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AMBIENT AIR QUALITY OF SOME SELECTED SITES IN FAISALABAD, PAKISTAN

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ABSTRACT

The quality of air was investigated from different environmental backdrops such as residential, commercial, industrial and rural (control) areas in Faisalabad, Pakistan. It was noticed that the SPM, NO_2 and SO_2 levels in all the locations were within the permissible limits but the raising levels were indicated in one residential-cum-industrial and one industrial area. The source of these pollutants is primarily transport sector and secondly industrial. The ambient air quality was generally low. Sociological survey revealed that pollution related diseases were quite prevalent and were compatible to the results reported by PPHE (Punjab Public Health and Engineering Department Lahore, Pakistan)

Key words*:* Air quality, Nitrogen dioxide, Sulphur dioxide, High Air Pollution levels, Health Hazards.

INTRODUCTION

Pollution is deteriorating ambient air quality in cities of Pakistan. The main contributing factors to this are the overwhelming increase in number of vehicles, poor transport infrastructure and the establishment of industries in urban areas. Epidemiological studies have shown that there is a significant association between the concentration of air pollutants and adverse health impacts (MJA, 2004). Air pollution contributes to illness like eye irritation, asthma, bronchitis, cardio-vascular diseases, etc. Among different types of air pollutants, suspended particulate matter (SPM), sulphur dioxide SO_2 and nitrogen oxide NO_2 are the most important in terms of their influence on human health. These pollutants can penetrate deep in to the respiratory tract and cause an increase in cardiac respiratory illness, even mortality; contribute to daily prevalence of respiratory symptoms and decrease pulmonary lung function in children and adults. These illnesses cause functional limitations as reflected by loss of work days, absence from school, restrictive activity days, and an increase in the visits to doctors and emergency rooms for aggravated asthma and other respiratory illness (CEPA, 2004)

The concentrations of toxic pollutants in urban areas have reached levels that pose risks to human health (Wagner, 1994). In metropolitan cities, vehicular sources are the major contributes to the total pollution load. Most of the cities have large number of industrial clusters intermingling with the residential areas and some of them even have thermal power plants located within or close to the city premises. All the above factors contribute to the increasing air pollution. Suspended particulate matter in most of the locations of Faisalabad city has been found to be exceeding the permissible limits. Whereas the average concentrations of sulphur dioxide and oxides of nitrogen surprisingly are found to be much less than the permissible limits at the various locations (Krishna Mohan *et al.*, 1996). Gupta *et al.* (1997) studied particulate matter (SPM) and oxides of Nitrogen (No_x) concentrations in residential and industrial areas of Paonta Sahib (HP) India during 1994 –1996 and reviewed maximum SPM and NO_x (722.0, 1 2.26 μg /m^3) in the residential area. Corresponding values in the industrial area were 928.27 ug /m^3 of SPM and 1 9.30 ug /m^3 of No_x. The Faisalabad city is the third largest gate way of all the industrial activities in Pakistan. It has an estimated population of almost 4 million citizens and important center for transport and production in the Punjab province. Before independence, there were only five industrial units in Faisalabad (Then Lyallpur). Now, there are dozens of textile mills with other subsidiary units. Roughly, there are more than 512 large industrial units out of which 328 are textile units, 92 engineering units and 92 of chemicals and food processing units other industries include hosiery, carpet and rugs, printing and publishing and pharmaceutical products etc. There are also some 12000 house-hold industries, which include some 60,000 power loam factories (District Census Report of Faisalabad, 1984).

The objective of this study was to collect suspended particulate matter (SPM) from selected sites in Faisalabad to generate a database which may be utilized for developing cost-effective and practicable strategies for environmental improvement - to deal with and manage SPM and other gaseous pollutants.

MATERIALS AND METHODS

Eight sampling sites in and around Faisalabad city were selected using space syntax method and SRS (simple

