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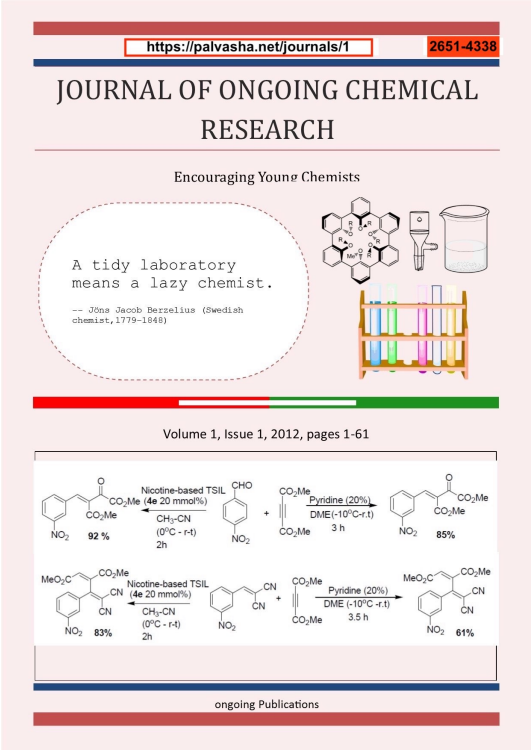

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Research Article

Immense Industrialization And Their Air Prominent Pollutants Effect On Urban Air Quality Index

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Abstract

On the basis of the reported air quality index (API) and air pollutant monitoring data obtained at the Peshawar over the last seven years, the characteristics of air quality prominent pollutants and variation of the average annual concentrations of SO_2, NO_2 total suspended particulate (TSP) fine particulates (PM_{10}) CO and dust fall in Peshawar City were analyzed. Results showed that SO_2 and NO_2 were the prominent pollutants in the ambient air environment of Peshawar City. Of the prominent pollutants TSP accounted for nearly 63 % SO_2, 32.8 ppb NO_2, 147 ppb of CH_4, 13.8 ppb of CO, 94.5µg/m^3 of MC and 0.60 ppb of O_3 respectively in 2013. NO_2 to SO_2 comparison ratio initially declined to 39.3 in 2009 and then starts to increase to 42.5 in 2010 while in 2013 reached upto 44.8 and O_3 to SO_2 ratio in the last year of observation, the ratio drop to 0.01830 µg/m^3. Concentrations of air pollutants have shown a upward trend in recent years but they are generally worse than ambient air quality standards for EPA-USA, Pak and EU. SO_2 and NO*x* pollution were still serious impling that waste gas pollution from all kinds of vehicles had become a significant problem for environmental protection in Peshawar. The possible causes of worsening air quality were also discussed in this paper.

Keywords: PM10, Air pollution, Health effect, Air quality index,

INTRODUCTION

Air pollution in urban areas remains a considerable issue in all time. Along with detrimental impact on well-beings, pollution also causes damage to ecosystems, materials and the visibility. Peshawar, capital city of Khyber Pakhtunkhwa, the ambient air quality is constantly deteriorating due to anthropogenic activities [Qadir, 2002]. As a result Peshawar is one of the most polluted cities [Ghauri et al, 2007] in Pakistan.

One cannot neglect the effort of government to implement different policies and devise different programs especially for those sectors which are more vulnerable to cause environmental pollution such as energy production particularly from fossil fuels, inception of heavy traffic load to meet the current need and many other harmful residues. Different international organization such as EPA (Environmental Protection Agency) [Khan, 2012] , World Bank, WHO (World Health Organization) [Technology et al, 1984], the European Union Air Quality Frame work and Daughter Directives, put their utmost attempt to establish and promote their own standards for this objective. Different Monitoring bodies play vital role in observing effectiveness of air quality control regulations and ensuring the implementation of air quality standards. Even this organization has the right to enforce local community to engineer the pollution control policies if ambient air quality unlikely meet certain standard.

Since 75 % of entire populations in developed countries are accommodated in urban air, their financial conditions make them capable of effective pollution prevention and control against pollutant [Kleveman, 2003]. In recent times, environment of developing countries are taken under serious condition in term of pollution prevention and its control. Still many cities of developing world are most vulnerable to have exposure to impure environment.

Many factors are responsible for formation of substandard environment in developing world [Manahan, 2013]. One of the major factors is uncontrolled increase in population; consequently, it leads to poor urbanization. Second principal aspect is of unplanned industrialization without consideration of local meteorological and topographical conditions. However, recently, almost 35 % of entire population resides in urban area in emerging nations, and this figure is twofold as five decades ago. In order to provide equal comfort and ease to increasing population, it disturb natural balance and in most serious condition cause natural calamities and catastrophe for instance consequences of deforestation. Other pollution sources are heavy vehicle traffic, dwelling heating, power generation, commercial and trade centers, and, many more, unavoidably root cause in increasing emission of air

pollutant in cities [Rehman et al, 2017]. It seems challengeable to control and prevent emission under stricter world figures and regulation with scarce resources.

