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MEASUREMENT AND ANALYSIS OF TAILPIPE EMISSION FROM PETROL DRIVEN PASSENGER CARS IN AGRA

[1]Avnish Yadav, [2]Dr. A. K. Mishra

[1]P.G scholar , [2]Assistant Professor, Civil Engineering Department,
Madan Mohan Malaviya University of Technology Gorakhpur, U.P, (India)

ABSTRACT

Motor cars are individual of the major sources of air pollutants worldwide. Even though their position, motor-vehicle emissions are defectively understood and enumerated. This is due in part to huge differences in distinguishable vehicle emissions with changing conditions, and to significant differences between cars. This study is conducted on National Highway-2 in between Bhagwan Talkies and Khandari x-ring Agra. The internal combustion engine is important to the modern civilization. Without transportation performed by the millions of cars on road and at sea we would not have reached today's living standard. The petroleum oxidation procedure in the engine creates not only useful power, but then similarly a considerable amount of pollutant emissions including Carbon Monoxide (CO), Unburned Hydro-carbon (HC). Carbon Monoxide is a very dangerous substance, since it decreases the oxygen carrying volume of the blood stream. At low concentrations, CO inhalation can cause dizziness and nausea, while at higher attentions, it can be poisonous. In the present study setup is observed that there is a reduction in the emission level of CO and HC, with the same power as obtained from a conventional petrol engine.

Keywords: Exhaust Analyser, HC Emissions, CO Emissions, Petrol engines

I INTRODUCTION

Maximum Indian Cities are suffering speedy development and the majority of the country's population is likely to be living in metropolises within a distance of next two years. The rapid development in India has also caused in a tremendous increase the number of motor vehicles imposing a serious effect on human life and its environment in recent years – what is being referred to as Urban Air Pollution (UAP) in the context of ever-expanding urban areas. According to Census reports, the urban population has increased from 10% in 1901 to 28% in 2001. And ever-increasing, the urban growth rate is running at 31.8% i.e., almost three times higher than rural areas in 2011 (Census, 2011). The World Health Organization (WHO) has estimated that in developing countries, increasing UAP has resulted in more than 2 million deaths per annum along with various cases of respiratory illnesses (WHO, 2005, 2014). It is reported that over 70–80% of air pollution in mega cities in developing nations is attributed to vehicular emissions caused by a large number of older vehicles coupled with poor vehicle maintenance, inadequate road infrastructure and low fuel quality (Auto Fuel Policy, 2002; Badami, 2005; Singh et al., 2007; Wang et al., 2010). Among the criteria pollutants, CO is the major pollutant coming from the transport sector, contributing 90% of total emission. Hydro-carbons (HC) are next to CO.

1.1 Study Objective

The primary objective of this study is to change in petrol consumption and emissions under various traffic conditions. Current state of the art models that are utilized to estimate petrol consumption and emissions, predicting their measures of effectiveness based on typical driving cycles using average speed. However, this approach of using certain cycle's average speed is not suitable for the evaluation of petrol consumption and emission impacts of operational level projects since it is impossible to differentiate projects having same average speeds with different driving conditions. This approach has been accepted by transportation planners and federal agencies to estimate highway impacts on the environment. This dissertation addresses this issue, presenting a mathematical model to predict petrol consumption and emissions for individual cars using instantaneous speed and acceleration as explanatory variables. Today, the availability of relatively powerful computers on the average desktop makes this approach feasible, even for large highway networks. The introduction of Intelligent Transportation Systems further makes a compelling case to compare alternative Intelligent Transportation Systems and non- Intelligent Transportation Systems investments with emphasis on energy and emission measures of effectiveness. Until now, the benefits derived from ITS technology in terms of energy and emissions have not been systematically quantified. The ultimate use of these models would be their integration into traffic network simulators and their use to better understand the impacts of traffic policies, including the introduction of Intelligent Transportation Systems technology, on the environment. Furthermore, these models can be utilized in conjunction with Global Positioning System speed measurements to evaluate the energy and emission impacts of operational- level projects in the field.

