A Review Paper on Vehicular Emission for Light Duty Vehicles in Jabalpur City (M.P)

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Abstract:Vehicle emissions account for roughly a third of all air pollution in cities. Vehicles emit carbon monoxide, nitrogen oxides, and sulphur oxides, as well as hydrocarbons, lead, ozone, and suspended particulate matter. These contaminants have negative consequences for human health and the environment. Poor air quality raises the chance of respiratory ailments such as asthma and bronchitis, as well as life-threatening diseases such as cancer. Due to India's rapid population growth and modernization, the impact of vehicular pollution is increasing day by day. Because of urbanisation, the impact of traffic pollution is greater in cities. Jabalpur is one of Madhya Pradesh's fastest growing cities, with a big number of registered vehicles, demonstrating the linked effects of vehicle emissions on polluting air. High volume air samplers were utilised to monitor air parameters in terms of SPM (PM10 and PM2.5 parameters), SO2, and NOX in Jabalpur city, and these measured parameters were compared to the national ambient air quality criteria established by the Central Pollution Control Board of India.

Key Words: Air Pollution, Urbanization, emisssion , Suspended Particulate Matter.

1. INTRODUCTION: A typical passenger vehicle emits approximately 4.6 metric tonnes of CO_2 each year. This figure varies depending on the type of fuel used, the vehicle's fuel economy, and the number of miles driven per year. The transportation industry is responsible for 25% of total CO_2 emissions from fuel combustion worldwide (IEA, 2020). It is the fastest-growing industry and a major source of global greenhouse gas emissions (GHGs). The Indian road transport sector has experienced rapid growth and is projected to continue to do so in the coming years. According to current projections, road transport traffic would increase by more than 5 times from 1385 billion tones-km (freight traffic) and 9329 billion passenger km in 2011-12 to 6559 billion tones-km (freight traffic) and 163,109 billion passenger km in 2016-17. (2031-32).

2. LITERATURE REVIEW

The literature review is based on the analysis of various methods and studies involved in the assessment of emission through vehicles.

Diagi, B. , Suzan, A. , Nnaemeka, O. , Ekweogu, C. , Acholonu, C. and Emmanuel, O. (2022) *An Assessment of Vehicular Emission in the Vicinity of Selected Markets in Owerri, Imo State, Nigeria.*

The concentration of contaminants at various marketplaces in Owerri was measured in this study. These markets were chosen after considering all of the major markets in the study area; the chosen markets were thought to be more congested during the day due to open access to road junctions, a high density of vehicular movement, the presence of offices, residential buildings, and human activities. Carbon monoxide (CO), carbon dioxide (CO2), nitrogen dioxide (NO2), particulate matter (PM 2.5), and particulate matter (PM 10) were all measured in the air from automotive emissions (PM 10). Assessments were completed in 3 hours each dual diurnal segment using approved standard methods and adjusted to a 1-hour mean for the morning and afternoon sample periods (7-10 am and 2-5 pm, respectively).

Within the research area, these times are noted for having the highest levels of people and vehicular mobility. The greatest CO content was measured at Alaba market (0.293 - 0.387 ppm), which is less than the allowed limit of 35 ppm set by the national ambient air quality standard (NAAQS). Alaba market had the largest CO2 range (1153 - 1875 ppm), which is greater above the ambient standard of 314 ppm. Relief market has the highest amount of NO2 (0.116 - 0.297 ppm), which is also greater than the NAAQS allowed limit (0.100 ppm).

The largest range of PM 2.5 and PM 10 particulate matter was reported from Relief market (0.011 - 0.029 g/m3) and (0.065 - 0.172 g/m3), respectively, which is significantly lower than the NAAQS and WHO acceptable limit (150 g/m3). The study shows that vehicle emissions have a substantial influence in the selected markets in Owerri metropolis, indicating a high risk of health problems in the markets due to elevated CO2 and NO2 levels. As a result, it advises that an effective system be put in place to decongest traffic density in the city, particularly near markets, in order to reduce vehicular emissions and improve inhabitants' livability.

