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Assessment of Physico-chemical Properties and Concentration of Lead (Pb) in Road-side Soil due to Vehicular Traffic on National Highway-275 from Mysuru to Bengaluru, Karnataka, India

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Abstract: Accumulation of lead (Pb) due to vehicular traffic activities on the road-side soil and farmland is a potential environmental hazard effecting the eco-system. Environmental pollution of heavy metal like lead(Pb) from automobiles has attained much attention in the recent past. The present research was conducted to study the influence of physiochemical characteristics on lead (Pb) concentration in road-side soil and farmland along a national highway-4 from Mysuru to Bengaluru. Conventional and analytical methods were employed for the determination of these physiochemical parameters. 35 soil samples were collected from the left and right side of the highway. Samples were collected at a distance of 10m and 200m away from the road edge. Amount of lead (Pb) level in soil was analyzed by using x-ray florescence spectrophotometer (model xrf-α-4000) and soil physiochemical properties of the soil were also determined. The results of the physiochemical analysis showed that the pH values in all sampling sites ranged from 3.55 to 6.58 and 3.65 to 6.36 at 10m and 200m away from the road respectively, indicating the acidity of soil. The total organic carbon values ranged from 0.00264% to 0.773% and 0.088% to 0.715%at 10m and 200m away from the road respectively, indicating the presence of organic matter and micro-biological activities in the soil sample. The conductivity values ranged from 0.002ms/gm to 0.026ms/gm and 0.002ms/gm to 0.036ms/gm at 10m and 200m away from the road respectively, indicating significant presence of some soluble inorganic salts. The road-side soil and farmland soil samples also had significantly high contents of lead (Pb) and its level increased with increasing traffic activities.

Keywords: -Physiochemical Parameter, Road-side soil, Lead (Pb), Traffic activity.

INTRODUCTION

The contamination of soil by heavy metals uniquely Lead(Pb) from automobile sources is a genuine natural issue. Metals are delivered during various operations of the road transports like ignition, component wear, liquid spillage and erosion of metals in this lead is the significant poison of the roadside climate which also incorporates corrosion of batteries and metallic parts, for example, radiators and so on[1]. Lead has a special place in the group of heavy metals which are widely utilized by a human. Lead is the most problematic harmful metal.

The government has taken many prevention steps to control Lead in the environment, but still large scale pollution of lead poisoning have occurred [2].

Exhaust emission and combustion of fossil fuels were identified as primary sources of atmospheric metallic burden and it is now well established that a variety of motor vehicles introduce several toxic metals into the environment. Most of which are released adjacent to roadways and among these metals lead (Pb) is the most toxic pollutant of the roadside soil and farmland ecosystem. Lead (Pb) emission from motor vehicles produces an elevated concentration of the element in roadside vegetation. Several studies have shown that metals such as Lead (Pb), cadmium (Cd), Nickel (Ni) amongst others are responsible for certain diseases and have a lethal effect on man and animals[3,4].

Recently it was claimed that Lead (Pb) in an urban area could be over 1000ppm. In addition FAO/WHO recommended tolerable intake of ingested lead (Pb) for adults to be 3000µgm per week, which is equivalent to an average daily uptake of 430µgm and 130µgm for children[5]. Several studies revealed that 60-80% of heavy metal toxins found in bodies, in urban areas were the results of consuming contaminated food rather than air pollution. The principal target organ-system of lead poisoning are the blood, brain, neuro system, kidney and reproductive system acute exposure lead to shocks, sever-anaemia, Lead is transferred to animals and human beings through the food chain system of soil-plant-animal-human[6,7] .

A significant piece of metal pollutants are deposited on adjoining road-side soil, they might be moved to different parts of the environment and their concentration and distribution in different road verge zone (border, slope, verge, and ditch) were determined. The conveyances of the metal Lead (Pb) in the roadside soil and farmland is emphatically yet inversely /directly associated with the distance away from the side of the road[8].

The huge number of motor vehicles on the highway is leading to an increasingly high level of heavy metal (Pb) in the highway environment ecosystem. This research consists of the study of the distribution of Lead (Pb) in road-side soil and farmland sampled at two different distances from the centre of traffic flow along the highway. This exploration comprises of investigation of the conveyance of physicochemical parameters and Lead (Pb) in Roadside soil and farmland tested at two different distances from the centre of traffic flow along the highway[9,10].

MATERIALS AND METHODS

Study Area: The study area consisted of 35-40 road-side sites in National highway-4 between Mysuru and Bengaluru along both the sides of the road. The geographical co-ordinates of the study area are from to **13° 13' 42" N (**latitude**)** and **77° 14' 30" E (**Longitude**) (**Mysuru) **13° 6' 7" N** and **77° 23' 23" E** (Bengaluru). The road is one of the oldest tarmacs in this area and carries average density of traffic. A typical road verge can be divided into four different arbitrary zones, Border, Verge, Slope and Ditch/hedge. The border is the narrow zone adjacent to road and it is heavily disturbed. The verge is next to border and usually 1-3m wide. The slope,

where present is 1-3m in height with 30-35 degrees inclination. The ditch is the last zone and usually had a hedge along it. The soil sampling along the road-side verges was therefore carried-out according to the different zones in the road-side verges depending on its condition. During the survey, however, it happened sometimes not all the four zones (particularly slope) were present at each site. The main socio-economic activity along this road is farming.

