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"Smoke from Automotive Diesel Engine: Study for Associate Health Risk"

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Abstract: **-- In terms of present engaged, clean of diesel engine emission within India is a challenging task. Progresses have been made in the North America, Europe and other part of the world for the health and environmental concerns. In India may take immediate action to setup a diesel engine emission control programme while being mindful that improvements will be available in the future. The crafted programme should take all into consideration and research work engaged in at present that will need to be addresses: Emission Control Regulation for both on road and off road diesel engines, and Diesel fuel specification, etc,**

The rapid growth of population and industry in India, during the last two decades has been resulted the need for adequate mass transport facilities for quick movement and material. The diesel engine has always been a preferred prime mover for haulage of heavy loads due to its superior fuel economy and but diesel engine smoke of the air due to various toxic gases and particulate matter has become a problem for the children's health risk in India.

The mechanism of Soot Formation in Diesel Engine, that all soot has a graphite structure with hexagonal basic Carbon units, forming a small crystalline atom.

There is a strong suggestion that it is a poly-benzene substance, which can cause lung cancer. The structure of soot is given below-

The basic reaction of soot formation is yet unknown but the following theories have been advanced…

The reaction forming Carbon Monoxide (2CO-C+CO2) is strongly catalyzed by Carbon. So when soot particles are already present in some form, they build up rapidly and then polymerizes. According to this second theory the hydrocarbons, especially heavy ends, decomposes into small basic units of C2 and C3 and those small radicals polymerize to form C6 ring polymers.

Guwahati is an important city of North East India and now it is biggest question that is Guwahati going the Delhi way? As the national capital struggle to cope with serve levels of toxic air pollution, there is some alarming news for Guwahati. Black smoke levels in the city atmosphere are on the rise and this may have server consequence on the respiratory health of children and elderly as an immediate impact, as per study.

Key word: **Diesel Smoke; In complete combustion, soot formation, mass transport,**

I. INTRODUCTION

The Diesel engine is a major contributor to air pollution-especially within the cities and also urban traffic routes. Because diesel engine exhaust emissions are extremely durable lasting for 20 to 30 years. Once they are introduced in area they contribute to the air pollution problem for decades.

However, we know that to move a vehicle, the primary requirement is power. Power can be available only when movement is created and movement is created by means of combustion process. For combustion process, the two primary requirements are Fuel and Air.

The levels observed in Guwahati are alarming and creasing in Guwahati city, in India, alarming and increasing, indicating

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the contribution of diesel vehicles more. Black carbon is a short-lived climate pollutant As compared with the CO2, it has a low residence time about one week. Black carbon concentrations change with seasons drastically. In monsoon, it has decreased by about 47% as compared to the values observed in the winter season, which is considered to be worst season for air pollution.

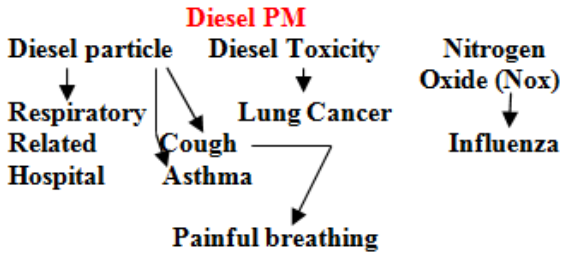

Fig: 2(a) Diesel Particulate chemical Characteristic

In order to address the health and environmental concerns, it is necessary to drastically reduce Nox, SPM and SO2 emission from diesel vehicles and require a system approach which utilized advance engine design, advanced and integrated exhaust control technologies and low sulfur fuel.

The biggest question today, before the metropolitan population of our Country like India, in particular is "pollution is snuffing us out", and will pollution ever be controlled? The reason for this type of thinking may be fact that in spite of several legislations from 1964 onwards, not much of progress can be visualized in this area.

Fig: 2(b) Visual picture Diesel Carbon

There is no doubt that the progress was achieved in the last few decades in some area is very negligible in comparison with the overall picture. For example, in Guwahati (East part) , the daily average black carbon concentration was found to be 19 microgram per cubic meter and the maximum recorded concentration during the season was up to 62 microgram per cubic meter. However, the post monsoon period, the concentration was 15 and 47 respectively.

