Analysis Of Particulate Matter Present In The Surroundings Of Udhampur District, J&K

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Abstract: In this research, we sought to evaluate the current air quality in the surroundings of Udhampur District, J&K. Results overwhelmingly demonstrate that all observed levels slightly exceed the PM10 and PM2.5 limitations set by the Central Pollution Control Board. There was a significant difference in the presence of particulate matter during the day and night. Local air pollution may be significantly exacerbated by the dust produced at the construction site by a variety of construction operations. When dust concentrations are high and other outdoor air contaminants are also present, respiratory issues may result. Although the current ambient air quality parameters are not much out of allowable limits, the construction activities and machine operation during the construction phase will have a temporary impact on the neighborhood. However, good site practices will help to maintain the ambient air quality parameters within limits.

Key words: Particulate matter, Ambient Air Quality, Udhampur

Introduction

In cities across the globe, gaseous and particle air pollution are known to reduce life expectancy and contribute to several cardiac and respiratory conditions. During the industrialization era, governments in Europe and the US began to realize the issue of particle air pollution, which prompted them to take steps to enhance air quality and so lessen the harmful health impacts caused by particulate air pollution. Even though particle concentrations have been steadily declining in many areas, air pollution has continued to be a significant cause of death and illness. Even low levels of air pollution are dangerous, and there is no number below which negative consequences don't happen. Now, 2.1 million premature deaths globally are thought to be brought on yearly, on average, by anthropogenic PM2.5 emissions [1]. Additionally, it has been calculated that every 10 mg/m^3 rise in PM2.5 concentration results in an 11% increase in cardiorespiratory mortality and a 6% increase in overall mortality. China has seen significant industrialization and economic growth in recent decades, which has led to persistently high levels of air pollution [2]. When emissions from traditional agricultural burning are coupled with emissions from an increased energy output, transportation, and industry, the resultant combination is considerably different from the existing levels of air pollution in many other industrialized civilizations.

According to estimations, air pollution in northern China shortens lives by 9 months in Europe while cutting them by an average of 5.5 years in northern China. respiratory and heart conditions are the most common ailments caused by particulate air pollution. Additionally, lung and other organ cancers are more likely to develop because of air pollution. Inflammation, oxidative stress, and genotoxicity are the key toxicological pathways linked to these disorders, although cytotoxicity may also cause harm to the cardiorespiratory system. Urban air pollution was classified as human carcinogenic by the International Agency for Research on Cancer in 2013. However, the exact processes by which air pollution exerts its harmful health consequences and which pollution ingredients are accountable for the damage produced are yet unknown [3]. Using the same techniques, particle air pollution samples were collected from six European cities and analyzed for their chemical makeup and any ensuing toxicological consequences in vitro and in vivo. The observed toxicological endpoints are affected by meteorological conditions, solar radiation, and emission sources, all of which change over time and are particularly different throughout the day and night. However, these factors are seldom ever considered when determining the particulate material's toxicity [4]. Our sample effort was carried out in the J&K district of Udhampur. With this study, we aimed to assess the level of particulate matter present in the air surrounding the 5 sites of the Udhampur district.

Material and methods

According to the Survey of India, the study area is close to Block No. 5 of Village Udhampur, Tehsil Udhampur, and District Udhampur, and is situated within a 10-kilometer range of the research site (Jammu & Kashmir). Core and buffer zones constitute the research area of the environmental impact assessment. The monitoring stations' sensitivity was evaluated by considering their closeness to sensitive or constructed zones.

- **Selection of Sample**

  Samples were collected from 5 different areas in the Udhampur districts of the village (Jammu & Kashmir). The air samples were collected 4 times in 24 hours. 2 times during the day and 2 times during the night. During the collection period, meteorological variables and the state of the air were noted to pinpoint the air pollution source sites. Chemical tests were performed on the obtained particle samples. On the sample station, a climate-controlled container was situated on the roof of a five-story structure at the NJU Xianlin campus. Every morning at dawn and every evening at twilight, the filters were replaced. The daytime sample was taken at 9 a.m. and 3 p.m., and the nighttime samples were collected at 9 p.m. and 3 a.m. The equivalent total sampling volumes for the daytime and the nighttime samples were 2800 m^3 and 3225 m^3, respectively.

  At the campaign location, climatic variables and air quality were continuously measured. According to the obtained filter sample periods, day's data was segregated from night's data. At a sampling rate of 850 l min^{-1}, the particle samples were taken using a Harvard high-volume cascade impactor. A 180 cm lengthy sample tube with a 60-centimeter extended cone-shaped

adjustable component was attached to the impactor. With the help of this tube, sampling was possible 150 cm above the tin roof. The applied sample volume flow rate required a sampling tube intake with an upper cutoff size of 10 mm. To prevent humidity condensation, the sample lines and impactor within the container were insulated. The samples were taken in four stages; samples of the size range $PM_{2.5}$ and PM_{10} were taken on polyurethane foam sampling substrates. Except for air sampling, the blank control filters were handled precisely like the real utilized filters.