1.2 Study Contributions

The study instantaneous petrol consumptions and emission models for passenger cars under hot stabilized conditions. These models use vehicle instantaneous speed and acceleration levels as independent input variables. It is anticipated that the microscopic modeling provided in this dissertation will have many practical and methodological implications to local transportation planners and traffic engineers who will be able to use this modeling to accurately estimate pollutants and petrol consumption and predict the impacts of operational- level projects. Furthermore, the output of such models can serve as input to utilize dispersion models for the evaluation of regional air quality impacts. More specifically, this study effort makes the following contributions:

- Study microscopic energy and emission models for normal passenger cars under hot stabilized conditions,
- Study a framework for modeling vehicle emissions microscopically,
- Study a procedures for estimating cold start impacts on vehicle emissions,
- Study a procedures for characterizing high emitting cars, and
- Study microscopic emissions models for high emitting cars.

II LITERATURE REVIEW

In order to provide a background for the study that is presented in this dissertation, a number of issues are discoursed in this segment. First, the US Federal air-quality necessities are obtainable because these offer the motivation for this study determination. Secondly, cars, road traffic, and driver associated variables that impact cars emission levels are discoursed. These significant variables are dangerous for the development of comprehensive energy and emission cars. Third, the present state-of-the-art energy and discharge cars are presented. In addition, the expectation, area of presentation, and short-comings of these cars are discussed. Finally, based on the limitations of the current state-of-the-art cars, study recommendations are well-known.

2.1 Clean Air Act (CAA) -1990

In 1990, the new Clean Air Act placed a heavy burden on the transportation community. This legislation was amended by Congress to require further reductions in HC, CO, and particulate emissions. It also introduced a comprehensive set of programs aimed at reducing pollution from cars. These included additional technological advances, such as lower tailpipe standards; enhanced vehicle inspection and maintenance (I/M) programs; new vehicle technologies and the use of clean petroleum; transportation management provisions; and possible regulation of emissions from non-road cars (EPA, 1994b).

The amendment of 1990 further defined sanctions for noncompliance. For failure to submit a SIP, EPA disapproval of a SIP, failure to make a required submission, or failure to implement any SIP requirement, highway projects assisted by federal government could be withheld. Additionally, if sanctions were commanded, the department of transportation (DOT) can only approve highway projects that would not increase single-vehicle trips (NRC, 1995).

III METHODOLOGY

The study methodology, that is future to estimate mobile sources, petrol consumptions and emissions. There are many methods and techniques utilized to predict accurate petrol consumption and emissions. For automobile energy consumption modeling, relatively simple methodologies such as average speed methods are utilized and it has been proved that the models estimate reasonably well petrol consumption. However, it is a different problem to predict mobile-source emissions. Emission models consider engine start emission soak time emissions, evaporation, high emitters, emission technologies which significantly influence to approximate precise automobile emissions. To describe these methodologies, several models are briefly investigated including the study of their assumptions, limitations and strengths. In the following sections, simple future methodologies to assess mobile source emissions and petrol consumptions are presented.

The study approaches include four basic tasks, as follows:

- Identification of the optimum model approach and structure for hot stabilized condition,
- Study of a framework for modeling vehicle emissions
- Study of new high emitter cut-points for newly developed EPA drive cycles and high emitter emission models,
- Study of a framework for estimating instantaneous vehicle start emissions.

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Emission Norms for Light Vehicles (Petrol)

Norms	Year	CO, %	HC, ppm
Bharat Stage II	2003	3.0	1500
Bharat Stage III	2005	0.5	750
Bharat Stage IV	2010	0.3	200
Bharat Stage VI	2020 (Proposed)	…	…

Table: 3.1. Emission Norms for Light Vehicles (Petrol)

IV ESTIMATING VEHICLE PETROL IGNITION & EMISSIONS

The energy and emission cars described in this study utilize data included petrol ignition and emission rate measurements (CO, & HC) for 203 passenger cars (shown in table.). Estimating exact petrol ingesting and emissions has been considering a key challenge in transportation arrangement procedure. But, it is discussed that calculations from current state of the art cars are not suitable for the consistent estimation of petrol ignition and emission impacts of operational level projects.

4.1 Study Area

Vehicular tailpipe emissions are becoming a face in urban areas due to rapid increase in vehicle usage. This study is conducted on National Highway-2 in between Bhagwan Talkies and Khandari x-ring Agra. The attention of this area is to estimate the actual level of tailpipe emission for petrol cars. Exhaust gases (i.e. CO and HC) were randomly measured from 203 cars using exhaust gas analyzer.

