Asian Journal of Chemistry; Vol. 24, No. 10 (2012), 4479-4482

ASIAN JOURNAL OF CHEMISTRY

www.asianjournalofchemistry.co.in

Evaluation of Ambient Air Quality in Faisalabad, Pakistan

M. IQBAL[1,*], Y. NIAZ[2], M. MUSHTAQ[1], R.A. KHERA[1], F. CECIL[1], M.A. WAQAR[1], M. ABBAS[1] and T.H. BOKHARI[3]

[1]Department of Chemistry and Biochemistry, University of Agriculture, Faisalabad-38040, Pakistan
[2]Department of Structures and Environmental Engineering, University of Agriculture, Faisalabad-38040, Pakistan
[3]Department of Chemistry, Government College University, Faisalabad-38000, Pakistan

*Corresponding author: E-mail: bosalvee@yahoo.com

(*Received*: 3 August 2011; *Accepted*: 7 May 2012) AJC-11416

According to air quality standards of NEQS and USEPA, the air quality parameter such as oxides of nitrogen (NO_x), sulphur (SO_x) and carbon (CO) and their variation in Faisalabad, Pakistan has been evaluated. The concentrations of these pollutants were measured at 24 different sites for the period of three month. Results showed that concentration of NO_x, SO_x and CO were higher in the ambient air of Faisalabad city during the month of June and July and NO_x reduced lower the limits of NEQS in August, but still higher than the USEPA ambient air quality standards while the level SO_x and CO was found higher than both the NEQS and USEPA standards throughout the study period. The variation in NO_x and SO_x level was also found significant ($p < 0.05$) in different periods and station. Furthermore, it is found that the vehicular and industrial areas were the major contributor as compared with residential/commercial areas.

Key Words: Faisalabad city, NO_x, SO_x, CO_x, ambient air quality, NEQS and USEPA.

INTRODUCTION

Faisalabad is a city in the province of Punjab, formerly known as Lyallpur and situated at 31°25'0"N/73°5'0" E. Faisalabad is the third largest city in Pakistan after Karachi and Lahore. Faisalabad GDP is expected to rise to $67 billion in 2025 at a growth rate of 5.7 % and has a population of 6 millions at present[1]. At the same time, it has high energy consumption and dense transport system. The most closely related health problem due to dense transport is the air pollution (www.smeda.org). Air pollution can lead to various health as well as environmental problems[2-4]. In urban centres, high vehicle density with heavy engines and horn use can also cause excessive noise pollution, which is associated with accelerated hearing loss and sleep degradation[5,6]. Finally, rising rates of traffic overcrowding can lead to increased stress levels and results work productivity[7].

As a result of worsening ambient air quality, there are growing concerns about the exposure of citizens to various air pollutants form last few decades[8-10]. Faisalabad has become one of the regions in Punjab, Pakistan, where control of air pollution is crucial. In progress of rapid urbanization and development of society and economy, Faisalabad, just like other metropolitan cities in the world, is facing more pressure for environmental protection and the restoration of environmental damage. Despite these problems, the developing countries have no monitoring and controlling systems/inefficient of these negative impacts of transport systems and industries.

The most closely related health problem due to dense transport is the air pollution[11]. Air pollution can lead to various health as well as environmental problems[3,4,12]. In urban centres, high vehicle density with heavy engines and horn use can also cause excessive noise pollution, which is associated with accelerated hearing loss and sleep degradation[5,6]. Finally, rising rates of traffic overcrowding can lead to increased stress levels and results work productivity[7,13-16].

Air pollution has long been a problem in the industrial nations. It has now become an increasing source of environmental degradation in the developing nations, because of their rapid push to industrialization and are experiencing dramatic levels of aerosol pollution[17-20].

As a result of worsening ambient air quality, there are growing concerns about the exposure of citizens to various air pollutants form last few decades[8-10]. Lahore has become one of the regions in Punjab, Pakistan, where control of air pollution is crucial. In progress of rapid urbanization and development of society and economy, Lahore, just like other metropolitan cities in the world, is facing more pressure for environmental protection and the restoration of environmental damage.

The aim of present study was to asses the ambient air quality in Faisalabad city and its comparison with of NEQS and USEPA as well as the previous studies. This method is considered a better way to asses the changes in ambient air quality with the passage of time. For this purpose, NO_x, CO

and SO_x air quality parameters were selected as a representative. The content of these parameter were studied for period of three month and the variation was measured as a function of time and station.

