Ambient Air Heavy Metals Monitoring In NCR Region

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Abstract- The present study deals with the ambient air quality monitoring with respect to heavy metals (Pb, Ni and As) concentrations in PM_{10} at seven locations of NCR region, a National Capital Region of India. The 24 hr mean concentrations of PM_{10} ranged between 126 to 237.67 µg m-3, which is beyond the permissible limit(100 µg m-3) of National Ambient Air Quality Standards (NAAQS) also found higher than the prescribed annual daily limit of US EPA (50 µg m-3). The ambient air was mostly dominated by the Ni and least by the As among the metal analysed. Ghazipur, a dumping site and also influenced by heavy vehicular transportation due to near highway, is found to be the most polluted area of NCR region and Mayur Vihar phase-I, Delhi the least. The ambient air of Ghazipur is rich in Ni, indicating contribution of dumping and also mobile sources. The Indrapuram, Ghaziabad a residential place near the industry, is rich in Pb but within the permissible limit, suggesting contribution of point sources. The Ni concentration is found to be alarmingly high in the air at three locations i.e. Ghazipur, Vasundhra (Ghaziabad) and Noida Sec-26, when compared with the WHO limits (10 ng m-3). The As concentration is found to be below the detection limit at all locations. The present study has focused on to understand the concentrations of heavy metals in ambient air and also to analyse the quality of air in NCR region due to presence of huge vehicular transportation and industralisation, which is extremely harmful due to their toxic and carcinogenic nature.

Index Terms- Ambient air monitoring, Heavy metals, air pollutants, PM_{10}.

I. INTRODUCTION

Heavy metals are released into the atmosphere from a wide range of anthropogenic and natural sources. Trace quantities of heavy metals are found in fossil fuels and they are released into the atmosphere following combustion processes, including power generation and emissions from vehicles. Industrial processes, including the manufacture of steel and iron, and other metallurgical and chloro-alkali Industries are also significant sources of heavy metals. Different industries release Different metals, for example, lead emissions, which were previously almost completely from road transport, are now dominated by processes in the iron and steel sector. The largest source of arsenic is the burning of wood which has been treated with copper-chrome arsenate. Non-combustion sources of heavy metals include Demolition of buildings, corrosion and abrasion of sources such as road surfaces, tyre and brake wear.

It is important to note that in addition to these anthropogenic sources, heavy metals are also released into the atmosphere from natural sources including volcanoes, forest fires, sea-spray and wind-blown soil particles. As they are chemical elements, heavy metals do not degrade. This means that any metals which are released to the environment have the potential to become re-suspended in the atmosphere, for example, windblown particles of soil and road dust. The paper presents the data collected on the presence of selected heavy/trace metals in the ambient air of NCR region during the air sampling studies at seven different locations. The three heavy metals which are monitored and analyzed are Arsenic (As), Lead (Pb), Nickel (Ni).

The objective of the study is to analyse quality of air in Delhi-NCR area and measurements of the concentration of Heavy Metals in Ambient Air and their health effects. For each heavy metal to identify sources, including point, area and mobile sources, and their comparative importance in terms of emissions and contribution to ambient air levels and also for each heavy metal, to identify and discuss any long-term trends in ambient air levels found in the data.

II. MATERIALS AND METHODS

Ghazipur, Delhi is an industrial area with a residential population. Overall this area is surrounded by different types of industries like aluminum product manufacturer, lead manufacturing producing lead, lead alloy manufacturers, ferrous metal unit, carbon product manufacturer. We considered the ghazipur dumping site as the central location for our study area. Seven monitoring sites were selected. All the seven locations are as: (i) Ghazipur- near to dumping site, (ii) Vasundhra sec-16, Ghaziabad-residential place, (iii) Vasundhra enclave, Delhi – institutional area, (iv) Mayur vihar- latitude 28.6077°N and longitude 77.2992°E.(v) Noida sec-1- latitude 28.57°N and longitude 77.32°E elevation is 200m (vi) Noida sec-26, 20 Km southeast and 20 Km northwest (vii) Nitikhand-II,Ghaziabad- residential area. Out of 7 locations, 5 locations (Ghazipur, Vasundhara sec-16, Noida sec-1, Noida sec-26, Indrapuram Nitikhand-II) are comes under residential area. At Mayur vihar phase-1, Delhi monitoring carried out in the School (ASN Sr.Sec.school) and Vasundhara Enclave, Delhi monitoring carried out in the College (M. Agrasen college). Therefore, these locations may be considered as residential cum Institutional area. All the two locations were also influenced by the vehicular pollution.

