International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 01 , January 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

AIR POLLUTION FROM VEHICLES: HEALTH EFFECTS AND EMISSION CONTROL

Umang Bedi[1], Sanchita Chauhan[2]

[1, 2]Dr SSBUICET PU Chandigarh (India)

ABSTRACT

In all the major cities of the world, air pollution from vehicles is one of the fast growing problems which has adverse effects not only on the health of living organisms degrades the environment. Major pollutants released by motor vehicles comprise of carbon dioxide (CO_2), carbon monoxide (CO), oxides of nitrogen (NOx), sulphur oxides (SO_x), hydrocarbon (HC), lead (Pb) and suspended particulate matter (SPM). Air pollution in developing countries is a major cause of thousands of deaths and a loss of billions of dollars in medical cost for treating air pollution related diseases. This paper highlights the effects of air pollutants on human health, natural environment and the measures taken to control air pollution. Measures for vehicle pollution control are analysed to reduce emissions with focus on reduced usage of vehicles. Some commonly taken measures to control the air pollution include change in fuel, use of bio filters, use of catalytic converter in vehicles, battery operated vehicles, solar operated vehicles and hydrogen fueled vehicles.

Keywords: Air Pollution, Pollution Control, Health Effects, Vehicle Exhaust Emissions

I. INTRODUCTION

Air pollution refers to the contamination of the earth's environment with constituents that have considerable effects on human health. The quality of life or the natural environment gets affected when pollutants accumulate in the air at higher concentrations [1].The present atmosphere is quite different from the natural atmosphere that existed before the industrial revolution in terms of chemical composition [2].Vehicles emissions have become the fore most source of air pollutants including carbon monoxide, lead, nitrogen dioxide, sulphur dioxide, ozone and particulate matters [3]. Vehicles emission mainly from automobiles is responsible for about two third of air pollution in the urban area. Petrol engines exhaust contains high concentration of HC whereas the diesel vehicular exhaust has higher concentration of particulate matter, NOx and CO_2. The concentration of CO and unburnt HC in the diesel exhaust are slightly lower as compared to petrol engine [4].

These emissions are stated to be a common cause of illness and mortality of living organisms, and also cause decrease in the air's visibility. These exhaust gases may not have a short term harmful effect on human's health and natural environment but they certainly have long-term harmful effects as they accumulate in the environment. For example emission of CO_2 from vehicles, combustion and other natural activity like volcanic eruption are considered to be safe as they are non-toxic at moderate concentrations, but long term accumulation

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

of CO_2 in air leads to global warming [2]. So a lot of efforts are needed to control and to reduce vehicle emissions by enforcing the latest automobile technologies and use of alternative fuels.

II. EMISSIONS EMITTED BY DIFFERENT VEHICLES

Different air pollutants have been described, differing in their chemical composition, reaction properties, emission rates, persistence in the environment, an ability to be transported over long or short distances and their eventual impacts on human and animal health [6]. Pollutants are basically categorised as a primary and secondary pollutants. Primary pollutants are those constituents which are directly released from sources into the atmosphere. The major primary pollutants which cause harm to living organism and natural environment include carbon compounds (CO, CO_2, CH_4 and VOCs), nitrogen compounds (NO, N_2O and NH_3), sulphur compounds (H_2S and SO_2), halogen compounds and particulate matter (PM2.5 and PM10) at high concentrations. Secondary pollutants are not directly released into the atmosphere but by reaction of primary pollutants in the atmosphere. The major secondary pollutants which cause harm to the environment include NO_2, HNO_3, and Ozone (O_3), sulphuric acid, nitric acid and organic aerosols [2].

The increase in the number of vehicles can be taken as a measure of the economic development of the Indian automotive industry. About 7-8 million vehicles are produced annually in the country today [5].In 2004 country had reported 72.72 million registered vehicles whereas in 2013 it increased to 182.45 million, so the registered motor vehicles has almost more than doubled in last 10 years as is also shown in detail in Table 1 [8].

Motors vehicles are the primary source of air pollution in India's major cities. Two-third (66%) pollutants are reported to be released from vehicles in Delhi alone, 52% in Bombay and close to one-third (33%) in Calcutta. The transportation sector in India consumes about 17% of total energy and responsible for 60% production of the greenhouse gases emission from various activities [5].

Table 1: Registered motor vehicles in India [8]

Year (As on 31st March)	Registered motor vehicles in India (in millions)
2004	72.72
2005	81.5
2006	89.62
2007	96.71
2008	105.35
2009	114.95
2010	127.75
2011	141.87
2012	159.5
2013	182.45

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

Nature and concentration of emissions from vehicles depend on the different factors such as type of fuel, type of combustion engine, emission mitigation techniques, maintenance procedures and vehicle age. Major air pollutants CO_2, CO, NOx, N_2O, SO_2, VOC, PM, and HC released as exhaust from road transport from different types of vehicles per year are shown in Table 2 [5].

