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Assessment of Impact of Vehicular Pollution on Ambient Air Quality A Case Study of Nagpur City

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***Abstract*- The rapid development in urban India has resulted in a tremendous increase in the number of motor vehicles. In some cities, this has doubled in the last decade. Rapid urbanization and growth of motor vehicles impose a serious effect on human life and the environment in recent years. Motor vehicles are a significant source of urban air pollution and are increasingly important contributors of anthropogenic carbon dioxide and other greenhouse gases. Transport sector contributes a major sector, contributing 90% of total emissions. Air pollution is a serious environmental health threat to humans. Adverse effects range from nausea, difficulty in breathing and skin irritations, birth defects, immunosuppression and cancer. All these situations indicate that air pollution becoming a major problem in Indian context and there is an essential need to build up healthy environment and increase the level of research around the world.**

Indian cities are facing the problem of severe air pollution and vehicles are a major source. The economically vibrant cities like Delhi, Bengaluru, Chennai, Hyderabad, Mumbai provide numerous job opportunities and hence have a large vehicle population. These cities thus contribute the largest share in emissions of pollutants. Other growing cities like, Jaipur, Pune, Coimbatore, Nagpur are also emitting a lot of pollutants. The present study is a case study of an increase in vehicular pollution in Nagpur.

Keywords- Vehicular Pollution, Motor Vehicles, Air Pollution,Nagpur City

I. INTRODUCTION

The growing cities, increasing traffic, trajectory growth, rapid economic development and industrialization with higher levels of energy consumption have resulted in an increase in pollution load in an urban environment (CPCB, 2010). Air pollution is the major environmental risk to health and is estimated to cause approximately 2 million premature deaths worldwide per year (WHO, 2005). Besides health effect, air pollution also contributes to tremendous economic losses, especially in the sense of financial resources that are required for giving medical assistance to the affected people.

Clean air can no longer be taken for granted. Today the air in most large Indian cities is severely polluted and this pollution has a tremendous impact on the health of the population. Industrialization, the growth in number of vehicles in urban areas and the burning of bio-fuels in rural households have lead to a rapid deterioration of indoor and outdoor air quality. Out of the 23 metro- and mega cities, Delhi is the most polluted followed by Mumbai, Calcutta, Bangalore, Chennai, Kanpur, Ahmadabad and Nagpur in India. They have severe air pollution problems with the average levels of suspended particulate matter levels much higher than the prescribed standards. Clean air has so far been treated as an unlimited and free natural resource. Only now as the health costs of polluted air are mounting, people are beginning to realize that clean air is valuable. The health impact of pollution is considerable. Premature deaths due to respiratory and cardio-vascular diseases and illness due to chronic respiratory diseases like asthma and bronchitis have increased. According to a world bank study, in 1995 air pollution might have accounted for some 40,350 premature deaths and 19,805 thousand hospital admissions, and 1201 million minor illnesses. In the last 4 years the numbers of premature deaths have increased by 28% and the number of sickness and hospital admissions by 30%. Another study estimates that 4,10,000 to 5,70,000 women and young children die prematurely every year because of indoor air pollution caused by the burning of bio- fuels in poor ventilated homes. Urban air pollution is growing due to increasing power consumption, industrialization and vehicle use.

In urban centers studied by the Central Pollution Control Board, the suspended particulate matter (SPM) in residential area exceeds critical limits set by the board in many cities. These studies revealed that it is not necessary that the larger cities are the more polluted ones. Kanpur, for instance has more particulate matter in the air than Mumbai, Calcutta or Delhi. In India surprisingly neither industries nor vehicles are the main source of air pollution. Burning of unprocessed cooking fuels in homes causes the most pollution. Pollutants released indoors, due to their proximity to humans are far more dangerous than those released outdoors. (Anonymous, 2001).

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(Fig.1 : India Gate Delhi, Due to Vehicular Pollution)

Transport affects the local and global environment in many ways and for a number of pollutants the road transport sector is one of the most significant contributors to environment externalities. Although, the significance of motor vehicle in overall socio economic development cannot be denied, but recently motor vehicles have been identified with various environmental pollution problems. The transportation activities particularly related to motor vehicle have been closely identified with increasing air pollution levels in various urban centers of the world. Substantial CO2 emissions apart from significant quantities of CO, SPM and NOx are emitted from the transport activities, particularly from the road transportation, causing serious environmental and health impacts. Besides air pollution, the pollutants emitted from these vehicles are responsible for various regional and global problems such as global warming, acid rain, ozone depletion etc., which are even threatening the very survival and existence of the mankind. Worldwide, the number of motor vehicles is growing faster than global population – about 5 per cent per year compared with 2 per cent for population (Sharma et al., 2008).

II. LITERATURE REVIEW

At any point of time, the quality of air i.e. ambient air quality would be determined by the amount of pollutants present, the rate at which they are released from different sources and also how quickly the pollutants get dispersed into the environment. There have been lot of research on assessment and establishment of baseline ambient air pollution and also there have been lot of research studies to study the impact of meteorological parameters on air pollutant. Lately there have been research studies on air dispersion modelling. Previous researches have used various mathematical models or simulations to assess air pollution, its dispersion in the environment and the impact on overall air quality in the region so as to able to estimate the level of pollution concentration. Such models then result in assisting designing of effective control strategies to reduce emissions of harmful air pollutants (Singh et al., 2006). To study the impact of vehicular pollution on ambient air quality, literature was reviewed extensively from different sources such as Ministry of Environment and Forests Library, Central Pollution Control Board, IIT, Delhi – Library, Indian Road Congress Publications, Ministry of Road Transport and Highways, Google Scholar etc. The literature gave reference of around 200 studies related to air pollution, and for the purpose of our study we have mentioned around 120 studies which are more closely related to impact of vehicular pollution on ambient air quality.

In Europe and United State, Small and Kazimi (1995) reported that motor vehicles emission account for 92 – 98% of national emission of CO. Furthermore, Cline (1991) stated that transportation accounts for an important fraction of greenhouse gases (especially CO2) emission. As per an estimate, air pollution contribution of transport sector was about 72% in Delhi and 48% in Mumbai (Goyal et al., 2006).

The origin of urban air pollution is mainly in anthropogenic emission sources, which include automobiles, industries, and domestic fuel combustion. In arid and semi-arid regions, deserts contribute to urban air pollution as does the sea in coastal regions. The air pollutants so generated are detrimental to human health. In addition, they cause negative impacts directly or indirectly, if at high concentrations, on vegetation, animal life, buildings and monuments, weather and climate, and on the aesthetic quality of the environment (Stern, 1976; Godish, 1985; Takemura et al., 2007, Shen et al., 2009). Rates of increase of air pollutant concentrations in developing countries such as India are higher than those in developed countries and hence atmospheric pollution is often severe in cities of developing countries all over the world (Mage et al., 1996).

