AIR POLLUTION AND CONTROL:
Impact of Vehicle Emission
A Case Study of Delhi- "The Smog City"

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ABSTRACT

The current paper aims to examine the amount of toxicity of environmental pollution and measures taken to control it in the mega city "Delhi". The trend of Environmental Pollution and their causes will be studied through secondary data-based research consisting mainly of reports and official data. The analysis depicts the rapid population growth and urbanization continues to be a matter of serious concern as it has many manifold effects, one of the most important being environmental pollution through the use of heavy vehicles by the overgrowing population .As the number of vehicles continues to grow and the consequent congestion increases, vehicles are now becoming the main source of air pollution. Densely populated and rapid rate of growing vehicles in Delhi is often entombed in a pool of pollution. Although, the air quality can be improved through a combination of technical and non-technical measures, legislative reforms, institutional approaches and market-based instruments, there are certain unique challenges which our country has to face in tackling the problem of air pollution. Improvements are required right from the improvement in the fuel quality, formulation of necessary legislation and enforcement of vehicle emission standards, improved traffic planning and management. The recent pollution control measures and vehicular pollution control device which could control the pollution & report online to the controlling agency about pollution emissions about any vehicle taken by central government reduced the environmental pollution up to some extent.

KEYWORDS: VEHICLE EMISSION, POPULATION ,CONTAMINATION ,CENTRAL GOVERNMENT ,POLLUTION, AIR QUALITY INDEX

INTRODUCTION

Environmental pollution is one of the serious problems in most of the mega cities of the world, especially in developing countries, which not only experiences a rapid growth of population due to increasing rate of rural urban migration but also industrialization .Pollution is now an almost an inescapable part of urban life of the world. The phenomenal increase in the population during the last 50 years has led to rapid industrialization and high rate of urbanization, which has created a great deal of pressure on its all natural resources. The increase of population has been tending towards alarming situation. If the world population continues to multiply, the impact on environment could be devastating. Though the relationship is complex, population size and growth tend to expand and accelerate these human impacts on the environment. All these in turn lead to an increase in the environmental pollution levels. The WHO Commission on Health and Environment recently concluded its work, identified air pollution as a major environmental health problem deserving high priority for action (WHO, 1992).

The rapid urbanization has also resulted in a tremendous increase the number of motor vehicles. The vehicle fleets have even doubled in some cities in the last one decade. As the number of vehicles continues to grow and the consequent congestion increases, vehicles are now becoming the main source of air pollution. Although, the air quality can be improved through a combination of technical and non-technical measures, legislative reforms, institutional approaches and market-based instruments, there are certain unique challenges which the country has to face in tackling the problem of urban air pollution. Improvements are required right from the improvement in the fuel quality, formulation of necessary legislation and enforcement of vehicle emission standards, improved traffic planning and management. This paper discusses towards the development of vehicular pollution control device which could control the pollution & report online to the controlling agency about pollution emissions about any vehicle.Air pollution can also significantly affect ecosystems.Not all pollutants are a result of human activity. Natural pollutants are those that are found in nature or are emitted from natural sources. For example, volcanic activity produces sulfur dioxide, and particulate pollution may derive from forest fires or windblown dust. Anthropogenic pollutants are those that are produced by humans or controlled processes. For example, sulfur dioxide is produced by fossil fuel combustion and particulate matter comes from diesel engines. Air pollutants also are classified as: Primary & Secondary. Primary pollutants are those that are emitted directly into the atmosphere from an identifiable source. Examples include carbon monoxide and sulfur dioxide. Secondary pollutants are those that are produced in the atmosphere by chemical and physical processes from primary pollutants and natural constituents. For example, ozone is produced by hydrocarbons and oxides of nitrogen (both of which may be produced by car emissions) and sunlight.

Delhi is one of the 10 most polluted cities in the world. In Delhi city the municipal services such as water supply and sanitation, drainage of storm water; treatment and disposal of waste water; management of solid and hazardous wastes; supply of adequate and safe food and housing are all un able to keep pace with urban growth. All these in turn led to an increase in the pollution levels. Also the unplanned location of industries in and around the Delhi mega city followed by improper traffic regulation causes serious pollution problems. However, all these factors together not only lead to deteriorating environmental conditions but also have adverse effects on the health of people. The people in environmental polluted areas are prone to pollution and infected by pollution related diseases. Delhi is perhaps one of the better examples to explain the environmental pollution and measures taken to control it. In light of the above, the present paper is an attempt to exam i ne the trend in the level of air and water pollution in Delhi and measures taken to control it. The data on population have been analyzed from various population censuses of India. The data on pollution was obtained from the Central Pollution Control Board (CPCB) and data on vehicular growth is taken from the Statistical Handbook of Delhi and Compendium of Environment Statistics. Although the available secondary data is not an end itself, it does provide a glimpse of the present scenario of the environmental degradation, its causes and reasons for concern. It provides the necessary base to bring out the magnitude of the problems in a focused way.