EXPERIMENTAL

Sampling and measurement NO_x, SO_x and CO_x: From Faisalabad city, 24 sites were selected for sampling (Table-1) and samples were collected and analyzed from June to August 2010. High volume sampler was used for sampling. The samples were collected for a period of 24 h at an average flow rate of 40 cfm (1.13 m^3/min) and three times per week. The level of NO_x, CO_x and SO_x, was analyzed by standard methods such as carbon monoxide analyzer, non-dispersive infrared detection, 6500-smoke meter and gas phase chemiluminescence method.

Statistical analysis: All the experiments were performed in replications and data thus obtained was analyzedfor mean ± SD.

RESULTS AND DISCUSSION

Level of NO_x: The level of NO_x was ranged from 26-64 µg/m^3 with average (42 µg/m^3) from June to August (Fig. 1). It noted that the concentration of NO_x was higher than NEQS and USEPA in June and July, whereas in august it became equal to the standards and constant decreasing trend was found form start of June to end of August 2010. The reduced concentration of NO_x might be due to the changes in weather condition. Our findings are quite higher as compared to Yousufzai *et al.*[21] who reported the NO_2 (32.3-35.9 µg/m^3) level at the Sindh Industrial Trading Estate, Karachi and Hashmi *et al.*[22], who also reported NO_2 level at different sites in Karachi, industrial site (13 µg/m^3), residential (2.60 µg/m^3) and downtown sites (2.20 µg/m^3). This difference between Faisalabad and Karachi may be due the weather condition difference.

Fig. 2 shows the level of NO_x in different areas (station) of Faisalabad city. The maximum value of NO_x was found at National Hospital Chowk (64 µg/m^3) and minimum at Wapda Colony (26 µg/m^3). The 35 % area showed the concentration of NO_x within permissible limits of standards, while other found beyond the permissible limits regarding NO_x level. The same variation was found in case of NO, but the concentration of NO remained lower the permissible limits of NEQS and

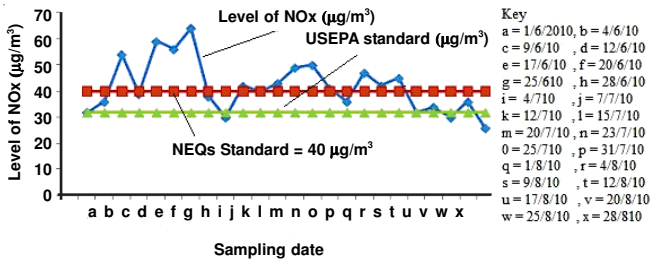
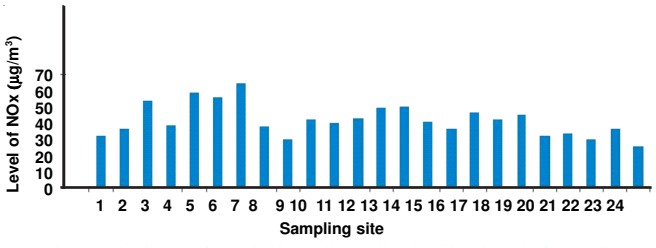


Fig. 1. NO_x concentration (g/m^3) in ambient air of Faisalabad City *versus* NEQS and USEPA



Key : 1 = Clock Tower Chowk, 2 = Narwala Chowk, 3 = Chenab Chowk, 4 = Gulfishan Colony Chowk, 5 = Jinnah Colony Chowk, 6 = RazaAbad Chowk, 7 = National Hospital Chowk, 8 = GTS Chowk, 9 = Station Chowk, 10 = Chenab Club Chowk, 11 =Katchery Bazar Chowk, 12 =Zarai Uni Chowk , 13 =Abdullah pur Chowk , 14 =Thathapull Chowk , 15 =D-Ground Chowk, 16 =Jhaal Chowk, 17 =D-Type Chowk, 18 =Samna Abad Chowk, 19 =Saleemi Chowk, 20 =Allied Morr Chowk, 21 =Millat Chowk, 22 =Nishatabad Chowk, 23 =Nishatabad Chowk, and 24 = Wapda Colony Chowk

Fig. 2. NO_x concentration in different sites of Faisalabad city

USEPA standards except June. Mostly, the Faisalabad city climate remained dry whole the year except the rainy season and the NO_x in ambient air is expected higher and this situation may worsen in coming days due to increased population which is directly related to the number of vehicles and industrialization. According to Colbeck *et al.*[1] the nitric oxide (NO) is one of a group of highly reactive gasses known as oxides of nitrogen, is the component of greatest interest and the indicator for the larger group of nitrogen oxides. NO converts quickly into NO_2 from emissions from cars, trucks and buses, power plants and off-road equipment and contributing to the decomposition of ground-level of ozone.