- **Chemical analysis of the collected sample**
  The CH_3OH-washed filters were weighed using an analytical scale that had an electrostatic charge remover built in both before and after sample collection. The fluoropore filters and PUF sample materials were given time to adjust to the weighing room's conditions before each weighing. Every time, the ambient temperature, pressure, and humidity were recorded. The filters were weighed before being put into fifty ml glass tubes filled with CH_3OH of High-Performance Liquid Chromatography. The samples were processed in those tubes for two hours and thirty minutes at a temperature no higher than 35 °C. The surplus methanol was then evaporated in a rotary evaporator at 150 m bar and 35°C after the samples were pooled according to the size range. After sample extraction and suspension procedures, the concentrated suspension was divided based on particle mass into 10 ml glass tubes, dried under N flow (99.5%), and then kept at 35°C for storage. The samples of dried particle material were kept at 20°C. The appropriate blank sample substrates were prepared using the same method.
- **Characterization of particulate matter**
  Inductively coupled plasma mass spectrometry was used to examine metals and other elements following EN ISO 17294-2. First, the samples were eluted. with HF and HNO_3, then heat up to a temperature of 190°C for 20 minutes. Ni had detection limits of 0.005 mg, Mn, Ag, and Zn of 0.025 mg, Fe of 0.075 mg, Mg of 0.25 mg, and Ca of 1 mg. The chemicals were separated using an HP-17-MS column. The system was run in the SIM (selected ion monitoring) mode.
- **Statistical analysis**
  IBM SPSS Statistics version 25 was used to conduct the statistical analysis. The Kruskale-Wallis test was used to compare the data obtained at a significance level of 0.05 (p-value).

Results

The samples obtained from 5 different locations in the Udhampur district were evaluated for the presence of particulate matter. The samples were collected 4 times during a day at 6-hour intervals.

- **Ambient air quality**
  Table 1 represents the ambient air quality ($\mu g/m^3$) of the studied locations both during the day and at night.

Table 1. The ambient air quality of the study area

Locations	Parameter ($\mu g/m^3$)	Day		Night	
		9AM	3PM	9PM	3AM
Site 1	$PM_{2.5}$	11.83	14.98	12.87	8.01
	PM_{10}	19.12	22.19	23.72	17.14
Site 2	$PM_{2.5}$	11.01	15.83	15.17	8.24
	PM_{10}	19.86	23.34	22.87	15.43
Site 3	$PM_{2.5}$	11.14	12.78	13.57	9.20
	PM_{10}	18.07	20.54	22.85	17.42
Site 4	$PM_{2.5}$	11.19	15.06	11.68	8.63
	PM_{10}	19.08	22.12	21.44	15.18
Site 5	$PM_{2.5}$	12.26	13.97	13.07	8.31
	PM_{10}	20.64	24.26	21.29	16.10

At site 1, the observed average $PM_{2.5}$ levels were 11.83 $\mu g\ m^{-3}$ at 9 AM and 14.98 $\mu g\ m^{-3}$ at 3 PM in the day-time whereas at night, it was 12.87 $\mu g\ m^{-3}$ at 9 PM and decreased significantly at 3 AM (8.01 $\mu g\ m^{-3}$). PM10 levels were observed higher at 9 AM (23.72 $\mu g\ m^{-3}$) whereas lowest at 3 AM (17.15 $\mu g\ m^{-3}$) (Figure 1a). At site 2, levels of $PM_{2.5}$ and PM_{10} were 11.01 $\mu g\ m^{-3}$ and 19.86 $\mu g\ m^{-3}$ at 9 AM and 15.83 $\mu g\ m^{-3}$ and 23.34 $\mu g\ m^{-3}$ at 3 PM respectively whereas, at night, it was 15.17 $\mu g\ m^{-3}$ and 22.87 $\mu g\ m^{-3}$ at 9 PM and 8.24 $\mu g\ m^{-3}$ and 15.43 $\mu g\ m^{-3}$ at 3 AM respectively (Figure 1b). At site 3, the higher PM2.5 levels were observed at 9 PM (13.57 $\mu g\ m^{-3}$) whereas the lowest was recorded at 3 AM (9.20 $\mu g\ m^{-3}$) whereas PM10 was higher at 9 PM and lower at 3 AM (Figure 1c). Similarly, at sites 4 and 5, the higher levels of PM2.5 were observed at 3 PM (15.06 $\mu g\ m^{-3}$ and 13.97 $\mu g\ m^{-3}$ respectively) and lowest at 3 AM (8.63 $\mu g\ m^{-3}$ and 8.31 $\mu g\ m^{-3}$ respectively) whereas PM10 were observed higher at 3 PM (22.12 $\mu g\ m^{-3}$ and 24.26 $\mu g\ m^{-3}$) and lowest at 3 AM (15.18 $\mu g\ m^{-3}$ and 16.10 $\mu g\ m^{-3}$) respectively at site 4 and 5 (Figure 1d-e).