Figure: 4.1. Imagery ©2016 DigitalGlobe, Map data ©2016 Google (Bhagwan Talkies Khandari x-ring, Agra, Uttar Pradesh)

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V DATA COLLECTION

The emission data that were collected included hydrocarbon (HC) and carbon monoxide (CO) on National Highway-2 in between Bhagwan Talkies and Khandari x-ring Agra. The attention of this area is to estimate the actual level of tailpipe emission for petrol cars. Exhaust gases (i.e. CO and HC) were randomly measured from 203 cars using exhaust gas analyzer (table: 4.1). In an attempt to overcome the limitations of current energy and emission cars, this chapter develops mathematical cars that predict vehicle petrol ignition and emissions using instantaneous speed and acceleration as explanatory variables.

Manufacturing Year	Number of cars	CO, %	HC, ppm
2001	4	0.168	199.75
2002	5	0.152	134.20
2003	4	0.118	79.75
2004	8	0.071	88.88
2005	3	0.150	106.33
2006	16	0.077	53.94
2007	17	0.075	59.24
2008	11	0.074	58.82
2009	14	0.049	39.10
2010	19	0.077	33.27
2011	17	0.094	46.30
2012	24	0.051	30.21
2013	20	0.040	44.30
2014	22	0.026	22.46
2015	15	0.032	30.47
2016	4	0.020	14.50

Table: 4.2. Average emission from vehicles according to their age

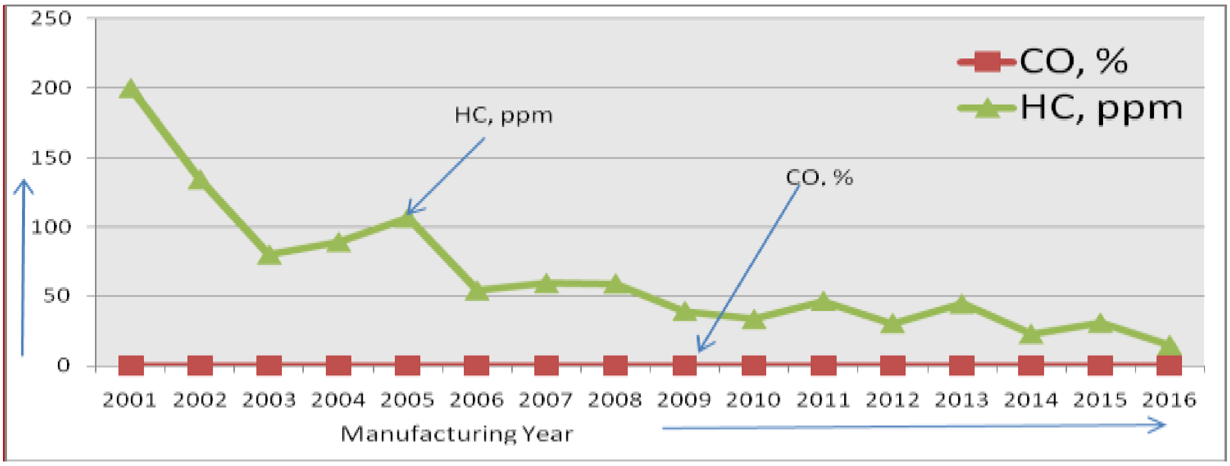

Figure: 4.2. Age of vehicles vs. their emissions (CO, % and HC, ppm)