In India extant researches have been carried out to establish baseline traffic and transport scenario and to understand impacts on ambient air quality in urban areas. Saini et al. in 1994 monitored suspended particulate matter in Chandigarh to study deteriorating air quality. Atmospheric concentrations of the SPM in the Chandigarh city and its industrial area were measured from April to December 1993. The data collected was investigated and its statistical distribution, the weekly, daily and monthly variations was studied. On the whole a resident of city was exposed to over the maximum desirable level of 200 µgm/m3 for about 126 day whereas a person in the industrial area was exposed to over the stipulated limit of 500 µg/m3 for about 13 day. Later Bansal in 1996 monitored NO2 Concentration to establish ambient air quality of Bhopal city with reference to nitrogen dioxide. In the commercial areas maximum NO2 was recorded as 96.4 µgm/m3 . Corresponding value in the industrial area as 66.3 µgm/m3 and 53.5 µg/m3 in the residential area. Das et al. in 1997 monitored SO2, NO2 and CO concentration during evening peak traffic hours in Jaipur to study the rapid assessment of air quality in Jaipur city and to identify critical zones for evolving a proper environmental management strategy. Later Panwar et al. in 1997 monitored SPM, SO2 and NOx in 62 cities across India to study ambient air quality status of various cities in India. The air quality levels were compared against the prescribed standards to draw inferences regarding the pollutant (s) of concern and the

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severity of the problem at various cities/towns in the country. Analysis of the data reveals the prevalence of high SPM pollution levels in most of the cities, while only a few of them have high SO2 or NOx problem.

III.VEHICULAR POLLUTION

3.1 VEHIC ULAR POLLUTION

Vehicular pollution is the introduction of harmful material into the environment by motor vehicles. These materials, known as pollutants, have several bad effects on human health and the ecosystem. Transportation is a major source of air pollution in many countries around the world due to the high number of vehicles that are available on the roads today. An increase in purchasing power means that more people can now afford cars and this is bad for the environment. Vehicular pollution has grown at an alarming rate due to growing urbanisation in India. The air pollution from vehicles in urban areas, particularly in big cities, has become a serious problem. The pollution from vehicles has begun to tell through symptoms like cough, headache, nausea, irritation of eyes, various bronchial and visibility problems.

Environmental concerns have become one of the most impotant issues in transport policy debates. Significant quantities of CO, HC, NOx, SPM and other air toxins are emitted from the motor vehicles into the atmosphere causing serious environmental and health impacts. Air pollution from motor vehicles in many countries, has replaced coal smoke as the major cause for concern. However, continuing growth in vehicle use means that efforts to reduce emissions from individual vehicles are being overtaken by increase in the volume of traffic. Vehicular traffic has become a major source of air pollution in urban areas.

Transport sector contributes around 14% towards the global emissions of green house gases (CPCB, 2010). Carbon dioxide represents the largest proportion of basket of greenhouse gas emissions. With rapid urbanization, road transport related CO2 emissions from urban areas are likely to increase further in coming years mainly due to inadequate public transport system, high vehicle density in urban areas and increasing share of private vehicles vis-a-viz public transport vehicles in developing countries (Sharma et al., 2010). During, the past three decades CO2 emissions from transport have increased faster than those from all other sectors and are projected to increase more rapidly in future. From 1990 to 2007, CO2 emissions from the world's transport sector have increased by 36.5%. Also, for the same period, road transport emissions have increased by 29% in industrialized countries and 61% in the other countries (CPCB, 2010). Worldwide, transport sector is responsible for approximate 23% of energy related CO2 and 13% of all GHGs emitted from various sources. Further, CO2 emissions is expected to increase by 1.7% a year from 2004 to 2030 largely attributable increased demand for mobility in developing countries where it is expected to grow with an average of 2.8% a year for the same period.

(Fig.2 :Vehicular Pollution)

3.2 Ingredients of Vehicular Pollution

The following are the major pollutants associated with motor vehicles:

Ozone- The primary ingredient in urban smog, ozone is created when hydrocarbons and nitrogen oxides—both of which are chemicals released by automobile fuel combustion—react with sunlight. Though beneficial in the upper atmosphere, at the ground level ozone can irritate the respiratory system, causing coughing, choking, and reduced lung capacity.

Particulate matter- These particles of soot, metals, and pollen give smog its murky color. Among vehicular pollution, fine particles pose the most serious threat to human health by penetrating deep into lungs.

Nitrogen oxides- These vehicular pollutants can cause lung irritation and weaken the body's defenses against respiratory infections such as pneumonia and influenza. In addition, they assist in the formation of ozone and particulate matter.

Carbon monoxide- This odorless, colorless gas is formed by the combustion of fossil fuels such as gasoline. Cars and trucks are the source of nearly two-thirds of this pollutant. When inhaled, CO blocks the transport of oxygen to the brain, heart, and other vital organs in the human body. Newborn children and people with chronic illnesses are especially susceptible to the effects of CO.

Sulfur dioxide- Motor vehicles create this pollutant by burning sulfur-containing fuels, especially diesel. It can react in the atmosphere to form fine particles and can pose a health risk to young children and asthmatics.

Hazardous air pollutants- These chemical compounds, which are emitted by cars, trucks, refineries, gas pumps, and related sources.

3.3 Causes of Vehicular Pollution

The main cause of vehicular pollution is the rapidly growing number of vehicles. The other factors of vehicular pollution in the urban areas are 2-stroke engines, poor fuel quality, old vehicles, inadequate maintenance, congested

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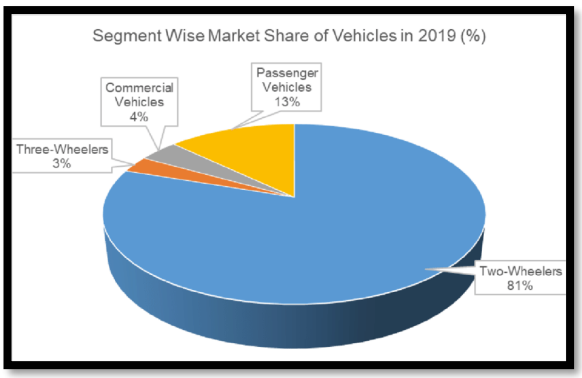
traffic, poor road condition and old automotive technologies and traffic management system.