Once air pollutant [Stein et al, 2000; Golinski, 1999] evolved from variant sources, are force to undergo mixing, transportation, dispersion and complex chemical reaction and physical transformation in urban atmosphere. For instance, reaction between emitted nitrogen oxides and volatile organic compound leads to synthesis of ground level ozone. Secondary particulates formation and acid deposition [Schwartz, 1989] occur in urban air when primary and secondary pollutants combine with emitted Sulphur compounds.

It has been reported that one of the main air quality parameter, SO_2 depict downward trend with certain exception of Central American and Asian cities. However, nitrogen dioxide level chases WHO standard but in Kiev, Beijing and Guangzhou, the NO_2 is almost threefold than WHO standard. Currently, Particulate matter is serious issue in Asian continent with concentration of more than 300µ g/m^3 in many urban areas. Ground level ozone (O_3) concentration value is above WHO, USEPA and EU standard criteria which demonstrate that it is global issue.

Poor urbanization and improper industrialization strategies have considerable contribution to air pollution in Peshawar as it has been noticed in developing world. Moreover, air quality become worse due to certain factors such as consumption of substandard fossil fuels, ill-mannered combustion techniques and drastic increase in traffic load. EPA [Salles et al, 2018] is the only main body in Pakistan whose responsibility cannot be neglected. Almost no reliable air quality assessment has been reported in Pakistan particularly in Peshawar.

Air quality parameters [Golinski, 1999; Nurnberg, 1984] such as SO_2, PM, NO_x, O_3, MC, CO and CH_4 are continuously monitored in Peshawar for 24 hours and depict real picture of ambient air quality with recently established continuous air monitoring station placed on roof of EPA building. The collected data were taken for average of 3 hour, 8 hour and 24 hour. Annual average concentration of NO_x, MC, SO_2 CO, O_3, CH_4 [Mirza et al, 2008] and particulate matter are shown in table 3 and 5. The result shows that all of the air pollutants in Peshawar air space were mainly caused due to combustion of bad quality fuel, heavy traffic load, brick kilns, industries, poor solid waste disposal and lake of town planning while other sources include road sweeping, burning of solid, wood, air traffic and commercial activities such as frying meat in oil and roasting on charcoal fire are minor contributors.

Geographically Peshawar lies between 33° 44 and 34° 15 North latitude and 71° 22, and 71° 42 east longitude. It is approximately 1173 feet above sea level. The climate of Peshawar is extreme. The summer season is hot, the mean maximum and minimum temperature is 40 °C and 25 °C in summer while the mean maximum and minimum temperature in winter is recorded as 18 °C and 4 °C respectively. In Peshawar mean annual wind speed in winter is 1.9 Knots (1 knot = 1.152 miles/hour or 1.85 km/hour) while in summer wind speed is 2.9 knots. Wind flows north-easterly during summer while south-easterly in winter. Summers are hot with temperature range 42-48 °C. It has a distinct winter season which brings daytime's temperatures to 16 °C or low. The annual rainfall is 13 inches. Most rain falls during the summer season from July to September. Peshawar also experiences a moderate winter rainy season as well.

Main objective of this study is to obtain a realistic picture of ambient air quality and generates a base line data in Peshawar city, to increase the public awareness, and to identify air pollution source in the city and also for the formulation of air quality standard. From the above discussion it can safely be concluded that the study about ambient air quality in Peshawar in past was not reliable. In this paper we have focus to collect reliable data and to measure the concentration of pollutants by using more advance technology.

RESULTS AND DISCUSSION

The above chart depicts a clear picture of air quality parameter variation in atmosphere during 2007 to 2013 in Peshawar-Capital city of Khyber Pakhtunkhwa, Pakistan. Furthermore, all the readings were taken on 1st July of each year. Figure 1, NOx is reported to be 24.8 ppb in 2007.However, it starts to increase either abruptly or gradually depend upon the measures which were taken by regulatory body. NOx amount in air is 26.3PPb in 2008 and further it is followed by 28.5 ppb in 2010 by passing through 27 ppb in previous year. Last but peak is touched in 2013 when its concentration reached upto 32.8 ppb.

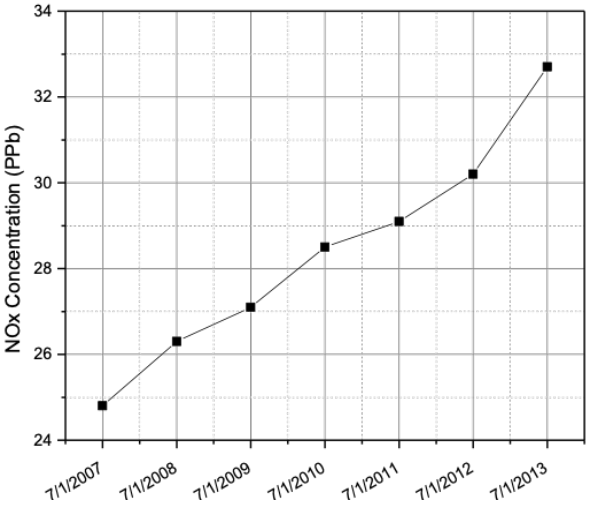

Figure 1: NO_x is reported to be 24.8PPb in 2007

Figure 2, One striking factor is notable in above chart that is overall SO_2 concentration climb up during

observation span of time except in 2010.Sharp inclination has been observed during 1st year of observation and furthermore it is followed by little bit less inclination and reached to 0.6875 ppb.This increase is almost 63 % of 2007 concentration. Drop in SO_2 is noted in 2010 and then it is followed by linear increase and reached to 0.725 ppb.