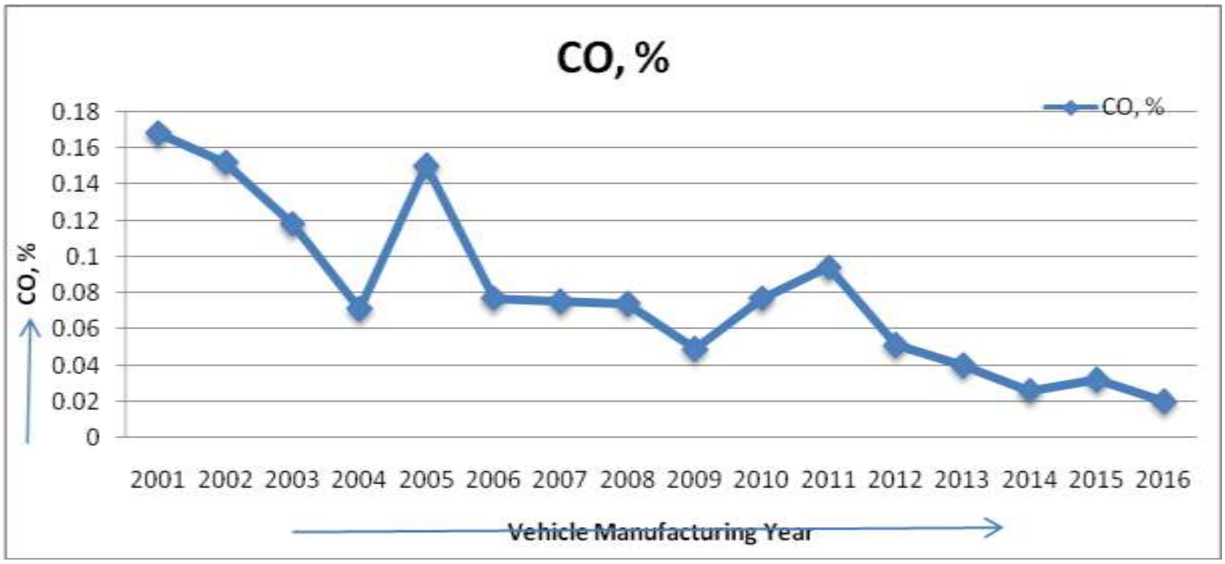

Figure: 4.3. Age of vehicle vs. CO, % emission

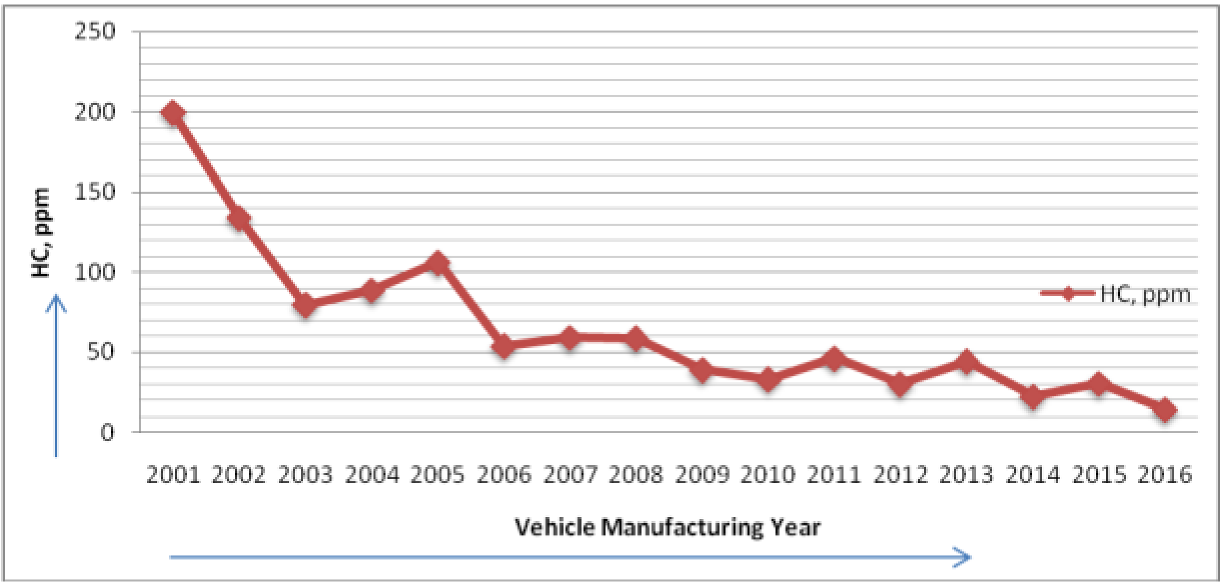

Figure: 4.4. Age of vehicle vs. HC, ppm emission

5.1 Effect of CNG on Petrol Engine

Ethanol is immoral and creates various bad acids. Many materials cannot stand up to the increase acidity present when burning advanced % of ethanol. CNG can only be used on modified PETROL engines. To date, there are no supercharged automotive PETROL engines made. The only way to get CNG into a petrol engine is to use very large superchargers which run automatically off the crankshaft to confirm sufficient air-fuel mixture gets into the engine. Traditionally, many petrol/CNG power plants run on CNG most of the time to save CNG is great for normally aspirated automotive spark-ignition engines. It may produce less peak power, but the cylinder wear is reduced, oil contamination reduced the engine runs so much cleaner it is incredible. Burning chambers remain spotless and spark plugs stay clean. CNG evaporator's essential a temperature source, so in cold weathers you may have to have a preheater. Total fleets of frozen food cars have been converted to CNG, but none has a petrol engine--they are all gasoline type engines. So they do use them in cars.

