Short communication

Dust Particle (PM_{10} and $PM_{2.5}$) Monitoring for Air Quality Assessment in Naryanganj and Munshiganj, Bangladesh

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Abstract

The present study is aimed to quantification of $PM_{2.5}$ and PM_{10} particulates from Narayanganj and Munshiganj by using Eco Tech Air samplers. Narayanganj is situated near the capital city of Dhaka. The river port of Narayanganj is one of the oldest district in Bangladesh. On the other hand, Munshiganj is a district in central Bangladesh. It is a part of the Dhaka Division and borders Dhaka District. There were two sites in Narayanganj, namely Pachani, Mongoler Gao, and Chorhogla/Balirghat, Kashimnagar, Sonargaon. The other two sites in Munshiganj are Gowal Gao and Vati Bolaki Government Primary School. The air samplings were done in four locations from 14 August to 7 September 2016 using same two Eco Tech Air samplers but in a cyclic order. All the samples were collected for 24h. It has found that the PM concentrations are significantly low in study areas. This is due to meteorological effect and as well as less anthropogenic activities in those areas. The Exceedance Factor (EF) levels of both $PM_{2.5}$ and PM_{10} were within the limits of low pollution area.

Keywords: air pollution, air quality, exceedance factor, particulate matter

1. Introduction

Air pollution has become one of the serious environmental concerns in urban areas, especially in view of the adverse health effects that have been associated with ambient fine particles [1, 2]. The rates of increase in pollutant concentrations in the cities of developing countries are higher than those of developed countries [3]. Up to 10% of respiratory infections and disease in Bangladesh may be attributable to urban air pollution [4]. While the problem is most severe in Dhaka, both because the air quality is poor and large number of people are exposed. The air pollution is also becoming a growing concern in other major cities of Bangladesh. The rapid growth in population, urban and industrial activities resulted in deterioration of air quality in urban environments. The major air pollutants deteriorated air quality is fine particulate matter and gaseous aerosols. Fine particulate matter is respirable in nature and is considered as potential pollutant which causes economic loss and health implications on society. Like other developing Southeast Asian countries, emissions from various kinds of diesel vehicle and badly maintained automobiles contribute most to air pollution problems. Ambient particulate matter (PM) with aerodynamic diameter <10 μm (PM_{10}) have both short-term and chronic adverse effects on health in both children and adults [5-7]. Pollution due to fine particle in the atmosphere primarily consists of micron and sub-micron particles from the manmade sources such as motor vehicles, industrial emissions, biomass burning, fossil fuel burning, and natural sources such as windblown soils and sea spray. A high concentration of air pollutants such as black carbon in Dhaka City air has been reported [8]. Vehicular emissions, as well as burning of biomass for cooking and coal in the brick kilns around the city, are the main contributor to these emissions. The characterization of these fine particles is very important for the regulators, and researchers due to their potential impact on human health, their ability to travel thousands of kilometers across countries, and their influence on climate forcing and global warming. Several Government policy interventions such as banning of two-stroke baby taxi, promotion of compressed natural gas (CNG) as alternative fuel for vehicles, improved inspection and maintenance of vehicles, especially diesel vehicles, etc. have been implemented to reduce the PM pollution in Dhaka city. The present study is aimed to quantification of $PM_{2.5}$ and PM_{10} particulates in Narayanganj and Munshiganj. The study is undertaken to understand the air quality status of the monitoring sites.

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2. Materials and Methods

2.1 Description of Sampling Sites

Pachani, Narayanganj: The samplers were placed at the roof of the mosque. The mosque is adjacent to the Meghna river. There are many boats which are driven by diesel engines. There are few houses at the west side of the mosque.

***2.1.1 Chorhogla/Balirghat, Narayanganj*:** The Ecotech samplers were placed at open yard of the houses. The site is also adjacent to the Meghna river. People use wood for their cooking.

***2.1.2 Gowal Gao, Munshigonj*:** Samplers were placed at open yard of the houses. The site is also adjacent to the Meghna river. People use wood for their cooking.

***2.1.3 Vati Bolaki Govt.primary School, Munshigonj*:** The samplers were placed at the roof of the mosque. The mosque is adjacent to the Meghna river. There are many boats which are driven by diesel engines.

2.2 Measurement of PM Concentration

PM Masses were measured in the Chemistry Division of the Atomic energy Centre, Dhaka (AECD) laboratory. The aerosol samples having PM were determined by weighing the filters before and after exposure using a micro balance

(METTLER Model MT5) maintaining room temperature approximately at 22°C and relative humidity at 50%. The air filters were equilibrated at constant humidity and temperature of the balance room before every weighing. The concentration of black carbon (BC) in the fine fraction of the samples is determined by reflectance measurement using an EEL-type smoke stain reflectometer.

3. Results and Discussion

Table 1 shows the daily PM_{10} and $PM_{2.5}$ concentrations of two locations in Munshiganj. It has found that the average PM_{10} concentrations in Vati Bolaki and Gowal Gao are 33.9±9.49 μg/m^3 and 34.0±12.9 μg/m^3 respectively. On the other hand, the average $PM_{2.5}$ concentrations in Vati Bolaki and Gowal Gao are 13.6±5.16 μg/m^3 and 18.2±8.31 μg/m^3 respectively. The small variation in these two sites is due to local contributions. The sampling site at Vati Bolaki is in the roof of the mosque but in Gowal Gao, the location was in the open area near houses. The high PM concentrations at Gowal Gao are due to house hold activities such as cooking, sweeping etc. There is also day to day variation which is due to rainy season.

