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Tracking of possible sources of Dhaka city air pollutants

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***Abstract*— The air quality of Dhaka city is regarded polluted. The exact sources of these pollutants are not known. The objective of the present study is to identify the possible sources within and surrounding areas of the city. There are various types of regulated and unregulated hazardous industries running within greater Dhaka, among them are cement, coal fired brickfields, stone crushers, garments, dying, tanneries, small chemical industries, as well as agricultural activities. A significant number of these facilities are old and use indigenous technologies. Within the greater city, substantial civil constructions including major flyover and buildings are ongoing. The city is traffic congested releasing high level of vehicular emission and tire wears. For the present studies three possible primary sources (cement industry, rock crusher and brick fields) and two secondary sources (road dust and airborne soil from agricultural fields) are examined. Results show some correlation between industrial emission and city air quality. However, other industries emissions should be included for conclusive result.**

INTRODUCTION

Air quality is one of the major environmental and health concerns in Bangladesh particularly in big cities. However, government and some non-government agencies have taken positive initiatives and steps in reducing vehicular emission by banning 2-stroke tri-wheeler and replaced them with 4-stroke CNG driven tri-wheeler in 2002. This approach has significantly improved the city air quality, but still the ambient air quality fails to meet the WHO standards [1-4].

Air pollutants are attributed to natural or man-made sources and may take the form of solid particles, liquid droplets or gases. The US EPA listed 188 toxic air pollutants in 1990 Clean Air Act Amendments, which are to be controlled. These pollutants are divided into various groups such as particulate matter, volatile organic compounds and halogen compounds including e more commonly–known pollutants such as lead, mercury and asbestos [5].

Trace heavy metals contamination in the environment is a major concern because of their toxicity and threat to human and environment. Trace heavy metals like arsenic, cadmium, chromium, cobalt, copper, lead, mercury, manganese, nickel, vanadium and zinc along with many other elements were found in the ambient air of Dhaka city [1, 4].

The characteristics of the sources of air pollutants are vital to understand the severity of their impact on the pollution and to establish proper abatement plans. One of the main difficulties in air pollution management is to determine the quantitative relationship between ambient air quality and pollutant sources. The objective of the present study was to identify the potential local air pollution sources particularly air borne heavy metal sources.

MATERIALS AND METHODS

In the present studies, three possible primary sources (cement industry, rock crusher and brick fields) and two secondary sources (road dust and airborne soil from agricultural fields) are examined. Eleven representative samples were collected. The soil samples were collected from Joynabari in Hemayetpur and Basta in Keraniganj and road dusts were Mohakhali, Farmgate, Gulistan, Jatrabari and Rayerbagh in Dhaka city. Coal samples were collected from HMB and HNB brickfields at Aminbazar, Dhaka and rock dust sample was taken from stone crushing areas near Kachpur Bridge. The cement sample (as a surrogate cement industrial fugitive particulate emission) collected from commercially available product of Scan Cement Company.

Approximately 500 g of road dust samples were collected from the pavement edges of different locations, the samples were then stored in small plastic containers. The road dust, soil and rock dust samples were screened through ASTM NO 35 sieve (500 μ) to remove extraneous matter such as small pieces of brick, paving stone, and other debris. The samples were further screened through ASTM NO 100 sieve (150 μ) and preserved in sealed plastic bags for subsequent sample preparation and analysis. The samples were dried and ground into fine powder in a mortar and preserved in sealed bags for analysis.

Approximately 0.25g from each sample was digested using Anton Paar Microwave 3000 acid digester. The digested samples were filtered and transferred to volumetric flask and diluted to 100 ml for ICP, AAS and Flame-Photometric analysis. HNO_3, HCl and HF acids were used in different proportions for different types of samples as recommended in the digester's programmed library.

Proper laboratory quality control procedures were also followed for the reliability of the analytical results. Duplicate and spiked samples were made and analyzed to check the accuracy of the concentration data. Control samples were also run to know the contaminants in the reagent. Moreover, equipments were calibrated with standard solution prior to analysis and in the middle of the analysis for monitoring the equipment performance.