random sampling) technique. Sampling done for eight hours (9:00 AM to 5:00 PM) was during day time. The samples were collected twice, during the months of June - August 2005. The sampling stations fell in different environmental backgrounds such as industrial, residential, commercial and rural areas. The characteristics and location of the sampling stations are mentioned (Table 1). Air sampling was carried out using the Kimoto high volume sampler with Whatman AF/G glass micro fibre filters to trap the SPM. The mass of SPM was ascertained by weighing the filter before and after sampling, with proper equilibration each time. From the mass of Suspended Particulate Matter and the volume of air sampled, the mass concentration of Suspended Particulate Matter in the ambient air, expressed in micrograms per cubic meter was calculated. The estimation of SO_2 made was made by WEST Gacks method using Sodium Tetra Choromercurate as absorbent by Spectrophotometric analysis. For estimation of Nitrogen dioxide, 0.1 N NaOH solution was used with 0.1% of Sodium Arsenate used as absorbing solution where it is converted to nitrite ion. The nitrite content was estimated spectrophotometrically by following the modified method of British standards. EPD has operated her mobile laboratory in selected areas in and around the city. The EPD laboratory confirmed the results obtained by these simple and low cost techniques used in this project within experimental error limits.

Table 1. Characteristics and location of the sampling sites of Faisalabad.

S. No.	Site code	Location	Type
1	2KI01	Industrial, Shopping Complex, Banks	Residential cum Industrial
2	2KC02	Bus Station, Commercial Complexes, Residential area of higher and lower income groups, Educational institutions	Residential cum Industrial
3	2KC03	Bus station, Commercial complexes, Hospitals, Residential areas of higher and lower income groups, Government offices, Educational institutions	Residential cum Industrial
4	2KC04	Bus station, Commercial complexes, Hospitals, Residential areas of higher and lower income groups, Government offices, Educational institutions	Residential cum Commercial
5	2KC05	Bus station, Commercial complexes, Hospitals, Residential areas of higher and lower income groups, Government offices, Educational institutions	Residential cum Commercial
6	2KC06	Bus station, Commercial complexes, Residential areas of higher and lower income groups, Government offices, Educational institutions	Residential cum Commercial
7	2KC07	Residential areas of higher and lower income group	Residential
8	2KC08	Rural areas, Residential and agricultural fields, cultivated mainly vegetables	Safe zone

RESULTS AND DISCUSSION

The ambient air quality at different environmental backgrounds of Faisalabad for the presence of different air pollutants such as suspended particulate matter (SPM), sulphur dioxide (SO_2) and Nitrogen dioxide (NO_2) is presented in Table 2

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SUSPENDED PARTICULATE MATTER (SPM)

The concentration of SPM varied among the locations and ranged from 350 $\mu g/m^3$ to 1180 $\mu g/m^3$. Among all the sampling stations, the industrial zone (2K I01 and $2KCO_2$) are recorded considerable amount of SPM concentration. 2K I01 an industrial state area recorded 1180 ug/m^3 and where as $2KCO_2$ recorded 1125 ug/m^3 , respectively. Both the values are within the permissible limits (CPCB, 1995). The residential and commercial areas covered five site locations namely $2KCO_3$,

$2KCO_4$, $2KCO_5$, $2KCO_6$ and $2KRO_7$ also recorded SPM concentrations in the range of 408ug/m^3 to 1180 ug/m^3. Among the residential stations, $2KCO_4$ recorded 1180ug /m^3 of SPM. The high amount of SPM in $2KCO_4$ may be attributable to automobiles and also to other mercantile activities, such as loading and unloading of goods, construction of multi-storey buildings etc. In the remaining stations of residential zone the concentration of SPM is varied from 408-1052 ug/m^3. Rural area (relatively unpolluted) recorded lowest SPM value, 350 ug/m^3.

Table 2: Concentration of air pollutants at different sampling stations of Faisalabad, Pakistan.

Site Code	Pollutants' Concentration
SPM (μg/m^3)	
2KI01	1180
2KC02	1125
2KC03	1052
2KC04	1035
2KC05	850
2KC06	680
2KRC07	408
2KS08	350
SO_2 (ppb)	
2KI01	20
2KC02	18
2KC03	38
2KC04	25
2KC05	25
2KC06	35
2KRC07	12
2KS08	19
NO_2 (ppb)	
2KI01	18
2KC02	38
2KC03	105
2KC04	104
2KC05	35
2KC06	52
2KRC07	39
2KS08	20

Table 3. Statistical analysis of identified phases/ Oxides

Sr. no.	Phase	Max	Min	Mean	S.D	C.V
1	SPM	1180	350	765	293.5	38.36
2	SO_2	38	12	25	9.2	36.80
3	NO_2	105	20	62.5	30.35	48.56
P.E Personal Error= 1.89						
R.P.E Relative Personal Error = 0.23						

SULPHUR DIOXIDE (SO_2)

The concentration of SO_2 varied from12 ppb to 38 ppb. Among all the sampling stations, the industrial zones (2KIO1 and 2KCO2) recorded 20 ppb and 18ppb SO_2, respectively. Among residential and commercial areas (2KCO3 and 2KCO4) relatively higher values of SO2 (25 and 38 ppb, respectively) were recorded. In the remaining station of

residential and commercial zone the concentration of SO_2 varied from 12 to 25 ppb. The rural area (2KSO8) recorded medium level of SO_2 - 25 ppb. The results are correlating with the results of Air Quality Survey of Visakhapatnam conducted in 1982 (VUDA, 1982-1983).