3.4 VEHICULAR AIR POLLUTION IN INDIA

Like many other parts of the world, air pollution from motor vehicles has become one of the most serious and rapidly growing problems in urban cities of India as well. Although, the improvements in air quality with particular reference to the criteria pollutants (SPM, SO2, NOX) have been reported for some of the metropolitan cities, the air pollution situations in most of the Indian cities is still not known and is a cause of increasing concern. Air pollution levels in urban centers (particularly metropolitan cities) generally exceed the National Ambient Air Quality Standards (NAAQS) specified by the Central Pollution Control Board (CPCB) and the World Health Organization guidelines for air pollution levels (CPCB, 2006). Vehicular emissions have been identified as one of the major contributors in deteriorating air quality in these centers.

The problem of air pollution has assumed serious proportions in some of the major metropolitan cities of India. The problem has further been compounded by the concentration of large number of vehicles and comparatively high motor vehicles to population ratios in these cities. In India, the number of motor vehicles has grown from 0.3 million in 1951 to 142 million in 2011, of which, two wheelers (mainly driven by two stroke engines) account for 70% of the total vehicular population. Two wheelers (2W) and car {four wheelers (4W), excluding taxis} which are mainly constitute personal mode of transportation, account for approximately four-fifths of the total vehicular population. Similarly, human population has also increased from 361 million to more than 1000 million during this period.



(Figure 3: Segment Wise Market Share of Vehicles in India 2019)

In India, 25% of the total energy (of which 98% comes from oil) is consumed by road sector only. Although gasoline vehicles dominate (approximately 85%) the vehicular population, the consumption of diesel is six times more than the consumption of gasoline (petrol). A gradual shift in passenger and freight movement from rail to road-based transportation has also lead to marked increase in fuel consumption by the road sector which ultimately results in increased emissions of various pollutants. Vehicles in major metropolitan cities in India are estimated to account for 70% of CO, 30%-40% of NOx, 30% of SPM and 10% of SOx of the total pollution load of these cities (Goyal et al., 2006). Increase in urban population, which constitute about 31% of the India's population (from approximately 17% to 28% during 1951-2001) has resulted in larger concentration of vehicles in these urban cities specially in four major metros, namely Delhi, Mumbai, Chennai and Kolkata account for more than 15% of the total vehicular population of the whole country, whereas, more than 45 other metropolitan cities (with human population more than 1 million) account for 35% of the vehicular population in the country. Two wheelers account for about 75% of the total vehicular population.

IV. NAGPUR CITY- AIR QUALITY PAST AND PRESENT SCENARIO

4.1 Nagpur City Profile

Nagpur city is located in Nagpur district in the State of Maharashtra .Nagpur is the administrative headquarters of Nagpur District and Nagpur Division. Nagpur is situated at 21° 06' N latitude and 79° 03' E longitude. A mean altitude of 310 meters above sea level and is located at practically the geographical center of India; in fact, the Zero Milestone of India

(Fig.4 : Map of Nagpur City)

- 300 Years old city.
- Nagpur is second greenest city & Geographical center of India.
- A heritage monument "Zero Milestone of India" located within the city.
- Known as "Orange City," is the largest city in Central India.
- Winter capital of Maharashtra.
- Connected to all main cities in the country by Air, Rail and Road.
- Global Connectivity.
- Health and Educational Hub.
- Emerging as Cargo Hub.
- Area - 217.56 Sqkms.

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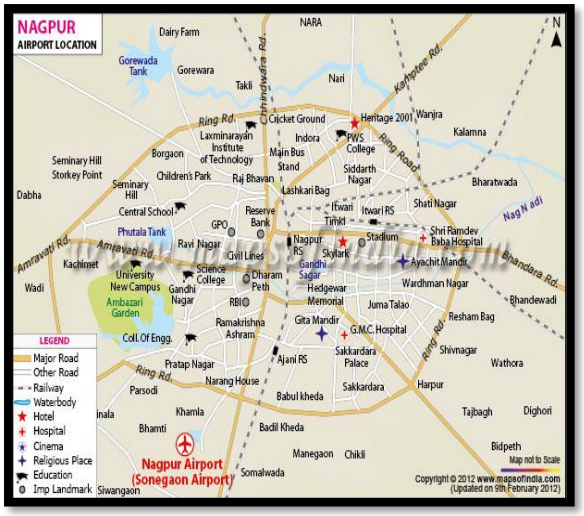
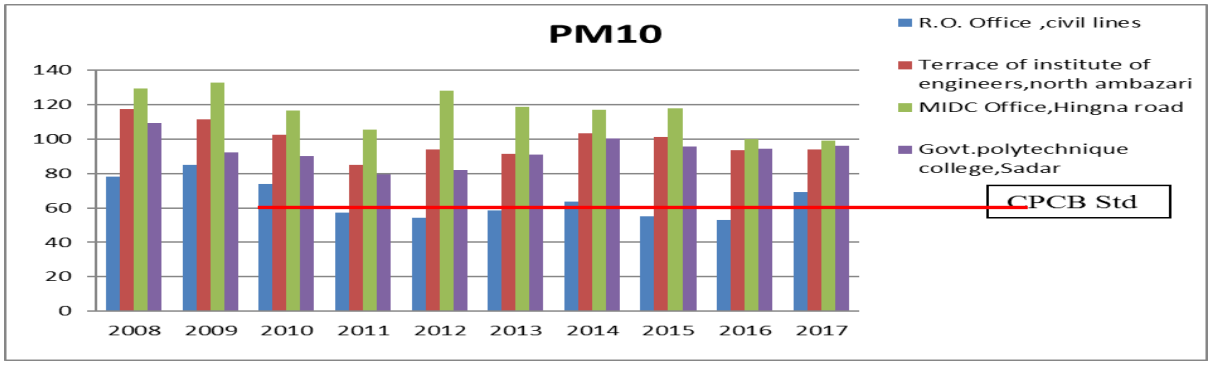
- Population (2014) - 25 Lacs
- Water supply - 645 MLD
- Water pipeline length - 3200 Kms.
- Sewerage length - 1670 Kms.
- Strom water drains - 980 Kms.
- MSW - 700-800 MT/Day
- Road length - 3947 Kms.
- Lakes - 11 Nos.
- Rivers - 3 Nos.

