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COMPARITIVE STUDY OF PARTICULATE MATTER (PM_{10} AND $PM_{2.5}$) IN DALIAN-CHINA AND FAISALABAD-PAKISTAN

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The current study was conducted to appraise the $PM_{2.5}$ and PM_{10} concentration in Dalian-China and Faisalabad-Pakistan. Study was conducted for the period of one year at different stations in both cities and the results were compared according to set standards of NEQS(Pakistan), CNAAQS(China), NAAQS(USEPA) and WHO (World Health Organization). The $PM_{2.5}$ concentrations in Faisalabad is variable from 22 to 49 μg/m^3 (Average 36.5 μg/m^3), whereas PM_{10} variation is from 109 to 164.3 μg/m^3 (148.3 μg/m^3). The $PM_{2.5}$ concentrations in Dalian varied from 5.5 to 93.3 μg/m^3 (29.1 μg/m^3), whereas PM_{10} values varied from 10.5 to 101.1 μg/m^3 (Average 45.9 μg/m^3). Both the average $PM_{2.5}$ concentration in Faisalabad, in winter season is higher than the dry summer season. Both $PM_{2.5}$ and PM_{10} concentrations were found significantly different in winter and summer seasons. The variations were considerably higher in Dalian comparing to those of Faisalabad. On average basis Faisalabad showed more PM concentrations comparing to Dalian, even higher than permissible limits set by NEQS and USEPA. Whereas the values representing Dalian are within the limits set by CNAAQS and WHO.
Keywords: Particulate matter, NEQS, USEPA, WHO, CNAAQS

INTRODUCTION

Majority of cities worldwide are facing challenges associated with the air pollution. A recent report of World Health Organization on ambient air pollution suggests that annual mean concentration of PM_{10} has increased by more than 5% between 2008 and 2013 in 720 cities across the world. The issue of air pollution becomes more prominent at certain locations such as signalized traffic intersections with high pollutant concentrations, which are termed as "hot-spots". The USEPA defines the signalized traffic intersections as small geographical locations such as, the busy roadsides where pollutant concentration is higher than the NAAQS (Goel and Kumar, 2014). In densely populated countries like Pakistan and Chine air pollution has become a serious threat mainly due to industrial establishment and un-controlled discharged of air polluting agents (Bradsher and Barboza, 2006; Kahn and Yardley, 2007; Kerchich *et al*., 2011; Liu and Diamond, 2005). Secondly, the emissions of particulate matter (PM_{10}, $PM_{2.5}$) and other organic agents due to dense road traffic system along with other factors are sources of air pollution (Chow *et al*., 1994; Eldred *et al*., 1997; Muller, 1999). Previous studies had shown that the air in metropolitan cities is more polluted as compared to rural areas. The mist, particulates and aerosols are contributing a major part of air pollution which disturb the dynamic atmosphere equilibrium and ultimately, affects the human health along with other living organisms (ADB, 1999). Among common ambient air pollutants, PM is currently under intensive epidemiological and toxicological investigation. Previously, environmental epidemiologists had mainly focused on PM with an aerodynamic diameter of PM_{10}. However there are increasing evidences linking $PM_{2.5}$ to various respiratory and cardiac disorders, therefore more and more attention is being paid to the exposure assessment of $PM_{2.5}$ and its cardiopulmonary impacts (Goldberg *et al*., 2011; Janssen *et al*., 2002; Magari *et al*., 2002).

The $PM_{2.5}$ refers to the particles of 2.5 μm in diameter responsible to reduce the visibility in air along with various health problems (MEP, 2012; WHO, 2005). It has been found that with increasing $PM_{2.5}$ concentration people would grow susceptible to certain diseases, including acute respiratory symptoms, asthma, myocardial infarction, lung cancer and mortality (Deng *et al*., 2013; Goss *et al*., 2004; Laden *et al*., 2006; Peters *et al*., 2001; Slaughter *et al*., 2003). $PM_{2.5}$ has gradually becoming a major environmental problem with the rapid economic development in China, urbanization and ever increasing demand of motor vehicles. The nationwide total possessions of civil vehicles are increased from 1358400 units in 1978 to 93563200 units in 2011; this represents an average annual increase of about 20.87% (National Bureau of Statistics, 2013).

Faisalabad in Pakistan, known as hub to textile industry and Dalian in China has many have many things in common. For

example both have dense population and are symbols of industrial cities in their respective countries. However, with the increase in industrial development in two cities air pollution control measures are often ignored and sometimes situation becomes alarming and pressing as far as the effects of industrial effluents, especially the effects of $PM_{2.5}$ and PM_{10} on human population residing in those cities are concerned. Therefore, we found a dire need to analyze and monitor the various pollutants in Dalian and in Faisalabad, where current research is taken into account. The major aim was to evaluate and compare the air quality of two different cities in view of increasing concerns of PM. The PM_{10} and $PM_{2.5}$ concentrations were evaluated from different stations of both selected cities for period of one year (2013). For the detail analysis and comparison the particulate matter PM_{10} and $PM_{2.5}$ concentrations, date wise, month wise and station wise data had taken throughout the whole period of one year. The final assessment of air quality (QA/QC) of both the cities have been made by comparing the results with NEQS-Pakistan, NAAQS-USEPA, China-CNAAQS and WHO standards. These air quality standards (QA/QC) and permissible limits of $PM_{2.5}$ and PM_{10} concentrations are NEQS-Pakistan (35µg/m^3 and 150 µg/m^3), USEPA-NAAQS (35 µg/m^3 and 150 µg/m^3), CNAAQS-China (75 µg/m^3 and 150 µg/m^3) and WHO (75 µg/m^3 and 150 µg/m^3) (Table 1).

