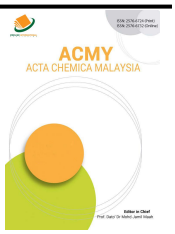
ZIBELINE INTERNATIONAL PUBLISHING

ISSN: 2576-6732 (Print)
ISSN: 2576-6724 (Online)
CODEN: ACMCCG

Acta Chemica Malaysia (ACMY)

DOI : http://doi.org/10.26480/acmy.02.2018.06.08



RESEARCH ARTICLE

PRELIMINARY MONITORING OF PARTICULATE MATTER AND GASEOUS EMISSIONS RELEASED FROM VEHICLES NEAR RAILWAY STATION LAHORE, PAKISTAN

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ARTICLE DETAILS

Article History:

Received 28 November 2018
Accepted 29 December 2018
Available online 27 January 2019

ABSTRACT

In all over the world air pollution is becoming a serious problem with enhancing of industrialization and development. Transport is a major key component of development and also a major source of ambient air pollution. The main constitute of air pollution are particulate matters and gaseous emissions. The present study was carried out to measure the concentration of gases e.g.CO, NO and $PM_{2.5}$ released from vehicles at railway station Lahore, Pakistan. The CNG rickshaws were selected at the rickshaw stand of the railway station for monitoring of gaseous emissions and $PM_{2.5}$. Results showed that the concentration of gaseous emissions and $PM_{2.5}$ were significantly higher than the permissible limits given by NEQS. The CNG rickshaws have less emissions of SO_2 but the concentration of other gases released from these rickshaws were high. Moreover, the vehicles are the major contributor of gaseous emissions and $PM_{2.5}$ pollution which have hazardous effects on air quality of the area. Emissions of different gases from vehicles are causing serious problems for the health of living beings. Emissions can be mitigated by using catalytic converter, alternate fuel, modification in engines and using pollution control devices which leads towards cleaner and sustainable environment.

KEYWORDS

Ambient, NEQS, Catalytic converter, Sustainable

1. INTRODUCTION

Modern societies face numerous problems of environmental degradation. The problem of safe drink water and clean air to breathe is now a major issue in metropolitan cities. The interaction of individuals and the whole societies with natural environment has to be revised in order to overcome these problems of modern world [1]. The contribution of transportation in air pollution is very high in many Asian countries. Uncontrolled traffic without any management that run on diesel and two stroke engines are the major contributors of this air pollution. Transportation plays a major role in the economic survival of metropolitan cities like Lahore. All the activities concede in cities are shaped by transportation system. Although the transportation system has direct impact on all the economic sectors, its environmental and social impacts are directly linked to the quality of life [2]. Air pollution from the rapid growing transportation is one of the major problems of developing countries in all over the world [3]. The health effect associated with the particulate matter $PM_{2.5}$ ranges from very severe to modest depending on the amount and duration of exposure. The risk associated with it increased the risk of hospitalization even death from the severe heart diseases and lung cancer [4]. In developing countries like Pakistan population growth have accelerated the number of vehicles. The number of vehicles in twenty years have increased from 0.8 million to four million an overall increase of more than 400%. In term of air pollution level, the densely populated cities of Pakistan are among highly polluted cities in the world. The increasing traffic on the roads day by day increased the rate pollution and related health issues [5]. Concentration of ambient air increased due to emissions from vehicles which have exacerbating effects on human health like cardiovascular disease and heart failure [6].

2. STUDY AREA

Lahore is metropolitan city of Pakistan and capital of Punjab state. Lahore is lying between 31°15′ to 31°45′ N and 74°01′ to 74°39′ E and surrounded north and west by Sheikhupura district, south by Kasur district and east by Wagah border. The present study was conducted for the measurement of gaseous emissions e.g. CO, NO and particulate matter ($PM_{2.5}$) from vehicles especially CNG rickshaws near railway station Lahore, Pakistan. At Lahore railway station the site of rickshaw stand was selected for the measurement of gaseous emissions and $PM_{2.5}$ concentration. The readings were taken for three different times (morning, afternoon and evening) of a day for emissions from muffle of rickshaws by using gas individual analyzer for gases emissions and Isokinetic assembly for $PM_{2.5}$.

