

A Review on CFD Simulation of Pollutants Inside a Car

Rajesh Kumar¹ and Hari Parshad²

¹Department of mechanical Engineering
Ganga Technical Campus
Soldha, Bahadurgarh, Haryana, India
rks07in@gmail.com

²Department of mechanical Engineering
Ganga Technical Campus
Soldha, Bahadurgarh, Haryana, India
hari.mech@hotmail.com

Abstract

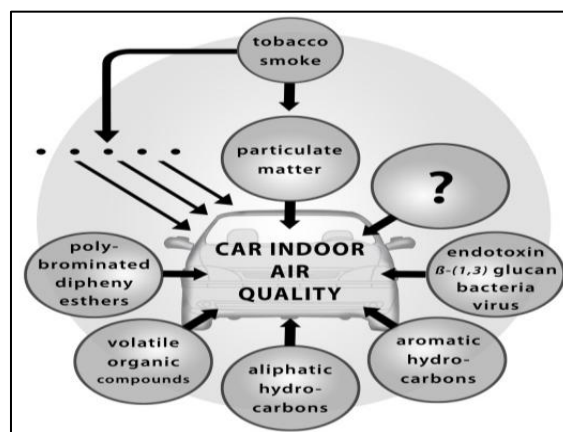
Now a day's peoples spend more than one hour in a car. A lot of studies have been done to study the outdoor pollution due to vehicle exhaust gas emission. Since last decade researchers are very much curious to study the quality of air inside a car. According to some study pollutants level inside a car is much higher than the pollutant level in the ambient air at road side. This research paper shows how to simulate the pollutants inside a car. This can be done by finding out the pollutants present inside the car with their concentration. Then flow parameter of pollutants will be measured at different places inside car mainly at inlet of pollutants and at rear seats. Car engine conditions will be played an important role in emission of pollutants so parameters related to car engine will also be measured. With this simulation we can conclude that inside pollutants affects the driver and passengers up to which extent and which passenger is much affected and then we can take some action to overcome these pollutants.

Keywords: CFD, Pollutants.

These pollutants caused by the vehicle sources and non vehicle sources. The vehicle sources contain air entering from engine and AC vents on the other hand the non vehicle sources contain reactive seat covers, paints and smoking inside the car. A little part of pollutants inside a car is due to non vehicle sources measure contribution is due to the vehicle sources. The measure pollutants due to the vehicle source are carbon mono oxide, benzene, nitrogen oxide and particulate matter caused by both. Many medical reports show these pollutants affect the health very badly like respiratory problems, cancer and premature death. The effect of these pollutants on human health depends on exposure of a person to these pollutants. This is our aim to study which person inside a car is more exposed to these pollutants. This can be carried out by simulation of the pollutants.

1. Introduction

Since last two decades automobile manufacturers provides lot accessories inside a car to provide the interior comfort and safety to the passengers. All new models of car come with inbuilt stereo system, dual airbags, tilt steering system, power locks and window. All the innovations are carried out to provide high extent of comfort and safety to drivers and passengers even if the conditions outside the car may be hazy hot and highly polluted. Most of the people think that outside air pollution can affect their health but they do not aware that there is polluted air inside the car also. As per some studies carried out truth is that air inside a car is more polluted as compare to the ambient air at road sides. Pollutants like carbon mono oxide, nitrogen oxide, hydrocarbon and particulate matter are present inside car.



2. Literature Review

In 2013, Roberto de Lieto Vollaro studied the CFD simulation of temperature distribution in a bus. As per this study the thermal comfort of the passengers is completely lost due to the frequent opening of doors so there should be air screened door in a bus.

In 2011, Wuhan carried out a research by CFD on distribution characteristics of pollutants in a vehicle cabin. He found that CO₂ concentration is high in middle zone as compare to near window.

In 2010, Otmar Geiss*, Josefa Barrero-Moreno, Salvatore Tirendi, Dimitrios Kotzias studied about particulate matter present inside a car and they found that particulate matter present inside a car exceeded the standard. In 2005, Kosmas Galatsis, Wojtek Wlodarsk suggest the embedded system to control the pollutants level inside a car. They introduced sensors which alerts when the pollutants levels exceeded the standard.

3. Methodology

The various pollutants concentration will be measured using particular devices for measuring the pollutants .The devices for measuring the CO and Benzene are shown in diagrams.