Transportation involves the combustion of fossil fuels to produce energy translated into motion. Pollution is created from incomplete carbon reactions, unburned hydrocarbons or other elements present in the fuel or air during combustion. These processes produce pollutants of various species, including carbon monoxide, soot, various gaseous and liquid vapour hydrocarbons, oxides of sulphur and nitrogen, sulphate and nitrate particulates, ash and lead. These primary pollutants can, in turn, react in the atmosphere to form ozone, secondary particulates, and other damaging secondary pollutants. Combustion also produces carbon dioxide, the primary greenhouse gas. The share of fossil fuel used in the transport sector varies widely from region to region and city to city. A number of factors can be identified as influencing the amount of emissions attributable to the transport sector, and an effective strategy will need to take all these factors into account. They include: The amount that vehicles are used in a given country or metropolitan area; The age of the vehicle fleet and the technology used within it; The extent to which vehicles are properly maintained; The availability of appropriate fuels and the extent to which they are used properly; and Atmospheric, climatological and topological conditions.

Automotive vehicles emit several pollutants depending upon the type of quality of the fuel consumed by them. The release of pollutants from vehicles also include fugitive emissions of the fuel, the source and level of these emissions depending upon the vehicle type, its maintenance etc. The major pollutants released as vehicle/fuel emissions are, carbon monoxide, nitrogen oxides, photochemical oxidants, air toxics namely benzene, aldehydes, 1-3 butadiene, lead, particulate matter, hydrocarbon, oxides of sulphur and polycyclic aromatic hydrocarbons. While the predominant pollutants in petrol/gasoline driven vehicles are hydrocarbons and carbon monoxide, the predominant pollutants from the diesel based vehicles are Oxides of nitrogen and particulates.

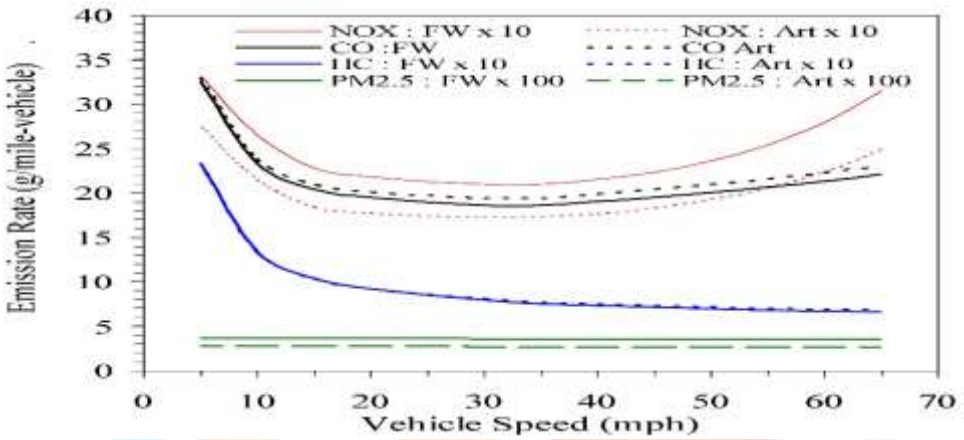


Fig: Typical vehicle emissions are affected by speed

POPULATION CHARACTERISTICS OF DELHI

Increase of Delhi Population According to the provisional results of the Census of India 2011, the population of Delhi on 1st March 2011 is 13.78 millions comprising of 7.57 million males and 6.21 million females growing at the rate of 3.81% per annum during 1991-2001 (Registrar General and Census Commissioner ofIndia, 2001). Population characteristics of Delhi mega city are presented in Table 1. The data reveals that the population of Delhi had grown from 1.44 to 12.82 millions during 1951-1991, depicting 8.9-fold population over the period. It is evident from table that the population in Delhi mega city more than doubled between 1951 and 1971. Delhi for the first time crossed 5 million mark and thus became the third mega city of India in 1981. The population of Delhi again almost doubled between 1971 and 1991. The annual exponential growth rate of Delhi mega city reveals fluctuations over the decades. The pace of population growth reduced considerably as it fluctuated from 7.26% per annum in 1951 to around 4-5% per annum till 1981 and decline further to less than 4% per annum during 1981-1991 and 5.13% per annum during 1991-2001. The number of persons per square kilometer was very large 7977 in 1991 and 9294 in 2001.