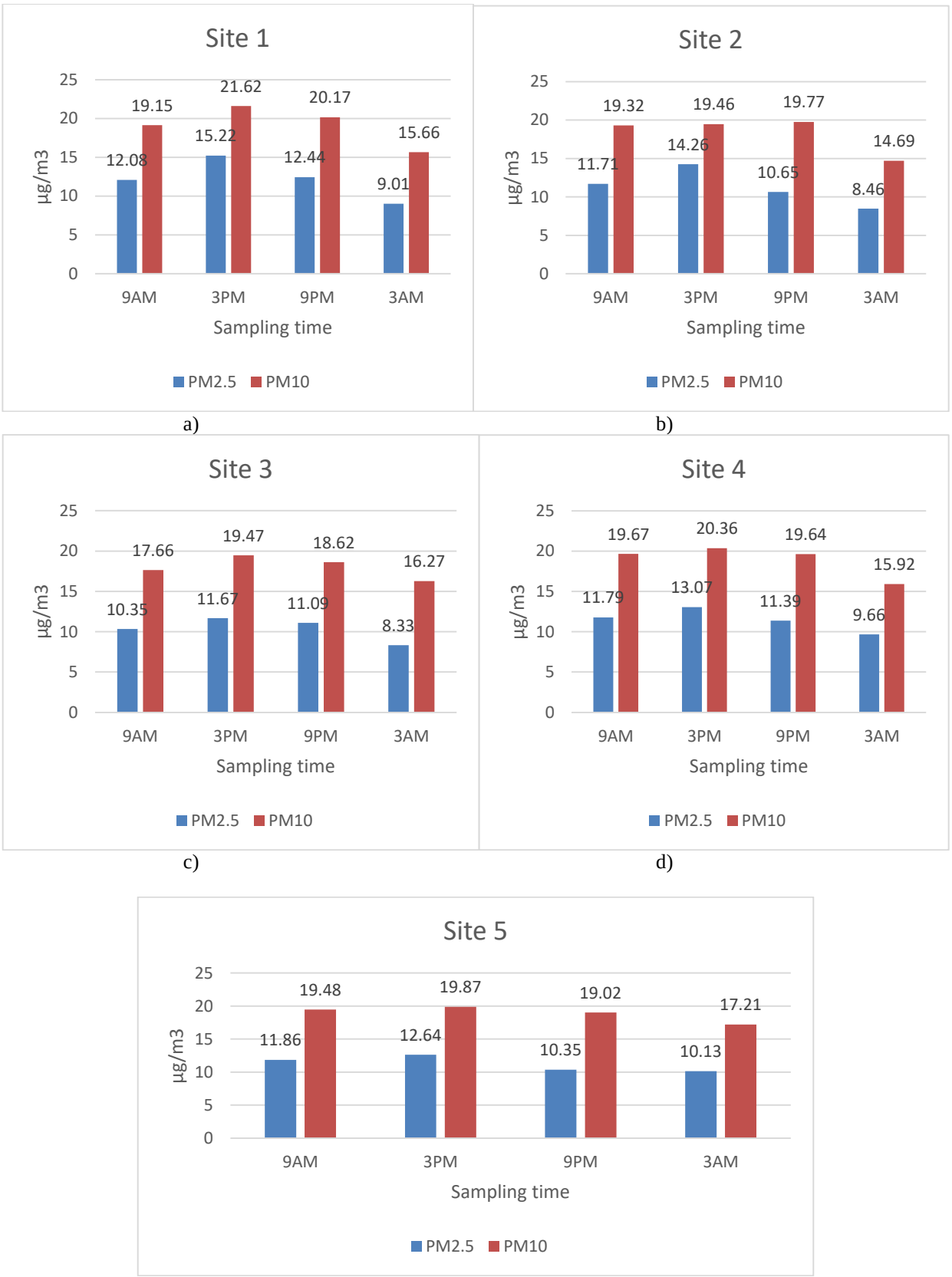

Figure 1. Level of $PM_{2.5}$ and PM_{10} at various studies sites (a-e).

- **Chemical Composition**

Table 2 represents the average chemical composition (ions and metals) of the day- and night-time samples.

