ZIBELINE INTERNATIONAL PUBLISHING

Earth Sciences Pakistan (ESP)

DOI : http://doi.org/10.26480/esp.01.2018.01.04

ISSN: 2521-2893 (Print)
ISSN: 2521-2907 (online)

CODEN : ESPADC

ATMOSPHERIC MONITORING FOR AMBIENT AIR QUALITY PARAMETERS AND SOURCE APPORTIONMENT OF CITY FAISALABAD, PAKISTAN

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ARTICLE DETAILS

Article History:

Received 12 November 2017
Accepted 12 December 2017
Available online 1 January 2018

ABSTRACT

Faisalabad is considered among the third most populated city in Pakistan. Industrialization and transportation framework has contributed essentially to the improvement of human progress and has enormously affects the encompassing ambient air quality. The rapid increase in particulate matters in Pakistan as well as all over the subcontinent over the last three to four years has a potential for significant health implications. The motivation behind this paper is to survey the preparatory air quality parameters including particulate matter PM_{10}, CO, SO_2 of city Faisalabad, Pakistan. The concentrations of pollutants were measured at 4 sites with weekly rotations for a specific period. Results demonstrated that concentration of PM_{10} in the surrounding area of Faisalabad city was higher during the study period while levels of SO_2 and CO are relatively lower as compared with NEQS. In addition, it has been observed that residential area is less polluted while the commercial, vehicular and industrial areas are extremely polluted. Ambient air quality may be improved by adopting different mitigation measures like reduce fugitive emissions, reduce vehicle emissions by using catalytic converter and plantation etc, which leads towards sustainable environment.

KEYWORDS

Ambient air quality, PM_{10}, CO, SO_2, fugitive.

1. INTRODUCTION

Air pollution has gained the attention of researchers all over the world. The epidemiological studies of effects of air pollution have demonstrated that the PM exposure and gaseous pollutants are associated with the occurrence of acute respiratory infections, lung cancer and chronic respiratory and cardiovascular diseases [1]. The sustainability of life is dependent on the environment since the environment plays important role in the health of many in the world [2]. The quality of air is determined by the amount of gaseous pollutants and particulate matter present in the air. Among all air pollutants, particulate matter (PM) which can be inhaled into the human respiratory system is related to the most serious health effects including pulmonary and cardiovascular illnesses [3]. Rapid industrialization and urbanization are the major causes of day to day increase in environmental pollution. Concern about air contamination in urban areas is accepting expanding significance around the world [1]. The release of gaseous pollutants and particulate matter into the atmosphere at concentrations high enough above their normal ambient levels have increased considerably as a result of increasing human activities. This eventually has a measurable effect on humans, animals and plants. Particulate Matter (PM) which can be inhaled into the human respiratory system is related to most serious health effects. PM_{10} particulate pollution is one of the major problems in major cities of developed world and has also becoming a serious and worsening situation in rapid growing cities in the developing world [4]. The development of industry particularly in last decades, has caused severe environmental pollution including particulate matter (PM) [5]. It is confirmed that a human can live a long time without having nourishment and five days without water, however just five minutes without air. This suggests air is extremely fundamental for human presence. Around 4 to 8 percent of deaths which happen each year on the planet are identified with air contamination related with human activities [6]. Anthropogenic sources which contribute to PM consist mainly of fossil fuel and biomass burning, industries and construction activities. Particulate matters not only influence global climate change, but also has been associated with adverse health and environmental impacts. Increased combustion of fossil fuels in the last century is responsible for the progressive change in the atmospheric composition. Air pollutants, such as carbon monoxide (CO), sulfur dioxide (SO_2), and Respirable particulate matter [7]. PM_{10} are associated with mortality [8]. Particulate matter (PM) is a heterogeneous mixture varying in physicochemical properties depending on meteorological conditions and emission sources [9]. Acute exposure to elevated levels of particulate air pollution has been associated with increased cardiopulmonary mortality, increased hospitalization for respiratory disease, exacerbation of asthma, increased incidence and duration of respiratory symptoms, higher risk of chronic respiratory disease and symptoms, and increased mortality have also been associated with chronic exposure to Respirable particulate air pollution [10]. Urban air pollution and industrial air pollution have been shown qualitatively to suppress rain [11]. Fine particles are thought to pose a particularly great risk to health because they are more likely to be toxic than larger particles and can be breathed more deeply into the lungs [12]. Both acute and chronic exposures to carbon monoxide are associated with increased risk for adverse cardiopulmonary events, including death. However, studies have not demonstrated a clear dose-dependent health risk response to increasing amounts of these pollutants except at high concentrations [13,14].