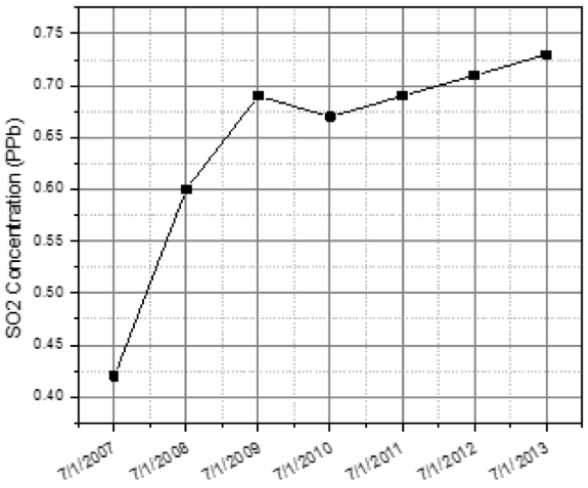

Figure 2: SO_2 concentration factor at different time scales

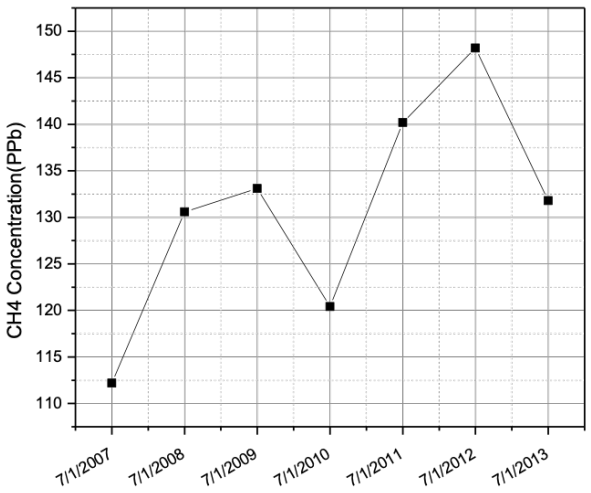

Figure 3: CH_4 concentration factor at different time scales

Figure 3, CH_4 concentration stands at 112 ppb in 2007 but its value climb up almost 16 % per annum and reach to 130 ppb in 2008. Due to implication of different Air quality control projects by different government and non-government organization, the CH_4 quantity remain 132 in 2009 by increasing only 1.5 % of the last year. Since, recovering of Air quality is slow and steady process. The last year's regulation of different regulatory authorities' measures show drastic decline in CH_4 value and decrease upto 9.0% in July, 2010. However, CH_4 concentration touch a peak of 147 ppb in 2012 by following 140 ppb in 2011.This peak is caused by different pollution sources such as frequent bomb blasts and exponential growth in vehicles. In 2013, again considering decrease is reported and CH_4 concentration remain the same as in 2009.

Figure 4, It's noteworthy that O_3 concentration varies irregular from 2007 to 2013. Firstly, It starts from 0.48 ppb and reached upto 0.51 ppb in 2009. However, In following year, it drops abruptly to 0.49 ppb.Once again, striking climb up has been observed from 2010 to 2011 and touch concentration of 0.57 ppb.Almost same inclination is followed by O_3 trend. Lastly, it declines to 0.60 ppb in 2013.

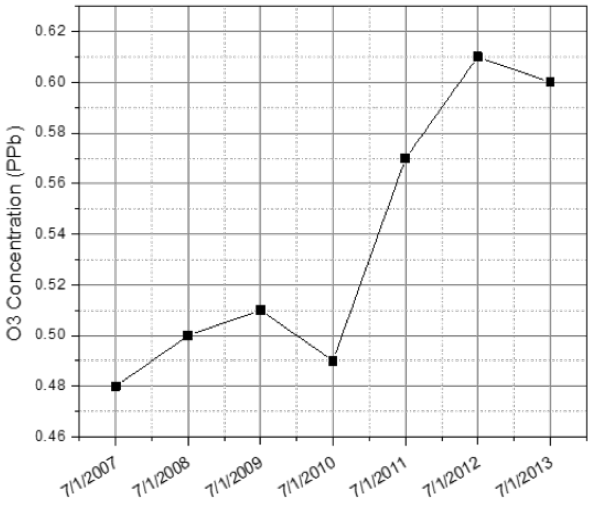

Figure 4: O_3 concentration and their effect

Figure 5, CO concentration starts from 3.5 ppb in 2007 and grows up sharply to 7.8 ppb by increasing almost 120 % in 2008.This drastic increment is due to installation of different industries which produce significant amount of pollutants such as CO and SOx. Furthermore, CO amount in air remains plateau from 2009 to 2010.This plateau is followed by abrupt increase in CO amount in 2012 and reached upto 12.8 ppb by escalation of 14 % of last years. Lastly, it touches a peak of 13.8 ppb in 2013