Table 2: Emission from different vehicles as reported in India [5]

Categories	CO_2	CO	NOx	SO_2	PM	HC
	g/km/year					
Bus	28748.16	207.26	679.73	79.24	31.36	51.72
Omni Buses	8508.42	60.94	200.53	23.45	9.28	15.11
2-Wheeler	8701.08	719.64	62.15	4.25	16.36	464.49
LMV(Passenger)	4378.10	370.29	92.93	2.11	14.52	10.16
LMV(Goods)	44654.58	442.04	110.94	123.02	17.33	12.13
Cars and Jeep	23901.22	212.30	22.14	5.67	3.22	38.01
Taxi	2367.08	10.23	5.68	117.05	.80	1.48
Others	5705.22	57.41	64.54	32.19	3.98	8.96

III. HEALTH EFFECTS OF VEHICULAR EMISSIONS

Considerable quantities of CO_2, CO, HC, NOx, SOx, SPM and other air pollutants are emitted from motor vehicles in the atmosphere have been analysed to be associated with serious health problems [5]. NO_x is found to increase the vulnerability to respiratory infections. Nose and throat irritation followed by bronchoconstriction and dyspnoea, particularly in asthmatic individuals, are usually experienced after exposure to increase levels of SO_2, NO_x and certain heavy metals such as arsenic, nickel or vanadium.

CO in high concentrations can cause a headache, dizziness, vomiting, nausea and even increased risk of heart disease and at very high levels it may lead to unconscious or even death [6]. Suspended particulate matter and repairable particulate matter (RPM) may be poisonous themselves or may carry trace amounts of poisonous material and therefore they have the ability to modify the immune system. Fine particulates penetrate deep into the respiratory system irritating lung tissue and causing long term illnesses [5]. Heavy metals can cause kidney damage whereas dioxins are found to damage the liver cell and cause liver cancer [6].

Hydrocarbon or VOCs are relatively very harmful for humans, fauna and flora. A variety of adverse health effects such as allergic skin reaction, dizziness, headaches, eye and respiratory tract irritation, coughing, visual

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

disorders, memory impairment, confusion, anaemia and fatigue are some of the symptoms associated with short-term exposure. Kidney, liver, brain damage, cardiac sensitization reactions and also damage to the nervous, reproductive and immune systems are caused by long-term exposure [7]. Ground level ozone is a crucial ingredient of urban smog, is created by a chemical reaction between oxides of nitrogen (NOx) and volatile organic compounds in the presence of sunlight [7]. Ozone initiate lung inflammation and reduces the growth rate of trees and agricultural production [6].

IV. MEASURE TO CONTROL THE AIR POLLUTION

Vehicles as a mode of transportation have shortened the distances through speed and comfort. Considering their importance in present scenario, it is impossible to immediately stop all the vehicles in order to control or reduce air pollution, so different measures or techniques are employed to control or reduce the air pollutionas discussed below:

4.1 Emission standards: Emission standards set quantitative limits on the acceptable amount of specific air pollutants that may be released from specific sources. They are generally designed to achieve air quality standards and to protect human health. India started adopting European emission and fuel regulations for four-wheeled light-duty and for heavy-duty vehicles from 2000. Vehicular emission standards define the Bharat stage emission norms similar to Euro I, II, III etc. [12].

Table 2: Emission Standards for passenger cars [12]

Norms	CO (g/km)	HC+ NOx (g/km)
1991 Norms	14.3-27.1	2.0 (Only HC)
1996 Norms	8.68-12.40	3.00-4.36
1998 Norms	4.34-6.20	1.50-2.18
India stage 2000 norms	2.72	0.97
Bharat stage-II	2.2	0.5
Bharat Stage-III	2.3	0.35 (combined)
Bharat Stage-IV	1.0	0.18 (combined)

4.2 Air–fuel ratio (AFR): Air-fuel ratio is the mass ratio of air to fuel during the combustion process such as in an internal combustion engine. The air-fuel ratio has an important effect on engine power, efficiency, and emissions. Decrease in air to fuel ratio is seen to increase the HCs content in exhaust [9].

4.3 Use of catalytic converter: Catalytic combustion is one of the most efficient means for controlling atmospheric pollution.The catalytic converter is used to convert harmful pollutants into less harmful emissions

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

before they leave the car's exhaust system [5]. The catalytic converter has been in use over the past three decades as an effective and economical solution for the reduction of pollutants emitted by the vehicles [10].