We know that, In June 1999, the Honorable Supreme Court of India ruled that vehicular emission had to be reduced at a much quicker pace than planned so far and in this reaction to increasing public complaints about the air quality in urban area i.e. Delhi and kolkatta. Automobile engine manufacture face the challenging engineering task to quickly find solutions, which are production feasible and technology, explained with Euro norms.

In this regard towards control the automobile exhaust emission, in USA have been introduced by OBD-II system (by California Air Resource Board from 1994) for the reduction of HC, NOx, CO etc.

OBD-II provides additional information to engineer for diagnosis and repair of emissions related problems. OBD-II, standardizes on the amount of memory (Freeze Frame) it uses to store the readings of the vehicle sensor when it logs on emission related Intermittent Trouble code (IT).

The intent of OBD-II, systems is to detect most vehicle malfunctions when performance of a power train component or system deteriorates to the point that the vehicle's HC emission exceed standard. The vehicle operator is notified at the time when the vehicle begins to marginally exceed emission standards, by illuminating the Malfunctions Indicator Light (MIL).
Control the automobile exhaust emission, two equipment's is most essential—

[2.1] Catalytic Converter –
2.1.1. Dual bed catalytic converter,
2.1.2. Three -way catalytic converter,

[2.2] Exhaust Gas Re-Circulation System (EGR).

In generally, Catalytic converters may reduced NOx (Oxides of Nitrogen) and convert to Nitrogen and Oxygen and two-stroke catalysts Design, the precious metals for two stroke catalysts are either platinum (pt) or rhodium (Rh) mixture. This ratio however has an influence on the overall performance of catalyst system for two-stroke application.

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II. LITERATURE REVIEW:

AS per Environmental Protection agency, USA has been pointed out that catalytic converter does not reduce the NOx emission. Because, when the temperature is increased in combustion process, HC (hydrocarbon) and CO (Carbon monoxide) are reduced but Nox does not reduce. We know that Nitrogen mixed with oxygen produced in high temperature Nox emission), because in atmosphere has 78% of Nitrogen and 21% oxygen and 1% other gases.

NOx control system that recycles a small part of the inert exhaust gas back through the manifold to lower the combustion temperature and this system is called Exhaust Gas Re-Circulation system. Catalytic converter converts harmful gases to harmless gases. A catalyst is a material that causes a chemical change without entering into the chemical reaction. For example, in the Catalytic converter converts harmful gases to harmless gases. A catalyst is a material that causes a chemical change without entering into the chemical reaction.

In USA had been introduced OBD-II and it is became effective in USA in 1994 and controlled by California Air Resource Board---
3.1. Half vehicle—(for 5 years or 50,000 miles),
3.2. Full circle- (for 10 years or 100000 miles).

As per Environment Protection Agency, (EPA) USA, and CARB standards the failure criteria for the catalyst monitor diagnostic are the following:

MY 96: xLEV's: converter efficiency: HC converter efficiency < 50 – 60 % on FTP Test. EPA MY 98: HC: exceeding 0.6 g/m or increase by 0.4 g/m over the 4000 m value. Catalyst heating system: Pre-start heater: attained designed temperature- after- start- heater: Exceeding any of the applicable, FTP standards x 1.5. etc.

From the above, it is an important system for diagnostic. The inputs to Enable Catalyst Monitor are: Engine air flow, closed loop stochastic state, coolant temperature, vehicle speed, engine air load, engine speed, throttle position, decal fuel cut of, fuel control requested , fuel control ready , intake air temperature an fault active start. This process determines if the catalyst monitoring is required for steady state condition or for FTP based conditions. Depending on this choice the appropriate catalyst temperature prediction model is used for the diagnostic test.

In our country like India, after spending lot of money and also enacting several statutory laws, the country could not make much headway, because of several factors. However, problems are still there particularly in maintaining clean Air. It is no doubt that western countries are the major contributions globally for air pollutants like CO, CO2 and NOx and because of these pollutants have got two serious phenomenon of global warming and ozone layer.