Table 1. Ambient air quality standards.

Standards	Time weighted Annual Avg.	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)
NEQS-PAK	24-hr**	150	35
USEPA-NAAQS	24-hr***	150	35
CNAAQS(Grade-II)	24-hr****	150	75
WHO(IT-1)	24-hr	150	75

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; *PM_{10}Not to be exceeded more than once per year on average over 3 year, $PM_{2.5}$ 98% average over 3 year; ****Grade II is for Residential, Commercial, Industrial and Rural Area.

MATERIALS AND METHODS

***Study area*:** Faisalabad is the second largest city in Punjab province, Pakistan, is situated at (31° 25' 4.8" N, 73° 4' 44.4" E) and formerly known as Lyallpur. The gross domestic product of Faisalabad is expected to raise $67 billion in 2025 at a growth rate of 5.7% and the current population of Faisalabad is 6 million people at present. At the same time, the city has very dense transport system with large energy consumption and requirements. Yet air pollution remains to be the biggest issue of Faisalabad which is directly related to many health problems among native citizens, with reference to dense transportation (SMEDA, 2006). According to a report by Pakistan Statistical Year Book 2012-13 the number of registered vehicles in Faisalabad city are 767,453 (7.7%) out of the total 9,893,373 vehicles of the Punjab province (Pakistan Bureau of Statistics, 2013). The city has elevation of 184 m above sea level and covers an area of 1,230 sq. km. Faisalabad stands in the rolling flat plains of northeastern Punjab and features hot desert like climates because of high transpiration rate across the year. Thus city experiences extreme climate, with summer temperature as high as 50°C and winter as low to -2°C and mean maximum and minimum temperatures in summer are 39 and 27°C, respectively. On the other hand winter temperature peaks around 17 and 6°C respectively. Summer season usually starts from April and lasts until October, out of which May, June and July are the hottest months. While, winter remains from November to March, in which December, January and February are the coldest months. The average annual rainfall is about 300 mm and it is highly seasonal with approximately half of the yearly rainfall in the two months i.e., of July and August (Monson season). The average humidity in the city is 40% and pressure recorded 1020 hPa (City District Government FSD, 2013).

While Dalian with the population of 6.6 million is one of the major cities in P.R.China. It is located in the south of Liaoning Province. It is the southernmost city of Northeastern China situated at (38° 55′ 15″ N, 121° 38′ 21″ E). Dalian has heavily developed industrial areas with an elevation of 33 m above sea level, the city covers an area of 13,237 sq. km. Dalian city has sloppy featured land and has a monsoon influenced humid continental climate, characterized by humid summers due to the East Asian monsoon, and cold, windy, dry winters. Though it is heavily concentrated in the summer months and can greatly vary from year to year, the annual precipitation averages 602 mm. With 2,740 hours of bright sunshine annually, the monthly percent possible sunshine ranges from 49% in July to 68% in September and October. The average humidity in the city is 56% and average pressure is recorded 1024 hPa. The annual mean temperature is 10.9°C. The city is witnessing double digit percentage increase in GDP annually since 1992. The city's GDP registered an increase of 15% since 1992 reaching $71.35 billion, while per capita GDP hit $11,586 billion in 2009 (Environmental Protection Bureau, 2013).

***Measurement of $PM_{2.5}$ and PM_{10}*:** The air quality data (QA/QC) for this research work were obtained from Environment Protection Bureau (EPB), Dalian-China and from the Environment Protection Department (EPD), Faisalabad-Pakistan. In Faisalabad city, 6 sites were selected for monitoring (Fig. 1 and Table 2) and samples were collected regularly for the period of one year (January to December 2013). A total numbers 144 samples of PM_{10} and 144 samples of $PM_{2.5}$ were obtained; this corresponds to 90% data capture for both particle fractions. Using two low-volume samplers, PM_{10} and $PM_{2.5}$ filter samples were used (USEPA approved Partisol Model 2000, Rupprecht & Patashnick) with sampling flow of 16.7 L/min. Sampler inlets

Table 2. Annual Average concentration of PM_{10} and $PM_{2.5}$ in Faisalabad and Dalian.