RESULTS AND DISCUSSIONS

Based on literature and previous research work twelve elements (Ca, Cd, Cr, Co, Cu, Fe, K, Mg, Mn, Ni, Pb and V) were selected as pollution precursor for the present studies. In addition Zn in coal samples was also looked at. The elemental concentrations of the samples are shown in Table 1 and 2 below.

Table 1. Elemental analysis of soil, coal, rock dust and cement samples

Element	Elemental Concentrations (mg/kg)					
	Soil Joynabari	Soil Basta	Coal, HMB Brickfield	Coal, HNB Brickfield	Rock dust Kachpur	Cement Rupganj
Ca	7773	5172	3237	3917	4717	166547
Cd	4.15	ND	ND	ND	ND	4.66
Cr	113	133	49.8	36.6	62.1	267.4
Co	19.9	21.2	2.65	3.12	16.3	36.4
Cu	86.6	90.1	48.8	33.7	69.4	165.1
Fe	38500	40467	14747	14209	17034	14429
K	15700	13960	ND	ND	8058	18200
Mg	12376	3842	ND	ND	1396	2189
Mn	812	698	19.4	45.5	675	684.4
Ni	54.5	73	43.6	16.2	25.2	165.1
Pb	174	50.5	14.2	14.3	50.5	140.7
V	125	155.7	46.3	44.8	109	93.3
Zn	-	-	36.1	18.2	-	-

Table 2. Elemental analysis of road dust samples collected from 5 locations within the greater Dhaka city

Element	Elemental Concentrations of Road Dust collected from Different Locations of Dhaka City (mg/kg)				
	Mohakhali	Farmgate	Gulistan	Jatrabari	Rayerbagh
Ca	46300	12200	18000	89233	101983
Cd	3.14	8.28	1.20	4.48	5.42
Cr	60.5	45.5	40.6	98.4	121
Co	10.8	8.17	7.06	12.5	18.3
Cu	68.5	122	111	216	103
Fe	28300	23700	29700	45900	53540
K	23400	12700	15128	30889	57600
Mg	4200	2669	527	7000	6279
Mn	652.6	619	472.8	1046	1338
Ni	21.5	24.8	24.5	33.5	42.4
Pb	144	108	83.6	164	238

The cement sample has significantly high Ca, Cr, Co, Cu, Ni, Pb and V content than any other samples (Table 3). In general, the concentrations of these elements in rock dust were lower except vanadium which is higher than that in most of the road dusts and coal samples. In coal samples, the concentrations of Ca, Cr, Co, Cu, Ni, Pb and V are observed low. However, when coal is burned, in brick fields, these heavy metals concentrate in ashes and air bourn particles that may have deposited on nearby areas. There are hundreds of brickfields and several cement factories within few kilometers of Katchpur, Dhaka. Heavy metals in road dusts collected from locations closer to kutchpur area are obtained higher than those collected from areas at further distances. It may be possible that air bourn particles from brickfields and cement factories may have deposited in nearby areas and have accumulated over the years which may have resulted in higher levels of heavy metals. Among the different sampling locations, Mohakhali was farthest from Katchpur. The heavy metals in the dust collected from this area were obtained higher. It may be mentioned that during the sample collection there was ongoing over bridge construction activities. It maybe suspected that the cement dust from the open construction activities in the area may have increased the heavy metals in the dust (collected from this area). On the north-west of the city, soil sample from Joynabari showed higher level of heavy metals. In this area, brick field are densely located. It maybe suspected that air bourn coal ash deposits, from these brick fields, maybe responsible for these heavy metal contents in the sample collected from the area. However, there may have other factors involved in the contribution of high heavy metal levels in road dusts and soil samples. Our study is limited to only cement, brickfields and stone crusher industrial emissions. It may be important to incorporate the impact of emissions from other industries operating within and surrounding areas of the Dhaka city for conclusive results.

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