3. MATERIALS AND METHODS

In the month of May, measurements were taken for two weeks from different Rickshaws by using Gas analyzer model NO: IMR 2800 for gaseous emissions and Westech isokinetic assembly for particulate measurements. Instruments measure the gaseous and particulate emissions according to USEPA approved method. In the second part of study, Concentration of Particulate matter of size less than 2.5µm ($PM_{2.5}$) was measured by using Isokinetic assembly at rickshaw stand of railway station Lahore. The time of morning and evening was selected for the measurement. One reading taken for three hours due to lack of time. The unit of measurement was gram (g) for filter paper and litter for volume air passed through the filter assembly and converted to µg/m^3.

3.1 Gravimetric Analysis for $PM_{2.5}$

The gross mass of particulate matter [PM] on the sample filter paper was found by subtracting the mass of unexposed filter paper [M_{cf}] from exposed filter paper [M_{ef}].

Mass of gross filter paper = Mass of exposed filter paper - Mass of unexposed filter paper.

$$M_{pm}=M_{ef}-M_{cf}$$

The volume of air that passed through the filter paper during the sampling period can be calculated by using the following formula

$$\text{Vact} = \frac{60_{\text{min/hr}} \times Q_{\text{act}} \times t_{\text{hr}}}{1000_{\text{l/m}^3}}$$

To calculate the concentration of $PM_{2.5}$ the net mass gain of the filter paper [M_{PM}] in micro gram (µg) was divided by the volume of air that passed through the filter V_{act} in cumic (m^3).

$$[PM]_{act} = \frac{[M_{PM}]}{V_{act}}$$

3.2 Statistical analysis of data

The data was presented in the form of bars and line graphs after analyzing using Minitab version 16. Mean standard deviation and standard error was calculated for data and T- test was applied.

4. RESULTS

4.1 Carbon Monoxide

The overall average concentrations of CO for two weeks are shown in (fig.3.1). The average concentration calculated for first week was 100.428±32.82ppm while the average concentration of CO for the second week was 1158.95±29.57ppm.

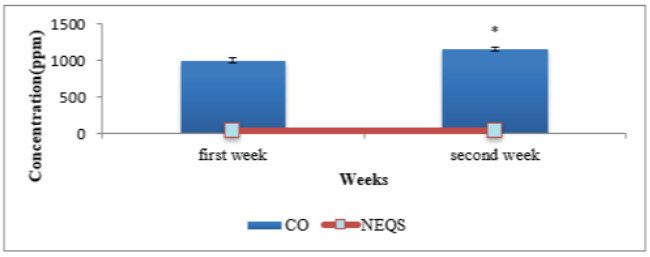

Figure 1: Comparison between overall average concentrations of CO (ppm) measured during two weeks with NEQS.

4.2 Nitrogen Oxide

The overall average values of NO for first and second week are shown in (fig.3.2). For the first week the average value was 15.667±0.812ppm and for the second week the average concentration of NO was 11.047±0.385ppm. These average values were above the standard.

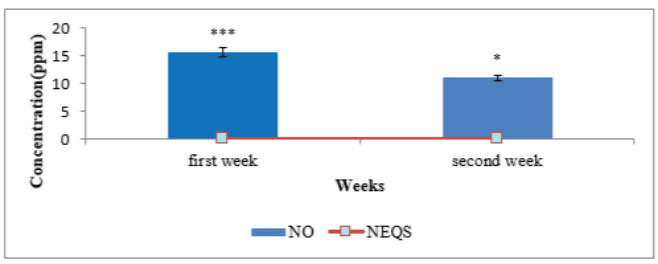

Figure 2: Comparison between overall average concentrations of NO (ppm) measured during two weeks with NEQS.