The most practical modifications for cars are propane kit. They are very simple: pressure regulator, evaporator, and some kind of throttle linkage. A few more miles per bottle of propane than CNG. Both propane and CNG keep engines spotlessly clean. Be sure to start with a clean engine and be sure that the valves have valve seats in the heads. Exhaust gases can run the valves a bit hotter than when burning gasoline because of un-burnt hydrocarbons in the exhaust, if your air-fuel ratio is right, you will never have that problem with CNG or LPG.

With fitment of CNG kit can reduce engine life slightly compared to that with petrol version. It also depends upon quality of engine, compatibility with CNG kit, maintenance carried out.

Manufacturing Year	(Petrol + CNG) Emission		Only Petrol emission (Avg.)	
	CO, %	HC, ppm	CO, %	HC, ppm
2001	0.168	6	0.01	199.75
2002	0.152	69	0.11	134.2
2003	0.118	85	0.1	79.75
2004	0.071	104	0.03	88.88
2005	0.15	63	0.01	106.33
2006	0.077	59	0.04	53.94
2007	0.075	393	0.05	59.24
2008	0.074	132	0.02	58.82
2009	0.049	248	0.05	39.1
2010	0.09	194	0.077	33.27
2011	0.094	433	0.06	46.3
2012	0.100	41	0.051	30.21
2013	0.040	139	0.04	44.3
2014	0.026	184	0.01	22.46
2015	0.032	148	0.02	30.47
2016	0.050	134	0.02	14.5

Table: 4.3. Comparative Emissions from Petrol Cars with CNG kit vs. Only Petrol car.