NITROGEN DIOXIDE (NO_2)

The concentration of NO_2 varied substantially from 18 ppb to 105 ppb. The industrial zone (2KIO1 and 2KCO2) recorded 18 ppb and 38 ppb, respectively. Among residential areas (2KCO3 and 2KCO4) recorded NO_2 concentration 105 ppb and 104 ppb, respectively. In the remaining residential and commercial areas NO_2 concentration was in the range of 30 to 52 ppb. The NO_2 concentrations were within the permissible limits (CPCB, 1995).
Large number of trees and other vegetation might have attributed to the low levels of SO_2 and NO_2 in urban areas in spite of the high vehicular population in Faisalabad City.

The statistical analysis of the data showed that there is no correlation between SPM , SO_2 and NO_2 concentrations hence heterogeneous nature of Faisalabad environment is confirmed. Positive relationship between CVs for SPM, SO_2 and NO_2 shows the stability of Faisalabad environment for the time being. It may, however, turn unstable and become disruptive in future if environmental protection measures are not are undertaken seriously.

Table 4: The result of sociological Survey for various diseases in the area and their comparison with data reported by EPAUSA (2005) and IPHA (1981-82).

Disease	Population Affected (%age)	Population Affected (%age) *	Population Affected (%age) **
ENT	64.75%	20.10%	Nil
Giddiness	83.33%	17.36%	64.70%
Fatigue	16.10%	9.07%	Nil
Gastrointestinal	Nil	10.97%	10.97%
Urinary	6.15%	6.15%	6.15%
Cancer	0.53%	0.53%	Nil
Heart Attack	9.35%35.79%BDL	9.35%35.79%BDL	Nil
Headache	9.07%	16.10%	6.25%
Skin Diseases	76.62%	2.45%	64.70%
Respiratory Diseases	95.25%21.21%BDL	7.8%21.21%BDL	50%

*, E P A U S A (2005); **, Ref: IPHA and Research (UET) report 1981-82 (Kala Shah Kaku).

Health hazards:

The data collected through questionnaire filled by 1000 residents of the area and consultation of doctors (Table 4) indicated that 0.53% had developed cancer, 64.75% ENT diseases, 16.10% fatigue, 21.20% respiratory diseases, 76.62% skin gastrointestinal, 83.33% giddiness, 9.07% headache, 9.35% heart attack and 6.15% urinary diseases. Comparison of the results obtained through sociological survey, with those reported by Public Health Engineering Department (UET) is given in Table 4. Our results are roughly in agreement with previous studies. Diseases of ear, nose, throat, skin, lungs, and heart are common. Of course, the frequency of cancer is low but most of the people are suffering from the giddiness.

CONCLUSIONS

This study indicates that SPM, SO_2 and NO_2 are on increasing trend in concentration due to air pollution in Faisalabad city. The highest value of SPM, SO_2 and NO_2 are recorded in residential cum commercial areas. However the values are marginally within the permissible limits as compared to CPCB standards. The source of these pollutants is primarily the transport sector and secondly the industrial. This study shows that the ambient air quality of Faisalabad is generally low. Air quality is more rapidly deteriorating in industrial areas than rural areas or residential areas. This is in agreement with the reports of Public Health and engineering Department (PPHE), Lahore in connection

with the degrading air environment of Faisalabad. Sociological survey conducted in collaboration of Environmental Protection Department, Punjab (EPD), to check the health hazards in the related population, widely indicated the prevalence of diseases primarily related to environmental pollution. It is apparent from this study that urban areas of Faisalabad in particular and similar areas in the country in general need to be saved from the menace of environmental pollution on priority level so that its negative effects on our ecosystems may be minimized and their sustained development may be ensured for peace and prosperity of mankind (Zereini *et al.* (2005); Lee *et al.* (2005); Dolgopolova *et al.* (2006)).

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