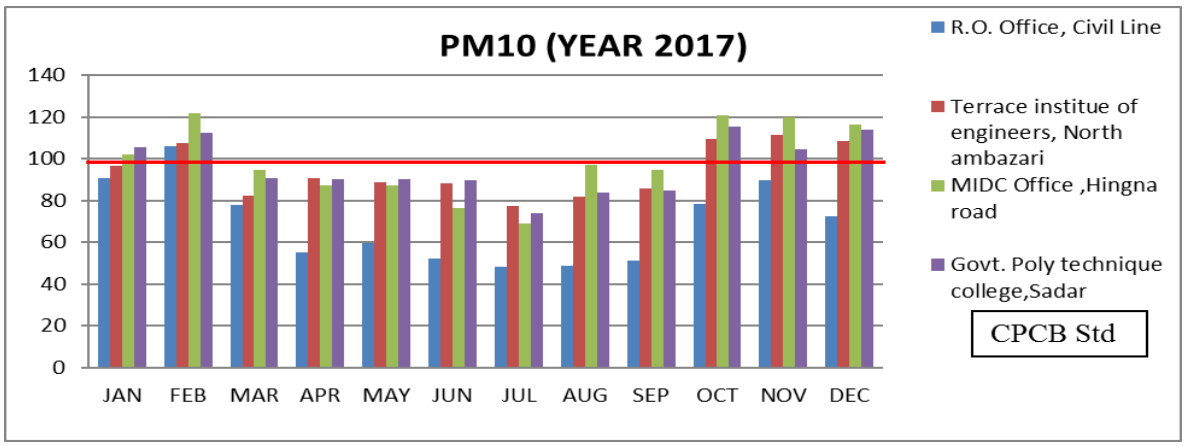


(Fig.5 :Nagpur city with NMC boundary and wards)

4.2 Air Quality of Nagpur

The seasonal levels of air pollutants shows that the average PM10 concentrations measured in µg/m3 exceeding the CPCB AAQ Standard at most of the sites.





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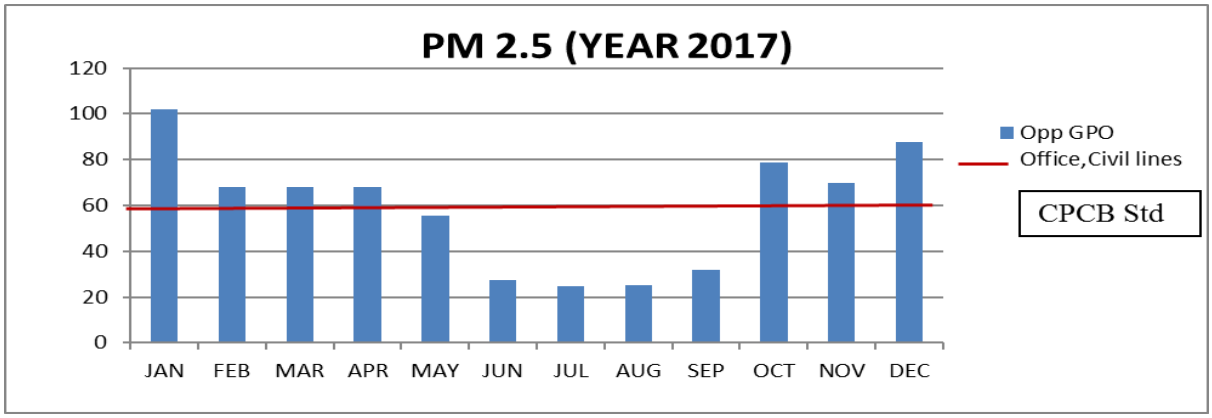

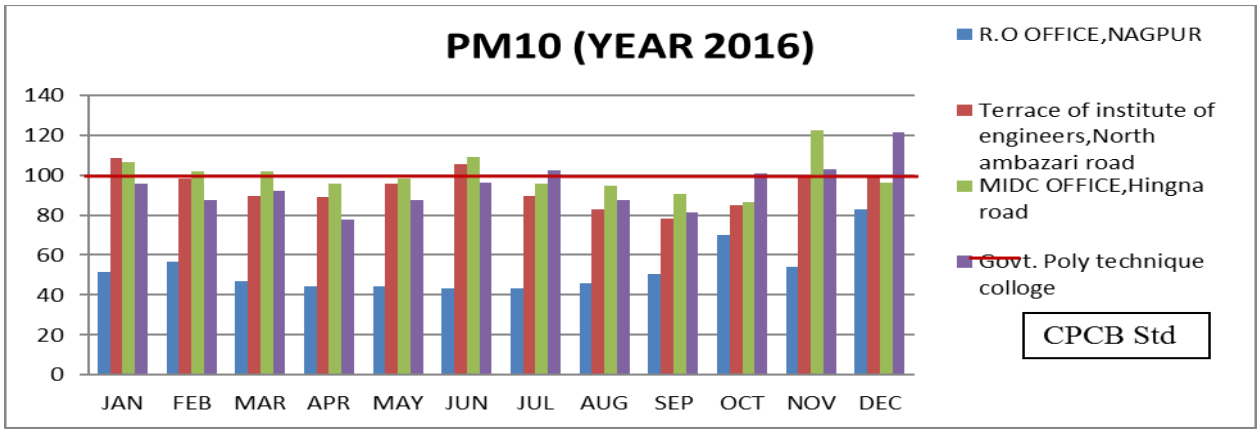

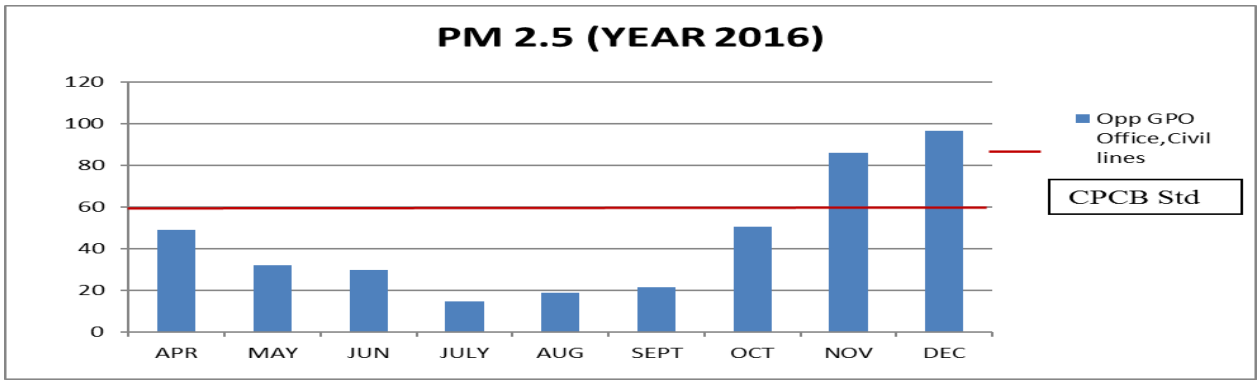

4.3 Source of Emissions

1. Point

- LSI (Large Scale Industries)
- MSI (Medium Scale Industries)
- SSI (Small Scale Industries)

2. Area

- Cooking Fuel
- Solid Waste Burning
- Road dust
- Crematoria
- Hotels, Restaurants, Bakeries, Open eat-outs
- Construction and Demolition

3. Line

- Vehicles

Nagpur has air polluting industries (LSI, MSI and SSI red and orange category) in areas viz., Butibori, MIHAN, Hingna industrial area, Koradi, Khaparkheda and other nearby areas.