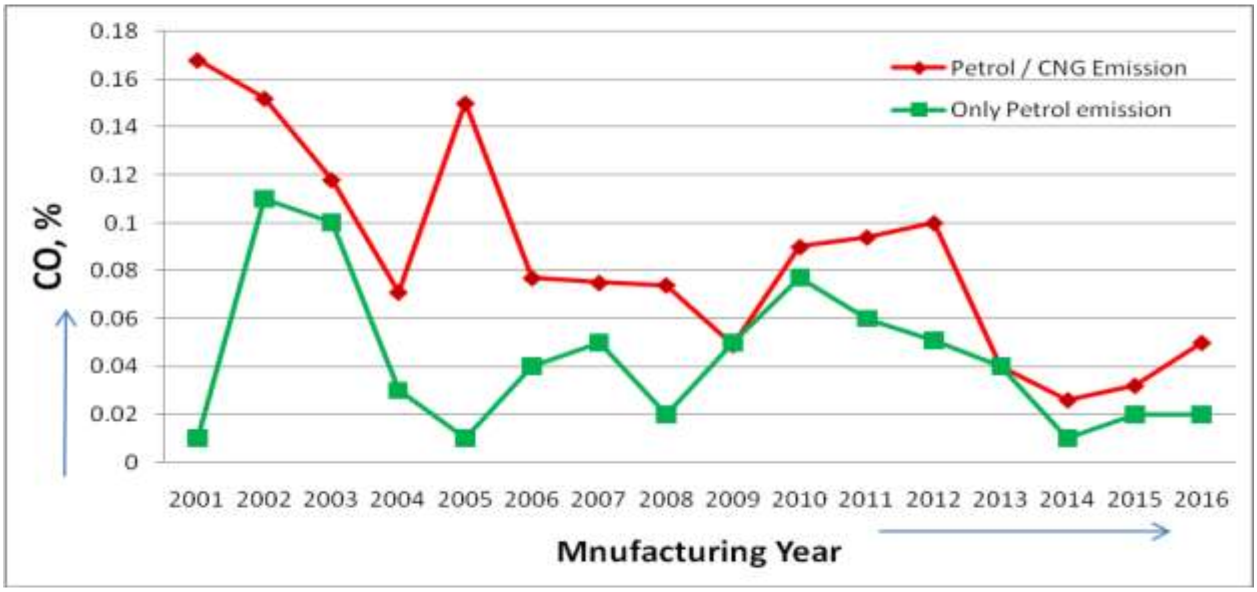

Figure: 4.5. CO, % emission from petrol cars and petrol cars with CNG kit fit.

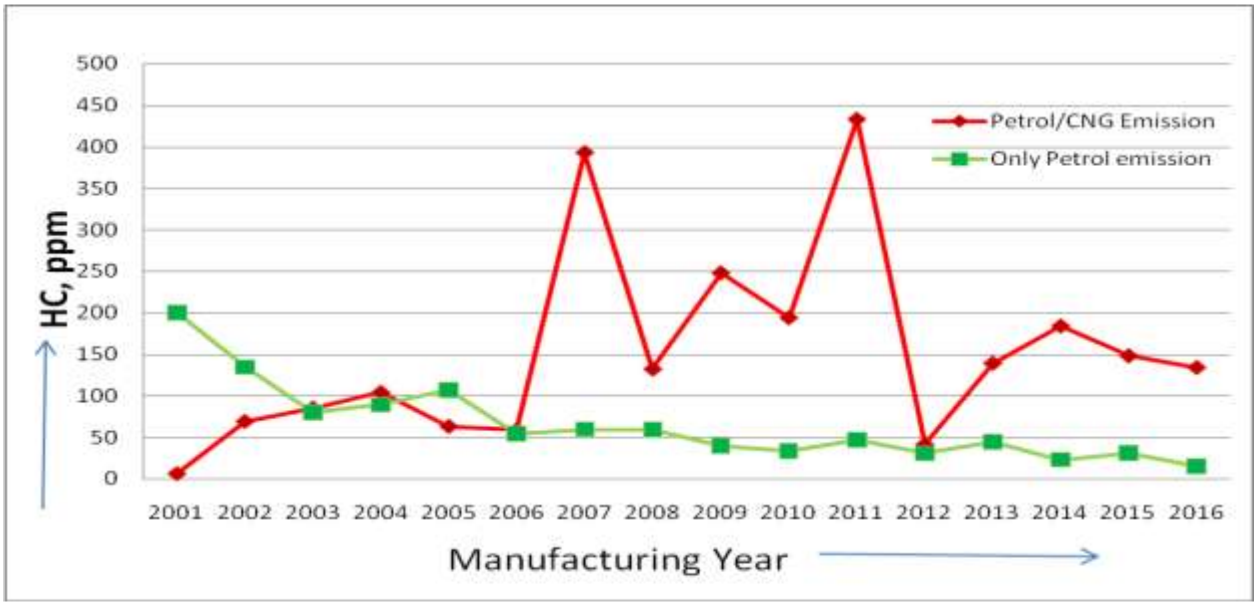

Figure: 4.6. HC, ppm emission from petrol cars and petrol cars with CNG kit fit.

CNG is made up mainly of the paraffinic compound methane, a small amount of propane, ethane, butane and other hydrocarbons plus some nitrogen and oxygen. So it mixes easily with air and gives better Distribution, so due to proper mixing the mixture is nearly 10 percent richer than stoichiometric ignition of the end gas is minimum and velocity of flame burnt completely and gives CO_2 not CO. but when we remove the CNG kit from cars, the engine produce more CO and HC in the exhaust emission because the engine works like CNG fuel not petroleum fuel, so all the processes are overlap and fuels are not burn completely and produce more CO and HC in the exhaust emission in compare to CO and HC produces when CNG kit was not attached with engine.

