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Short Communication

Air Quality Monitoring of $PM_{2.5}$ and PM_{10} at Heavy Traffic sites of Asian's Oldest Market: Anarkali Bazaar, Lahore

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Abstract: The main environmental problem in these days is polluted air. Transportation is the basic source of air pollution which release high volumes of particulate matter. This study is based on the disastrous impacts produced due to increasing numbers of automobiles. Data gathered through research, shows that the problem of particulate matter is increasing day by day. The present study was carried out at Anarkali Bazaar, Lahore for the measurement of Particulate matter$_{2.5}$ and Particulate matter$_{10}$. The concentration of Particulate matter$_{2.5}$ and Particulate matter $_{10}$ was measured using an air sampler for ten days in May 2016. Overall results revealed that the concentration of Particulate matter$_{2.5}$ and Particulate matter $_{10}$ was higher than the permissible limit given by National Environmental Quality Standard (2010). It is concluded that automobiles are the leading sources of Particulate matter$_{2.5}$ and Particulate matter$_{10}$ pollution which is destroying air quality of the area. As the technology is constantly changing and improving, the manufacturers of vehicles should apply latest technology to assure that the products are environmental friendly.

Keywords: Air quality, $PM_{2.5}$, $PM_{10,}$ pollution and national environmental quality standard.

Introduction

Anarkali bazaar is an important and busiest bazar in Lahore. It is one of the oldest surviving markets in South Asia. It is divided into two parts, Old Anarkali and new Anarkali. Due to high quality of things a lot of masses come here for shopping of nice and cheap things (Anjum, 2015) and people reach there by using vehicles. So this create high burden of traffic.

Clean air is a main component for life continuity, but in today's technology dependent world, clean air is something that is extremely hard to find. Land usage, economic centers, commerce centers and housing designs are all supported by the transport system. So this transport framework has coordinate effect on all areas society we live in! (Ali et al., 2012).

The environmental pollution has been increasing with the haphazard growth of industries and population. Factories are releasing toxicants, and polluting air water and soil. Air pollutants due to traffic would depend on the composition and type of fuel used. (Srivastava et al., 2010).

A study conducted by Kalara, (2012) shows that increasing human actions and liveliness, is leading to an increase in pollution of environment. In (2002) Transportation Research Board of Washington, DC has reported that traffic on roads has significantly increased worldwide in the past years. Oxides of carbon and nitrogen with high amount of particulate matter released from automobiles are the main components of increasing air pollution.

Lahore is 1244.41 km^2 and according to government figures, in 1998 total number of registered vehicles was 0.5 million this number increased to 1.2 million in 2005. With the rate doubled over time, it was estimated that in 2010 the number of vehicles will be 2,400,000 and keeping in view the highest growth rate of 16% among all cities of Punjab, the number of vehicles was estimated to be 2,400,000 in 2010 (Planning and Development Department, 2014).So this research is based on the study of air pollution caused by the vehicles in the most valuable and highly populated location of Lahore city: Anarkali Bazar.

This study is based on the current quality of air at Anarkali Bazar. Matter of the time is that the release of polluted material from vehicles cannot be stopped completely. The current study was carried out to assess the concentration of Particulate Matter (PM_{10} & $PM_{2.5}$) at different sites around and inside the Anarkali Bazar and to compare them with NEQS.

Methodology

The heavy traffic sites of Anarkali Bazaar including Lohari gate, Old Anarkali, Mid of Anarkali and Mall road Lahore was selected for the sampling purpose to measure the concentrations of Particulate matter$_{2.5}$ and Particulate matter$_{10}$.Anarkali Bazar is the oldest bazaar of Lahore, Pakistan. It is located on the Mall Road and also very near to gate of Mayo Hospital, Lahore. The

total number of vehicles registered in Lahore has increased from seventy thousands to eleven millions in 35 years and is growing rapidly day by day (Dawn, 2005). High amount of vehicles are increasing the problem of air pollution. For measurement of Particulate matter$_{2.5}$ and Particulate matter$_{10}$ concentration heavy traffic sites of Anarkali bazaar were selected. The readings were taken at three different times (morning, noon and evening) of a day (at each time three readings were taken and average was then calculated) for Particulate matter$_{2.5}$ and Particulate matter$_{10}$ by using MiniVol SN: 3224 air sampler. The measurements were taken for ten days from 21 May 2016 to 30 May 2016. Gravimetric analysis procedure was used to calculate the concentration of Particulate matter$_{2.5}$ and Particulate matter$_{10}$. The effect of moisture content of surronding environment.and airborne particulates present within airflow paths have been neturilized by the use of polyvinyl chloride (PVC) filters placed in closed-face filter cassettes. The PVC filter is weighed before and after sample collection. The concentration of Particulate matter$_{2.5}$ and Particulate matter$_{10}$ was calculated and recorded in microgram per cubic meter.