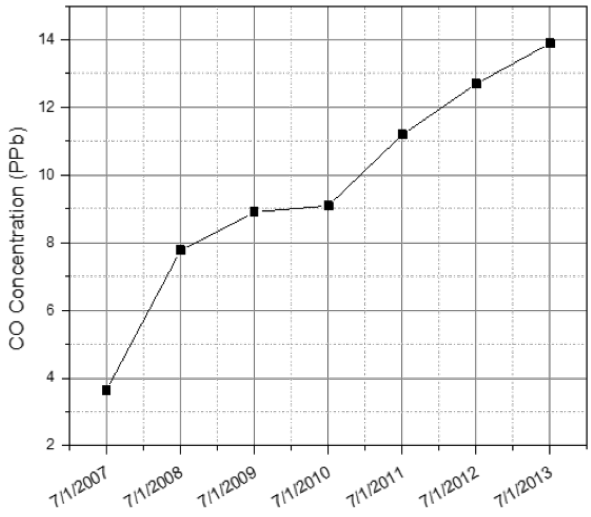

Figure 5: CO concentration at urban area

Figure 6, the below chart clear illustrate MC concentration from 2007 to 2013. All measurement was carried out on 1st July. Overall MC concentration trend increase except in 2010. Firstly, it increase to 81.5 µg/m^3 in 2008 followed by 87.9 µg/m^3 in 2009. However, gradual decrease has been reported in 2010 and it drop to 85.5 µg/m^3. After that, It followed almost a linear trend till 2013 by achieving 94.5 µg/m^3 .

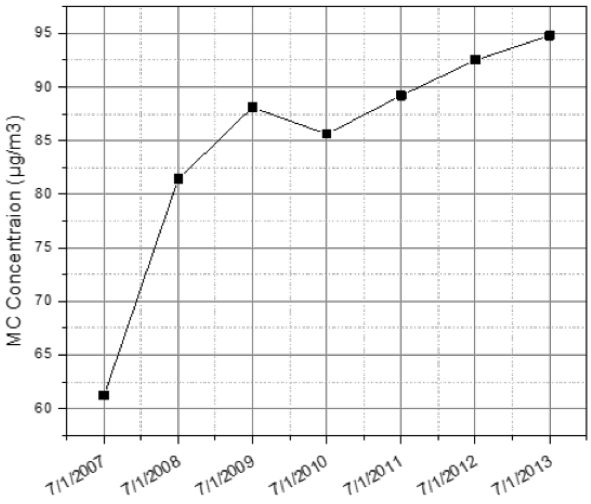

Figure 6: MC concentration from 2007 to 2013

Figure 7, Below chart shows the ratio of NO_2 to SO_2 first decline to 39.3 in 2009 and then starts to increase to 42.5 in 2010. Again said trend decrease but slightly to 42.1in 2011. However, in 2012, the trend gradually goes up to 42.5 and remain the same as in 2010. But 2013 shows drastic increase and reached upto 44.8.

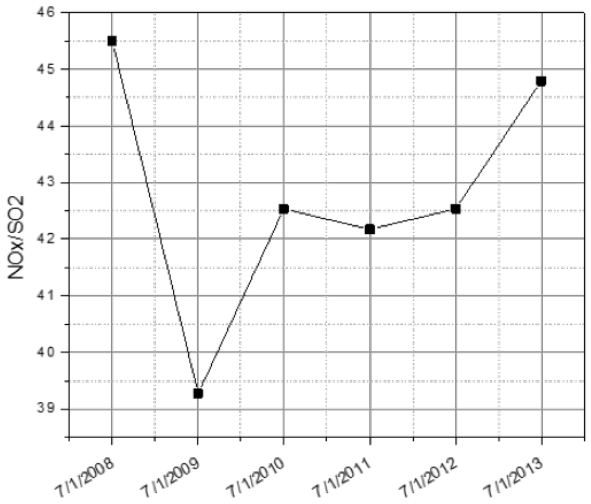

Figure 7: The ratio of NO_2 to SO_2

Figure 8, the below chart shows O_3 to SO_2 ratio from 2008 to 2013. Although, There is no such regular increase or decrease but the trend first goes up to 0.01875 in 2009. However, drastic decline observed in 2010. It's value stand at 0.01680. One can't neglect the peak of 0.02025 in 2012 just after 0.01960 in 2011. In last year of observation, the ratio drop to 0.01830.