2. MATERIAL AND METHODS

2.1 Study area

Faisalabad is major industrial hub and third most populated city in Pakistan. Faisalabad city is inhabited about four million people and has an area of 1230km^2, thus its ambient air quality is cornerstone concern. There are different brick kilns, food processing factories, engineering complexes, soap factories, chemical factories, marble factories, flour mills and textile mills in the proximity of selected sampling sites. Heavy traffic is the main source of air pollution in the vicinity of study area. Four distinct seasons present in the city Faisalabad. Mean minimum and maximum temperatures in summer are about 27C^o and 40C^o and in winter about 6C^o and 21C^o, respectively.

3. SAMPLING SITES

By a walk-through survey of Faisalabad, four sites representing commercial area, vehicular area, industrial area and residential were selected for sampling purpose as shown in (Table 1) and measure the ambient air quality at respective sites.

Table 1: Air Quality Monitoring Sites in Faisalabad City

Sr. No.	Monitoring Sites	Emissions Source
1	G.M Abbad	Residential area
2	Haji Abbad	Industrial area
3	Katcheri Bazaar	Commercial area
4	General Bus Stands	Vehicular area

3.1 Monitoring and sampling method

Ambient air quality parameters, like PM10, SO_2 and CO were measured for the month of July 2017 and each parameter measured after rotation of week. PM_{10} (Particulate matter of size less than 10 micron) was measured by using high volume sampler for a period of 24hr time weighted average with flow rate of 1.3m^3/min. A rectangular glass fiber filter placed in the filter assembly and measured the concentration of PM10 by difference of pre-weight and post-weight of filter paper. SO_2 was measured by using 6400A SO_2 analyzer for 24hr average based on proved technology and method Ultraviolet Fluorescence Method. CO was measured by hand held meter of CO for 8hr average based on standard method of Non-Dispersive Infra-Red (NDIR) detection method.

4. RESULTS AND DISCUSSION

4.1 Level of CO

The CO contents were analyzed for different time period at four different sites and levels of CO were found to complying NEQS throughout the study period. The level of CO was lower in the start of study period at two sites Haji Abbad and General Bus Stand while it was higher at other two sites G.M. Abbad and Katcheri Bazaar.

During the whole study period, the level of CO remained below the permissible limit of NEQS (5mg/m^3) as shown in Figure (1, 2, 3 and 4). Overall the level of CO was observed ranging from 1.7mg/m^3 to 4.5mg/m^3 with average values of 1.73mg/m^3, 3.63mg/m^3,2.86mg/m^3,and 4.55mg/m^3 for different sampling stations G.M Abbad, Katcheri Bazaar, Haji Abbad, and General Bus Stand respectively.

Table 2: National Environmental Quality Standards for Ambient Air

Concentration in Ambient Air Pollutants	Time Weighted Average	Effective from 1st January 2009	Effective from 1st January 2012	Method of Measurements
Sulphur Dioxide (SO_2)	Annual average*	80 µg/m^3	80 µg/m^3	Ultraviolet Fluorescence Method
	24 hours**	120 µg/m^3	120 µg/m^3	
Respirable Particulate Matter, PM_{10}	Annual average*	200 µg/m^3	120 µg/m^3	β Ray Absorption Method
	24 hours**	250 µg/m^3	150 µg/m^3	
Carbon Monoxide (CO)	8 hours**	5 mg/m^3	5 mg/m^3	Non Dispersive Infra-Red (NDIR) Method
	1 hour	10 mg/m^3	10 mg/m^3	