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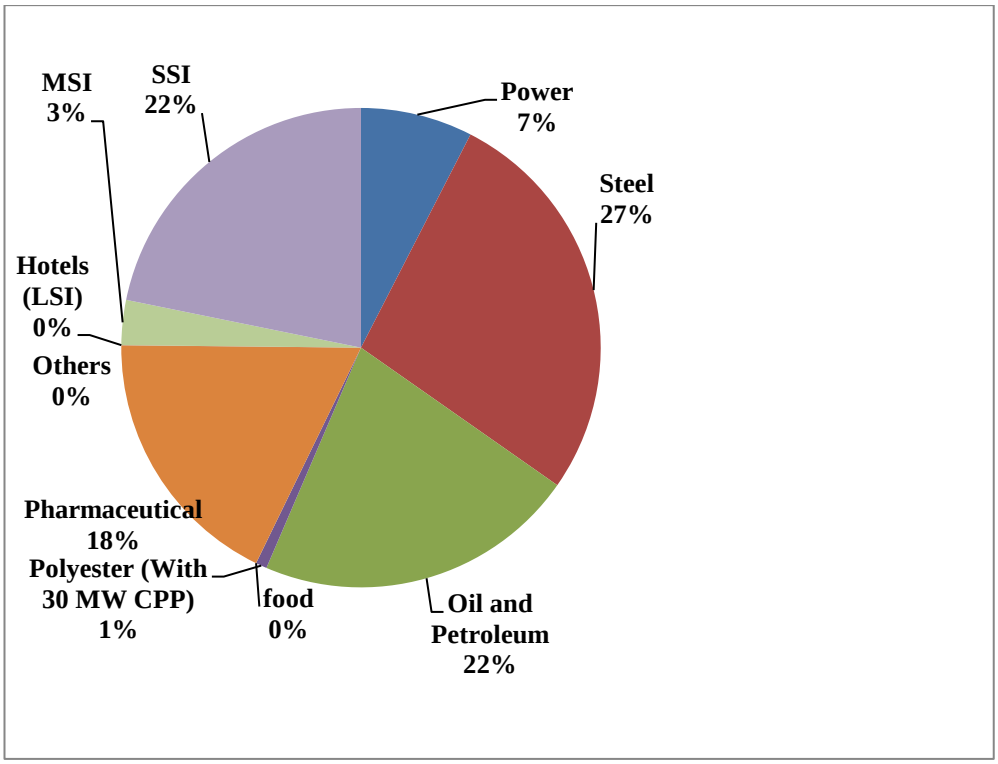
Table 1:Category Wise Numbers of Industries

Industry Category	No. of Industries
LSI	
Power	7
Steel	18
Oil and Petroleum	2
Polyester-yarn (With 30 MW CPP)	2
Food Manufacturing and processing	2
Others	3
Hotels (LSI)	5
Pharmaceutical	1
MSI	10
SSI	109
Total	159

Chart 1: Sector Wise Industrial PM2.5 Emission Distribution



Line Source: Vehicles

- City has 3465 km network of roads
- People prefer to use personal vehicles than public transport
- Hence, there is significant increase in new vehicle registrations every year.
- It is observed that on an average 59000 new vehicles are registered every year in Nagpur.
- Two wheelers followed by LMV have a major share in total vehicle fleet

Emission Estimation for Vehicles:

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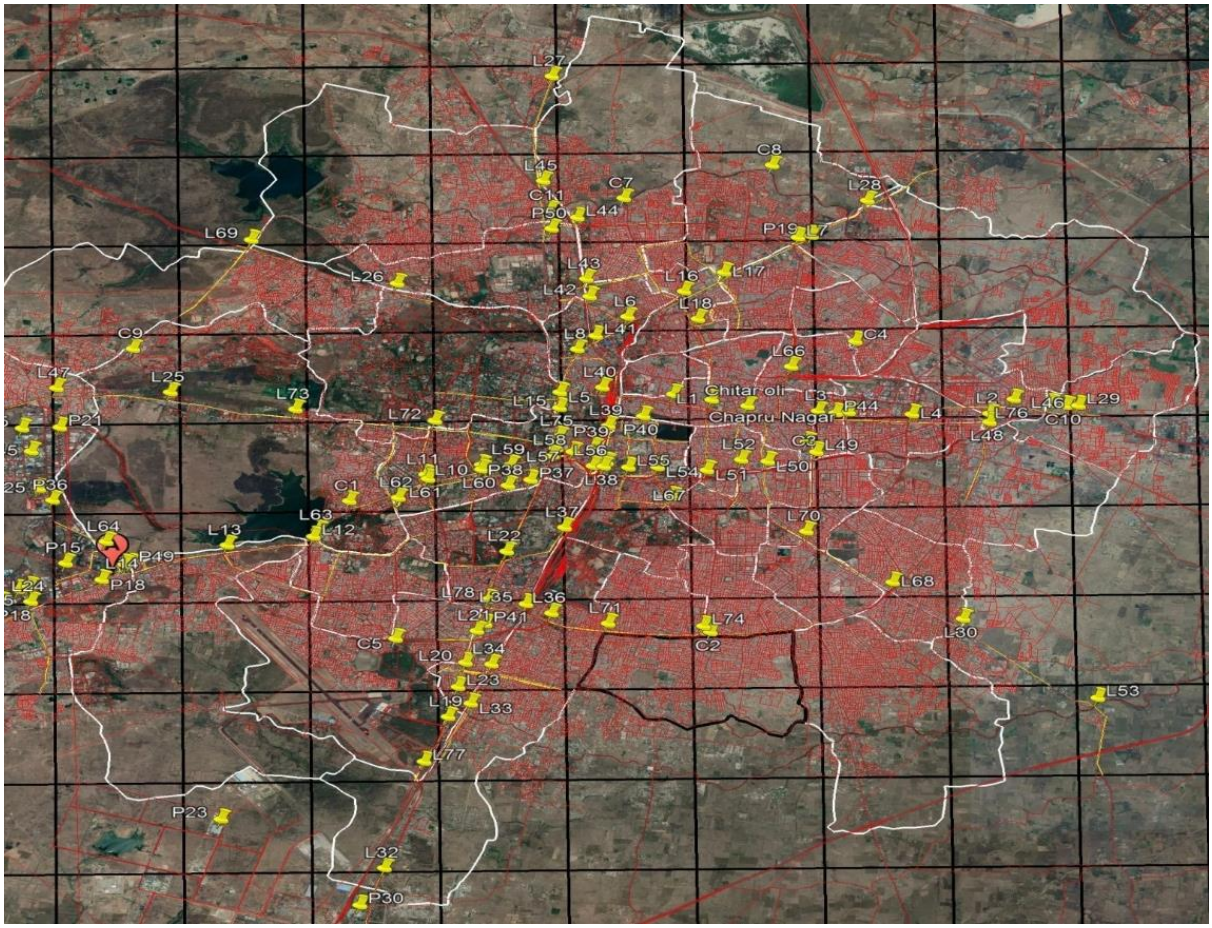