CO Measurement Device

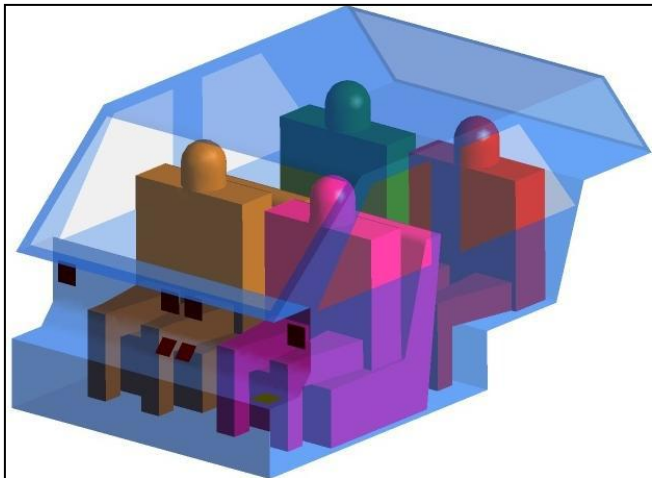


Benzene Monitoring Devices



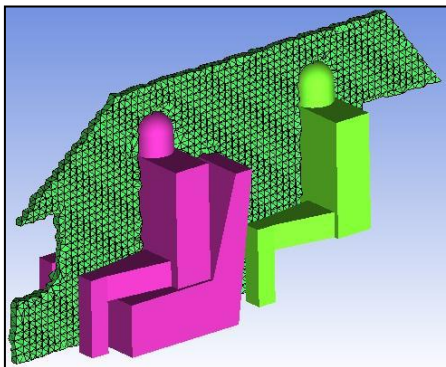
Light Scattering Device to measure the particulate matter

Now the dimensions of car cabin will be measured and sensors are placed to monitor the various pollutants and their flow parameters. Idling combustion efficiency is to be calculated to know the status of complete combustion of fuel. Now mathematical model is applied on the system. The model used to solve the problem is standard with thermal diffusion, full multi component diffusion and the solver used is 3-D segregated solver. The various boundary conditions will be considered like pollutant concentration at air vents, at rear portion, inlet air conditions and car exhaust conditions. The CFD package is used to solve the governing equations of pollutants levels in 3-D.



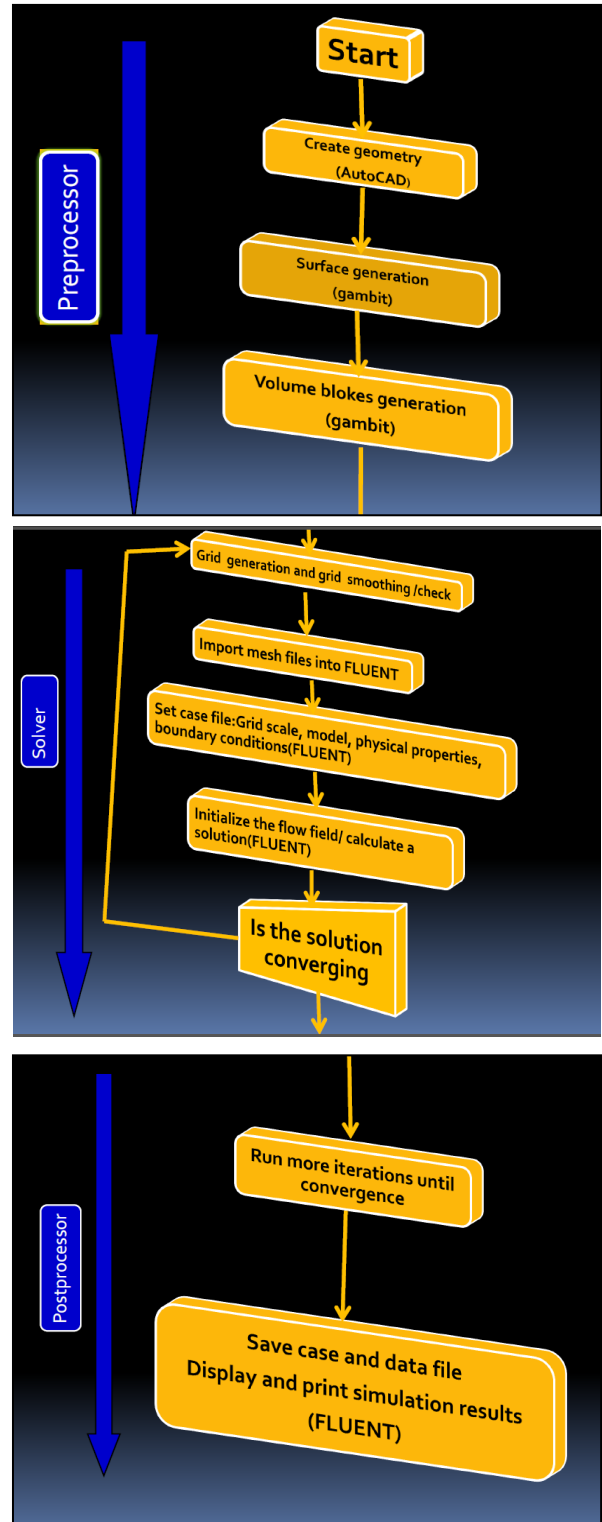
3-D Car Cabin Model

The mesh structure of the computational domain will be formed to get the accuracy in result. The volume of the human models and seats will be excluded from the meshing process since they were treated as solid bodies.



Cross sectional view of volume mesh cell

The CFD procedure is explained in flow diagram as:



4. Conclusion

The pollutants diffusion will be monitored at various places inside a car cabin. Fluent will be used to introduce the boundary conditions and result will be obtained in the form of various pollutants concentration. Hence experimental and CFD simulations will be carried out in order to characterize the pollutants diffusion patterns inside a car.

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