4.3 Particulate Matter

The overall average comparative values of $PM_{2.5}$ for two weeks are shown in (fig.3.4). For the first week the average concentration measured was 108.5±3.153µg/m^3 and for the second week average value of $PM_{2.5}$ was 154.26±5.127µg/m^3.

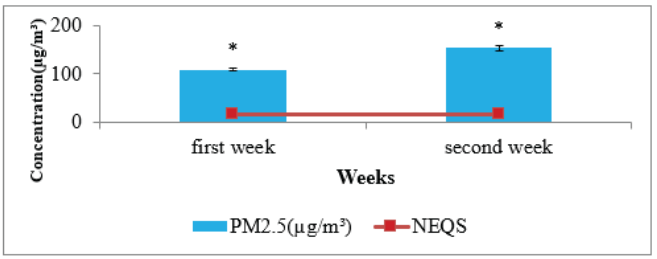

Figure 3: Comparison between overall average concentrations of $PM_{2.5}$ (µg/m^3) measured during two weeks with NEQS.

5.DISCUSSION

In our present study all the concentrations of different gases like carbon monoxide and NO were very high than the permissible limit of NEQS. Higher concentration of gaseous emissions may be due to lack of proper maintenance of the engine, not presence of catalytic converter and due to two stroke engines. High concentration of gaseous emissions n two stroke engine due to incomplete combustion of fuel. The concentration varies during different times of the day depending on the amount of traffic. By setting the proper air to fuel ratio there may be less emissions of gases.
The results of present study show that the concentrations of NO expressed in ppm were highly above the NEQS. The highest concentration of NO was 70ppm. Due to excess of Carbon monoxide in ambient are also poisoning for health [7]. According to a research in Europe a number of epidemiologic studies have reported close associations between residential areas near the busy roads and a variety of adverse respiratory health outcomes, including respiratory symptoms, asthma, and decrease in lung function [8]. $PM_{2.5}$ consists mainly of combustion particles from motor vehicles and the burning of coal, fuel oil, and wood, but also contains some crustal particles from finely pulverized road dust and soils [9]. A research carried out in USA shows that chronic exposure to $PM_{2.5}$ contributes to the risk of developing cardiovascular diseases and lung cancer. Particulate matter can have either a cooling or a warming effect on climate and also has a key role in the ecosystem impacts of air pollution. Health effects of PM are caused after their inhalation and penetration into the lungs. The smaller the particles, the deeper they penetrate into the lungs [10].

In present study all the measured concentrations of particulate matter were highly above the permissible limit of NEQS may be due to improper function of catalytic converter or lack of catalytic convertor.

6. CONCLUSION

The present study concludes that the process of burning fuel in engines of rickshaws contributes to air pollution by releasing a variety of gaseous and particulate emissions into the atmosphere at railway station Lahore. Emissions that are released directly into the atmosphere from the muffle of rickshaws are the primary source of vehicular pollution. According to findings the concentrations of gases e.g. CO and NO emitted from the rickshaws exhaust were highly above the permissible limit of NEQS. The concentrations of particulate matters ($PM_{2.5}$) were also above the NEQS standard. The old and poorly maintained rickshaws are causing more emissions of gases and $PM_{2.5}$ than the new and well-maintained rickshaws.

6.1 Recommendations

Pollutant emissions from motor vehicles are determined by vehicle´s engine type and the fuel used. Emissions of hydrocarbons and nitrogen oxide can be reduced by more than 50% and the emission of particulate matter by more than 75% through modification in design of engine and improved fuel injection system like electronic fuel injection system. Use of alternative fuel which have less emissions as compare to convention fuel. Simple servicing procedures, such as cleaning and adjusting the carburetor, adjusting the ignition system, cleaning and adjusting or replacing spark plugs, and cleaning air filters, timely tuning of engines can

reduce emissions level significantly. Use of cleaner production technologies, alternative fuel, biofuel, electric vehicles and modification in engines are corner stone steps which leading towards sustainable development.

ACKNOWLEDGEMENT

Authors would like to pay special thanks Environmental protection agency for providing laboratory facility and technical support.

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