The study was carried out in the month of June 2012. The temperature and relative humidity was recorded hourly by auto

weather station (model WM 200, Envirotech, New Delhi). During this period, the daily mean of average temperature and relative humidity ranged between 28.6 to 34.81o and 57.8 to 91.7% respectively. Respirable dust samplers (RDS) were used for the monitoring of particulate matter at all the locations at an approximate height of 1.5 m from ground level. Monitoring was carried out for one week, and the collection was done continuously for 24 hr with RDS for RSPM and for Heavy metals detection. The PM samples were collected at flow rate of 1.1-1.2 m³ min-1 on Whatman EPM 2000 borosilicate glass micro fibre filters. The mass of collected particles was determined gravimetrically after drying. The total volume of air was calculated by multiplying average flow rate by total sampling time in minutes. After sampling extraction of sample is done by using hot plate procedure in which filter paper is digested with 3% HNO_3 and 8% Hcl. Final extracted sample is ready for the analysis which is done with ICP-OES (Inductive coupled plasma- optical emission spectroscopy). For Lead (Pb) and Nickel (Ni), the wavelength required for analysis is 217nm and 232nm respectively. Where as in case of Arsenic (As), the wavelength required for analysis is 193.7nm.

III. RESULTS AND DISCUSSION

Table 1: Avg. Conc. of Heavy Metals in NCR in the month of June

Locations	Ni ng/m3	Pb ng/m3	As ng/m^3
Mayur Vihar Phase-I (ASN School), Delhi	BDL	63	BDL
Vasundhra Enclave (Maharaja Agrasen college), Delhi	BDL	93	BDL
Ghazipur (New Police station), Delhi	26	308	BDL
Vasundhra(Sec-16) , Ghaziabad	20.5	121	BDL
Indirapuram (NitiKhand-II), Ghaziabad	BDL	391	BDL
Noida (Sec-1), U.P.P.C.B	BDL	132	BDL
Noida (Sec-26), Apollo Hospital	20	167	BDL

Table 2: Ratio of Pb to PM_{10}

Locations	Pb ug/m3	PM_{10}	ratio of Pb to PM_{10}
MayurVihar Phase-I(ASN School),Delhi	0.063	237.67	0.000265
Vasundhra Enclave (Maharaja Agrasen college),Delhi	0.093	304.67	0.000305
Ghazipur (New Police station),Delhi	0.308	342.33	0.0009
Vasundhra(Sec-16) ,Ghaziabad	0.121	309.67	0.000391
Indirapuram(NitiKhand-II),Ghaziabad	0.391	270.33	0.001446
Noida (Sec-1), U.P.P.C.B	0.132	192	0.000688
Noida (Sec-26), Apollo Hospital	0.167	126	0.001286

Table 3: percentage of Pb in PM_{10}

Locations	Pb ug/m3	PM 10	% of Pb in PM_{10}
MayurVihar Phase-I(ASN School),Delhi	0.063	237.67	0.026507
Vasundhra Enclave (Maharaja Agrasen college),Delhi	0.093	304.67	0.030525
Ghazipur (New Police station),Delhi	0.308	342.33	0.089972
Vasundhra, Sec-16,Ghaziabad	0.121	309.67	0.039074
Indirapuram (NitiKhand-II),Ghaziabad	0.391	270.33	0.144638
Noida (Sec-1), U.P.P.C.B	0.132	192	0.06875
Noida (Sec-26), Apollo Hospital	0.167	126	0.13254