Monitoring stations	Locations		Avg. PM_{10} (µg/m^3)	Avg. $PM_{2.5}$ (µg/m^3)
	Latitude	Longitude		
Clock Tower Chowk	31°25'07"N	73°04'44"E	148.0	34.0
Station Chowk	31°25'07"N	73°05'43"E	151.0	40.0
Chenab Chowk	31°24'47"N	73°04'02"E	149.0	36.0
D-Type Chowk	31°22'47"N	73°04'19"E	148.0	38.0
National Hos. Chowk	31°25'15"N	73°03'46"E	147.0	37.0
Millat Chowk	31°26'49"N	73°05'48"E	146.0	34.0
Ganjingzi	38°57'10.65"N	121°31'31.68"E	61.4	39.1
Zhoushuizi	38°57'57"N	121°32'18"E	53.2	31
Xinghai three stations	38°54'31.81"N	121°36'39.92"E	58.8	31
Qingniwaqiao	38°55'04.82"N	121°38'09.16"E	42.8	29.8
Fujiazhuang	38°52'05.35"N	121°37'29.90"E	30.1	30
Qixianling	38°51'02.74"N	121°31'21.78"E	30.9	19

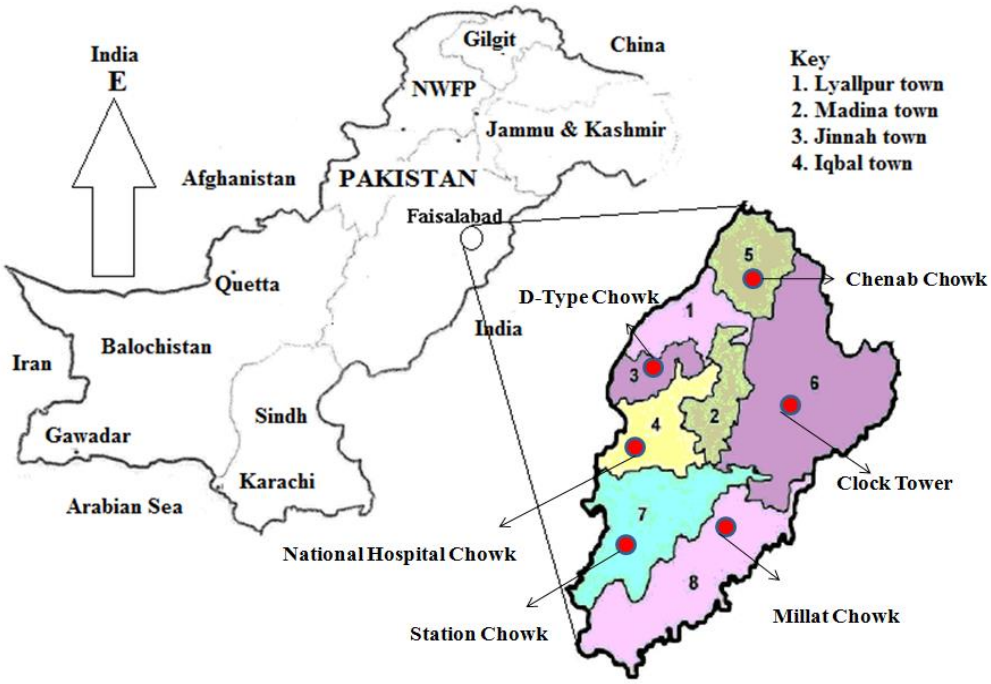

Figure 1. Map of Faisalabad air monitoring stations.

were located 7 m above ground and particles were collected using 47 mm Pall flex TX40 filters (Teflon-coated glass fiber filters), which were mounted in plastic filter holders. Using an electronic microbalance the concentrations of particle were determined gravimetrically with 0.01 mg resolution (Mettler Toledo AT201). Samples were conditioned; both blank and field filter at constant (temperature 20±5°C, relative humidity 40±10%) for at least 24 h prior to being weighted. PM_{10} samples were measured by Beta ray absorption method.

Similarly, 6 sites were identified in Dalian city as well for the measurement of $PM_{2.5}$ and PM_{10} and data was monitored regularly by obtaining samples during the period from January to December 2013 (Fig. 2 & Table 2). To determine the concentrations of PM_{10} and $PM_{2.5}$ gravimetric method was adopted at monitoring stations. The data thus collected was compared with those of four different regional standards for $PM_{2.5}$ and PM_{10}. These air quality standards (QA/QC) and permissible limits of $PM_{2.5}$ and PM_{10} concentrations are NEQS-Pakistan (35µg/m^3 and 150 µg/m^3), USEPA-NAAQS (35 µg/m^3 and 150 µg/m^3), CNAAQS-China (75 µg/m^3 and 150 µg/m^3) and WHO (75 µg/m^3 and 150 µg/m^3) (Table 1).

***Statistical analysis*:** The particle concentration data of station wise analysis was presented as mean ± standard deviation (S.D) by using Microsoft Excel 2007.

Figure 2. Map of Dalian air monitoring stations.

