DESIGN AND CFD ANALYSIS OF FLOW THROUGH VENTURI OF A CARBURETOR

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Abstract- *The process of forming a combustible fuel-air mixture by mixing the right amount of fuel with air before admission to the cylinder of the engine is called carburetion and the device doing this job is called carburetor.Modern passenger vehicles with gasoline engines are provided with different compensating devices for fuel air mixture supply. One of the important factors that affect the fuel consumption is that design of carburetor. The venture of the carburetor is important that provides a necessary pressure drop in the carburetor device. Since different SI engine alternative fuels such as LPG, CNG are used in the present day vehicles to reduce the pollution and fuel consumption. Still for a better economy and uniform fuel air supply there is a need to design the carburetor with an effective analytical tool or software.In this project venture of carburetor is modeled in 3D modeling software Creo/Engineer. CFD analysis is done on the venture by varying the fuel discharge nozzle angle on the flow.*

Key word: *Carburetor, Venturi, Throttle, Creo Software, CFD Analysis*

1. INTRODUCTION

Engine is a device that transforms one form of energy into another form. Heat energy is a device that transforms the chemical energy contained in a fuel to another form of energy and utilizes that energy for some useful work

1.1 Carburetor

The simple carburetor consists of the following basic parts
Float chamber

- Venturi
- Fuel discharge nozzle
- Metering orifice
- Choke
- Throttle valve

1.3 PRINCIPLE OF CARBURETION

Both air and gasoline are drawn into the cylinder due to suction pressure created by the downward movement of the piston. In the carburetor, the air passing into the combustion chamber picks up the fuel discharged by a fine orifice in a tube called the carburetor jet. The rate of discharge of the fuel depends on the pressure difference between the float chamber and the throat of the venturi of the carburetor and the area of the outlet of the tube. In order that the fuel is strongly atomized the suction effect must be strong and the nozzle outlet must be comparatively small. To produce a strong suction, a restriction is generally provided in the pipe in the carburetor carrying air to the engine. This restriction is called throat. In this throat due to increase in the velocity of the air the pressure is decreased and suction is created.

The venturi tube has a narrower path at the center so that the path through air is going to travel is reduced. As same amount of air must travel must travel through the path of the tube so the velocity of the air at the venturi is increased and suction is created.

Usually the fuel discharge jet is located at the point where the suction is maximum. So this is positioned just below the throat of the venturi. The spray of the fuel from the fuel discharge jet and the air are mixed at this point of the throat and a combustible mixture is formed. Maximum amount of fuel gets atomized and some part gets vaporized. Due to increase in the velocity of the air at the throat the vaporization of the fuel becomes easier.

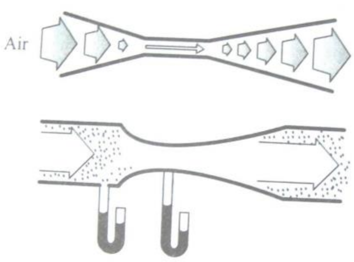


Fig-1: Operation of venture tube

2. DESIGN OF VENTURI

PTC CREO, formerly known as Pro/ENGINEER, is 3D modeling software used in mechanical engineering, design, manufacturing, and in CAD drafting service firms. It was one of the first 3D CAD modeling applications that used a rule-based parametric system. Using parameters, dimensions and features to capture the behavior of the product, it can optimize the development product as well as the design itself.