In this regard, there has been remarkable change in the concept of I.C. engine i.e. design, MPFI (Multi Point Fuel Injection) and incorporation of EGR, Catalytic Converter respectively. In June 1999 the honourable Supreme Court in India ruled that vehicular emission had to be reduced at a much quicker pace than planned so far and engine manufactures are taking challenging task to quickly find solution by Bharat Norms.

Euro – II, III, IV (Petrol)

Parameters 1996	Euro-II 2000	Euro-III 2005	Euro-IV
Oxygen % Max.	2.7	2.7	2.7
Benzene % Max	5.0	1.0	1.0
Aromatic %	–	41	35
Sulphur Max.	0.05	0.015	0.005

Table 3a).

Bharat Stage – II (Petrol)

Bharat Stage – II (Petrol)		
Density	gg/cc	0.710-0.770
Octane No	RON, Min	88
Sulphur	% mass	0.06
Benzene	% vol max	3 (metro) 5 (rest)

Table 3.(b)

As per experimental , it was found that, CO and HC emission limits are easily met with Direct Injection Diesel Engines and on the other side, NOx and SPM are more of a challenge , especially for heavy duty diesel engine.

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As the Indian emission legislation corresponds to the European regulation, it is worth looking into limits planned for European in future and therefore, Indian automobiles manufactures have to change from Euro Norms to Bharat Norms (Recommendation of Interim Report of the expert committee on Auto Fuel, 28th December/2001.

Hence, for a Country like India, Containing pollution is of primary importance and OBD-II, system as on alternative method toward maintain low-emission. For example, OBD-II standards have been set for the vehicle half-life (5 years or 10000 miles). The following are enforced 100% after 1996.
HC: 0.31 gms/mile,
CO: 4.20 gms/mile,
NOx): 0.60 gms/mile (Non-Diesel)
1.25 gms/mile (Diesel)

In order for this initiative to be successful India must revise the diesel fuel specification to a low sulfur fuel at least below 0.05% sulfur content. :

[3.6.] It cause reduction in visibility. It may thus constitute a traffic hazard also.
[3.7.] It has disagreeable colour due to the presence of certain aldehyde, Ketones and oxygenated compound.
[3.8.] The soot particles in the exhaust gases settle down on building and trees etc in the vicinity of the source.
[3.9] The diesel engine smoke is dangerous for health and causes troubles in breathing, etc.

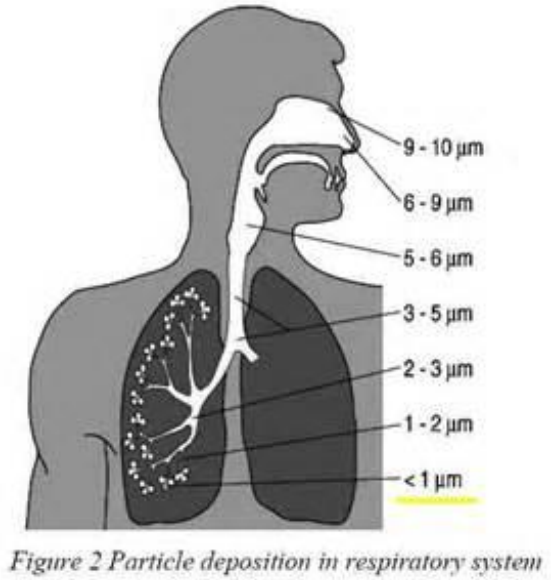

Figure 2 Particle deposition in respiratory system

Fig: 3{c) Particle Deposition on respiratory System:

III. METHODOLOGY:

Clean diesel engine exhaust emissions within India is a challenging task and the following basic phased approach to achieve our goal.
Provide for the supply of diesel fuel with specification Sulfur Content limit 0.05% maximum, which means special reference for children health:

4.1. Diesel oxidation catalyst (DOC)- destroys about 55% to 90% of gaseous hydrocarbons (HC) (including toxic about 65%), carbon monoxide (co) by 40 % to 70% and the part of diesel soot particulate matter (pm) known above as soluble organic fraction (SOF) by about 30% to 90%.