M. Nigar Neema and J. Jahan (2014), *An Innovative Approach to Mitigate Vehicular Emission through Roadside Greeneries: A Case Study on Arterial Roads of Dhaka City.*

As the human population grows, so does the demand for goods and people to be transported, resulting in urban air pollution from emissions from motorised traffic, particularly in developing countries. By directly absorbing automotive generated carbon, roadside greeneries can function as ecological features that minimise the concentration of contaminants from vehicular emissions. This study attempts to assess the contribution of roadside greeneries in absorbing automotive carbon dioxide emissions in this environment. A case study was undertaken on arterial highways in the megacity of Dhaka to quantify automotive carbon emissions and correlate them with the ability of roadside plants to absorb the CO2.It is worth noting that carbon dioxide is responsible for more than 90% of air pollution in Dhaka. To meet our objectives, we used two of the busiest arterial highways (Mirpur Road and Rokeya Shoroni Road) to calculate automobile carbon emissions and analyse carbon absorption by roadside greeneries. The amount of woody biomass has been used to quantify carbon absorption by various tree sizes. The results demonstrate that the route with additional side greeneries absorbs more of the carbon dioxide generated by vehicles. As a result, it is clear that increasing the number of roadside trees is an efficient way to reduce air pollution and, as a result, make a city healthier and more livable.

Posada, E. , Gómez, M. and Monsalve, V. (2016) *Assessment of Organic Compounds as Vehicular Emission Tracers in the Aburrá Valley Region of Colombia.*

The Aburrá Valley region of Colombia, with Medelln as its capital, is a three-million-person metropolis. In order to determine a set of baseline concentrations for VOC chemicals linked with diesel fuel and gasoline as vehicular emission tracers in the region, a research was conducted. VOC measurement campaigns were conducted in low and high vehicular flow locations, as well as on-board measurements encompassing key Medelln road networks for 24 hours, using TENAX tube sampling and analysis according to the TO-17 EPA technique. There was a link between VOC concentrations and vehicular activity, according to the findings. The sulphur level of diesel fuel was also discovered to be a significant role in the creation of VOC hydrocarbons.

Kumar, A. , Dikshit, A. , Fatima, S. and Patil, R. (2015), *Application of WRF Model for Vehicular Pollution Modelling Using AERMOD. Atmospheric and Climate Sciences*

The study uses the AMS/EPA Regulatory Model to model vehicular pollution in Chembur, which is the most polluted district in Mumbai due to industrial and vehicular sources (AERMOD). AERMOD requires the collection of meteorological information, land use surface features, and source emission data. The results of modelling are dependent on the accuracy of the input data, and meteorological data plays a critical part in the model's success. Modeling often employs temporally and spatially interpolated weather data. This is usually obtained from a nearby meteorological station, however the results are inaccurate as a result. The Weather Research and Forecasting (WRF) model was utilised in this study to generate onsite data on nine meteorological parameters using the WRF model.Using the above meteorological data, the modelling of six Chembur roads was completed. This method produces good traffic modelling results. The AERMOD results are compared to observed air quality, which includes contributions from all sources in the area as well as the relative contribution of vehicular sources.

Achour, Hussam (2012), *Estimation of motor vehicle emissions with respect to controlling air pollution. PhD thesis, Dublin City University.*

COPERT, one of the most widely used tools for estimating emissions, was employed in this study. It uses bulk traffic movements and average vehicle speeds to estimate emissions. To better assess the contribution of private cars to local emissions inventories, a combination of On-board diagnostic data extraction incorporated in all modern passenger cars and COPERT emission factors were used to account for real-world vehicular activity. In order to log and save the data taken from the OBD system, LabVIEW has developed a built-in data acquisition package. This information is then evaluated to produce driving cycles for specific routes, which are subsequently displayed to provide emission factors.This method has the advantages of being simple to use, affordable, and producing results that are close to the estimated values.

Gas analyzers, which measure the generated emissions straight from the exhaust manifold, are a frequent method. The findings of the estimation approach, which used several routes in Dublin city, time, and cars to provide a preliminary case study of a regular driving cycle in the Dublin city urban region.

Franco, V., Kousoulidou, M., Muntean, M., Ntziachristos, L., Hausberger, S., & Dilara, P. (2013), *Road vehicle emission factors development: A review.*

To guarantee that air quality strategies are established and implemented properly, pollutant emissions must be precisely estimated. Emission factors (EFs) are functional empirical relationships between pollutant emissions and the activity that creates them. The approaches used to monitor road vehicle emissions in connection to the generation of EFs found in emission models used to build emission inventories are addressed in this review paper. The techniques addressed include chassis and engine dynamometer measurements, remote sensing, road tunnel investigations, and portable emission measurement equipment, which are the most extensively used for road vehicle emissions data collecting (PEMS). The key benefits and drawbacks of each method in terms of emissions modelling are discussed. There's also a look at how EFs can be generated from test data, with a clear distinction made between data collected under controlled conditions (engine and chassis dynamometer readings using conventional driving cycles) and data collected in real-world situations.