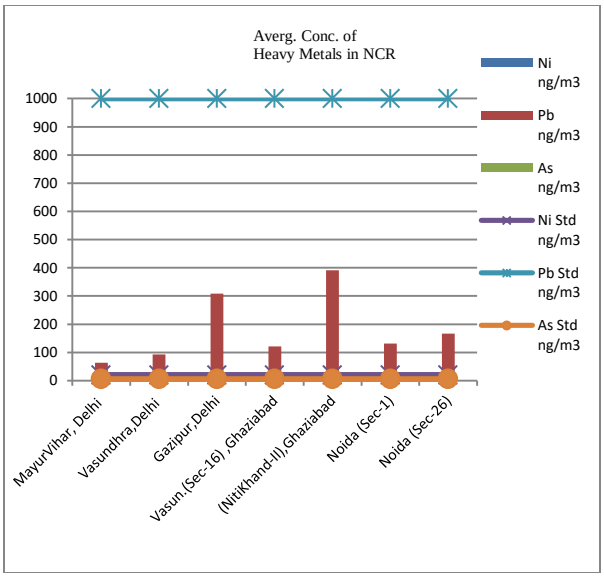

Fig 1: Average conc. of Heavy metals in NCR region

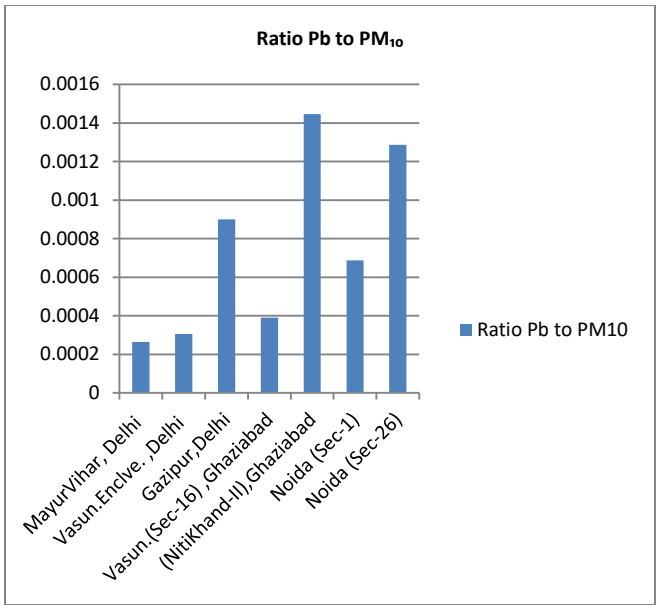

Fig 2: Ratio Pb to PM_{10}

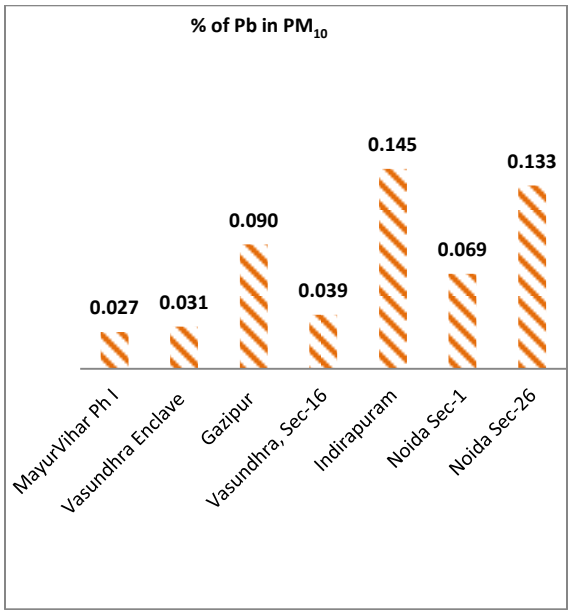

Fig: 3 % of Pb to PM_{10}

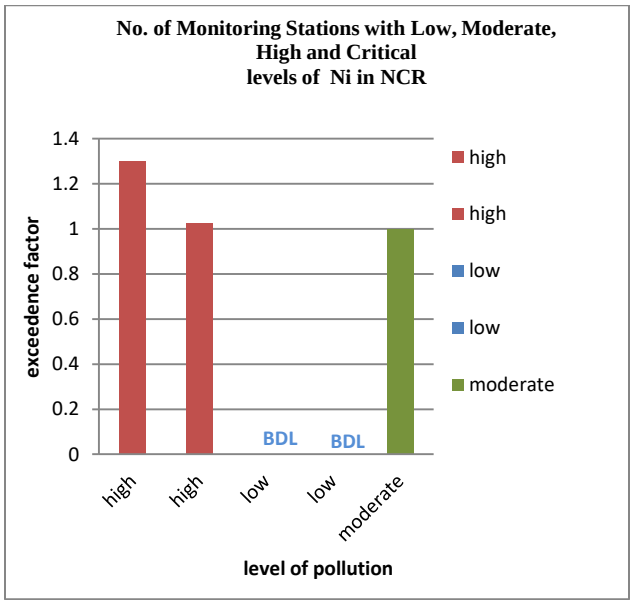

Fig 4: number of monitoring stations with Low, Moderate,High and Critical level of Nickel in Delhi- NCR region.

The study provides valuable preliminary data on regional ambient concentrations of heavy metals in Metropolitan Delhi and NCR area.

The range of Lead (Pb) is 63 ng/m³-391 ng/m³ in the seven locations. The minimum

Value found at Mayur vihar phase-I, Delhi The maximum value found at value at Nitikhand-II Indrapuram, Ghaziabad. This is mainly due to the heavy vehicular transportation. The second highest value is found at Ghazipur, Delhi 308 ng/m³ which is mainly due to the burning of waste in the landfill site. These values are slightly higher but under the Pb ug/m³ National Ambient Air Quality Standard (NAAQS) (1.0 µg/ m³) prescribed by the Central Pollution Control Board (CPCB) of India (MoEF, 2009) and around times the annual Pb ug/m³ air quality guideline (AQG) (20 µg m–3) set by the World Health Organization (WHO, 2006).