*Annual arithmetic means of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

**24 hourly/8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days.

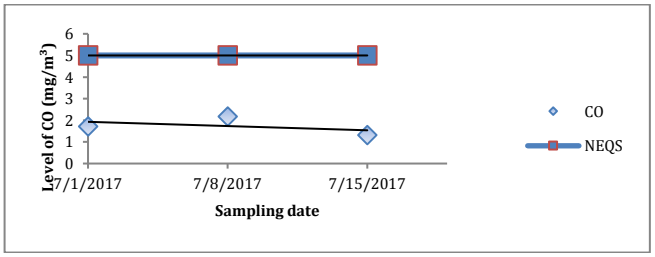

Figure 1: Level of CO verses NEQS in G.M Abbad sampling station

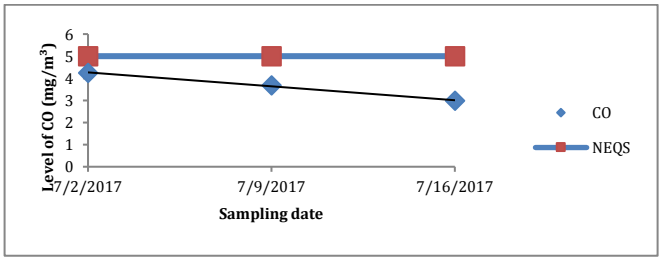

Figure 2: Level of CO verses NEQS in Katcheri Bazaar sampling station

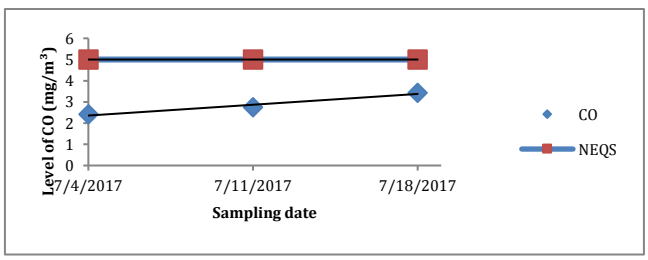

Figure 3: Level of CO verses NEQS in Haji Abbad sampling station

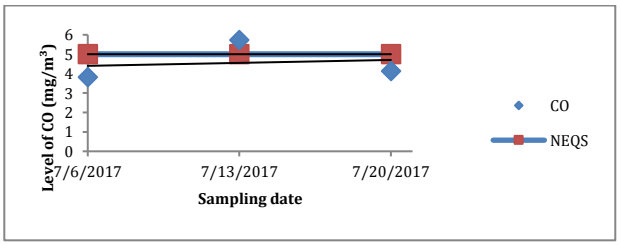

Figure 4: Level of CO verses NEQS in General Bus Stand sampling station

4.2 Level of SO_2

The levels of SO_2 contents were analyzed for different time periods at four different sampling sites and the contents of SO_2 were found to complying NEQS throughout the study period. SO_2 Concentration was lower in the start of study period at G.M. Abbad sampling station while it was higher for two sampling sites Haji Abbad and Katcheri Bazaar and remains almost constant for General Bus Stand.

During the whole study period, the level of SO_2 remained within the permissible limit of NEQS (120µg/m^3) as shown in Figure (5, 6, 7 and 8). Overall the level of SO_2 was observed ranging from 39.28µg/m^3 to 97.17µg/m^3 with average values of 50.62µg/m^3, 84.76µg/m^3, 29.33µg/m^3 and 35.49µg/m^3 for different sampling stations G.M. Abbad, Katcheri Bazaar, Haji Abbad, and General Bus Stand respectively.