Comparison between Petrol Engine and CNG Engine

Below, I have provided the major difference that brings in-front you. As per my research says, only petrol is comparatively a best option in compare to establish CNG kit in petrol cars as it is offers you affordability along best attractive features. The differences are listed below:

Significant	Petrol engine	CNG kit engine
Pickup	Recognized as good pickup option as well as operational. It is even known as a quiet and smooth operating variant.	Suffers from initial pickup
Cost	Lower in price in compare to CNG	Cost of CNG kit is higher i.e. Rs. 50000 per gas kit
Maintenance	Require less maintenance	Higher maintenance and special attention need to be paid for checking fuel filter regularly.
Mileage	Low mileage in compare to CNG	Better mileage
Effect of cold weather	It do not get freezes, therefor do not require pre-heating	Easily get freezes causing inconveniences. It requires pre-heating
Environmental friendly	No	Yes

Table: 4.4. Difference between petrol engine and CNG kit engine

Manufacturing Year	Petrol Engine (CNG kit fit)		CNG Kit Fit Engine (Petrol Engine)	
	CO, %	**HC, ppm**	**CO, %**	**HC, ppm**
2001	0.08	70	0.05	15
2002	0.15	104	0.03	29
2004	0.07	33	0.03	12
	0.06	27	0.06	7
	0.04	84	0.03	34
2006	0.07	62	0.06	7
	0.02	97	0.01	13
2007	0.05	59	0.04	14
	0.05	393	0.01	63
2008	0.07	67	0.03	19
2009	0.03	15	0.01	10
2010	0.03	68	0.01	24
2011	0.04	78	0.01	32
	0.01	13	0.01	3
2012	0.07	18	0.01	1
	0.35	184	0.02	97
	0.05	148	0.03	61
2013	0.01	8	0.00	4
	0.05	248	0.03	71
	0.08	182	0.05	35
	0.08	6	0.04	10
	0.19	12	0.01	12
2014	0.11	19	0.05	3
	0.07	14	0.01	4
	0.01	7	0.00	3
	0.07	18	0.01	55
	0.13	44	0.09	14
	0.06	8	0.04	1
	0.29	169	0.01	78
2015	0.01	5	0.00	5
	0.05	148	0.02	120
	0.01	14	0.01	2
2016	0.01	6	0.01	5
	0.04	132	0.04	44
	0.25	10	0.01	1