TABLE 1

Population characteristics of Delhi mega city, 1951–1991

Year	Population (in millions)	Average annual exponential growth rate (%)	Ratio of population 1951 population. (1951 = 100)
1951	1.44	7.26	100
1961	2.36	4.96	164
1971	3.65	4.36	254
1981	5.73	4.52	399
1991	8.47	3.85	586
2001	12.82	4.1	890

Source: Census of India, New Delhi, 2001.

THE POPULATION COVERED BY BASIC SERVICES IN DELHI: Table 2 shows the population covered by basic services in Delhi. The Census of India data indicates that the city fails to provide basic amenities to this large population, as a result it poses problem of garbage collection and disposal which is one of the reason behind environmental pollution in the city (Registrar General and Census Commissioner of India,

TABLE 2

Population covered by basic services, Delhi, 1994

Area	Percentage population covered by							
	1	2	3	1&2	2&3	1&3	1&2&3	None
Delhi (Total)	79.48	95.78	63.38	76.93	61.56	59.86	58.16	1.54
Municipal Corporation of Delhi (MCD)	83.09	96.56	68.75	80.73	66.85	66.71	64.88	1.02

Note: 1—electricity, 2—safe drinking water, 3—toilet. *Source*: Census of India, Housing Amenities, Occasional Paper No. 5, New Delhi, 1994.

in 1993 and 126 in 1996 due to the better infrastructural and location facilities (Table 3).

1994)

INDUSTRIAL PROGRESS IN DELHI : Directorate of Economics and Statistics (1997) data shows that there has been steady rise in the number of industrial units from 85 in 1991 to 93 .

VEHICULAR EMISSION STANDARDS - On August 14, 2000 under the chairmanship of the chairman CPCB. The committee in its report submitted to MoPNG on 31.3.2001 recommended the road map for introduction of Bharat stage – II norms in entire country along with fuel quality specifications. 2000: India 2000 (reference Euro)

Emission norms have been implemented all over the country. 2000: Modified IDC (Indian Driving Cycle)

2001: The Honble Supreme Court of India, in the matter of CWP No. 13029 of 1985, passed the orders on 05.04.2001, regarding formulation and implementation of action plans for control of pollution in cities namely Kanpur, Lucknow, Varanasi, Agra, Jharia, Patna, Jodhpur, and Pune & Faridabad.

2001: Bharat stage-II (reference Euro 2) emission norms have been implemented in NCR, Mumbai, Kolkata and Chennai.

2002: the Hon'ble court has also asked the union of India to prepare a scheme for compulsory switch over to CNG/LPG as automotive fuels in the cities those are equally or more polluted than Delhi. Later CPCB identified these cities as Ahemedabad, Kanpur, Kolkata and Pune.

2003: the Hon'ble Supreme Court Court vide its order dated 16.8.2003 directed Union of India and State Government to prepare action plan for lowering the rate of RSPM level for cities of Kanpur, Ahemedabad, Sholapur, Bangalore, Lucknow, Chennai, Hyderabad, Mumbai, Kolkata. Hon'ble Supreme Court also asked
respective State Boards to place the proposed action plans before EPCA.

2003: Bharat stage-II (reference Euro 2) emission norms have been implemented in 11 megacities (Mumbai, Kolkata, Chennai, Bangalore, Hyderabad, Secunderabad, Ahmedabad, Pune, Surat, Kanpur and Agra).

2004: New PUC norms have been implemented for in-use vehicles.

2005: Bharat stage-III (reference Euro 3) emission norms have been implemented in NCR & 11 megacities, while Bharat stage-II norms have been implemented all over the country .

2010: Bharat Stage IV (reference Euro 4) emission norms have been implemented in NCR & 11 megacities, while Bharat stage-III norms have been implemented all over the country .