RESULTS AND DISSCUSSION

***Date wise $PM_{2.5}$ concentration and comparison of Dalian and Faisalabad*:** The concentration of $PM_{2.5}$ was calculated for one year (January to December, 2013), samples were collected quarterly and data thus obtained of $PM_{2.5}$ form both is shown in Figure 3. $PM_{2.5}$ concentrations in Faisalabad varied from 22 to 49 µg/m^3 with an average of 36.5 µg/m^3. These concentrations are relatively lower than the other cities in the regions like Lahore-Pakistan (191µg/m^3), Bangkok-Thailand (143 µg/m^3), Beijing-China (148 µg/m^3), Chennai-India (46.5 µg/m^3), Bandung-Indonesia (72 µg/m^3), Manila-Philippine (391 µg/m^3), Hanoi-Vietnam (48 µg/m^3) but higher than the Islamabad-Pakistan (30 µg/m^3) (Husain *et al*., 2007; Hopke *et al*., 2008; Oanh *et al*., 2006). The minimum value of $PM_{2.5}$ concentration was found 22µg/m^3 in September, 2013 and maximum (49 µg/m^3) was recorded in January, 2013. The $PM_{2.5}$ concentration in Faisalabad was recorded to be higher than the NEQS and USEPA values from January to May, 2013 and reduced below the NEQS and USEPA from June to December, 2013. The $PM_{2.5}$ concentration decreased significantly in the month of August, 2013. On the other hand, The $PM_{2.5}$ concentration was found significantly lower than the permissible limits of CNAAQS and WHO. The average $PM_{2.5}$ concentration during the winter season (November to March) was found 39.5 µg/m^3 which was slightly higher than NEQS and USEPA standards 35 µg/m^3 and within the permissible limits of CNAAQS and WHO of 75 µg/m^3 (Table 2). The average $PM_{2.5}$ concentration during summer period (April to October) was found 34.28µg/m^3 and was within the permissible limits of NEQS, USEPA, CNAAQS and WHO (Table 2). The P.$M_{2.5}$ concentrations in Dalian city China is also given in Figure 3 and $PM_{2.5}$ concentration varied from 5.5 to 93.3 µg/m^3 with an average of 29.1 µg/m^3. The upper concentration of $PM_{2.5}$ recorded in Dalian was found higher than the other cities in the regions such as Chennai, Bandung, Hanoi, Islamabad and lower than Manila, Bangkok, Beijing and Lahore (Husain *et al*., 2007; Hopke *et al*., 2008; Oanh *et al*., 2006). The minimum value of $PM_{2.5}$ concentration was found 5.5µg/m^3 in December, 2013 and maximum (93.3 µg/m^3) in February, 2013. The $PM_{2.5}$ concentration was lower than the CNAAQS and WHO standards in the period January to April, 2013, whereas it was higher than the permissible limit May, 2013 and again decreased. The $PM_{2.5}$

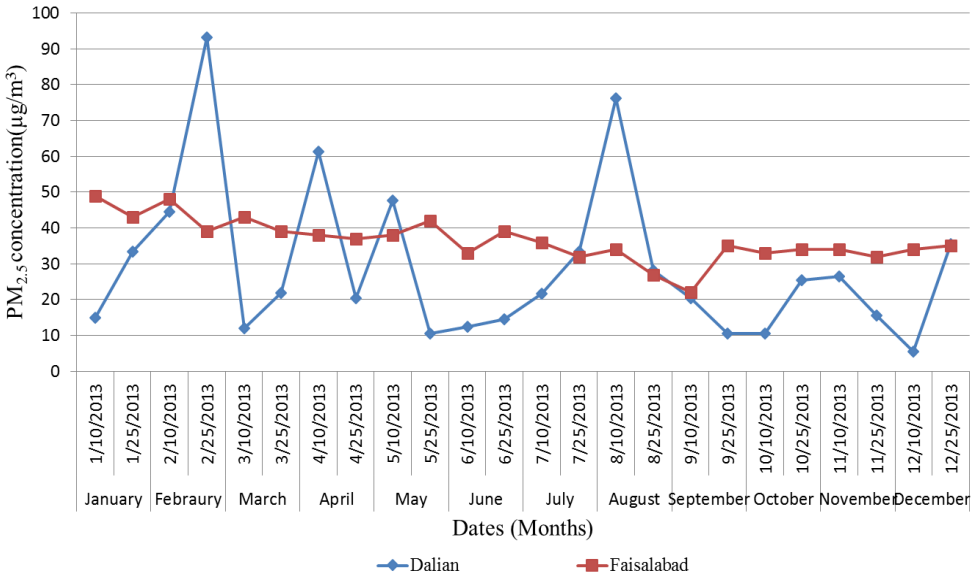

Figure 3. Month wise comparison of $PM_{2.5}$ concentration between Dalian and Faisalabad.