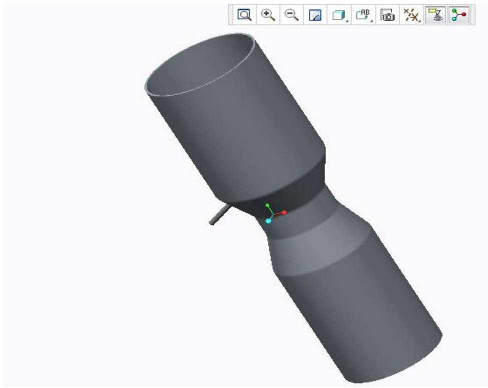


Fig-2.1: MODELS OF VENTURE 3D MODEL

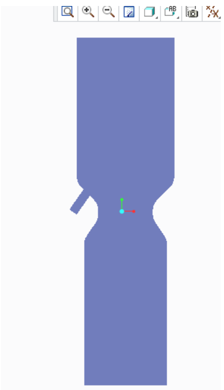


Fig-2.1: FUEL DISCHARGE NOZZLE ANGLE – 30^0

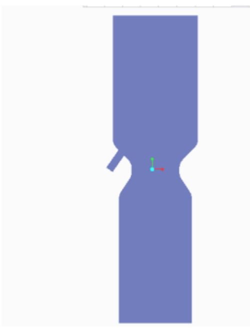


Fig-2.1: FUEL DISCHARGE NOZZLE ANGLE – 35^0

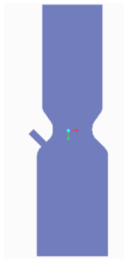


Fig-2.1: FUEL DISCHARGE NOZZLE ANGLE – 45^0

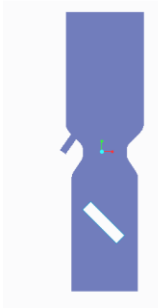


Fig-2.1: THROTTLE PLATE ANGLE – 45^0

3. INTRODUCTION TO ANSYS

3.1 Structural Analysis

ANSYS Autodyn is computer simulation tool for simulating the response of materials to short duration severe loadings from impact, high pressure or explosions.

3.2 ANSYS Mechanical

ANSYS Mechanical is a finite element analysis tool for structural analysis, including linear, nonlinear and dynamic studies. This computer simulation product provides finite elements to model behavior, and supports material models and equation solvers for a wide range of mechanical design problems. ANSYS Mechanical also includes thermal analysis and coupled-physics capabilities involving acoustics, piezoelectric, thermal–structural and thermo-electric analysis.

3.3 CFD Analysis Of Venture Of Carburetor

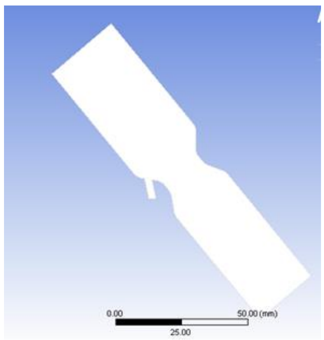


Fig-3.1: FUEL DISCHARGE NOZZLE ANGLE – 30^0

3.4 SPECIFYING BOUNDARIES FOR INLET AND OUTLET

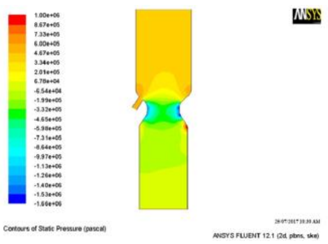


Fig-3.2: Static Pressure

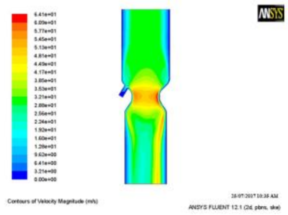


Fig-3.3: Velocity

3.5 FUEL DISCHARGE NOZZLE ANGLE – 35^0

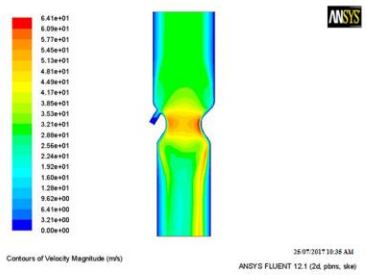


Fig-3.4: Static Pressure

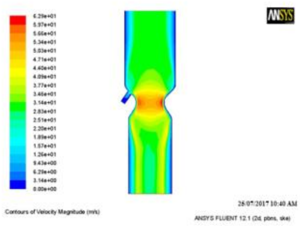


Fig-3.5: Velocity

3.6 FUEL DISCHARGE NOZZLE ANGLE – 45^0

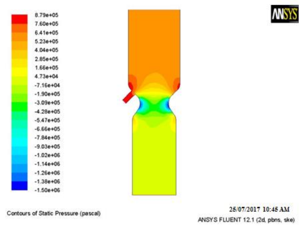


Fig-3.6: Static Pressure

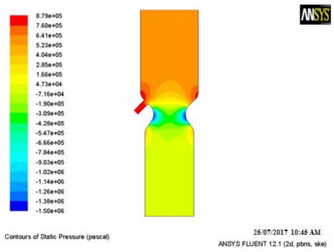
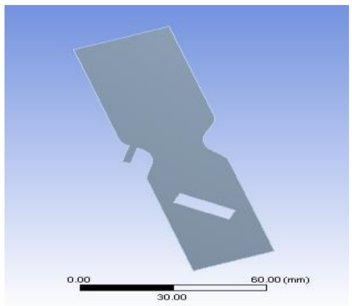