(Fig.6 : City image showing vehicle count locations)

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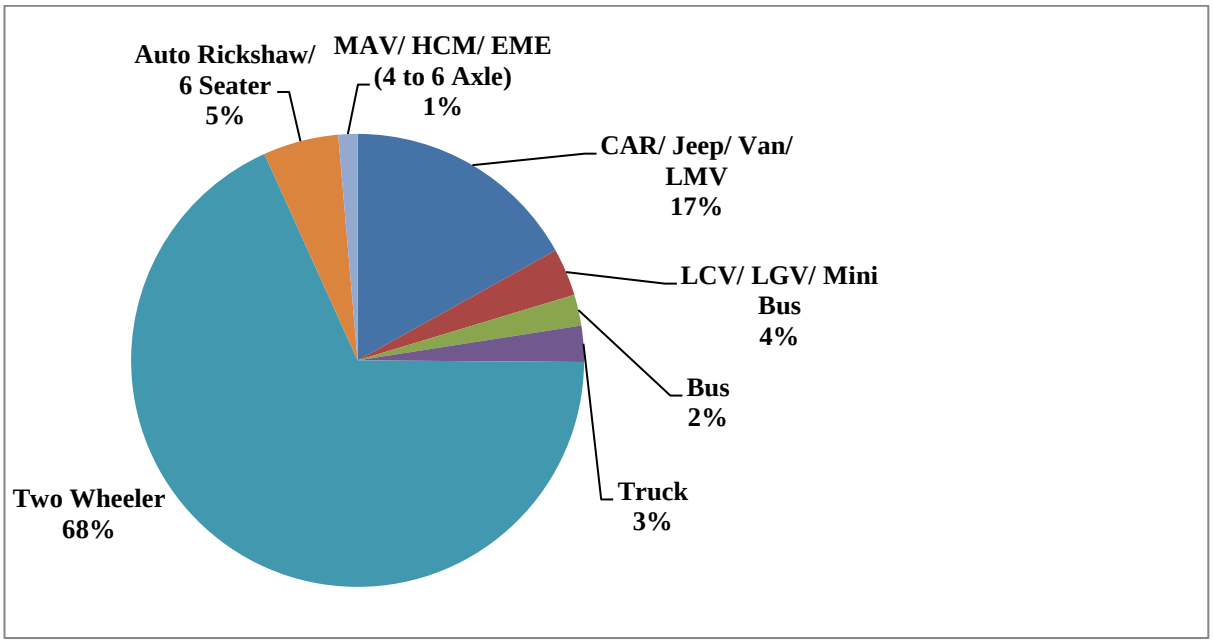
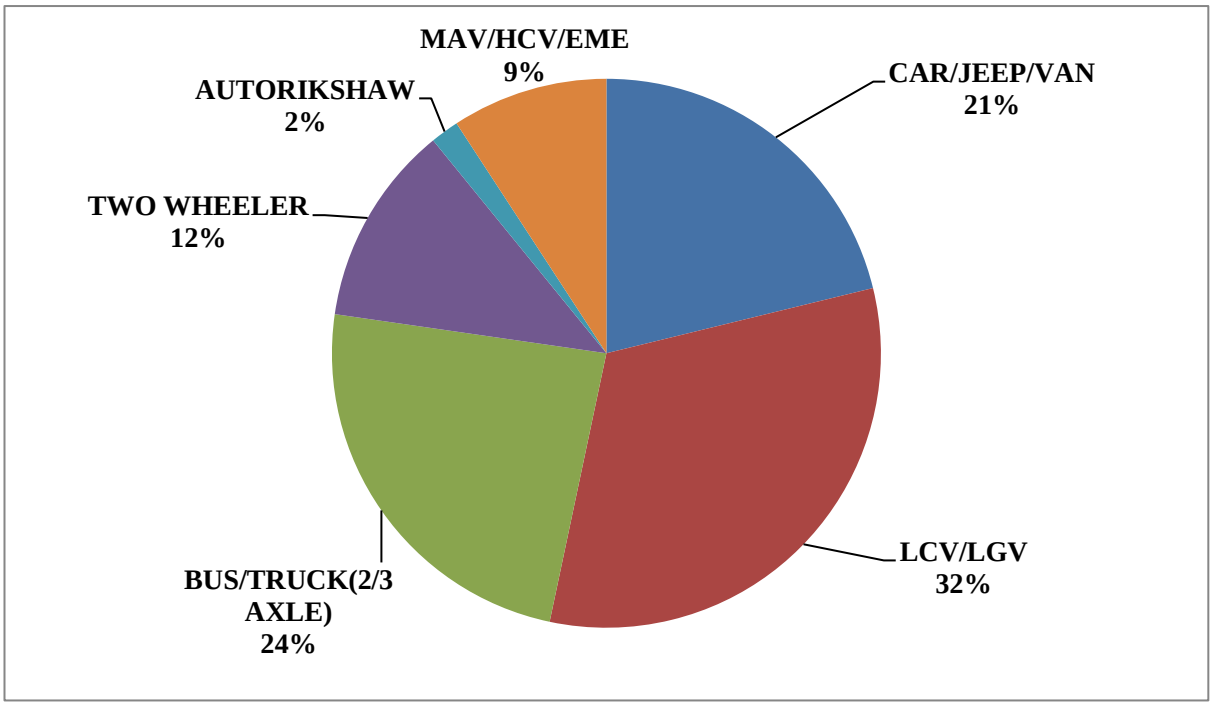
Emission Estimation for Vehicles:

Around 36 lakh vehicle trips are on-road /day



(Chart 2 : % share of different vehicle categories in total on-road vehicles)



(Chart 3: Category Wise PM 2.5 Emissions)