Nickel(Ni) during monitoring found at only 3 locations i.e.Ghazipur-26ng/m³, Vasundhra sec-16, Ghaziabad.- 20.5 ng/m³,and Noida sec-26- 20ng/m³ and at other locations Nickel is found below the detection limit. The higher concentration at Noida sec-26 is due to civil construction work impact in this area. These values are above the Ni ng/m³ National Ambient Air Quality Standard (NAAQS) (20 ng/ m³) prescribed by the Central Pollution Control Board (CPCB) of India (MoEF, 2009.

Arsenic was found below its detection limit at all the seven locations. There is no relevant concern for Arsenic in ambient air, the measured concentrations of this relatively low toxicity metal because it is below the detection limit.

Nickel concentration is high as compare to the lead and arsenic. The level of Ni at seven locations of NCR region with low, moderate, high and critical level is found. At 2 locations Mayur Vihar Phase-I, Delhi and Ghazipur, Delhi the Nickel concentration is found to be high due heavy transportation and nearer site of metro station. At Noida sec-26 the concentration was found to be moderate due to high transport activity and also due to industrialization of that area. By Air Quality assessment we have found that the area with Critical pollution (C): when EF is > 1.5 High pollution (H): when the EF is between 1.0 - <1.5; Moderate pollution (M): when the EF between 0.5 - <1.0; and Low pollution (L): when the EF is < 0.5.

Lead is very toxic to the human health as well as for the environment. Their relatively high toxicity should represent a concern at a regional level. The lower concentration of lead was found presumably due to the official ban of leaded gasoline in all over India.

Lead to PM_{10} ratio was found to be higher at Nitihkand-II, Ghaziabad and presents in higher amount in Pb to PM 10 ratio which is not good for health. Nitikhand-II is an industrial area many small working industries are there which is causing the release of heavy metals in ambient air.

The Lead concentration at Ghazipur, Delhi was elevated with respect to other regions. It is likely that these concentrations may be associated with dust containing lead and also due to the burning of waste at dumping site which backside to the monitoring site.

Average concentration of Nickel and Lead found higher representing impacts of industrial sources present in the upwind direction (possibly in the form of metal smelting, metal product manufacture and industrial oil combustion) suggesting crustal origin.

IV. CONCLUSIONS

The three metals Pb, Ni, As associated with PM_{10} were characterized at Delhi- NCR region, we need to identify and quantify their major sources. Crustal source (49–65%) having significantly higher contributions in summer. The loading factor was probably due to resuspension of road dust by vehicular turbulence. So, this factor represents vehicular sources. According to the Noida office of the Uttar Pradesh Pollution Control Department, the residential colonies have a higher level of air pollution because of the growing number of automobiles. A rise in the number of restaurants, roadside eateries and power generators has also been a contributing factor. Pb and Ni concentration at Noida is high."In spite of the presence of a decent public transport system, which includes the Delhi Metro, the number of registered and unregistered vehicles has increased dramatically in Noida. The smoke released by individual households has led to the shooting up of the pollution levels in residential areas .As per the report, 70% of the total air pollution in Noida is caused by automobiles, 20% by industries and 10% by households. Ghaziabad is an industrial area and total of 67 industries categorized as Large & Medium units & 313 units under SSI category have been identified under Red Category Polluting Industries in the area. Major industrial sector of concern from Air Pollution point of view. Induction Furnace - Such industries are marked with generation of substantial amount of process of Air Emission. Provision of secondary hoods & additional ID Fan etc. for collection of entrapped Air Emission in all the Induction Furnaces. Crustal sources dominated with 49–65% contribution to ambient metals on a mass basis. Delhi Government took up 59 projects/schemes (mostly construction–related) all over the city. These might have served as local sources of crustal matter at the sites. On the other hand, its seasonal variation was highly significant with distinctly higher contributions in summer. Summer– time migration of trans–boundary dust carried by strong westerly and northwesterly winds might be an important factor contributing to this source. Vehicular sources contributed 27–31% at the sites with insignificant spatial and seasonal variations. This shows that traffic was nearly ubiquitous at all the sites and the nearness of these sites to traffic precluded the importance of atmospheric conditions on the transport of traffic–generated metals to the sites. Most of the small–scale industries located in Delhi cannot afford pollution abatement technologies and pose severe problems for effective monitoring and enforcement.

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