Results and Discussions

Some of Anarkali sites like Neela Gumbad, Mall road are famous for traffic jam. During the period of traffic jams the rate of fuel burning increases. This increase in fuel burning emits high level of particulate matter from high numbers of vehicles present at traffic jams. These emissions destroy quality of air which is also hazardous to health of humans and the environment. The present study was conducted for the measurement of Particulate matter$_{2.5}$ and Particulate matter$_{10}$ from Anarkali Bazar. PM level was strongly associated with traffic volume. The levels of Particulate matter$_{2.5}$ and Particulate matter$_{10}$ vary during two weeks considerably throughout the day.

The measurement of $PM_{2.5}$ was taken at different time during two weeks on the basis of which concentration differed, the average concentration of Particulate matter$_{2.5}$ in first week was Mean ±SD (462.4±60.5)µg/m^3 in range of 367-524 and the average concentration of Particulate matter$_{2.5}$ in second week was Mean ±SD (561.1±43.4)µg/m^3 in range of 492-598. The average concentration of Particulate matter$_{2.5}$ during two weeks was Mean ±SD (511.5±70) µg/m^3 in range of 462-561ug/m^3 which is shown in (Figure 1) these results of two weeks was compared with each other and it was calculated that the level of $PM_{2.5}$ was higher in 2nd week then 1st week and the maximum concentration was found mostly in afternoon and evening and minimum concentration was found in morning (Figure 2) but these levels were exceeding NEQ's standards i-e 35 µg/m^3. A similar study was conducted at Niazi and Daewoo bus stations of Lahore, in this study the minimum and the maximum average concentrations of PM2.5 were recorded to be Mean±SD (321±17.2) µg/m^3 and Mean ±SD (559.7± 157.6) µg/m^3 respectively (Moneeza et al., 2016).

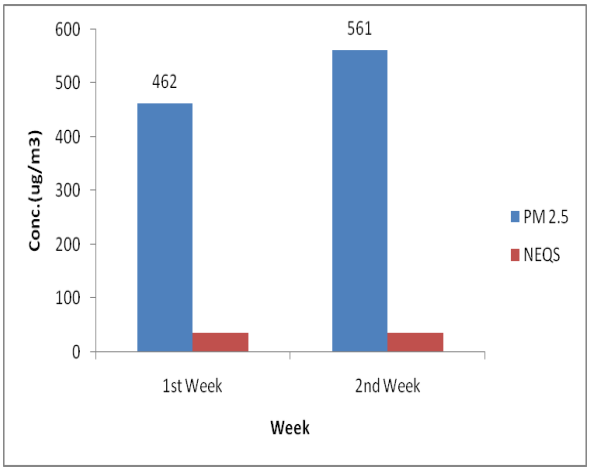

Fig. 1 Comparison between average values of PM2.5 (µg/m3) of two weeks emitted from vehicles at Anarkali Bazar with NEQS.

Same as PM $_{2.5}$ the measurement of PM_{10} was taken at different time during two weeks on the basis of which concentration differed, the average concentration of PM_{10} in first week was: Mean ±SD (694.1±90.3)µg/m^3 in range of 593-836.and the average concentration of PM_{10} in second week was: Mean ±SD (800.8±77.5) µg/m^3 in range of 737-835. The average concentration of PM_{10} during two weeks was Mean ±SD (747.5±75.5 µg/m$^{3)}$ in range of 694-800 which is shown in (Figure 3). These results of two weeks were compared with each other and it was calculated that at level of $PM_{10}$was higher in 2nd week than 1st week and the maximum concentration was found mostly in afternoon and evening minimum concentration was found in morning (Figure 4) and these levels were exceeding NEQ's standards i-e 150µg/m^3.

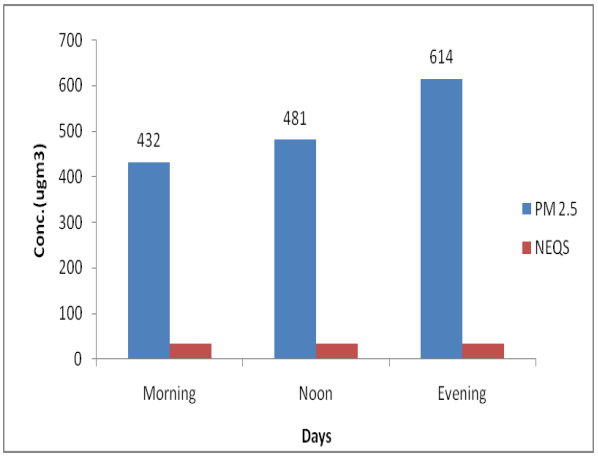

Fig. 2 Comparison between average values of PM2.5 (µg/m3) of morning, noon and evening of two weeks emitted from vehicles at Anarkali Bazar, with NEQS.

In first part of study the concentration of $PM_{2.5}$was assessed. A very high concentration of $PM_{2.5}$ was found that were beyond the standard limit of NEQS.

Highest average concentration was found in evening which was 611 µg/m^3 during 1st Week of study. At evening as people are free from jobs so they visit markets .That's why due to heavy traffic there is high amount of particulate matter present in evening.