Level of SO_x: The concentration of SO_x was found in the range of 110-144 µg/m^3 with average value (126 µg/m^3) and found to be higher than the permissible level of NEQS and USEPA during the analysis period. The month wise SO_2 concentration is given in Fig. 3, which indicated that the level of SO_2 decreases in the months of July and august and still remained little higher than both the standards (NEQS and

TABLE-1
AIR MONITORING SITES IN FAISALABAD CITY

S. No.	Located sites	Latitude	Longitude	S. No.	Located sites	Latitude	Longitude
1	Clock Tower Chowk	31°25'07N	73°04'44E	13	Abdullah pur Chowk	31°25'10N	73°05'41E
2	Narwala Chowk	31°25'08N	73°04'26 E	14	Thathapull Chowk	31°25'38N	73°06'59E
3	Chenab Chowk	31°24'47N	73°04'02E	15	D-Ground Chowk	31°24'32N	73°06'35E
4	Gulfishan Colony Chowk	31°24'16N	73°02'34E	16	Jhaal Chowk	31°24'36N	73°05'38E
5	Jinnah Colony Chowk	31°25'26N	73°04'04E	17	D-Type Chowk	31°22'47N	73°04'19E
6	RazaAbad Chowk	31°25'51N	73°02'58E	18	SamnaAbad Chowk	31°23'22N	73°04'29E
7	National Hospital Chowk	31°25'15N	73°03'46E	19	Saleemi Chowk	31°24'30N	73°07'58E
8	GTS Chowk	31°25'00N	73°05'28E	20	Panj Puli Chowk	31°27'19N	73°04'32E
9	Station Chowk	31°25'07N	73°05'43E	21	Allied Morr Chowk	31°27'08N	73°05'06E
10	Chenab Club Chowk	31°25'24N	73°05'18E	22	Millat Chowk	31°26'49N	73°05'48E
11	Katchery Bazar Chowk	31°25'11N	73°04'49E	23	Nishatabad Chowk	31°27'18N	73°07'22E
12	Zarai Uni. Chowk	31°25'42N	73°04'31E	24	Wapda Colony Chowk	31°27'32N	73°06'20E

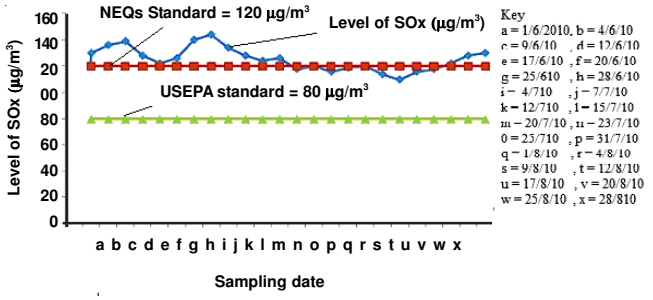


Fig. 3. SO_x concentration (g/m_3) in ambient air of Faisalabad City *versus* NEQS and USEPA

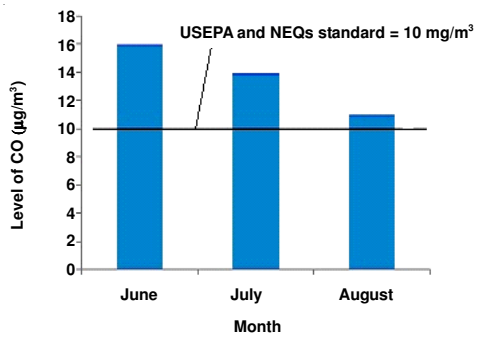


Fig. 5. Month wise CO concentration (mg/m^3) *versus* NEQs and USEPA

USEPA). Our finding was found higher as compared to Hashmi *et al.*[23], Hashmi *et al.*[24] in Karachi, Ali and Athar[25] and Ghauri *et al.*[25] who reported that SO_2 level in Islamabad (52.4 $\mu g/m^3$), Rawalpindi (41.9 $\mu g/m^3$), Faisalabad (57.6 $\mu g/m^3$), Karachi (57.6 $\mu g/m^3$), Peshawar (57.6 $\mu g/m^3$) and Quetta (68.1 $\mu g/m^3$), Pakistan.