4.2. Catalytic soot filters (CSF) – capture and destroy the black carbon soot with about 80% to 90% efficiency, over 99% of the fine particulate and destroys the same exhaust components as the diesel oxidation catalyst (DOC) described above with better efficiency.

4.3. Selective catalyst reduction of NOx (SCR NOx) with urea (NH3) reduces NOx to Nitrogen with 70% to 90% efficiency and destroys the same exhaust components as DOC described above SCR NOx demonstration programme have started in the USA and Europe.

4.4.. Engine Modification: : Exhaust Gas Recirculation (EGR) including cooled version Turbo-charge, modified cans and ceramic cylinder coating have been adapted to the engine, etc

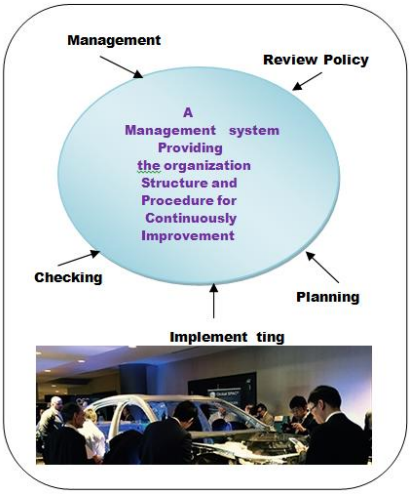

Fig: 4(a) continuously Improvement methods

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As the Indian emission legislation correspondence to the European legislation, it is worth looking into the limit planned for Europe in future. Euro III value which was implemented from Ist January for light duty and light commercial vehicle and passengers cars and will become effective in October 2000 for HCV. However, it was observed that only methods available to control the smoke in India from the diesel engine:

4.1. Run at lower load i.e. derating.

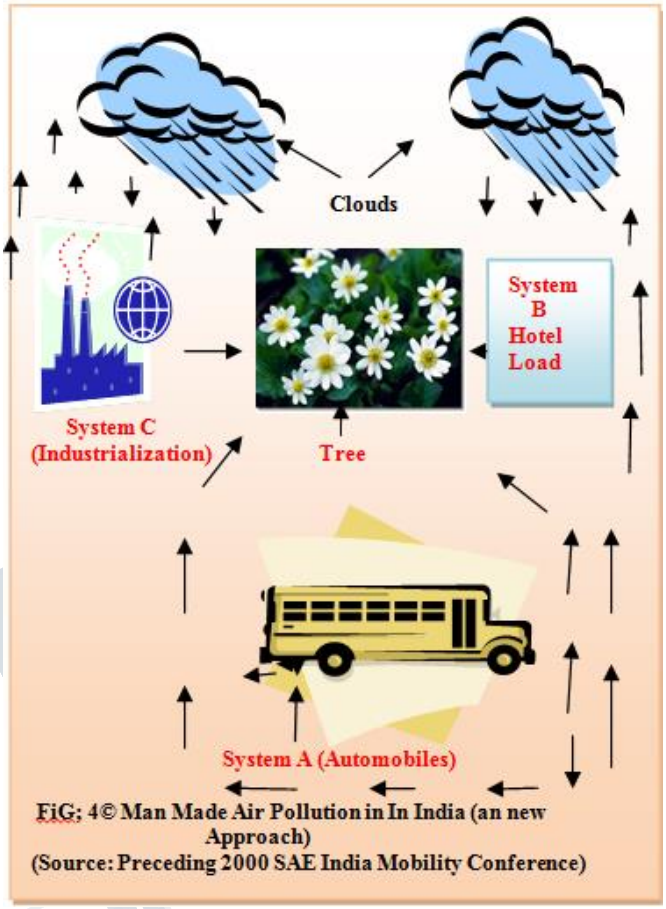
For example, Telco 1612 (Heavy Diesel vehicle), have maximum gross vehicle weight 16 tone and horse power is in between 120 to 130 PS (perfect stake). However, for the bigger profit road transport industry have been loaded up to 30 tone and as a result, engine breakdown, body noise on highway and tyre wearing etc. and directly and indirectly may problem towards warranty procedure.