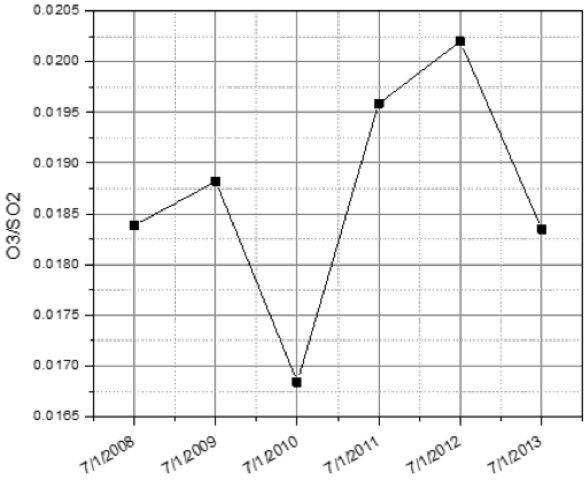

Figure 8: The O_3 to SO_2 ratio from 2008 to 2013

The chart given in Figure 9 illustrates bomb blast in KPK from 2000 to 2012. The objective of this trend is to relate environmental pollution especially air pollution caused by bomb blast. Although, there was counted number of blast upto 2005 but 2006 saw sharp increase and reached upto 200. This figure play vital role in air pollution. However, their effect may not appear instantly, but with passage of time, Blast's product may react with other element or compound in atmosphere and lead to produce most harmful substance. Furthermore, Explosions were not stopped at that level. In 2008, it touched the peak of 235. In 2009, decline in blasts were reported followed by further decrease to 130 in 2010. Again in 2011, number of blast were 198. Since it contain elemental sulfur and Tri Nitro Toluene (TNT) but after blast it react with oxygen to form Sulfur and nitrogen oxides.

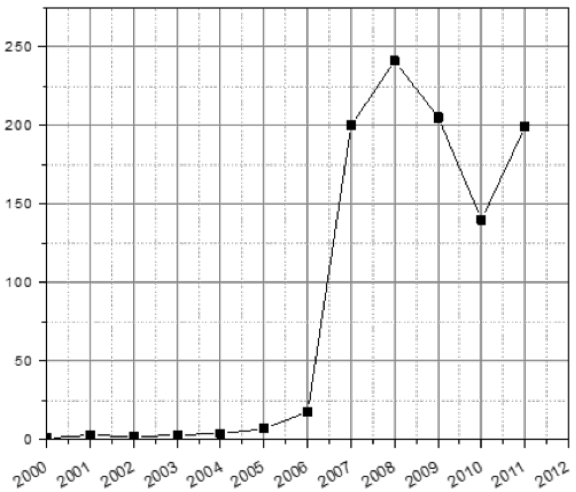

Figure 9: bomb blast in KPK from 2000 to 2012

The below bar chart (Fig. 10) depicts daily

concentration of NO_2 in month of July, 2007. Since the analyzer was installed on Khyber Road. This aforementioned road is considered to be one of the busiest roads. In mid of the month, the concentration leveled off at 24 ppb.It is noteworthy that on either on Friday or Monday, Peaks were reported mostly due to heavy traffic and these peaks were of same level. Highest peak was observed on 25 of July. This sudden and distinguished peak is due to some terrorism activities which cause drastic increase.

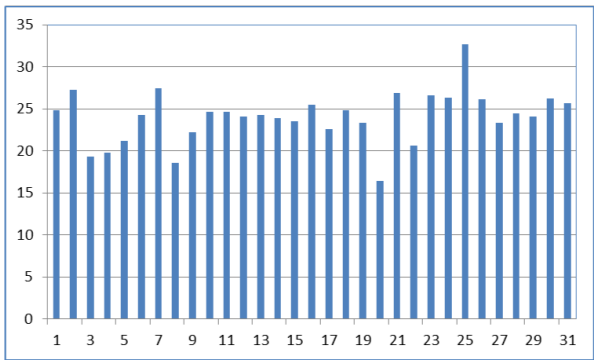

Figure 10: Concentration of NO_2 in month of July, 2007

Second major factor of air pollution is solid waste produced by principal hospitals, situated in Peshawar. Name and amount of waste generated by corresponding hospital are tabulated in above table. Tertiary hospital such as Lady Reading Hospital, Khyber Teaching Hospital and Hayatabad Medical Complex produce 300, 300 and 250 Kilogram (Table 1) per day of solid waste respectively. Since most of hospital have either no incinerator or faulty incinerator. Due to improper disposition of this waste lead to both water and air pollution. Overall, 965 Kg of solid waste per day cause tremendous destruction to environment in term of air and water. Although, Rehman Medical Institute and Hayatabad Medical complex generate significant figure of waste but they are incinerated properly and it cause comparatively less detrimental to air.

Table 1: Various hospitables and their generated wastes

S. No	Name of Hospital	Solid Waste Generated (Kg/day)	Status/Incinerator
1	Lady Reading Hospital	300	Non functional
2	Khyber Teaching Hospital	300	Non functional
3	Naseer Teaching Hospital	50	No incinerator
4	Aman Hospital	60	No incinerator
5	Nasir Mehmmond Hospital	15	No incinerator
6	North West Hospital	120	Non functional
7	DHQ Charsadda	80	Non functional
8	City General	20	No incinerator
9	Doctors Hospital	20	No incinerator
10	Rehman Medical Institute	120	Functional
11	Hayatabad Medical Complex	250	Functional

Table 2 compare and contrast Peshawar with other metropolitan cities of Khyber Pakhtunkhwa such as Mingora and D.I. Khan. Daily waste solid generation is high in Peshawar with value of 602 ton per day in comparison with other two cities. Although, The Population density in Peshawar is more due to which the Per capita per day solid waste is equal to other two districts. Solid waste per capita per day for all three cities is 0.5.