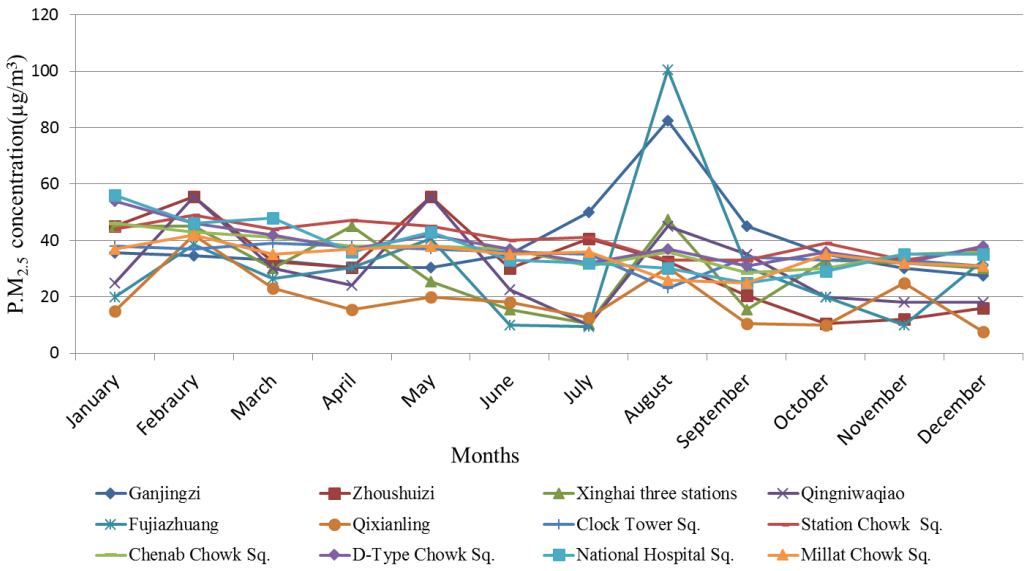

Figure 4. Station wise comparison of $PM_{2.5}$ between Dalian and Faisalabad.

concentration was lower than the CNAAQS and WHO standards throughout of the year, 2013, whereas it was higher than the permissible limit In February and August, 2013 and again decreased. The average $PM_{2.5}$ concentration in winter season (October to March) was found 28.3 µg/m^3, whereas during summer season (April to September), the average value was recorded to be 29.8 µg/m^3 which was lower than the NEQS (35 µg/m^3), USEPA standards (35 µg/m^3), CNAAQS and WHO standards (75 µg/m^3) (Table 2). The overall 75% of samples monitored in Dalian showed that $PM_{2.5}$ concentration was within the permissible limits of NEQS and USEPA standards and 92% of the overall values were within the permissible limits of CNAAQS and WHO (Table 2). Regarding $PM_{2.5}$ concentration in Faisalabad, 41% values were within the permissible limits of NEQS and USEPA standards, whereas 59% value did not meet these standards. The Dalian city showed that more samples were beyond the permissible limits as compared to dense population and road traffic density. The average $PM_{2.5}$ concentration of Faisalabad city in winter season higher than the dry summer season but the average $PM_{2.5}$ concentration of Dalian city in summer season higher than the winter season. The major sources of $PM_{2.5}$ in the air are automobiles and other construction equipment. The Figure 3 also shows the month wise comparison of $PM_{2.5}$ concentration in Faisalabad and Dalian which indicates that $PM_{2.5}$ concentration was higher in Faisalabad versus Dalian on average basis. In Figure 4 shows the monitoring station wise comparison of $PM_{2.5}$ concentration in Dalian and Faisalabad. These 6-measuring stations selected purely on the basis of residential, commercial, industrial and vehicular pollution. The minimum value of $PM_{2.5}$ concentration was found in Dalian at Qixianling station (19.1±9.86 µg/m^3) and maximum value at Ganjingzi station (39.1±15.10 µg/m^3) with an average value (30.33±15.42 µg/m^3). The minimum value of $PM_{2.5}$ concentration was found at Millat Chowk (34.1±4.9 µg/m^3) and maximum value at Station Chowk (40.4±5.6 µg/m^3) with an average value (36.5±5.9 µg/m^3) (Table 3). On average basis, the $PM_{2.5}$ concentration was recorded to be low at Dalian. However, there was a significant variation in $PM_{2.5}$ concentration in Dalian City as compared to Faisalabad.

Table 3. Station wise analysis of $PM_{2.5}$ (µg/m^3) concentrations.

Stations	Count	Sum	Average	Mean±SD
Clock Tower Sq.	12	414.0	34.5	34.5±4.3
Station Chowk Sq.	12	485.0	40.4	40.4±5.6
Chenab Chowk Sq.	12	439.5	36.6	36.6±5.2
D-Type Chowk Sq.	12	464.0	38.7	38.7±6.6
National Hospital Sq.	12	448.0	37.3	37.3±9.1
MillatChowk Sq.	12	409.0	34.1	34.1±4.9
Ganjingzi	12	469.2	39.1	39.1±15.10
Zhoushuizi	12	381.0	31.8	31.8±15.4
Xinghai three stations	12	374.0	31.3	31.3±12.8
Qingniwaqiao	12	358.5	29.9	29.9±14.9
Fujiazhuang	12	369.5	30.8	30.8±24.5
Qixianling	12	229.5	19.1	19.1±9.86