Fig: 4(b) Overload

4.2. Maintain the Engine best possible condition: Maintain the Engine properly, especially the injection system, will not only result in significantly reduced smoke but also keep the performance of the engine at its best.

Environment pollution is a complicated as it serious. It is complicated because much pollution is caused by thing that benefits us. Air bone pollutants form smog and air pollution, which endangers human health. The transport sector in India is a major energy-consuming sector as well as another factor typical under Indian scenario is the use of older vehicles, as a result continue to disrupt traffic due to breakdowns besides causing very high levels of pollution in the congested cities in India.

The following, model is consist by three system i.e. System A, B,&C and emphasized to awareness to control the man made air pollution in India.



FiG; 4© Man Made Air Pollution in In India (an new Approach)
(Source: Preceding 2000 SAE India Mobility Conference)

Instead of starting sub-system, A in our environmental model and we can start a new approach staring. Fig 64c), Man Made Air Pollution which are effects on environment from the subsystem B. Nevertheless this "Hotel Load" is difficult o regulate in a short time. This load depends on long term policy decision, so we would better start from the sub-system C, the uncontrolled source, the uncontrolled source. This is within the reach of policy makers. Further, any attempt to reduce pollutants from uncontrolled source is not coupled with other factors like those in the case of vehicular emission. It is here that public awareness program, education and citizens responsibilities play significant role NGOs assisted by the corporations or municipalities are very essential for this. Automobiles industries may well subsidize promotion of NGOs program policy makers and industries must give first priority for this approach.

Last priority could be sent to the sub-system A, the vehicular pollution control. Again, here the starting point would be clean fuel infrastructure and the inspection/maintenance program has to ensure low emission performance. Finally, when all theses supporting requirements are satisfaction,

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emission norms can be formulated and legislated. This plan should not be constructed as a drag on our industrial policy of up gradation to excellent quality in terms of emission norms. It is only for domestic market that an extension be granted for compliance to the stringent emission norms since the benefits of this cannot be transferred to improve the air quality to reduce acid rain.

IV. RESULT AND DISCUSSION:

The infrastructure that service of the diesel smoke and health concerns consist of the following main components:
5.1. Fuel Extraction,
5.2.. Fuel Production,
5.3.. Fuel Storage and Distribution,
5.4. Vehicle Service and Repair,
5.5.. Roads, Bridge and Parking facilities, etc.

Elements of a Comprehensive Vehicle Pollution Control Strategy:

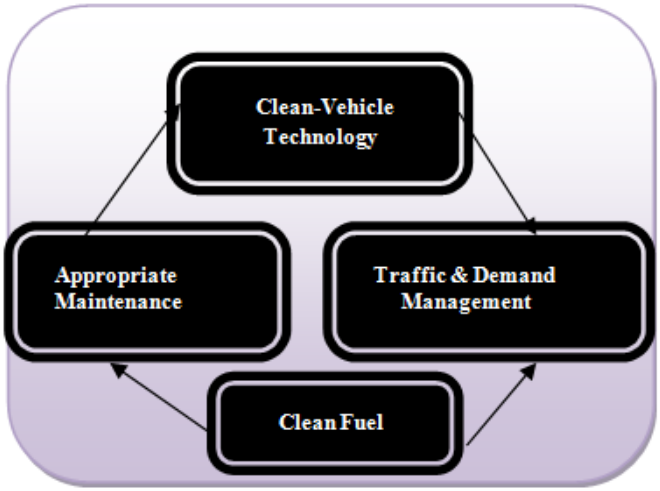

Fig: 6(g) Elements of a Comprehensive Vehicle Pollution Control Strategy:

Among the Four metropolitan cities along with Guwahati, the quantum of vehicular pollutants is highest at present in Delhi, followed by Mumbai and Kolkatta. Cars, Trucks Motorcycles, Scooters and buses emit significance quantities of CO, Nox, SO2 and PM etc toxic air pollutants and green house gases and as vehicle population grows they could be an even greater contribution in the future. Soot has a free valiancy, so it has tremendous agglomeration proprieties and can absorb in metal surface. Once it sticks to the metal it is very difficult to remove.