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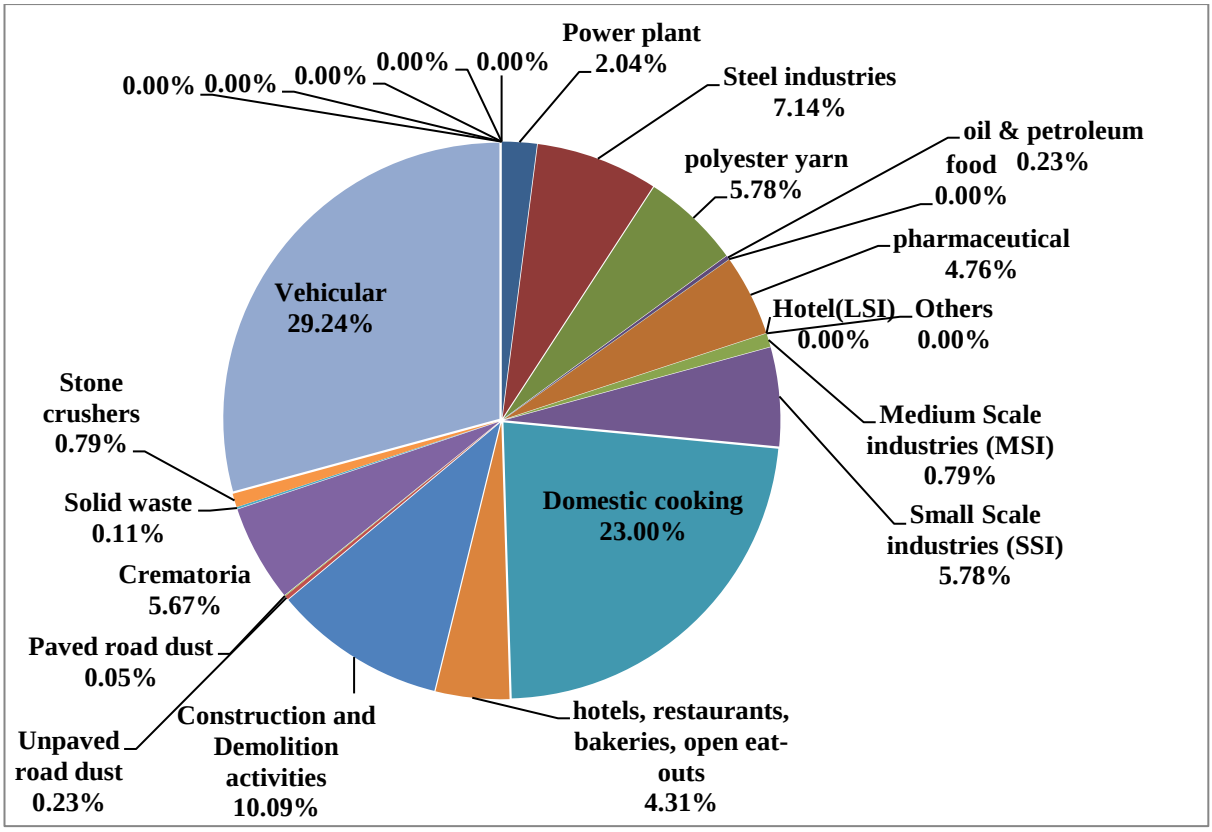

(Chart 4 :Category Wise PM2.5 Emissions from All Sources)

4.4 Vehicular Pollution Control Measures

- Mass Emission Standards (Bharat Stage IV) implemented across the country for all categories of new vehicles from 01 April, 2017. India will leap frog from BS-IV norms to BS-VI and Notification for implementation of BS-VI emission norms for all categories of new vehicles from 01 April, 2020 has been issued.
- Fuel efficiency norms for passenger cars have been notified on 23 April, 2015.
- Promotion of electric/hybrid vehicles through National Electric Mobility Mission Plan 2020 and Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles.
- Introduction of cleaner / alternate fuels such as LPG, CNG, Bio-Diesel Blends, Battery Operated, Hydrogen and Solar Operated vehicles.
- Promotion of public transport and network of metro, e-rickshaws, promotion of car pooling, Pollution Under Control Certificate, lane discipline, vehicle maintenance, etc.

4.5 Pollutants specific health effects (CPCB, 2010)

1. Carbon monoxide:
Carbon monoxide (CO) is an odorless, invisible gas created when fuels containing carbon are burned incompletely—poses a serious threat to human health. CO is known to cause death at high levels of exposure. The affinity of blood hemoglobin is 200 times greater for carbon monoxide than for oxygen, CO hinders oxygen transport from the blood into the tissues. The effects of this gas on human have been shown even at low levels of exposure. The low level of exposure accelerates and angina (chest pain) in people having coronary artery diseases. Healthy individuals are also affected, but only at higher levels. Exposure to elevated CO levels is associated with the impairment of visual perception, work capacity, manual dexterity, learning ability and the performance of complex tasks.

2. Nitrogen Oxides:
Nitrogen dioxide (NO2) has been linked to increased susceptibility to respiratory infection, increased airway resistance in asthmatics, and decreased pulmonary function. It has been shown that even short-term NO2 exposures have resulted in a wide range of respiratory problems in school children; cough, runny nose and sore throat are among the most common. The oxides of nitrogen also contribute to acid deposition on plants and surface water resulting in damages of trees and aquatic life. NOx emissions also increase the levels of particulate matter by changing into nitric acid in the atmosphere and forming particulate nitrate.

3. Photochemical Oxides (Ozone):
There is no release of ozone as such from the vehicles, but it is formed as a result of chemical reactions of volatile compound and NOx in the presence of heat and sunlight. In other words, the pollutant release from vehicles also results

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in the formation of ozone through chemical reactions. The ground level ozone, which is the main part of the smoke, can cause respiratory problems such as chest pain, cuffing etc. The ozone gas is known to cause inflammation respiratory tracks, reduction in the ability to breath (lung function), increase in asthma and other lung diseases. In addition to, effects on human health, ozone is also known to adversely affect the environment in many ways, including reducing yield for crops, fruits, commercial forests, ecosystem etc. It also damages urban grass, flowers, shrubs and trees etc.

4. Oxides of Sulphur:
High concentrations of sulfur dioxide (SO2) can result in temporary breathing impairment in asthmatic children and adults who are active outdoors. Short-term exposures of asthmatic individuals to elevated SO2 levels while on moderate exertion may result in reduced lung function that may be accompanied by such symptoms as wheezing, chest tightness, or shortness of breath. Other effects that have been associated with longer-term exposures to high concentrations of SO2, in conjunction with high levels of PM, include respiratory illness, alterations in the lungs' defenses, and aggravation of existing cardiovascular disease.