VEHICLE GROWTH With the increasing population, urbanization transport demand has also increased consequently. increase in the number of vehicles to keep pace with people. The data reveals that the total number increased from just 37.4 thousands in 1961 to 2229.6 The number of two wheelers has increased from to 1741.8 thousands in 1996. In Delhi two wheelers to their economic use. The number of car/jeep sands in 1961 to 633.8 thousands in 1996 followed vehicles, buses and taxis. The two wheelers contributing vehicles in metropolitan cities of Delhi followed by Cars and Jeep 24%.
(Table 4). The environmental effects of fuels like oil and petroleum products are of growing concern owing to increasing consumption levels. The increasing vehicles in Delhi have also increased the vehicular pollution and it accounts for a considerable share of air pollution. Vehicular traffic is the most important source of air pollution in Delhi mega city.

TABLE 3

Industrial progress in Delhi, 1990–96

Year	1991	1992	1993	1994	1995	1996	% growth (1991–96)
Industrial units (in '000')	85	89	93	97	101	126	55.65

Source: Statistical Handbook, NCT of Delhi, 1997.

TRENDS IN THE LEVEL OF AIR POLLUTION

The pollution can be broadly categorized as flux type of pollution and sink type of pollution. The former refers to the pollutants dumped into the environment, either to air or in water; while the later is caused by accumulation either in soil or riverbed or also in groundwater. In this paper, however, the study is restricted to air and water pollution.

The World Health Organization (WHO, 1996) defines air pollution, as "substances put into the air by activity of mankind into concentrations sufficient to cause harmful effects to health, property, crop yield, or to interfere with the enjoyment of property".

According to Bhargava (1995) some of the most important air pollutants are suspended particulate matter (SPM); nitrogen oxides (NOx); carbon monoxide (CO); lead, sulfur dioxide (S02) etc. (Table 5). According to the Article 48 of constitution of India, the state shall endeavor to protect and improve the environment and to safeguard the forests and wildlife of the country. The main instruments for control pollution are the Air (Prevention and Control of Pollution) Act, 1981 and the Environment (Protection Act, 1986). The Environment (Pro tection) Act 1986 is implemented through Delhi government and through other relevant agencies such as Pollution Control Boards and Factory Ins pectorates in order to reduce levels of suspended particulate matter (SPM); nitrogen oxides (NOx); carbon monoxide (CO); lead, sulfur dioxide (S02) etc.

THE MAJOR IMPACTS HAVE BEEN OBSERVED THROUGH THE FOLLOWING STEPS TAKEN BY THE GOVERNMENT TO CONTROL AIR POLLUTION:

(i) Unleaded petrol: With the gradual reduction of lead content in petrol and finally supply of unleaded petrol for all vehicles from September 1998 in the capital city of Delhi, a lethal pollutant from vehicular exhaust has been removed. The lead content in the atmosphere near traffic intersections of Delhi has reduced by more than 60% with this measure.

(ii) Sulphur in diesel: The sulphur content in the diesel supplied in Delhi has been reduced from 0.5% in 1996 to 0.25% in 1997 so as to meet the EURO-II norms.

(iii) Tightening of the vehicular emission norms: From 1995 new passenger cars were allowed to register only if they were fitted with catalytic converters. Emission norms for such cars were tightened by 50% as compared to 1996 norms. With the recent directions of the Hon'ble Supreme Court, passenger cars (both petrol and diesel) are required to meet at least EURO-I norms in June 1999 and from April 2000 only such vehicles are also permitted by the Supreme Court directions.

(iv) 2T oil for two stroke engines: From 1.04.99, on the recommendations of CPCB, the low smoke 2T oil became effective. To prevent the use of 2T oil in excess of the required quantity, premixed 2T oil dispensers have been installed in all the petrol filling stations of Delhi. Sale of loose 2T oil has also been banned from December 1998.

(v) Phasing of grossly polluting vehicles: On CPCB's recommendations initially 20 years old vehicles were prohibited from playing from December 1998, followed by phasing out of 17 years old vehicles from November 1998 and 15 years old from December 1998.

(vi) The implementation of emission norms and fuel quality specifications effective from 1996, as also phasing out of 15 year old commercial vehicles and leaded petrol in the year 1998 and phasing out of 8 year old commercial vehicles and 15 year old two wheelers from 2000 onwards.