Table 2 shows the daily PM_{10} and $PM_{2.5}$ concentrations of two locations in Narayanganj. It has found that the average PM_{10} concentrations in Pachani and Chorhogla are 28.6±12.4 μg/m^3 and 38.5±19.1 μg/m^3 respectively. On the other hand, the average $PM_{2.5}$ concentrations in Pachani and Chorhogla are 11.0±1.84 μg/m^3 and 19.1±5.34 μg/m^3 respectively. The variation in these two sites is due to local contributions. The sampling site at Pachani is in the roof of the mosque but in Chorhogla, the location was in the open area near houses. The high PM concentrations at Chorhogla are due to house hold activities such as cooking, sweeping etc.

Table 1: The PM concentrations (μg/m^3) at Vati Bolaki and Gowal Gao in Munshiganj during monitoring period

Sampling Date	Vati Bolaki		Sampling Date	Gowal Gao	
	PM_{10}	$PM_{2.5}$		PM_{10}	$PM_{2.5}$
	μg/m^3			μg/m^3	
14/8/2016	32.8	15.2	15/8/2016	23.3	11.5
18/8/2016	34.0	17.4	19/8/2016	43.9	24.8
23/8/2016	54.0	22.0	24/8/2016	54.9	31.2
27/8/2016	24.8	10.8	28/8/2016	25.2	13.6
31/8/2016	28.6	9.25	1/9/2016	22.5	9.94
04/9/2016	29.2	6.80	5/9/2016	21.0	9.34

Table 2: The PM concentrations (μg/m^3) at Chorhogla and Pachani in Narayanganj during monitoring period

Sampling Date	Chorhogla		Sampling Date	Pachani	
	PM_{10}	$PM_{2.5}$		PM_{10}	$PM_{2.5}$
	μg/m^3			μg/m^3	
16/8/2016	25.1	14.2	17/8/2016	20.7	11.8
20/8/2016	75.1	29.3	21/82016	25.5	12.1
25/8/2016	43.8	21.6	26/8/2016	27.5	12.1
29/8/2016	24.0	13.7	30/8/2016	15.1	8.69
02/9/2016	24.6	16.6	3/9/2016	54.2	10.5
06/9/2016	21.6	18.2	7/9/2016	31.7	14.7

In all sites, the PM_{10} and $PM_{2.5}$ level observed is low compared to Bangladesh National Ambient Air Quality Standard which is set for PM_{10} and $PM_{2.5}$ are 150 μg/m^3 and 65 μg/m^3 respectively [9]. There are two reasons for this low value. One is for rainy season and the other is no other anthropogenic activity except biomass burning for cooking and diesel engine boats. It has been found that the ratios of BC/$PM_{2.5}$ in Pachani, Chorhogla, Vatibolaki and Gowal Gao are 0.16±0.06, 0.23±0.05, 0.21±0.09 and 0.20±0.05 respectively. From this study, it has found only on average 20% of $PM_{2.5}$ is BC.

It is found that the PM concentrations are lower than the previous study [10] which was done during winter season. The present study has been done during rainy season. In the present study, the PM concentrations are lower than Bangladesh National Ambient Air Quality Standard (BNAAQS, 2005) data for $PM_{2.5}$ and PM_{10}. The exceedance factor (EF) can be used in order to assess the air quality of an area. Exceedance Factor (EF) is calculated using equation 1. There are four air quality categories based on exceedance factor; these are

Critical pollution (C) - when EF is more than 1.5; high pollution (H) - when EF is between 1.0 to 1.5; Moderate pollution (M) - when EF is between 0.5 to 1.0; Low pollution (L) - when FE is less than 0.5.

The air quality of different study locations with respect to size has been compared with Bangladesh National Ambient Air Quality Standard (BNAAQS) and has been categorized into one category based on Exceedance Factor (EF) and has been categorized into four categories based on exceedance factor (EF).

$$EF = \frac{Observeddailymeanconcentration}{24haverages\tan dardfortherespectivepollu\tan t} \quad (1)$$

From the Table 3, it is noticed that in study areas both $PM_{2.5}$ and PM_{10} were reported air quality is low pollution. It has found that EF value in the different study locations is similar which is <0.5 and shows low pollution [11] areas.

Table 3: Exceedance factor (EF) of particulate matter in the study areas

Study Area	$PM_{2.5}$	PM_{10}	EF value
Vati Bolaki	0.2	0.2	Low pollution
Gowal Gao	0.2	0.3	Low pollution
Chorhogla	0.3	0.3	Low pollution
Pachani	0.2	0.2	Low pollution

4. Conclusion

From source apportionment study it was found that about 50.4% of total fine PM came from biomass burning/brick kilns. It has also found that concentrations of O_3, CO, SO_2 and NO_X are lower than the corresponding BNAAQS. It was also found that high PM concentrations were found only in winter season. The results of the present study shows that significant low fine PM concentrations in study

areas. This is due to meteorological effect and as well as less anthropogenic activities in those areas.

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