***Date wise PM_{10} concentration and comparison of Dalian and Faisalabad*:** The concentration of PM_{10} was also measured for 1 year at both cities. The PM_{10} concentration recorded at Faisalabad station is shown in Figure 5. PM_{10} concentrations in Faisalabad varied from 109 to 164.3 µg/m^3 with an average of 148.3 µg/m^3. These concentrations are relatively lower than the other cities in the regions such as

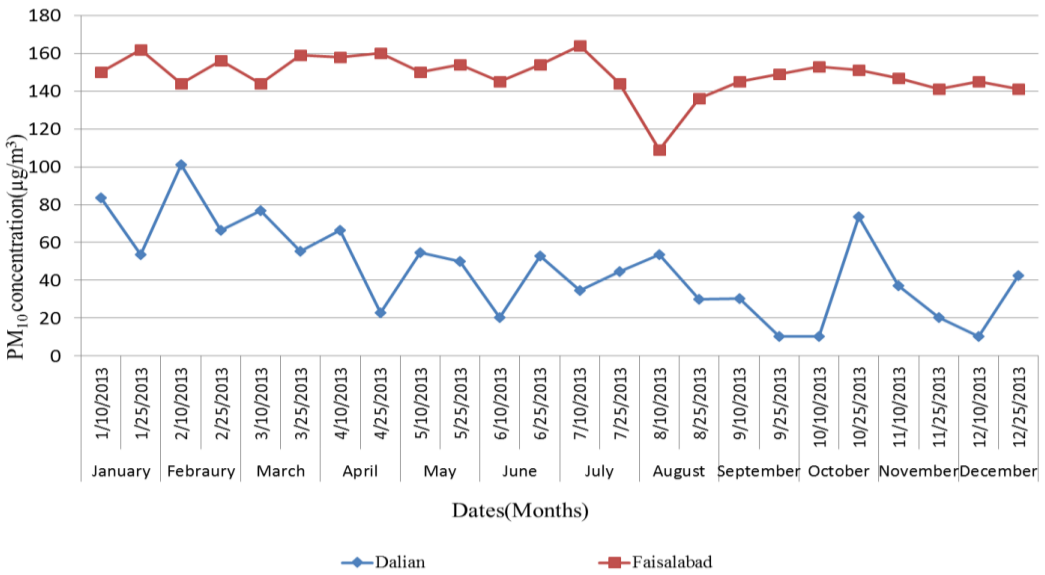

Figure 5. Month wise comparison of PM_{10} concentration between Dalian and Faisalabad.

Lahore-Pakistan (406 µg/m^3), Kolkata-India (197 µg/m^3), Peshawar-Pakistan (350 µg/m^3), Quetta-Pakistan (331 µg/m^3), Karachi-Pakistan (302µg/m^3), Islamabad-Pakistan (280 µg/m^3), whereas these were higher than the Hangzhou-China (119 µg/m^3), Punjab-India (116 µg/m^3), Beijing-China (140 µg/m^3), shanghai-China (100 µg/m^3), Taipei-China (60 µg/m^3) (Awasthi *et al*., 2011; Cao *et al*., 2009; Gupta *et al*., 2007). The minimum value of PM_{10} concentration was recorded to be 109 µg/m^3 in August, 2013, whereas maximum (164 µg/m^3) was in July, 2013. The PM_{10} concentration was relatively higher than the NEQS, USEPA, CNAAQS and WHO standards except November to December, 2013 (Table 2). The average PM_{10} concentration during the winter period (November to March) was 149.9 µg/m^3 which is slightly higher versus standard 150 µg/m^3, whereas in summer (April to October) it was found to be 148µg/m^3 which is within the permissible limits of NEQS, USEPA, CNAAQS and WHO standards (Table 2). Overall, 58% values were within the permissible limits of NEQS, USEPA, CNAAQS and WHO standards, whereas 42% did not meet the standards. The PM_{10} concentrations in Dalian are also shown in Figure 5, which was recorded to be in the range of 10.5 to 101.1 µg/m^3 with an average of 45.9 µg/m^3. The PM_{10} detected concentration was relatively lower Lahore, Kolkatta, Peshawar, Quetta, Karachi, Islamabad, Hangzhou, Punjab, Beijing, shanghai and Taipei (Awasthi *et al*., 2011; Cao *et al*., 2009; Gupta *et al*., 2007). The PM_{10} concentration in Dalian was lower than the CNAAQS, WHO, USEPA and WHO standards (150 µg/m^3) from January to December, 2013. The average PM_{10} concentration in winter season (October to March) was 52.6 µg/m^3, whereas in summer season (April to September) it was 39.2 µg/m^3 (Table 2) and overall, the detected values was recorded within the permissible limits set by international environmental agencies. The month wise comparison of PM_{10} concentration showed that Faisalabad showed linear behavior, whereas Dalian showed a significant variation which might be attributed to the different road traffic round the year. Regarding PM_{10} concentration among stations in Figure 6, Fujiazhuang showed minimum (29.6±12.9 µg/m^3), whereas was maximum value detected in Ganjingzi (61.4±21.9 µg/m^3) with average value of (46.05±16.6 µg/m^3). In Faisalabad, the minimum PM_{10} concentration was recorded at Millat Chowk (146.5±11.3 µg/m^3) and maximum at Station Chowk (151.2±13.9 µg/m^3) with average value of (148.6±11.5 µg/m^3) (Table 4).