TABLE 4

Percentage distribution of total registered motor vehicles in Delhi during 1995 and 1996 (in thousands)

Year	Two wheeler	Car/jeep	Taxis	Buses	Good vehicles	Others	All vehicles
1961	12.1	15.1	2.0	1.3	4.1	2.7	37.4
1971	109.1	61.5	4.1	3.3	15.3	10.8	204.1
1981	36.4	123.6	6.6	8.5	38.1	20.9	561.8
1995*	1617.7	575.8	12.5	26.2	125.1	75.0	2432.3
1996*	1741.8	633.8	13.7	27.9	133.5	59.0	2629.6

Source: Statistical Handbook, NCT of Delhi, 1997 and *Compendium of Environment Statistics, 1999.

Table-5

Major sources and health effects of pollutants

Pollutant	Main source	Health effects
SPM	Ceramic and glass, thermal power	Damage of lungs, may cause bronchitis and asthma
SO2	Thermal power, chemicals, ceramics, textiles	Acid rain, damage to lungs, eyes, skin
No_x	Diesel engines, ceramics	Form smog, damage to respiratory system and eye irritation
CO	Two wheelers, engineering	Toxic causes blood poisoning
HC	Two wheelers, ceramics, chemicals	Cancer
Aldehydes	Chemicals	Cancer
Lead	Petrol engines, water pipes, food cans, batteries	Nervous system shows down and brain development is retarded, shows reaction time, reduces attention span
Chromium and nickel	Alloys plating, electronics and fungicide	Cancer
Noise	Industry, traffic	Deafness, irritation and nervousness
Mosquitoes	Stagnant pools	Malaria
Bacteria, worms and virus infections	Infected water	Jaundice, cholera, dysentery, typhoid, diarrhea, polio, worms

Source: Delhi Environmental Status Report: Pollution, Monitoring and Technology Corporation Division, New Delhi, 1995.

Central Pollution Control Board (1997) data indicates that the quantity of vehicular emissions without measures is estimated to have increased from 2047 thousand tones per day in 1995-1996 to 2459 thousand tones per day in 1998-1999. But the estimated quantity of vehicular emissions with measures has been decreased from 1957 thousand tones per day in 1995-1996 to 1825 thousand tones per day in 1998-1999 (Table 6). However, there are some positive signs noticed in the direction of con trolling vehicular pollution by the

traffic department along with the Government of the National Capital Region of Delhi. The tightening of norms of emissions both by the industries as well as vehicles has resulted in the falling of the level of harmful gases in the atmosphere. With the alarming increase in the atmospheric pollution, especially in the Delhi mega city, Government has taken some important initiatives in the recent years. These relate to the progressive tightening of the auto-emission norms (1991, 1996, 1998 and 2000) and fuel quality specifications (1996) as recommended by the CPCB. Till early 1994 ambient air quality standards in India were based on 8 hourly average times only. In April 1994, these standards were revised and 24 hourly standards were also prescribed. National ambient air quality standard are prescribed for three distinct areas viz., (i) industrial, (ii) residential, rural and other areas and(Mi) sensitive areas. It is evident from table that the major air pollutants show a steady decrease during 1995-1996 to 1998-1999. The percent reduction in 1998-1999 as compared to 1995-1996, has been about 4% in carbon monoxide, 12% in nitrogen oxide, 27% in sulphur dioxide, 97% in lead, and 25% in particulate matter whereas there is a marginal increase of 2% in hydrocarbons (Table 6). Ambient air quality in Delhi is depicted in Table 7. It indicates decreasing trend and reduction in the percentage of sulphur dioxide, nitrogen oxide, SPM and carbon monoxide. The percent reduction in 1998 as compared to 1995, in the most harmful emissions of industry viz., sulphur dioxide's level has fallen down by 16%, SPM by 13% lead by 5% and nitrogen dioxide by 4% in industrial areas. The level of sulphur dioxide has fallen by 4%, nitrogen dioxide by 13%, SPM by 17% and lead by 39% in residential areas, which is quite significant achievement. The percent reduction during 1995 - 1998 has been about 60% in lead, 40% in sulphur dioxide, 6% in SPM followed by 5% in nitrogen dioxide and 3% in carbon monoxide on traffic intersections. Industries are the second major source of air pollution in Delhi, though like vehicular pollution it is also decreasing. The period between 1971 and 1981 witnessed massive industrialization in various parts of Delhi, including the residential areas. The government at that period of time did not take any measure either to shift such industries from the residential areas or impose strict pollution control measures.