Table 3 also depict amount of solid waste which was recovered and disposed properly. In this column, Peshawar also stands first with value of 398 Ton per day while rest of solid waste are either dumped or incinerated in open atmosphere. Although, efficiency of Peshawar and D.I khan are almost same.

Table 2: Solid waste produced by principal hospitals in KPK

Main Cities	Solid Waste generated (tons / day)	Capita per day (kg)	Solid waste collected (tons / day)	Efficiency (%)
Peshawar	602	0.5	398	66
Mingora	450	0.5	221	49
D.I. Khan	510	0.5	332	65

Table 3: Pollutants caused by burning of various fuel in 500 Brick Kiln units

Sr.No	Fuel Consumed/Year			Particulates		Carbon Monoxide		Hydrocarbons		Nitrogen Oxides		Sulphur Oxides	
	Type	Wt. /Kiln (tons)	Total (Tons)	Unit	Total	Unit	Total	Unit	Total	Unit	Total	Unit	Total
				Tons	Kg/T	Tons	Kg/T	Tons	Kg/T	Tons	Kg/T	Tons	
1.	Coal	1100	550,000	19	10,450	30	16,500	1.6	880	0.7	385	18	9,900
2.	Rubber	10	5,000	69	345	-	-	-	-	-	-	-	-
3.	Saw Dust	270	135,000	15	2,025	15.5	2,092.5	18	2,430	5	675	0.75	101.25
4.	Used Engine Oil	40	20,000	0.31	6.2	0.63	12.6	0.12	2.4	2.3	46	5.1	102
	Total				12,826.2		18,605.1		3,312.4		1,106		10,103.25

The below table clearly show different amount of pollutants caused by burning of various fuel in 500 Brick Kiln units in Peshawar. Different fuels such as Coal, Rubber, Saw dust and Used Engine Oil were used for baking of Brick. Although, variant amount of above mentioned fuels were utilized in brick kilns with maximum of 1,100 Ton of coal for one unit. Substances vulnerable to cause air pollution are discussed one by one. Rubber has maximum particulates content with value of 69Kg/Ton but maximum particulates were produced by coal due to consumption of highest amount of coal (550,000 Ton).Similarly, supreme quantity of Carbon monoxide exist in Coal and coal stood first in CO production followed by Saw dust and then Used Engine oil. Their values are 16,500, 2092.5 and 12.6 Tons respectively. Other important factor is Hydrocarbon, Saw dust has more hydrocarbons. As a result, maximum amount of hydrocarbon are generated by saw dust whose value is 2,430 Tons. Last but vital pollutants are Nitrogen Oxides and Sulphur oxides, 2.3Kg/T of Nitrogen Oxide contain in Used Engine oil but the maximum NOx is produced by Saw dust which is 675Tons per annum. As far as Sox is concern, 9,900 tons are generated by

burning of coal for 500 Brick Kilns. To sum up, 12,826.2, 18,605.1, 3,312.4, 1,106 and 10,103.2 tons are annually generated quantity of Particulates, Carbon monoxide, Hydrocarbon, Nitrogen Oxides and sulphur oxides respectively.

EXPERIMENTAL

The ambient air quality was carried out by using automatic fixed air monitoring station (Horiba, Japan), surrounded by air masses reach polluted area. The analyzers used in this study are NO, NO_2, SO_2, O_3 CH_4 and particulate matter, which were regularly calibrated using zero and respective span gases. Data received and averagely analyzed for 3, 8 and 24 hours. During the measurements, metrological data were collected for wind speed, wind direction, humidity, temperature and solar flux. Table 4 show different analyzer used for this study with function and ranges.

Table 4: Analyzers used with their function and ranges

Ambient air Monitor	Functions	Range
CO APMA-370	CO in ambient air	0-100 ppm
SO2 APSA-370	SO2 in ambient air	0-10 ppm
NO_x APNA-370	NO_2, NO and NO_x in ambient air	0-10 ppm
THC APHA-370	THC, NMHC, and CH_4 in ambient air	0-100 ppm
O_3 APOA-370	O_3 in ambient air	0-10 ppm

SO_2 Analyzer

The pararrosaniline method used for the determination of sulfur dioxide concentration in ambient air. This method is based on fluorescent light measurement given off by certain molecules. SO_2 in sample react with potassium tetrachloro mercurate solution TCM (K_2HgCl_4) and form stable monochloro-sulfonatemercurate complex which resist air oxidation even stable in the presence of powerful oxidizing agents such as ozone (O_3) and nitrous oxides (NOx). Complex then reacts with pararrosaniline and formaldehyde to form intense colored pararrosaniline methyl sulfonic acid, while optical density of this compound were measured on spectrophotometer.

NOx Analyzer

Nitrogen oxides were measure in ambient air through gaseous phase chemiluminescence's technique [Gupta et al, 2003]. Nitrogen dioxide (NO_2) measured indirectly, by photometric determination of light intensity at wavelengths greater than 600 nm, resulting from the chemiluminiscent reaction of nitrous oxide (NO) and ozone (O_3). NO_2 is quantitatively reduced to NO by a converter. The NO normally present in the air along with the NOx pass through the converter unchanged, causing a resulting total concentration of nitrous oxides (NOx) equal to NO + NO_2. A sample of incoming air (NOx) were measured, bypass the converter and subtracted from the first (NO + NO_2) to give the final measurement of NOx. Chemiluminescence's analyzers for NO/NO_2/NOx are also sensitive to other nitrogenated compounds, such as peroxyacetyl nitrate (PAN), which may be reduced to NO in the thermal converter.