Table 4. Station wise analysis of PM_{10} (µg/m^3) concentrations.

Stations	Count	Sum	Average	Mean±SD
Clock Tower Sq.	12	1783	148.6	148.6±11.9
Station Chowk Sq.	12	1815	151.3	151.3±13.9
Chenab Chowk Sq.	12	1799	149.9	149.9±8.4
D-Type Chowk Sq.	12	1779	148.2	148.2±10.9
National Hospital Sq.	12	1764	147.0	147.0±12.9
Millat Chowk Sq.	12	1759	146.6	146.6±11.3
Ganjingzi	12	737	61.4	61.4±21.9
Zhoushuizi	12	638	53.2	53.2±12.7
Xinghai three stations	12	706.0	58.8	58.8±26.4
Qingniwaqiao	12	513.5	42.8	42.8±14.9
Fujiazhuang	12	359.5	29.6	29.6±12.9
Qixianling	12	335.8	30.5	30.5±11.1

According to recent finding by (Goel and Kumar, 2014) the airborne particles come from a variety of exhaust and non-exhaust sources in the urban environments. Road vehicles are a major source of such type of particle emissions and these

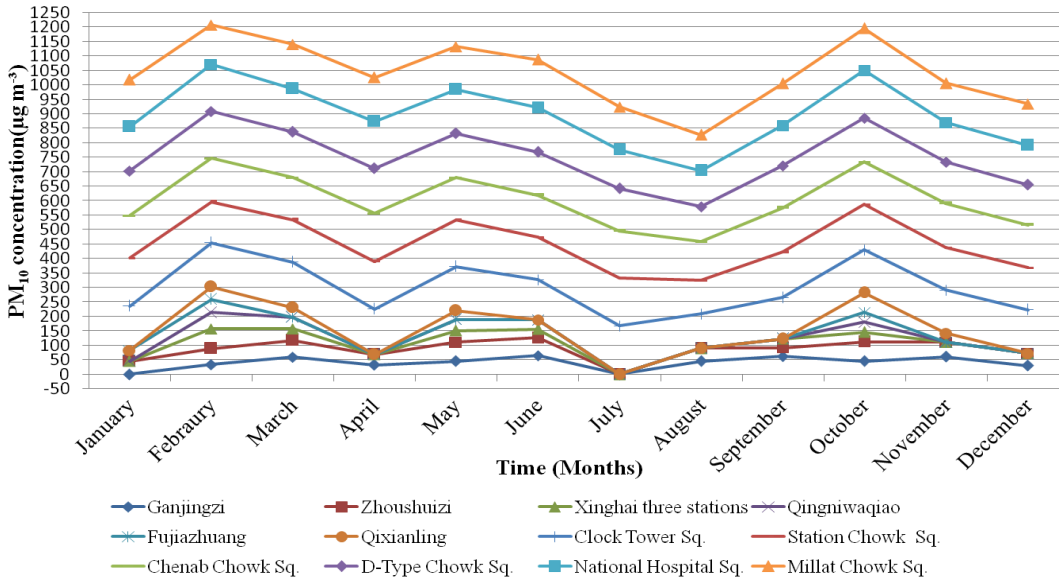

Figure 6. Station wise comparison of PM_{10} between Dalian and Faisalabad.