AMBIENT AIR QUALITY OF DELHI IN COMPARISON TO WHO AIR QUALITY GUIDELINES

The primary aim of the ambient air quality standards is to provide a basis for protecting public health from adverse effects of air pollution and for eliminating and reducing minimum against established guidelines. The ambient air quality as monitored by CPCB during 1999 shows reduction in levels of various air pollutants in ambient air as compared to previous years. The reducing trend was observed with respect to carbon monoxide, nitro gen dioxide and lead in residential areas. But in comparison to WHO air quality guidelines, the levels of suspended particulate matter is more than the double and the levels of lead are much more whereas the levels of sulphur dioxide and nitrogen dioxide are lower. After having analyzed the trend in the level of air pollution it becomes necessary to discuss the major sources responsible for causing such pollution. The three main sources of air pollution in Delhi are industrial, vehicular and domestic (Table 8). The vehicular emissions cause 72% of air pollution in Delhi, and the number of vehicles on the road growing by 500 day, its getting worse. At the same time there is a decline in pollution from 56 to 20% due to industrial sources and from 21 to 8% due to domestic sources during 1970-1971 to 2000-2001 respectively.

Table 1

Yearwise Annual Mean Ambient Air Quality Levels in Delhi: Year Concentration in Ambient Air (mg/m³)

Year	SO_2	NO_x	CO	SPM	RSPM
1997	18.68	44.85	4810	362.58	—
1998	20.37	42.17	5450	377.92	—
1999	19.46	40.11	4241	374.92	—
2000	18.05	41.83	4686	430.83	191.00
2001	14.10	41.75	4183	381.67	150.08
2002	11.33	47.28	3258	455.92	192.25
2003	9.49	45.00	2831	352.30	148.86

SUGGESTIONS

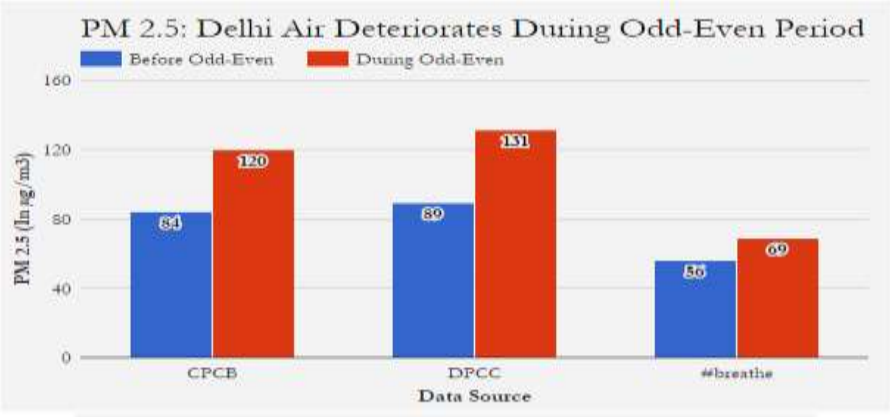
Concept Design by Government for Vehicle Manufacturing and its usage;