CO Analyzer

Non-dispersive photometer method was used for determination of carbon monoxide concentration in ambient air, by infrared absorption process. This method based on the absorption of certain wavelength in IR regions by the carbon dioxide. A beam of infrared energy is passed through a cell containing the air sample to be analyzed by NDP.

O_3 Analyzer

Chemiluminiscence method was used for determining the concentration of ozone in the ambient air. This process based [Foyer et al, 1994] on the capacity of ozone to emit light when it reacts with ethylene. Mixture of air and ethylene were used in this method, ozone present in the air reacts with the ethylene and emits light, which is detected using a photo-multiplier tube. The resulting photo-current is amplified and may be read directly or shown on a gage, in accordance with the kinetics of the (corresponding) reaction.

CH_4 Analyzer

Methane hydrocarbons were determined in voltage by combustion method. Hydrocarbon molecules with hydrogen pass through jet nozzle tip ionizer which receives high temperature energy by applying a direct current voltage between two electrodes. Flame generator produces a minute ion current, proportional to the carbon of the ionized hydrocarbon. The total hydrocarbon can be measured by passing this ion current through high resistant to convert it to voltage.

The Study Area and Sampling Sites

Area meteorology and topography greatly influence the dispersion pattern of air emission. Meteorological parameters such as wind speed, wind direction, humidity and temperature differences that exist within in air mass, are the major governing factors. The most important is wind speed which affects the horizontal dispersion efficiency wind direction determine the area affected by emission while vertical temperature variation, determine the upward dispersion efficiency. The topography of large cities also influences the manner in which pollutants are transported and dispersed. Peshawar has plain topography [Gupta et al, 2003]. The Degree and type of air pollution is not only depend on the source, but also on the climate, weather, wind speed, wind direction, temperature, humidity can transfer the pollution hazard from one area to another. Similarly Inversion of temperature and sunshine can produce deadly results in heavily polluted areas.

Geographically Peshawar district lies between 33°, 44 and 34° 15 north latitudes and 71° 22 and 71° 42 ° east

longitude. It is bounded on the north by Charssadda district, on the east by Nowshera, on the south by tribal areas adjoining Peshawar and Kohat and on the west by Mohmand and Khyber agency. The total area of the district is 1,259 square kilometer. The district is almost a fertile plain [Ahmad et al, 2008]. There are no proper forests in the district. It is approximately 1173 feet above sea level. The terrestrial climate of Peshawar city is extreme. The summer season is hot, the mean maximum and minimum temperature is 40 °C and 25 °C in summer while the mean maximum and minimum temperature in winter is recorded as 18 °C and 4 °C respectively. In Peshawar Mean annual wind speed in winter is 1.9 Knots, while summer wind speed is 2.9 knots. Wind flows are north –Easterly during summer while south – easterly in winter Humidity in August, July is 63.8 % May, June 44.4 % Mean monthly winter rain fall is 16.5 cm while summer mean rain fall is 19.1cm shown in table 5. Mean monthly winter sun shine 6.7 hr. / day while summer 8.8 hr/ day. An important element for accelerating to heavy air pollution in Peshawar city is its location inside the land. Besides Peshawar have not enough wind speed which will take away air pollutants from the city [HomerDixon, 1994]. In addition it has not enough rain falls to prevent scattering of pollutant from emission source.

Table 5: Mean monthly temperature, precipitation and relative humidity recorded at Peshawar station, Peshawar district

Month	Mean Temperature (°C)		Precipitation	Relative
	Maximum	Minimum	(Millimeters)	Humidity (%)
January	18.5	4.00	26.00	58.60
February	19.46	6.34	42.67	57.50
March	23.74	11.16	78.41	58.43
April	29.98	16.40	48.87	51.72
May	35.94	21.30	26.98	37.35
June	40.42	25.68	7.72	36.16
July	37.73	26.59	42.31	55.03
August	35.72	25.74	67.68	64.58
September	35.02	22.69	17.90	58.68
October	31.23	16.09	9.66	54.88
November	25.62	9.56	12.34	60.11
December	20.12	4.92	23.29	63.72
Annual	29.44	15.87	403.83	54.73

According to 2013 Census the present (2013) population of the city is estimated to be over 3,307,798 (Density 2,600/km^2 (6,800/sq mi) increasing at a growth rate of 3.3 percent per annum (Table 6). The growth rate of population in Peshawar has been very high and no sign of decline has been noticed yet, in spite of government's efforts in this connection. With this much population and limited resources available no improvement in the situation is expected. Larger population, it may be urban [Qadir, 2002] or rural [Luken, 2000], spoils the environment through human activity including irrational use of chemicals. Peshawar population is growing at a high rate, widening the gap between consumption and resource availability and causing congestion in many areas. Out of total population 46.52 % are migrants, from other parts of Khyber pakhtunkhwa and other provinces. Besides there are approximately 400000 afghan refugees in Peshawar. The available recourses of Peshawar to support the increasing population are not encouraging and no improvement in the situation is expected. Larger population spoils the environment through human activity. Such tremendous population has resulted in huge load on Peshawar and has enhanced pollution problems manifold [Sawyer et al, 2000].