can contribute up to 90% in polluted urban environments. Small size of nanoparticles enables them to enter deeper into lungs, causing both acute and chronic adverse health effects such as asthma, cardiovascular and ischemic heart diseases. However, the number of excess deaths that occur in cities worldwide due to the exposure to nanoparticles are yet largely unknown. The measured PM in both cities was found higher some periods of the year and this situation may became more worsen in coming year due increased population and traffic in big cities like Dalian and Faisalabad e.g. the annual mean concentration of PM at the commercial city center was 332 µg/m^3 during 1978 and increased to 690 µg/m^3 in 1980, respectively. Similarly, at the Space and Atmospheric Research Center in Karachi the annual mean concentration of PM was recorded to be 239 µg/m^3 in 1985 and increased to 265, 275, and 328 µg/m^3 in 1986, 1987 and 1988, respectively and the annual mean PM concentrations during 1987 and 1988 in Karachi at the Sindh Industrial Trading Estate and Sadar sites were recorded 254, 459 and 333, 397 µg/m^3 respectively (Colbeck *et al*., 2010). The PM concentration within a specific year is likely to vary due to different road traffic level and weather conditions. An ambient air pollution survey was carried out at 13 sites in Karachi for 15 consecutive days during 1990. The survey reported that the daily mean concentrations of total suspended particulate (TSP) was found as 240±62 µg/m^3 (March), 230±55 µg/m^3 (May) and 260±57 µg/m^3 (June) (Ghauri *et al*., 1992a, 1994). Similarly, the measured average PM_{10} concentration in sindh Industrial Trading Estate and Korangi Industrial Area (Karachi) was recorded as 176.5 and 147.2 µg/m^3, respectively. The hourly average PM_{10} concentration at Port Qasim in Karachi for 7 days during November was recorded as 123.49 µg/m^3 (Hashmi *et al*., 2003, 2005a). The Pakistan Environment Protection Agency reported the concentration of PM at four different locations. The observed concentrations of TSP, PM_{10}, and $PM_{2.5}$ were found to be varying between 385–1,778 µg/m^3, 126–709µg/m^3 and 104-222 µg/m^3, respectively (PAK-EPA, 2007). The 24-hour average concentration of Total suspended particles (TSP) in Faisalabad for three months (June, July, August) 2010 on 24-sites was calculated 105-560 µg/m^3 with an average value of 363 µg/m^3 (Niaz *et al*., 2015). They are also reported the concentrations of particulate matter PM_{10} and $PM_{2.5}$ in 2011 on different locations in the Lahore city was 103 and 50 µg/m^3 (Colbeck *et al*., 2011). The most recent study was conducted in Lahore 2014 for measurement of P.M_{10} concentration of urban environment is 406 µg/m^3 (Alam *et al*., 2014). The annual average of PM_{10} concentration was decreased from 180 mg/m^3 in 1999 to 142 mg/m^3 in 2005 in Beijing. But the annual average of PM_{10} concentration was almost constant from 2003 to 2005, and was about 40% higher than the Chinese Grade-II standards and seven times as the latest WHO Air Quality Guidelines (He *et al*., 2001). In the last 10 years, the $PM_{2.5}$ concentration in Beijing has been widely reported. The first comprehensive $PM_{2.5}$ measurements in Beijing revealed the annual average of $PM_{2.5}$ concentration of 115 mg/m^3 at Chegongzhung (an urban site) from September 1999 to September 2000. Similarly, The annual average PM_{10} concentrations in Wuhan was reported to be 156 mg/m^3 at an urban site (Hankou), and 197 mg/m^3 at an industrial site (Changqian). The major sources like cement, steel manufacture, smelting and fugitive dust contributed up to 34% of the PM_{10} mass at the industrial site, followed by a 20% contribution from a coal-fired power plant and a 16%

contribution from the anthropogenic regional background (Querol *et al*., 2006). Another two week PM_{10} and $PM_{2.5}$ observation was made at a residential site in Wuhan in 1988. The average mass of PM_{10} and $PM_{2.5}$ was recorded as 225 and 139 mg/m^3 (Waldman *et al*., 1991). Then are also been reported some short term measurements of atmospheric PM in other mega cities such as Nanjing, Guiyang, Chongqing and Qingdao. The difference between the PM_{10} and $PM_{2.5}$ masses in these studies were probably due to the different in station, sampling period and other environmental conditions (Wang *et al*., 2002, 2003, 2006; Xiao *et al*., 2004; Zhang *et al*., 2005). The recent research study has been conducted for the measurement of $PM_{2.5}$ and PM_{10} concentration in the 31 provincial cities of china for the period of March 2013 to Feb 2014. The average $PM_{2.5}$ and PM_{10} concentrations were recorded in Tianjin (92±63 and 148±68 µg/m^3), Beijing (87±67 and 109±62 µg/m^3), Shenyang (67±48 and 115±62 µg/m^3), Wuhan (92±70 and 135±75 µg/m^3), Nanjing (75±50 and 134±73 µg/m^3), Shanghai (56±41 and 80±47 µg/m^3), Guangzhou (52±28 and 72±35 µg/m^3) and Wulumqui (69±44 and 135±64 µg/m^3), respectively (Wang *et al*., 2014).

***Conclusion*:** The ambient air particulate matter ($PM_{2.5}$ and PM_{10}) was evaluated in Dalian-China and Faisalabad-Pakistan in 2013. The $PM_{2.5}$ concentrations in Faisalabad is variable from 22 to 49 µg/m^3 with an average of 36.5 µg/m^3, whereas PM_{10} variation is from 109 to 164.3 µg/m^3 with an average of 148.3 µg/m^3. The $PM_{2.5}$ concentrations in Dalian varied from 5.5 to 93.3 µg/m^3 with an average of 29.1 µg/m^3, whereas PM_{10} values varied from 10.5 to 101.1 µg/m^3 with an average of 45.9 µg/m^3. Both the average $PM_{2.5}$ concentration in Faisalabad, in winter season is higher than the summer season. The quarterly average concentrations showed that the annual average concentrations of $PM_{2.5}$ and PM_{10} were higher than the Pakistan's NEQS and USEPA, whereas within the limits set by CNAAQS and WHO. The Dalian city showed the PM concentration within the permissible limits. The station wise analysis showed that the transportation is a major source of such high concentrations of PM.

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