The concept design of " pollution lock" composed of hardware & software, to be installed in new produced vehicles by the vehicle/ engine producer. It will be similar to the central remote locking, the difference is that alike remote control of central locking, the pollution lacking will be done by the software installed based on the sensors feedback to the software. It will be a smart operating system that will work on artificial intelligence. This pollution lock will stop the engine working on emission of pollutants above the permitted standard level. This concept is based on the integration of mechanical, electronics and computer engineering. For any emergency the vehicle should be equipped with the catalytic converters. This information about pollution should be conveyed to the driver/ operator via any meter or sound (device) beep. The working principle of pollution lock will be similar to the governors for the speed controls. The sensor box fitted with sensors is Sensing & measuring pollutant level from the exhaust pipe. The sensor sensed level of the pollutants is send continuously to the microcontroller. The microcontroller is having a installed program with a number of set of instructions. An electrically operated control valve to be build up inside the fuel pump, which will allow the fuel supply based on the electrical signals from the microcontroller. Based on the controller instructions the control valve will allow or block the fuel supply. If the pollutant level is below the permitted level, the control valve will permit the fuel supply to fuel pump. And if the pollution level will raise the controller via an electronic circuit will close the control valve and the fuel supply will be blocked till further instructions from the microcontroller. Conceptual design of pollution remote sensing device (PRSD)- To develop the conceptual design of " Pollution Remote Sensing Device(PRSD)" that will check the pollution of running vehicle without stopping the vehicle as the speed is checked by the highway patrolling police on highways. There are two concepts for development of pollution checker: Pollution check gate as like toll tax on highways & smart card system Pollution check gate (PCG) - In this concept the pollution check post has to be developed at the toll tax on highways. The toll gate will be equipped with pollution check equipments, the fitted sensors will be fitted at the toll gate, which will analyze the pollutants level in the emissions of the particular vehicle. For development of pollution check along with the toll gate will not be a typical task. It will be a cheaper concept too. The work that needs to be done is that the pollution analyzing sensors set up need to be installed along with the toll tax. The printer printing the toll tax credits will print the pollutants level also. This information collected by the pollution analyzing sensor set-up will be made online to the traffic police so that the vehicle could be identified. This will be similar to the concept of paying the toll tax, sales tax. In the fashion sales tax department checks the sales tax certificate/ slip, in the similar way the pollution department will check the pollution slip of the toll tax. The problem will arise when the vehicle is not crossing the toll gate. For that type of vehicles the second concept will work. On an estimated average approximation (observation only, no proof data), 50% of the total vehicle population of that area crosses the toll gate daily. This check will drastically reduce the vehicular pollution rate. For the development of pollution analyzing set up, there will be one box set up, which will produce the beam of charged particles, from one end, on the other end is the receiver of the charged particles beam. This intensity beam of charged particles at the receiver will be reduced on passing through the specified pollutants. The difference between the intensity of the beam produced and the intensity of the beam received, the pollutants level in the emissions will be calculated by the calibrated scale. This value of the specified pollutants will be send to the toll taxcollecting personnel device, from where the pollutant level will be printed on the toll tax slip. The same information will be made available to the police & pollution check people for necessary action. Pollution remote sensor detector (PRSD) - For the vehicles not going through the toll gates, the PRSD will be developed. In this system a sensor box similar to the sensor box in the pollution lock will be required to install and set up on the vehicle. The research work can bring the cost ofthis sensor box to several

hundred from the initial cost ofseveral thousands. This information of the sensor box will besending to a smart card, via wireless/ wired connection. Thesmart card will display some color coding. The pollutionmeter reading machine (RSD) will read the color coding ofthe smart card, in the similar way as the smart card system onthe toll gates reads the smart cards for the toll tax.

2.Delhi Odd-Even rule implemented to tackle air pollution

Delhi government has announced that it is ready to implement the odd-even scheme again in the wake of the alarmingly high level of pollution in the air. The scheme will be in place starting 13th to 17th November 2017. The government had said that the system would be in place if air pollution remains above 'severe plus' category for 48 hours. Transport Minister Kailash Gahlot has asserted that he had directed the Delhi Transport Corporation (DTC) to hire 500 buses on a short-term basis and the Delhi Metro Rail Corporation (DMRC) has been asked to procure 300 buses to handle the rush if and when the odd-even scheme is launched. The AAP government has asked IGL to keep 1.5 lakh stickers ready for CNG-run vehicles which would also be given exemption from the odd-even scheme. Gahlot held a meeting with top officials of the Transport Department, DMRC, DTC, Delhi Integrated Multi-Modal Transport System (DIMTS) and the divisional commissioner regarding preparations for the odd-even scheme.



CONCLUSIONS

Rapid population growth continues to be a matter of concern as it has manifold effects, one of the most important being environmental pollution. With the increasing population, urbanization and industrialization, the transport demand has also increased consequently. Delhi is one of the most polluted cities in the world, caused by vehicular growth and industrial pollution. In order to restore the air quality, Delhi government has taken some measures to such extent as already discussed, and these have helped to reduce the levels of air pollution to a large extent. If such measures are carried out in full swing as the study proves that the days are not far away when pollution in Delhi can be minimized to a great extent. The concept design of .pollution lock. Composed of hardware & software, to be installed in new produced vehicles by the vehicle/ engine producer. It will be similar to the central remote locking, the difference is that alike remotecontrol of central locking, the pollution lacking will be done by the software installed based on the sensors feedback to thesoftware. It will be a smart operating system that will work on artificial intelligence. This pollution lock will stop the engine working on emission of pollutants above the permitted standard level.Plans be established in accordance with the need of time and heavy penalty be imposed on industries causing air Contamination. There is now high time for giving top priority to control population and pollution of all types. The government should make special efforts to bring about awareness among the people for a collective action to solve this problem. Only legislation may not be able to protect theenvironment. All citizens and voluntary associations come forward and work together with environment scientists to protect the environment for present and future generation.

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