Clean Diesel Engine Emission within India is a Challenging task. A progress has been made in Europe and other part of the world to the health and environmental concerns. Using this process India can achieve the following basic approach to our goal:

First Step:
Provide for the supply of diesel fuel with specification sulfur content limit – 0.05% maximum. This was the first approach taken by North America and Japan and is spreading globally other regions and India also already had achieved this target. Sulfur removal capability during diesel fuel production/processing at the oil refinery is a fully developed, cost – effective and is issued by many refineries.

Second Step:
Adopt an existing set of regulations from those implemented in the other countries, starting with interior diesel standard.

5(a) Interested way in China

3rd Step:
Adopt a set on road, off road diesel "Retrofit" (note A and rebuild note B) regulations and or requirements similar to those of the USA, Sweden and other countries. Set the regulation to make effective use of already developed emission control technologies that are adaptable to in use engines and their specific application.

4th Step:
Continue to monitor the progress for EURO – 4 and the expected USA2007 & standard and adopted as appropriate.

To obtain the first level of diesel engine emission control for India to children health risks, wishing to adopt programme, the diesel fuel of 0.05% Sulfur maximum specification are :

{5.1]. Diesel oxidation catalyst (DOC) – destroy about 60% to 90% of gaseous hydrocarbons (HC) [including toxic about 65%] , Carbon monoxide (CO) by 40 70 75% and the part of Diesel soot or particular matter (PM) , known as Soluble Organic Friction (OF) by about 35 to 90%.
[5.2} Catalytic Soot Filter (CSF): Capture and destroy the

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black carbon soot with about 80-90% efficiency, over 99% of the fine particulate and destroy the same exhaust components as the diesel oxidation catalyst (DOC) described above with better efficiency.

[5.3] Selective Catalyst reduction of Nox (SCR Nox) with urea (NH3) reduces Nox to Nitrogen with 70 to 90%.

V. BASIC RESEARCH IN THE COUNTRY (INDIA)

Guwahati is the premier city of North East India and population of more than 19 lakes and as result, the tremendous growth of population the vehicles are increased. The vehicular population in Guwahati city near about 1, 50,600 .The exhaust emission goes to the atmosphere from automobiles and they are contributing the following exhaust gases—

Vehicular pollution monitoring in the City of Guwahati, India)

Total	119.66
Carbon	80.35
Hydrocarbon	23.00
Oxides of nitrogen	15.36
Sulphur di oxide	0.68
Suspended particular Matter.	0.21

Experimental was conducted about 40 trucks/buses at Athgaon and 30 trucks/buses at Ganeshguri-charali. Among them was found that, 400 trucks/Buses at Athgaon and 10 trucks/buses Ganeshguri-charali were exceeding the out of pollution level. The vehicles owners/drivers were advised to checkup and service the vehicles to control the exhaust emission and free eyes tests were carried for drivers.

Urbanization and Industrialization has resulted in increase vehicular traffic in the city of Guwahati, India. The ambient air quality of this city is generally polluted by obnoxious and toxic pollutants emanated by vehicles.