Fig-3.7: Velocity

3.7 THROTTLE PLATE ANGLE – 45^0



3.8 SPECIFYING BOUNDARIES FOR INLET AND OUTLET

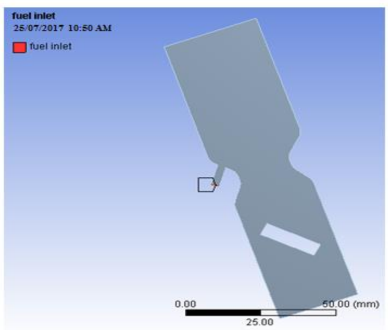


Fig-3.8: Fuel Inlet

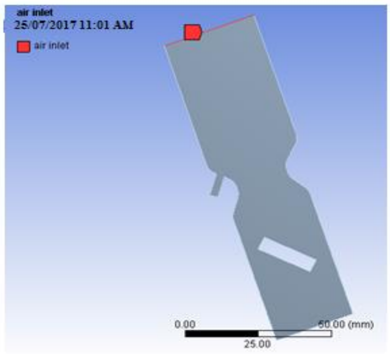


Fig-3.9: Air Inlet

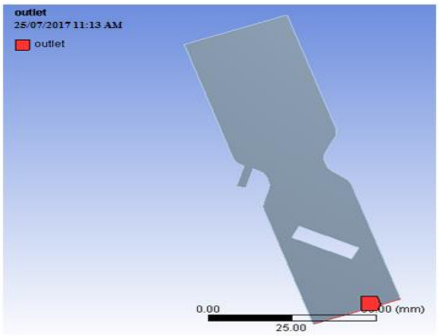


Fig-3.10: Outlet

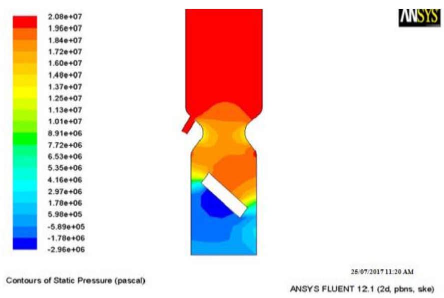


Fig-3.11: Static Pressure

3.9 THROTTLE PLATE ANGLE – 60^0

Fig-3.12: Static Pressure

3.10 THROTTLE PLATE ANGLE – 90^0

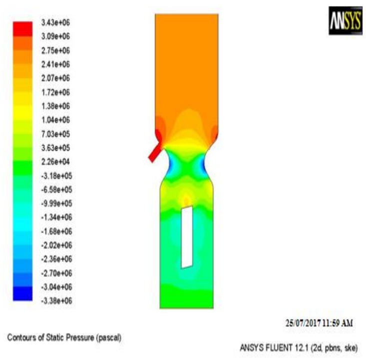


Fig-3.13: Static Pressure

4. RESULTS TABLE

FUEL DISCHARGE ANGLE	30	35	40	45
STATIC PRESSURE (Pa)	$1e^6$	$6.75\ e^5$	$7.4\ e^5$	$8.79\ e^5$
VELOCITY (m/s)	$6.41\ e^1$	$6.21\ e^1$	$6.33\ e^1$	$6.37\ e^1$

THROTTLE PLATE ANGLE	45	60	75	90
STATIC PRESSURE (Pa)	2.08^7	$2.21\ e^7$	$4.22\ e^6$	$3.43\ e^6$

5. CONCLUSION

From the above analysis the conclusions obtained are

1. When the flow inside the carburetor was analyzed for different angles of throttle plate opening, it was found that the pressure at the throat of the venturi decreased with the increase in opening of the throttle plate. Because when the throttle plate opening increases then the flow of air through the carburetor increases but the fuel flow remains constant. So the mixture becomes leaner. But as obtained from the analysis above the pressure at the throat the throat also decreases with increase in opening of the throttle plate so the flow of fuel from the float chamber into the throat increases and hence the quality of the mixture tends to remain constant.

2. When analyzed for fuel discharge nozzle angle of 30^0, it was observed that the pressure distribution inside the body of the carburetor is quite uniform which leads to a better atomization and vaporization of the fuel inside the carburetor body. But in other cases like where the fuel discharge nozzle angle was 35^0, 40^0 or 45^0, the pressure distribution is quite non-uniform inside the body of the carburetor. So it is concluded that for gasoline operated engine the optimum fuel discharge nozzle angle is 30^0.

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