Ericsson, E. (2001). *Independent driving pattern factors and their influence on fuel-use and exhaust emission factors.*

The goal of this research is to develop independent measurements to define the characteristics of urban driving patterns and to determine which properties have the greatest impact on emissions and fuel consumption. For each of the 19 230 driving patterns gathered in real traffic, 62 driving pattern parameters were determined. These featured both classic speed and acceleration driving pattern characteristics as well as new engine speed and gear-changing behaviour parameters. The initial 62 characteristics were reduced to 16 independent driving pattern factors using factorial analysis.

Chan, T. L., Ning, Z., Leung, C. W., Cheung, C. S., Hung, W. T., & Dong, G. (2004). *On-road remote sensing of petrol vehicle emissions measurement and emission factors estimation in Hong Kong.*

Carbon monoxide (CO), hydrocarbons (HC), and nitric oxide (NO) emissions from on-road petrol vehicles were evaluated at nine locations in Hong Kong in this study. According to the effects of instantaneous vehicle speed and acceleration/deceleration profiles for local urban driving patterns, a regression analysis approach based on measured petrol vehicle emission data was utilised to predict the on-road petrol vehicle emission factors of CO, HC, and NO.

Mishra, Dhirendra; Goyal, P. (2014). *Estimation of vehicular emissions using dynamic emission factors: A case study of Delhi, India.*

The variations in emission variables as well as emission rates in Delhi were investigated in this study. In the year 2001, the introduction of compressed natural gas (CNG) in diesel and petrol public vehicles transformed the entire air quality scenario in Delhi. After that, dynamic emission factors for criteria pollutants such as carbon monoxide (CO), nitrogen oxide (NOx), and particulate matter (PM10) for all types of vehicles were developed, which are based on a number of factors such as regulated emission limits, vehicle deterioration, vehicle increment, vehicle age, and so on.Thus, based on dynamic emission parameters, vehicular emissions have been predicted for the years 2003e2012, which have been shown to be comparable to observed concentrations at various places in Delhi. Up to the year 2012, total CO, NOx, and PM10 emissions increased by 45.63 percent, 68.88 percent, and 17.92 percent, respectively, and NOx and PM10 emissions have continued to climb at an annual average growth rate of 5.4 percent and 1.7 percent, respectively.

Kousoulidou, M., Fontaras, G., Ntziachristos, L., Bonnel, P., Samaras, Z., & Dilara, P. (2013). *Use of portable emissions measurement system (PEMS) for the development and validation of passenger car emission factors.*

Using real-world operation data, this work examines the development and validation of passenger automobile emission factors. A total of six passenger automobiles with various technology were investigated. The vehicles were tested in the Lombardia area of Italy under diverse driving conditions and on two distinct routes. These routes were created with a variety of driving scenarios in mind, including urban, rural, and highway driving. Using a portable emissions measurement instrument, tailpipe emissions and exhaust gas flows were monitored on-board the car. (PEMS). In addition, all vehicles were tested over the European type-approval driving cycle (NEDC) with the same PEMS equipment.

3. RESULTS/DISCUSSION

The Indian government has enacted laws known as Bharat Stage Emission Standards to restrict pollutants released by cars and two-wheelers (BSES). From April 1, 2020, the Central Government has ordered that all vehicle manufacturers, including two-wheel and four-wheel, must build, market, and register only BS6 (BSVI) vehicles.

Fuel Type	Pollutant Gases	BS6 (BSVI)	BS4 (BSIV)
Petroleum Distillate Vehicle	Nitrogen Oxide (NOx) Limit	60 mg	80 mg
	Particulate Matter (PM) Limit	4.5 mg/km	-
Diesel Fuel Vehicle	Nitrogen Oxide (NOx) Limit	80 mg	250 mg
	Particulate Matter (PM) Limit	4.5 mg/km	25 mg
	HC + NOx	170 mg/km	300 mg

Table 1: Permissible emission levels of BS6 vehicles compared to BS4 vehicles

Both BSIV and BSVI are emission standards that define the maximum levels of pollutants that can be released from an automobile or two-wheeler exhaust. BS6 emission regulations are stricter than BS4, and manufacturers exploit this variation to upgrade their vehicles with new features and safety standards. The most significant or widespread change is in the form of stricter permitted emission norms.

The below table offers Associate in Nursing insight into the modification within the permissible emission levels of BS6 vehicles compared to BS4 vehicles:

4. CONCLUSIONS

It's often been said that we only have one earth and we should do everything to protect it. One cannot afford to sit on the sidelines and watch because when it comes to pollution, everyone is affected, even the ones that did not contribute to it. Vehicle transportation is one of the leading causes of air pollution the world over. The good thing is that something can actually be done about it. It begins with individual responsibility in having a cleaner planet. When people change their 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.

5. REFRENCES

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