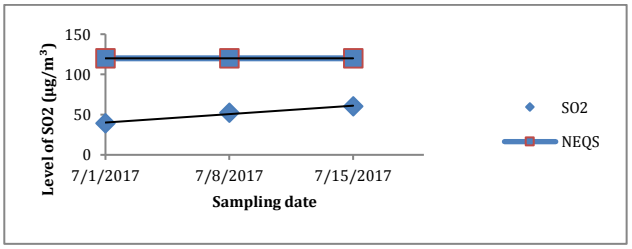

Figure 5: Level of SO_2 verses NEQS in G.M Abbad sampling station

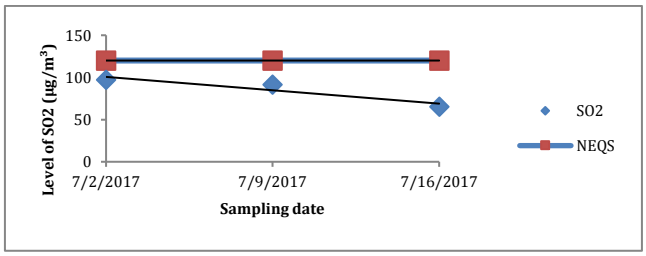

Figure 6: Level of SO_2 verses NEQS in Katcheri Bazaar sampling station

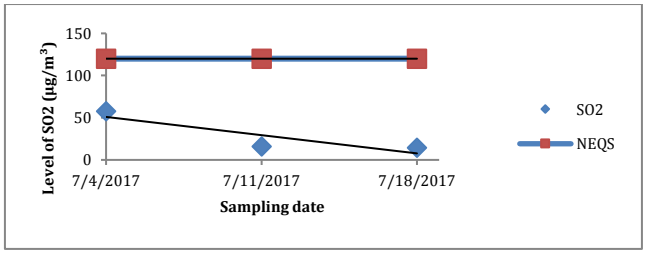

Figure 7: Level of SO_2 verses NEQS in Haji Abbad sampling station

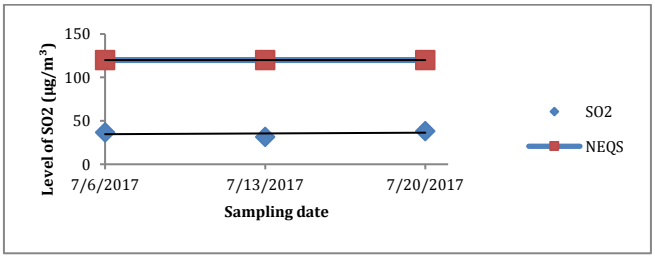

Figure 8: Level of SO_2 verses NEQS in General Bus Stand sampling station

4.3 Level of PM_{10}

The PM_{10} contents were also analyzed for different time period at four different sampling sites and the contents of PM_{10} were found higher than NEQS throughout the study period. During the study period, the level of PM_{10} remained above the permissible limit of NEQS (150µg/m^3) as shown in Figure (9, 10, 11 and 12). Overall the level of PM_{10} was observed ranging from 868µg/m^3 to 285µg/m^3 with average values of 383.33µg/m^3, 447µg/m^3, 400.33µg/m^3 and 669.33µg/m^3 for different sampling stations G.M. Abbad, Katcheri Bazaar, Haji Abbad, and General Bus Stand respectively.

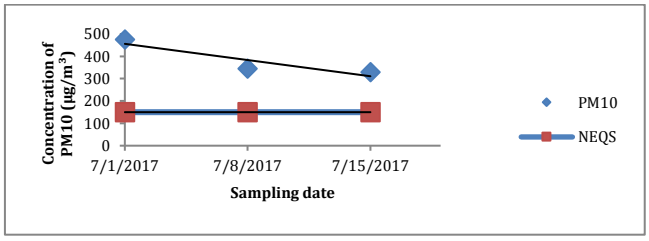

Figure 9: Concentration of PM_{10} verses NEQS in G.M Abbad sampling station

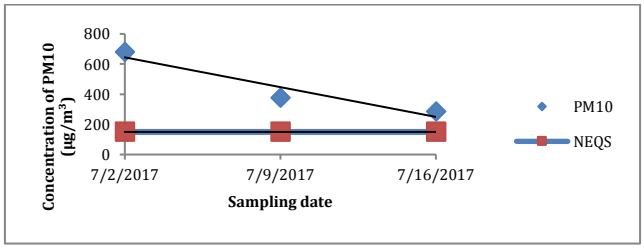

Figure 10: Concentration of PM_{10} verses NEQS in Katcheri Bazaar sampling station