Level of CO_x: The concentration of CO in Faisalabad for the period of three month is shown in Fig. 4. A constant decreasing trend was found through out the study period from start of June to end of August. The concentration of CO remind above the limits until the mid of July and was ranged form 8.56-19.00 mg/m^3 with average 12 mg/m^3. Month wise concentration of CO is given in Fig. 5 and showed that the concentration was greater than NEQS in June, while lower the limit of USEPA throughout the study. The maximum of Level of CO was found at Station Chowk (19 mg/m^3) and the minimum concentration was at Saleemi Chowk (8.245 mg/m^3). In this figure 80 % of values found lower the permissible limits according standards. Our finding sare some what than the earlier findings such as Ghauri *et al.*[25] reported CO in the range 10.4-11.5 mg/m^3 in Karachi in Rawalpindi and Islamabad, 2.1 and 1.8 mg/m^3, respectively[22]. Hashmi *et al.*[23,24] who reported in industrial area (0.56 mg/m^3), downtown (0.32 mg/m^3), residential site (0.14 mg/m^3) and Port Qasim (0.71 mg/m^3) Karachi and our findings are similar to Ghauri *et al.*[25] who reported the highest concentrations of 16.1 mg/m^3 in Quetta and he also reported the increased level of CO in Karachi (5.8 mg/m^3), Rawalpindi (4.6 mg/m^3) and Islamabad and Peshawar (3.5 mg/m^3) as compared previous studies[22-24].

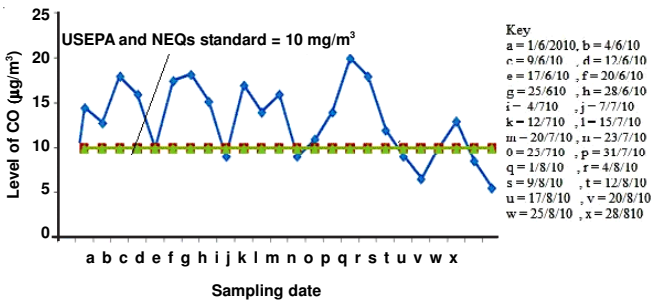


Fig. 4. CO concentration (mg/m^3) in ambient air of Faisalabad City *versus* NEQS and USEPA

Overall, it is found that the air quality pollutant has increased in Faisalabad as compared to earlier studied in Faisalabad and all other big cities of Pakisan. The trend of air polluter in different areas of Faisalabad was found the following order; vehicular + commercial + industrial > vehicular + industrial > vehicular + commercial > industrial + residential > residential. This unbalanced increment in ambient air quality is attributed to uncontrolled and unbalance use of energy. To reduce production costs, high sulphur coal and petroleum are used by many companies, industries and manufactories in Faisalabad without any control measures and as a result of this the total emissions of atmospheric pollutants has been raised along with rapid socioeconomic development in Faisalabad. Faisalabad city has severe drought condition and the total annual rainfall is less than the usual annual quantity required. Landing typhoons and strong updrafts and downdrafts in the ambient air of Faisalabad are lacking, so air pollutants cannot be easily diffused and diluted. It has been noted that the emission volume of pollutants in Faisalabad ambient air will increase, because the environmental protection authorities seems to having no positive or initiative step in this regard. So, it is necessary to optimize energy consumption, utilization of clean fuels and renewable energy and augmentation in the vegetation cover as well as improve ecological service and implement an integrated environmental plan within region in future, is best way to control the pollution at initial step. In order to greatly improve the quality of the air environment and to carry out international agreements to mitigate climate change, rigorous and forceful measures should be adopted and the total emission volume of pollutants must be controlled, the sustainable develop economic mechanism will be built to optimize the energy structural imbalance in the long term planning. Furthermore, in order to maintain sustainable and coordinated development, Faisalabad authorities must have taken a series of appropriate measures for controlling the air pollution. The greenbelt area per person and the greenbelt vegetation can cover ambient air pollution. However, in the process of rapid urbanization and rapid development of society and economy, Faisalabad, just like most of the developing countries and metropolitan cities in the world, is facing more and more pressure to protect the atmospheric environment. In fact, air environmental pollution has to some extent restricted sustainable development and damaged citizen health.

