes and 8286 nodes for the double holes of the domain. Mesh of the system was influence the result because of structured and unstructured condition. The model was simplified for the purpose of meshing the model with optimum nodes



(a)Computational mesh employed for single orifice



(b)Computational mesh employed for double orifice

Fig. 3 Computational mesh system

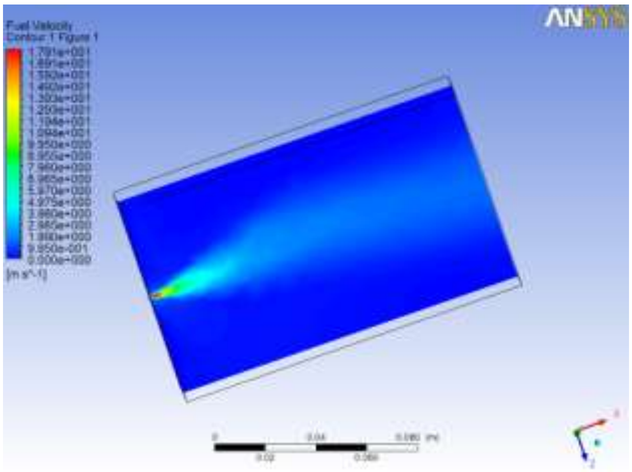
The computational domain are structured mesh are created with reference to the CAD data of single hole and double hole geometry. The computational domain is available to precisely calculate the internal flow through orifices.

The double hole configuration is of for same flow rate diameter is reduced placed 1mm apart from each other.

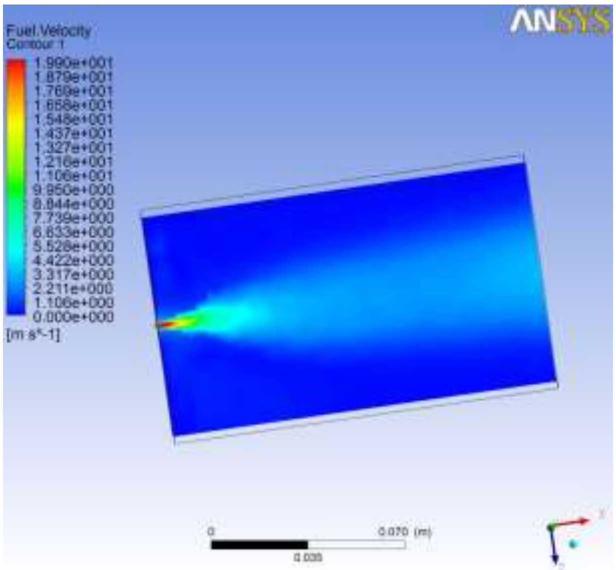
3. RESULTS AND DISCUSSION

Velocity contours of fuel

Conclusion content comes here Conclusion content comes here Conclusion the figure 4 shows the velocity contours for single hole and double hole. For single hole it having the less particles part as compared to the double holes.

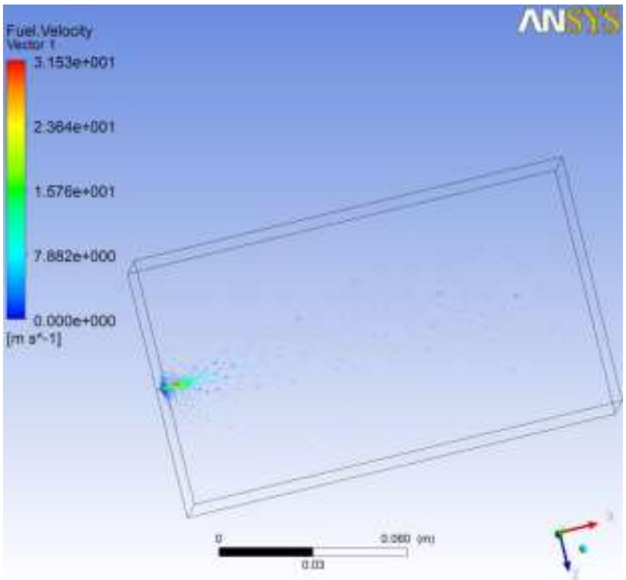


(a)Fuel velocity contours for Single holes

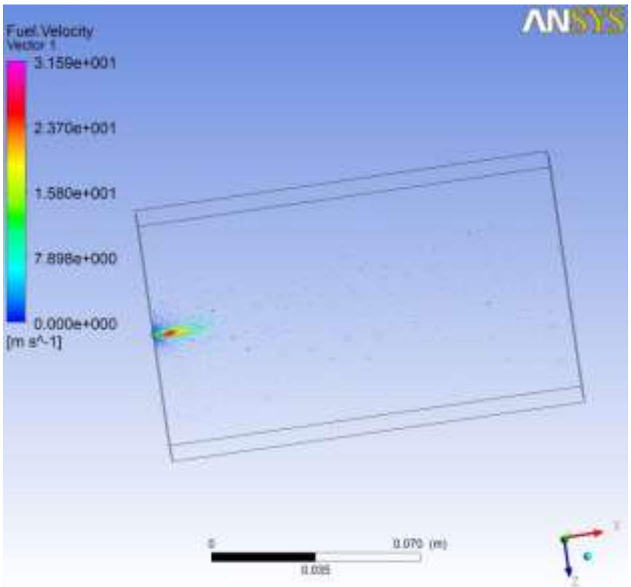


(b)Fuel velocity contours for double holes

Fig. 4 Velocity contours for injector nozzle



(a) Fuel velocity vectors for Single holes



(b) Fuel velocity vectors for double holes

Fig. 5 Velocity contours for injector nozzle

Velocity vectors of fuel

4. CONCLUSIONS

In this work simulation has been carried out for different configuration of orifice having one hole and two holes. It was also possible to simulate accurately fluid beak up that is, atomization with the help of particle tracks and gives the sauter mean diameter at certain defined position. The two holes of orifice gives better velocity compared with the single hole. Also there is unaffected fuel penetration for both position of orifice gives more combined velocity compared to the parallel position of orifice.

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