Table 2. Average chemical composition (ions and metals) of the day- and night-time samples		
Elements (µg/m^3)	**Day**	**Night**

SO_4	34.15	23.4
PO_4	3.15	4.96
NO_3	106.45	98.1
Zn	1.35	1.04
Cl-	8.82	5.12
Pb	0.06	0.06
Ni	0.04	0.03
Na	2.01	2
Mn	0.18	0.22
Mg	1.57	2.75
k	3.95	4.01
As	0.02	0.02
Ag	0.88	0.15
Ca	23.64	19.4
Fe	8.75	8.53
Cu	1.03	0.29
Sr	0.04	0.06

The average level of the studied elements was higher in the daytime and lower at night except for PO_4, Mn, Mg, k, and Sr which were observed to have lower concentrations during the daytime.

Table 3. Significance value between air quality ($PM_{2.5}$ and PM_{10}) during day and night.

Location	Time	Sig. (2-tailed)	
		PM2.5	PM10
Site 1	**Day**	0.014	0.013
	Night	0.031	0.027
Site 2	**Day**	0.045	0.023
	Night	0.011	0.030
Site 3	**Day**	0.038	0.025
	Night	0.022	0.012
Site 4	**Day**	0.003	0.042
	Night	0.003	0.007
Site 5	**Day**	0.021	0.040
	Night	0.003	0.023

The significant value between air quality ($PM_{2.5}$ and PM_{10}) during day and night were depicted in table 3. Both $PM_{2.5}$ and PM_{10} levels showed statistically significant differences between the levels at 9 AM and 3 PM during the day and also at night between 9 PM and 3 AM at all the studied sites. It indicated that the levels of both $PM_{2.5}$ and PM_{10} levels decreased significantly at night as compared to the daytime.

Discussion

The hazardous potencies of the PM samples obtained at night and during the day were found to vary significantly. Two shifts were taken to measure toxicity in the air, the timing was 9 am and 3 pm during the daytime, and 9 pm, and 3 am during the nighttime. Daytime samples acted as more powerful inducers of the examined parameters than nighttime samples due to a considerable variation in the particle chemistry between the two. But in the daytime, 3 pm was more active than 9 am and at 9 pm was more active than 3 am. In addition, the night and day had varied wind directions. Additionally, the toxicity caused by particles in various size ranges varied significantly, demonstrating the importance of various emission sources.

Midnight particulate matter concentrations were almost the same throughout the three mass fractions studied (Particulate Matter 2.5 and 10). However, Jalava et al., (2010) showed that the polyurethane foam sample substrate in the latter stages of the high-volume cascade impactor also collects gaseous polycyclic aromatic hydrocarbons compounds, therefore it's important to note that Particulate Matter 10-2.5 had the lowest total polycyclic aromatic hydrocarbons concentrations [5].

The ratio of sulfate to N_3 was higher in daytime samples across all particle size ranges (Particulate Matter 2.5 and 10), but nitrate concentrations were higher in nighttime samples. Concentrations of sulfate and nitrate in the PM10-2.5 size range rarely

changed between day and night. In an epidemiological study conducted by Willis et al., (2003), sulfate aerosol was connected to harmful health impacts [6].

Endotoxin, carbonaceous chemicals, and metals were identified to be the primary chemical constituents influencing inflammatory reactions in particles collected from the emission intervention scenario during the "Beijing Olympic Games", according to research by Shang et al. (2013) [7].

In the small particle size range, these anions were in excess compared to the cations under investigation., and nitrate and sulfate constituted the largest fraction of the particulate mass. This suggests that these are mostly secondary aerosol species, which Sillanpaa et al., (2006) observed to be present in ambient air samples as ammonium sulfate and ammonium nitrate [8].

Samples collected during the day had a higher concentration of phosphate across all particle sizes compared to those collected during the night. Since there is no permanent gaseous form of phosphorus in the atmosphere, it must come from local daylight particle sources. Phosphate may, for instance, result from the chemical industry or the burning of coal, as studied by Mahowald et al., (2008) [9].

Metals have been demonstrated to contribute to several harmful effects of air pollution. According to research by Beaver et al., (2009), persistent tissue damage and inflammation brought on by repeated exposure to Cr (VI) particles may promote Cr (VI)-mediated carcinogenesis [10].

Conclusion

Nowadays, air pollution is the leading cause of premature death in developed countries. Life expectancy has dropped by about 5 years in certain parts of India due to air pollution, providing a stark example of the potential consequences of the current air pollution situation for human health. Vehicle emissions, fuel combustion in industries, and diesel generator usage all have a role in the midday increase in NO3 and SO2 concentrations seen in this research. Higher levels of PM10 were observed throughout the day because of the presence of factories and the burning of coal as a fuel, as well as the poor condition of the roads and the large volume of traffic. However, in all locations, the total concentration of individual pollutants was below the thresholds established by the National Ambient Air Quality Standards (NAAQS).

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