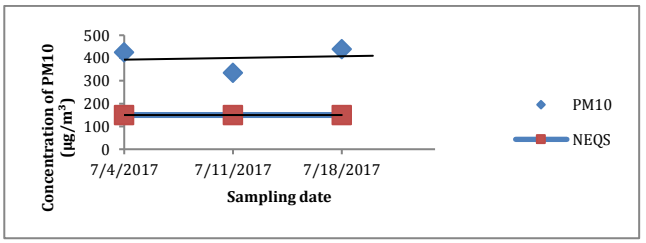

Figure 11: Concentration of PM_{10} verses NEQS in Haji Abbad sampling station

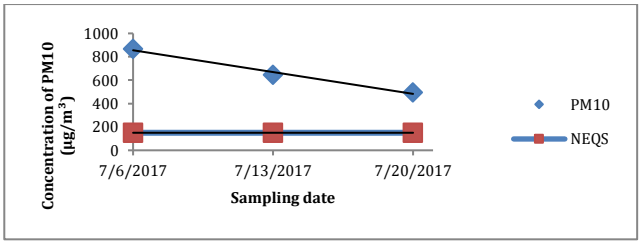

Figure 12: Concentration of PM_{10} verses NEQS in General Bus Stand sampling station

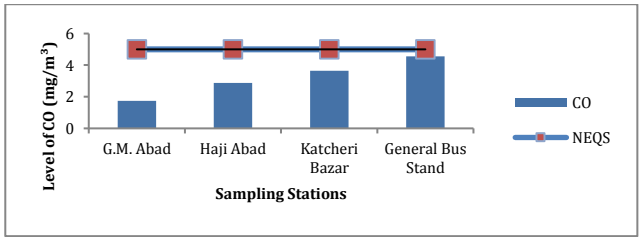

Figure 13: Level of CO verses different sampling stations

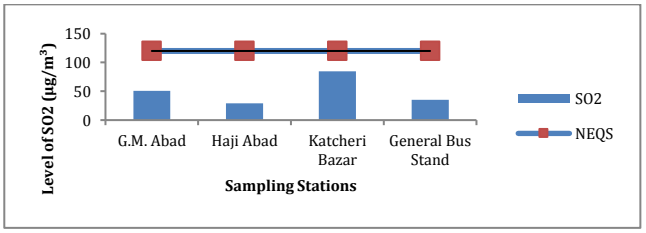

Figure 14: Level of SO_2 verses different sampling stations

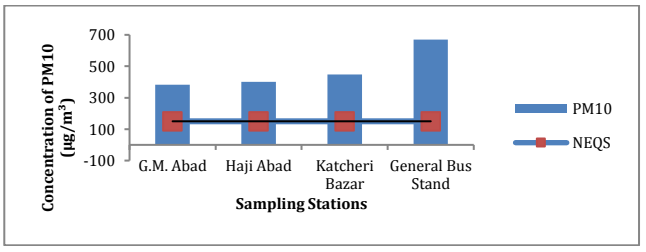

Figure 15: Concentration of PM_{10} verses different sampling stations

5. CONCLUSIONS

Following are the conclusion during the current study period:

1. The daily average concentrations of PM_{10} were higher as compared National Environmental Quality Standards. Concentration of PM10 was much higher at General Bus Stand site which might be related to fugitive emissions, vehicles movements, vehicles exhaust and construction work during study period and lower concentration in G.M.Abbad as compared to other sampling sites but higher than NEQS which might be related to less vehicles load and meteorological conditions.

2. The daily average levels of SO_2 were within limits NEQS but higher in katcheri bazar as compared to other sampling sites.

3. Eight hours average levels of CO were within limits of NEQS but higher concentration at General Bus Stand as compared to other sites which might be due to incomplete combustion of fuel in vehicle engines and no presence of catalytic convertor.

ACKNOWLEDGEMENTS

The authors would like to thank Mr. Toheed Asghar (Deputy Director Lab, EPA, Faisalabad), Mr. Mubashir (Lab Technician, EPA, Faisalabad) for providing measuring instruments, Laboratory facilities and technical assistance, and authors also feel pleasure to say thanks to Mr. Muhammad Ahmed (District Officer field, EPA, Faisalabad) for making access to the sampling site.

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