Table 6: Population of the Peshawar city

Division/ District	Area in Sq. K.M	Population		%age Change in 1998 over 1981	Population Density per Sq. K.M		Growth Rate 1981-1998 (Percent)
		1981	1998		1981	1998	
Peshawar	1257	1113303	2019118	81	886	1606	3.56

CONCLUSION

Major problem come from automobile exhaust emissions, industrial emissions, especially from brick kilns factories, domestic burning and wind-blown dust arising from unpaved roads. Urban air pollution in Peshawar is attributable to many sources, the most prominent are vehicular pollution, dust particles, emission from the large number of small scale brick kilns and stone crushers. The rickshaws, a traditional means of public transport, emit noise and smoke, increasing pollution in the Peshawar city. Therefore is needed to establish and enforce ambient air quality standard in Pakistan on priority basis. The main source of air pollutant (NOx) in the Peshawar air space is motor vehicles. Measures should be adopted for strick enforcement of NEQS. Efforts should be made by Government of Khyber Pakhtunkhwa to increase the number of environmental tribunals. To minimize air pollution in Peshawar, measure should be adopted to improve traffic flow, upgrade public transport system. In brick kilns rubber and tyres are added which increase the emission of SO_2 so there should be a ban on use of rubber and tyres.

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Bibliography

Ahmad et al, 2008 Ahmad, Rizwan; Naveed, Muhammad; Aslam, Muhammad; Zahir, Zahir A; Arshad,

Muhammad; Jilani, Ghulam (2008). *Renewable Agriculture and Food Systems*, **23**, 243-249
Foyer et al, 1994 Foyer, C H; Descourvieres, P; Kunert, K J (1994). *Plant, Cell and Environment*, **17**, 507-523
Ghauri et al, 2007 Ghauri, Badar; Lodhi, Arifa; Mansha, M (2007). *Environmental Monitoring and Assessment*, **127**, 237-252
Golinski, 1999 Golinski, Jan (1999). *Science as public culture: Chemistry and enlightenment in Britain, 1760-1820*, , Cambridge University Press
Gupta et al, 2003 Gupta, Abha; Kumar, Ranjit; Kumari, K Maharaj; Srivastava, S S (2003). *Atmospheric Environment*, **37**, 4837-4846
HomerDixon, 1994 Homer-Dixon, Thomas F (1994). *International security*, **19**, 5-40
Khan, 2012 Khan, Arshad Samad (2012). *UNEP EIA Training Resource Manual, Case Studies from Developing Countries*, , 37-44
Kleveman, 2003 Kleveman, Lutz (2003). *The new great game: blood and oil in Central Asia*, , Grove Press
Luken, 2000 Luken, Ralph A (2000). , ,
Manahan, 2013 Manahan, Stanley (2013). *Fundamentals of environmental and toxicological chemistry: sustainable science*, , CRC press
Mirza et al, 2008 Mirza, Umar K; Ahmad, Nasir; Majeed, Tariq (2008). *Renewable and Sustainable Energy Reviews*, **12**, 1988-1996
Nurnberg, 1984 Nurnberg, H W (1984). *Analytica Chimica Acta*, **164**, 1-21
Qadir, 2002 Qadir, Noman Fazal (2002). *Cities*, , 1-12
Rehman et al, 2017 Rehman, Zahir Ur; Khan, Sardar; Brusseau, Mark L; Shah, Mohammad Tahir (2017). *Chemosphere*, **168**, 1589-1596
Salles et al, 2018 Salles, Fernanda Junqueira; Sato, Ana Paula Sayuri; Luz, Maciel Santos; F'avaro, D'eborah In^es Teixeira; Ferreira, Francisco Jorge; da Silva Paganini Wanderley; Olympio, Kelly Polido Kaneshiro (2018). *Environmental Science and Pollution Research*, **25**, 10701-10713
Sawyer et al, 2000 Sawyer, Robert F; Harley, Robert A; Cadle, Steven H; Norbeck, Joseph M; Slott, Robert; Bravo, H A (2000). *Atmospheric Environment*, **34**, 2161-2181
Schwartz, 1989 Schwartz, Stephen E (1989). *Science*, **243**, 753-763
Stein et al, 2000 Stein, Ariel F; Lamb, Dennis (2000). *Atmospheric Environment*, **34**, 1681-1690
Technology et al, 1984 Technology, National Research Council (US). Advisory Committee on; Association, Nitrogen Fixing Tree (1984). *Leucaena: Promising Forage and Tree Crop for the Tropics: Report of an Ad Hoc Panel of the Advisory Committee on Technology Innovation Board on Science and Technology for International Development, Office of International Affairs in Cooperation with the Nitrogen Fixing Tree Association, Waimanalo, Hawaii*, **52**, National Academies

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