Table: 4.5. Exhaust emission from petrol engine car with CNG kit fit

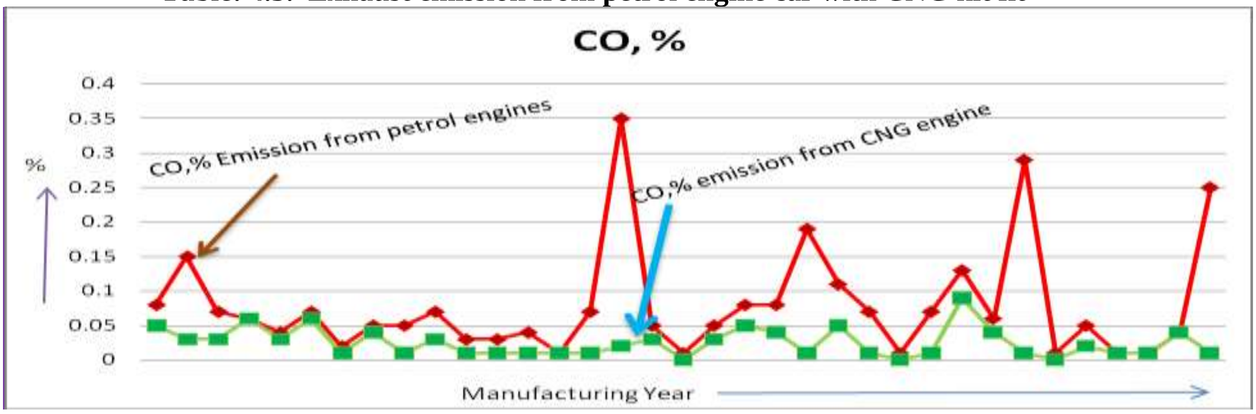

Figure: 4.7. CO emission petrol engine and CNG kit engine

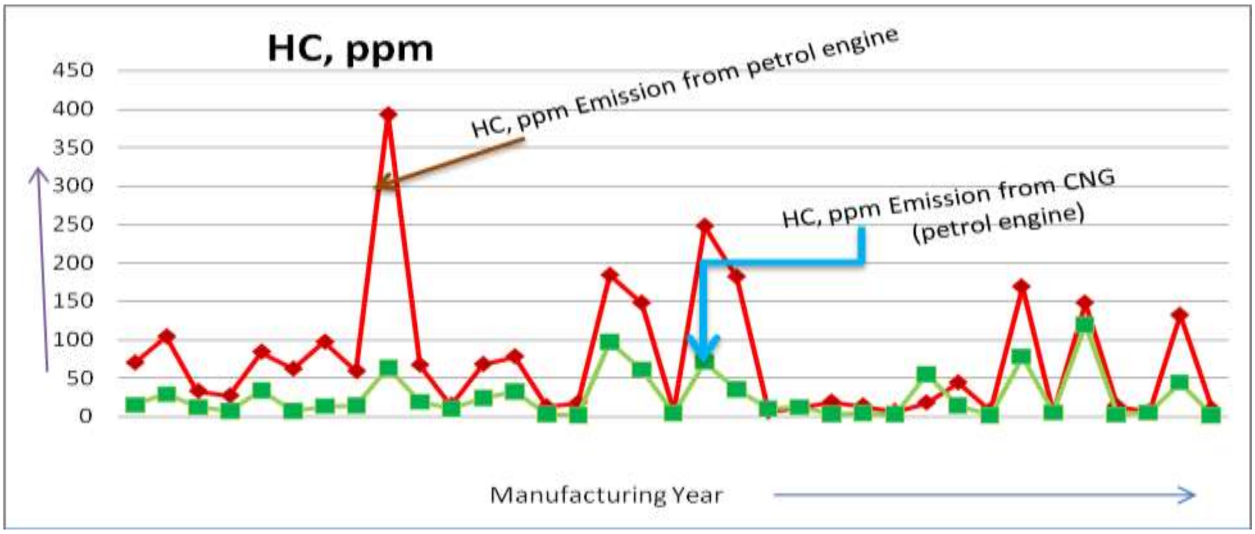

Figure: 4.8. HC emission petrol engine and CNG kit engine

The only drawback with CNG performance is a slight 5% (or thereabout) decrease in engine power. And if you're saving 50% of fuel costs then who cares. Technical improvements for internal combustion engines are hopeful to bring nearby an important change in the fuel effectiveness of cars in the nearby future. The dual mode vehicles (Petrol car with CNG kit) emission level moves slightly higher then only petrol driven vehicles. (As shown in the figure: 4.7 and figure: 4.8).

VI HEALTH EFFECTS

The exhaust gases released by cars hold some levels of pollutant concentration which have effects on the health of humans, plants and animals (table 5.1).

Pollutant	Effect on Human Health
Carbon Monoxide	Distresses the cardio vascular system, intensifying circulatory disease symptoms, particularly angina; may also particularly distress fetuses, sick, anemic and young children, affects nervous system harmful physical coordination, vision and conclusions, creating nausea and problems, reducing productivity and increasing personal discomposure.
Nitrogen Oxides	Increased susceptibility to infections, lung diseases, weakening of lung function and eye, nose and throat crossness.
Hydrocarbons	Potential to cause cancer

Table: 5.1. Effect on Human Health

VII CONCLUSION

In this study one vehicle of old model give the result beyond the prescribed limit. Thus the governing authorities should check the fitness of all vehicles every 15 years and then they gave permit to run on the road.

The dual mode vehicles (Petrol car with CNG kit) emission level moves slightly higher then only petrol driven vehicles.

CNG is made up mainly of the paraffinic compound methane, a small amount of propane, ethane, butane and other hydrocarbons plus some nitrogen and oxygen. So it mixes easily with air and gives better ma Distribution, so due to proper mixing the mixture is nearly 10 percent richer than stoichiometric ignition of the end gas is minimum and velocity of flame burnt completely and gives CO_2 not CO. But when we remove the CNG kit from cars, the engine produce more CO and HC in the exhaust emission because the engine works like CNG fuel not petroleum fuel, so all the processes are overlap and fuels are not burn completely and produce more CO and HC in the exhaust emission in compare to CO and HC produces when CNG kit was not attached with engine.

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