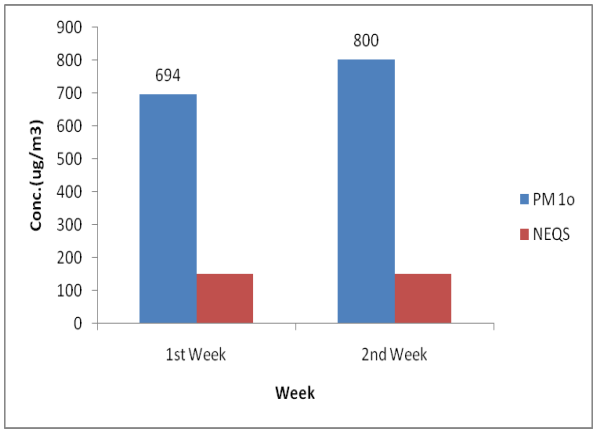

Fig. 3 Comparison between average values of PM10 (µg/m3) of two weeks emitted from vehicles at Anarkali Bazar, with NEQS.

Comparing the average $PM_{2.5}$ emission of 1st week with 2nd week it was found that average concentration of $PM_{2.5}$ was much more in the 2nd week which was Mean ±SD (561±43.4)µg/m^3.The concentration of $PM_{2.5}$ was maximum in evening but sometimes morning and noon concentration was also find higher than evening this was because of variation in traffic volume on roads.

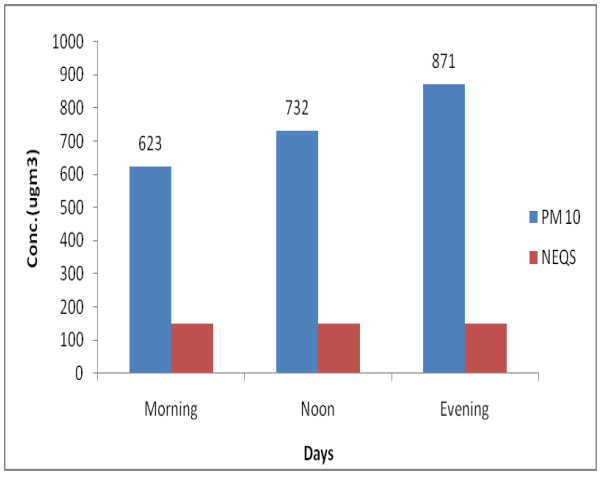

Fig. 4 Comparison between average values of PM 10(µg/m3) of morning, noon and evening of two weeks emitted from vehicles at Anarkali Bazar, with NEQS.

A study conducted in Lahore by Aziz and Bajwa (2008) shows that improper running without any check and balance by transportation board ,of the vehicles in Lahore was responsible for more than 26% of excess Carbon mono-oxide and it has been observed that a strong interdependence exists between the automobiles and urban air pollution (Aziz and Bajwa, 2008). According to a number of studies, traffic related air pollution and short term and long term exposure to particulate matter can cause respiratory diseases and result in cardiovascular mortality and morbidity (Adar et al., 2007; Anderson et al., 2012). So, the vehicle system in cities plays a major role in destruction of air quality of cities (Abbas et al., 2017).

The 2nd part of study was PM_{10}. We studied PM_{10} to evaluate the average concentration of PM_{10} in detail as like $PM_{2.5}$ it is also a common particulate matter that releases from vehicles. It was found that level of PM_{10} was beyond the standard limit of NEQS. Highest average concentration was found in evening which was 871.8±86.4µg/m^3. This was also because of lack of traffic control department and the internal maintenance of vehicles and most of the buses are diesel fueled. Mostly the new and well maintained vehicles emit less particulate matter than the poorly maintained vehicles.

Comparing the average PM_{10} emission of 1st week with 2nd week it was found that average concentration of PM_{10} was much more in the 2nd week which was Mean ±SD (800±75.5) µg/m^3.The concentration of PM_{10} was maximum in evening but sometimes morning and noon concentrations were also found higher than evening this was because of variation in traffic volume and may be due to variation in types of fuels used by vehicles on roads during a day .The concentration in second week were high. This might be due to high traffic levels or can be a result of orange line train because in these days the area was under construction.

A study by Ghauri et al. (2007) conducted in Pakistan shows that with an increase in number of vehicles on road. The concentration of PM_{10} was observed in higher amounts in Lahore, it also focused that none of the pollutant levels were in compliance with the NEQS Standards. $PM_{2.5}$ and PM_{10} concentrations were much higher than the NEQS standard of 35µg/m³ and 150 ug/m^3 respectively even in the morning time (Ghauri et al., 2007).

Conclusion

From the present study it is concluded that vehicles are one of the major source to release particulate pollution into the air and general environment from their internal combustion engine in which incomplete combustion tend to release a lot of pollutant including particulate matter in higher amount. The present study was conducted to analyze the extent of $PM_{2.5}$ and PM_{10} concentration emitted from vehicles passing through Anarkali Bazaar, Lahore by using air sampler. According to our findings it was concluded that means of transportation are releasing high amount of particulate pollution in the air. It is suggested that more planned and coherent studies be conducted and monitoring strategies be adopted to reduce further damage on air and human health. By the use of optimal air pollution monitoring, general population will be aware and information in turn will inform policy makers how best to legislate for cleaner air. Then effective policies will be generated which will reduce air pollution and threat to public health.

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