The particulate matter ($PM_{2.5}$) and NO_x pollution in Faisalabad city has became a serious problem and their level found enough high in air irrespective to NEQS and USEPA, the level of NO, SO_2 and CO was not so much high on average basis and station wise the concentration of these pollutant is crossing the permissible limit and in the month of June the concentration was found enough high. As the weather condition

changed the contents of the pollutant also changed considerably. The higher concentration of the pollutant was found in vehicle dense and industrial areas.

ACKNOWLEDGEMENTS

The authors thank Mr. Nisar Ahmad Category Manager (Subcontracts) Honeywell Building Solutions (HTAL) for providing the technical assistance.

REFERENCES

1. I. Colbeck, Z.A. Nasir and Z. Ali, *Environ. Sci. Poll. Res*., **17**, 49 (2010).
2. Y.L. Guo, Y.C. Lin, F.C. Sung, S.L. Huang, Y.C. Ko and J.S. Lai, *Environ. Health Perspectives*, **107**, 1001 (1999).
3. R. Stott, *Med. Confl Surviv*, **16**, 94 (2000).
4. J.A. Patz, D. Engelberg and J. Last, *Ann. Rev. Public Health*, **21**, 271 (2000).
5. N.M. Singh and S.N. Rao, *Indian J. Environ. Health*, **43**, 138 (2001).
6. C.L. Wong, W. Chau and L.W. Wong, *Noise Health*, **4**, 65 (2002).
7. D.C. Greenwood, K.R. Muir, C.J. Packham and R.J. Madeley, *J. Public Health Med*., **18**, 221 (1996).
8. A. Kristin and X.C. Pan, *Sci. Total Environ*., **329**, 3 (2004).
9. X.K. Wang, W.Z. Lu and W.J. Wang, *Chemosphere*, **52**, 1405 (2003).
10. Z. Kai, Y.-H. Ye, L. Qiang, L. Ai-Jun and P. Shao-Lin, *China J. Environ. Sci*., **19**, 432 (2007).
11. www.smeda.org/downloads/Cluster_Profile_LightEngineering.pdf
12. Y.L. Guo, Y.C. Lin, F.C. Sung, S.L. Huang, Y.C. Ko and J.S. Lai, *Environ. Health Perspect*, **107**, 1001 (1999).
13. M. Kavakli and H.G. Zdilek, *Asian J. Chem*., **21**, 915 (2010).
14. K. Haryani, D.M. Kumawat and P.S. Dubey, *Asian J. Chem*., **18**, 2479 (2006).
15. S. Erdogan, A. Baysal, O. Akba, M. Merdivan and C. Hamamci, *Asian J. Chem*., **19**, 1703 (2007).
16. S.M. Talebi, M. Abedi, M.M. Gheisari and M. Saber-Tehrani, *Asian J. Chem.*, **22**, 971 (2010).
17. J. Liu and J. Diamond, *Nature*, **43**, 1179 (2005).
18. K. Bradsher and D. Barboza, The Energy Challenge (2006).
19. J. Kahn and J. Yardley, Choking on Growth, Part I: As China Roars, Pollution Reaches Deadly Extremes, The New York Times, World, Asia (2007).
20. Y. Kerchich, R. Kerbachi and H. Khatraoui, *Asian J. Chem*., **23**, 323 (2011).
21. A.H.K. Yousufzai, D.R. Hashmi and I.Q. Khani, *J. Chem. Soc. Pak*., **22**, 209 (2000).
22. D.R. Hashmi, G.H. Shaikh and T.H. Usmani, *J. Chem. Soc. Pak*., **27**, 6 (2005).
23. D.R. Hashmi, G.H. Shaikh and T.H. Usmani, *J. Chem. Soc. Pak*., **27**, 575 (2005).
24. M. Ali and M. Athar, *Environ. Monit Asses*, **136**, 219 (2008).
25. B. Ghauri, M. Salam and M.I. Mirza, *Global Environ. Change-Hum Policy Dimens*, **2**, 157 (1992).