5. Gaseous Air Toxic:
The hydrocarbon emissions release from vehicles also contained toxic air pollutants that may have a significant effect on public health.

6. Benzene:
Benzene is a known human carcinogen by all routes of exposure. Low term respiratory exposure to high level of ambient benzene has been shown to cause cancer all the tissues that formed white blood cells. Exposure to benzene or its metabolites have also been linked with genetic changes in human and animals. The occurrence of certain chromosomal changes in individuals with known exposure to benzene may serve as a marker for those at risk of contracting leukemia.

7. Formaldehyde:
Formaldehyde has been classified as a probable human. Epidemiological studies suggest that long-term inhalation of formaldehyde may be associated with tumors of the nasopharyngeal cavity (generally the area at the back of the mouth near the nose), nasal cavity and sinuses. Formaldehyde is also known to produce mutagenic activity.

8. Lead:
Lead affects many organs and organ systems in the human body, with subcellular changes and Neurodevelopmental effects appearing to be the most sensitive. Lead also causes impaired sensory motor function and renal functions. A small increase in blood pressure has also been associated with lead exposure. Airborne lead can be deposited on soil and water, thus reaching humans through the food chain and drinking water (CPCB, 2010). Atmospheric lead is also a major source of lead in household dust. Ingested, inhaled or absorbed through skin. 86% of atmospheric lead – auto exhaust, leaded petrol, water pipes, paint, battery storage, crystal glass, ceramic glaze, enamel jewelry, etc. Lead concentration in dust is directly proportional to the volume of traffic. Children absorb 50% and adults 10-20% of ingested lead. Lead in tissue, cord blood correlates with air levels. The effect of lead is on GIT, peripheral nerve, central nervous system, decreased IQ, convulsions, coma, death (H. Paramesh, 2003).

9. Particulate Matter:
represents a broad class of chemically and physically diverse substances that exist as discrete particles (liquid droplets or solids) over a wide range of sizes. Particles may be emitted directly to the atmosphere or may be formed by transformations of gaseous emissions such as sulfur dioxide or nitrogen oxides. The key health effects associated with PM include premature death, aggravation of respiratory and cardiovascular disease, as indicated by increased hospital admissions and emergency room visits, school absences, work loss days, and restricted activity days; changes in lung function and increased respiratory symptoms; changes in lung tissues and structure; and altered respiratory defense mechanisms. Exposure to coarse fraction particles is primarily associated with the aggravation of respiratory conditions such as asthma. Fine particles are most closely associated with health effects such as premature death by cardiopulmonary diseases.

10. Suspended particulate matter (SPM):
In particular, high levels of sulphur dioxide and suspended particulate matter (SPM) are associated with increased mortality, morbidity and impaired pulmonary function. Environmentalists claim that living in an Indian metropolitan city is like smoking 10-20 cigarettes every day. More than 40,000 people die prematurely every year because of air pollution, says a World Bank report, of which Delhi's share is the highest i.e. 19% (Tahir et al., 2012). Table 7 presents total deaths by cause. Out of all causes of death, 16% and 27% deaths are due to respiratory infections and respiratory diseases and cardiovascular problems in India respectively. Table 8 shows age specific death by cause. It reports which age groups affect more due to pollution led diseases and how acute the diseases related to pollution are. The table shows that population belonging to the age group of 60+ are suffering more from Asthma and Bronchitis (82.9%), heart attack (60.7%) and Tuberculosis of lungs (32.4%) while children under 1 year are from pneumonia (54%). If we compare the past data of 1984, 1988 and 1998 it is seen that the respiratory problem and related diseases like asthma and bronchitis among the different age groups are increasing; especially the senior citizens are most affected (Mukhopadhyay, 2009).

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V. MAJOR CONCERNS

The main source of vehicular pollution is the fuel itself. The way it undergoes combustion inside the engine determines the amount of pollutant emissions from the engine. Any strategy then has to aim at the use of cleaner fuel, reduction in fuel consumption, adoption of efficient engines and installation of pollution control device at the tail end pipes of vehicles. Use of adulterated fuel and poor inspection and maintenance practices are identified as the two major cause of vehicular pollution, which are to be tackled by Government as well as the people of Nagpur.

5.1. ADULTERATION OF FUEL AND FUEL PRODUCTS

The possibility of adulteration could be at three points: during transportation from refinery outlet/storage to petrol pump, at the petrol pump and by the consumers. Adulteration by commercial vehicle owners (auto and taxi) is ruled out due to shifting to CNG. No private vehicle owner would adulterate the fuel at the cost of his/her vehicle. The best check point is at the petrol pump. Adequate facilities should be established and the petrol pump owner should ensure receipt and distribution of un-adulterated fuel. Some guidelines in this regard should be formulated with the direct responsibility on the petrol pump owner.

5.2. INADEQUACY OF INSPECTION AND MAINTENANCE (I&M) PRACTICES

Tendency of not to go for servicing unless the vehicle develops some problem deteriorates the mechanical condition of even the new vehicles over a period of time and thus emit more pollutants than at the time of their designing. Plying older vehicles on roads is not a problem but plying older vehicles that are not properly maintained is a problem. Newer vehicles can also pollute equally in absence of regular maintenance and repairing practices. In India one-time registration procedure at the time of purchase of a new vehicle is followed, whereas countries like Japan have a mandatory renewal registration system inter-locked with compulsory I&M system in which the owner has to get his registration renewed only after necessary I&M formalities are complete.

In order to promote better I&M practices, it is proposed to have free pollution checking facility along with minor servicing, at petrol pumps. People should get the vehicle checked while re- fuelling the vehicle. A certificate ensuring that the vehicle meets the emission norms could be issued, with a validity of 2 months (initially for the first year). Fuel should be given only after check and ensuring that the vehicle meets the norms.

CONCLUSION

The worldwide vehicle population is increasing, and environmental pollution due to vehicle emission are becoming more and more dangerous. The annual growth rate of vehicle population globally has increased form the 1980's, and now the number of vehicles in developing countries has grown to nearly 30% of the world total, and this will reach 1.1 billion in 2020. Vehicle population in urban settings is much larger than those in rural areas, and as a result, vehicle pollution is a more serious problem in an urban environment.

Thus vehicle transport is one of the leading causes of air pollution the world over. It begins with individual responsibility in having a cleaner planet. When we change our mindsets and become more proactive, a lot of good things can be achieved. In the same manner, vehicle pollution can also be reduced and managed.

An efficient and cheap public transport system in cities, such as Metro rail, buses, taxis, waterways (if possible) go a long way in discouraging individuals from using their vehicles and thereby reduce pollution, through vehicular emissions to a very great extent.

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