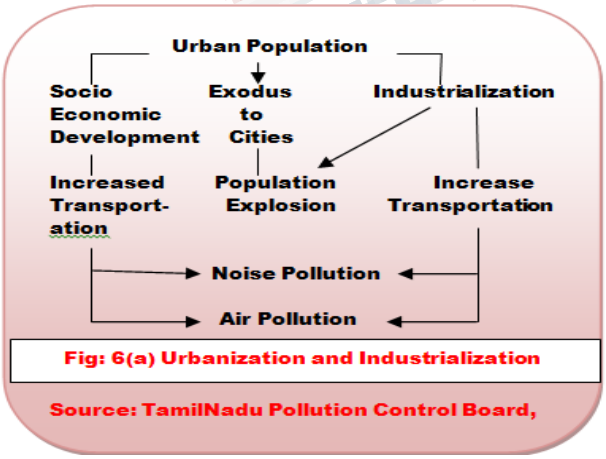

Fig: 6(a) Urbanization and Industrialization

Source: TamilNadu Pollution Control Board,

It was observed that unplanned development of control business areas, inadequate and ill maintained roads, lack of discipline in driving, ill maintained vehicles are the contributory factors. Moreover, the high rise building tends to interfere with dispersion of pollutant.

The automobile exhaust emission problems were both from petrol and diesel engine, the major problem for the city of Guwahati. Most of the air pollution of the Guwahati city, is contributed by the emissions of the toxic gases and SPM by the fossil fuel.

From the above discussion, need of immediate action the above problem and there is no reason for delay.

VI. CONCLUSION:

It is true that pollutants from one vehicle does not amount too much, say half kg of pollutants for a single day and if we consider the very large number of automobiles in India, arising very rapidly. Hence, it will be cause for the children or other health problem.

Attention has been drawn into the gasoline direct injection (GDI) engine due to various Potential advantages. GDI engine provide various advantages, including precise control of fuel injection to each cylinder in each cycle and the capability of producing stratified charge lean-burn combustion with fully un-throttled operation. Especially, viable one GDI engines that have been introduced since 1996, which have overcome problems of earlier GDI system based on diesel – injection systems will advanced – computer- controlled fuel injection system. In cylinder direct injection of fuel allows two different combustion strategies to be used:

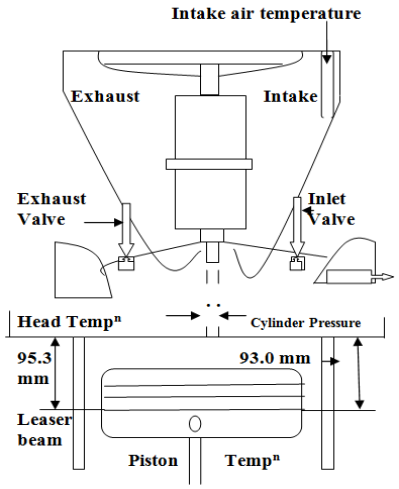

Fig: 7(a) Combustion Chamber with DI System:

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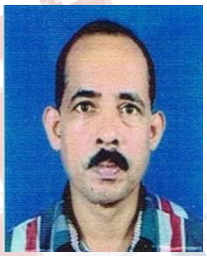
The simplest method is to produce a homogenous charge by injecting the fuel during the intake stroke to allow enough time for fuel vaporization and mixing. Load Control is achieved via throttling. Direct injection stratified –charge (DISC) engines, in which compact fuel rich clouds is formed around the spark plug in an
Overall lean mixture. Spark ignition is used to intake combustion both GDI strategies and can be adjusted for various engine speeds and loads by a computer based control system. The full potential of the GDI combustion systems requires use of both GDI strategies. The current emission legislation i.e. OBD – II, tests all sensors, actuators (valves) , switches and wiring for proper connectivity and checks the inputs and output of each are within allowed range of value. Each sensor circuit consists of mainly three parts, i.e. sensor, signal processor and a display device.

Oxygen sensor and Heater, monitoring for the performance of oxygen sensor, while its operating temperature maintained within a specific range above 260° C. For this reason a heater is used to keep the oxygen sensor temperature at the desire value However, fuel injection system plays an important part in supplying the required air fuel mixture to a spark ignition engine for improving mixture preparation contributes to an enhanced power and fuel economy.

VII. ACKNOWLEDGEMENTS:



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Abbreviation

CARB = California Air Resource Board.
CCR = California Code of Regulations.
DTC = Diagnostic Trouble Code,
FTP = Federal test Procedure.
I.C. ENGINE = Internal Combustion Engine.
MIL = Malfunction Indicator Light.
MAP = Manifold Absolute Pressure