4.4 Change in type of Fuel: Use of less polluting fuel with low sulphur content instead of high sulphur fuel, unleaded fuel and use of oil with low ash content or natural gas helps to reduce exhaust emissions [11]. Battery, hydrogen and solar operated vehicles and alternative fuels such as Liquefied Petroleum Gas (LPG), Compressed Natural Gas (CNG), and bio-diesel blends for automobiles have further helped in the reduction of pollutants released from the vehicular exhaust. LPG comprises of a mixture of gases namely propane and butane, stored under pressure to be kept in a liquid state. Advantages of LPG include its burning releases minimum air pollution and it has a high octane rating. Use of LPG indicates 90% fall in poisonous emissions as compared to gasoline, and it also reduces the CO_2 by 22-24% as compared to gasoline.

Bio-fuels are also a good alternative for diesel. CNG comprises of a mixture of methane, ethane, propane, butane etc. Methane is the major constituent of CNG. Table 3 shows the percentage reduction in release of some major air pollutants CO, NOx and PM by use of CNG as compared to diesel [4].

Table 3: Comparative emissions from diesel and CNG for buses [4]

Type of fuel	**Amount of Pollutant released**		
	CO	NOx	PM
Diesel	2.4 g/km	21 g/km	0.38 g/km
CNG	0.4 g/km	8.9 g/km	.012 g/km
% reduction	84	58	97

Battery, hydrogen and solar operated vehicles are reported to be an alternative to gasoline and diesel. Battery operated vehicles use the battery power to run the vehicle and produce almost zero emission. Hydrogen operated vehicles use hydrogen as a fuel which is directly used in internal combustion engine. Solar operated vehicles use solar panels placed on the vehicles. By using solar, the batteries are recharged and the vehicles are operated with the battery power and with no vehicle emissions. Indian car maker Mahindra REVA is the popular car for battery operated vehicle. Different car maker like BMW, Tesla, Toyota, etc. are working on hybrid cars [4]. Most common example for the use of alternative fuel is seen in Delhi where the use of CNG was made compulsory for all public transport vehicles post the year 2000 [5].

4.5 Inspection and Maintenance: One of the most significant step to control the release of emission is the formulation of a mandatory inspection and maintenance system. It is possible to reduce 30-40% pollution load produced by vehicles through suitable periodical inspection andmaintenance of vehicles [5]

V. CONCLUSION

Air pollution is a serious environmental problem in most countries including India that has led to drastic air quality degradation over the past few years. The majority of the Indian population resides in cities and is therefore exposed to polluted air mostly from vehicular or industrial exhausts resulting in many health related

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

problems such as chronic respiratory infections, heart diseases, and lung cancer. The long term exposure to these exhaust pollutants also effects brain, liver, kidneys, and nervous system. Technical measures alone are not appropriate to ensure the desired reduction of air pollution. In addition use of alternative fuel such as LPG, CNG, the use of latest technologies like battery, solar and hydrogen operated vehicles when put into use can ensure a significant improvement in environmental conditions over the period of time.

VI. ACKNOWLEDGEMENTS

The author Umang Bedi is thankful to Technical Education Quality Improvement Programme (TEQIP-II) at Dr. S.S.B University Institute of Chemical Engineering and Technology, Panjab University, Chandigarh for providing TEQIP-II PhD assistanceship.

REFERENCES

[1] S.A. Rizwan, B. Nongkynrih, and S.K. Gupta, Air pollution in Delhi: its magnitude and effects on health, Indian Journal of Community Medicine, 38(1), 2013, 4-8.

[2] A. Daly, and P. Zannetti, An introduction to air pollution –definitions, classifications, and history, the Arab School for Science and Technology, 2007, 1-14.

[3] K. Zhang, and S. Batterman, Air pollution and health risks due to vehicle traffic, Science of Total Environment, 450-451, 2013, 307-216.

[4] S. Bhandarkar, Vehicular Pollution: Their Effect on Human Health and Mitigation Measures, Vehicle Engineering, 1(2), 2013, 33-40.

[5] R.K. Shrivastava, N. Saxena, and G. Geeta, Air pollution due to road transportation in India: a review on assessment and reduction Strategies, Journal of Environmental Research and Development, 8(1), 2013, 1-9.

[6] M. Kampa, and M. Castanas, Human health effects of air pollution, Environmental Pollution, 151, 2008, 362-367.

[7] A.O. Rusu, and E. Dumitriu, Destruction of volatile organic compounds by catalytic oxidation, Environmental Engineering and Management Journal, 2, 2003, 273-302.

[8] https://data.gov.in/catalog/total-number-registered-motor-vehicles-india.

[9] A. Faiz, C.S. Weaver, and M.P. Walsh, Air pollution from motor vehicles: Standard and technology for controlling emissions (The World Bank, Washington, D.C., 1996).

[10] J.C. Prince, C. Treviño, and M. Díaz, Modeling a catalytic converter for CO and NO emissions, World Congress on Engineering, 2, 2008, 2–6.

[11] S. Kumar, and D. Katoria, Air pollution and its control measures, International Journal of Environmental Engineering and Management, 4(5), 2013, 445–450.

[12] Central Pollution Control Board, Environmental Standard,http://www.cpcb.nic.in, 2008.