Sampling: Samples were collected from Mysuru-Bengaluru highway about 24km from the nearest rural centre(Mysuru).This highway carrying an average of 10^x motor vehicles per day.35-40 sites were selected for the study along both sides of highway. At each site two samples of soil were collected at two different distances from the road edge (10m and 200m).Soil samples randomly distributed, round the observation point were taken with the aid of stainless steel ditch auger at a depth of 0-15cm and width of 15-30cm circumference on the surface of the soil and samples were kept in labelled polyethylene bags. Soil samples were air-dried before chemical analysis.

SAMPLE PREPARATION AND ANALYSIS

Each soil sample was air-dried in the laboratory, soil samples were gently ground using an acid washed porcelain pestle and mortar and then passed through a 0.2mm nylon sieve and stored in plastic bags until analysis. The soil sample for Metal analysis was digested using concentrated Nitric acid. The digested samples were analyzed for the Metal using X-ray Florescence Spectro-photometry (XRF-α-4000). Soil pH was measured in a soil water suspension (1:10) using an electric digital pH meter and electric conductivity of soil was determined using conductivity cell (Deluxe Water and Soil analysis kit-model-191E). Acidity of soil [NaOH v/s sample(1:10)], % of calcium carbonate (NaOH v/s HCl and sample), % of oxidized organic carbon, % of total organic carbon and % of organic matter (FAS v/s $K_2Cr_2O_7$, conc. H_2SO_4, conc. Ortho phosphoric acid, water and sample)was determined by volumetric titration method using Diphenylamine as indicator.

RESULT AND DISCUSSION

The main aim of this study is to determine the change in the physical properties and contamination of Lead (Pb) in road-side and farmland around National Hihaway-4 from Mysuru to Bengaluru due to vehicular traffic activity. Range of the physiochemical properties and contamination level of Lead (Pb) in the soil samples are present in the Table 1.

Soil pH is ranged from 3.55 to 6.58 at 10m away from the road and 3.65-6.36 at 200m away from the road. This range indicates, the samples taken 200m away from the road edge are more acidic than the samples taken 10m away from the road and the average is 4.73, this indicates that the soil around the our study area is slightly acidic. Electric conductivity of soil is ranged from 0.002mS/gm to 0.026mS/gm at10m away from the road and 0.002mS/gm to 0.036mS/gm at 200m away from the road and average is0.0117mS/gm, this indicate that the presence of some salts. The % of calcium carbonate is ranged from 96 to 104at 10m away from the road and 96

to 105 at 200m away from the road and average is 99.77. The Total organic carbon is ranged from 0.00264 to 0.773 at 10m away from the road and 0.088 to 0.715 at 200m away from the road edge and average is 0.3766, indicates presence of some soluble organic matter is our study area. Lead (Pb) level in soil sample is ranged from 17ppm to 49at 10m away from the road edge and 16ppm to 40ppm at 200m away from the road edge and average is 23.58 this indicate the Lead (Pb) is accumulate high level in soil samples in our study area than the standard level (10ppm).

PHYSIOCHEMICAL PROPERTIES AND LEAD (Pb) LEVEL IN SOIL SAMPLES

The present investigation showed that the concentration of lead (Pb) and some of the physiochemical properties of soil sample collected in road-side are given in the Table 2.

The above table gives the data about the concentration level of the lead (Pb) and some physiochemical parameters in soil samples collected at south-east direction at 10 meter away from the road edge along the nation highway-4 from Mysuru to Bengaluru. First column indicates the sampling number and LS indicates the samples collected at left side of the road. Highest concentration level of lead (Pb) is found to be 49ppm at site RS-7 and lowest concentration is 17ppm at site RS-11, the average lead (Pb) concentration level is 28.3ppm at 10m away from the left side of the road edge (Table 3).

The above table gives the data about the concentration level of the lead (Pb) and some physiochemical parameters in soil samples collected at south-east direction at 200 meter away from the road edge. First column indicates the sampling number and RS-a indicates the samples collected at left side of the road. Highest concentration level of lead (Pb) is found to be 40ppm at site RS-8a and lowest concentration is 16ppm at site RS-7a, the average lead (Pb) concentration level is 25.6ppm at 200m away from the left side of the road edge (Table 4).

The above table gives the data about the concentration level of the lead (Pb) and some physiochemical parameters in soil samples collected at north-west direction at 10 meter away from the road edge, we collect only 5 soil samples in this region, because there is no available space for smple collection due to industrial activity and road construction. First column indicates the sampling number and LS indicates the samples collected at right side of the road. Highest concentration level of lead (Pb) is found to be 25ppm at two sites LS-2 and LS-4, and lowest concentration is 17ppm at site LS-3, the average lead (Pb) concentration level is 22.4ppm at 10m away from the right side of the road edge (Table 5).

The above table gives the data about the concentration level of the lead (Pb) and some physiochemical parameters in soil samples collected at north-west direction at 200 meter away from the road edge. First column indicates the sampling number and LS-a indicates the samples collected at right side of the road. Highest concentration level of lead (Pb) is found to be 29ppm at site LS-2a and lowest concentration is 16ppm at site LS-4a, the average lead (Pb) concentration level is 18ppm at 200m away from the right side of the road edge.

CONCLUSION

The above graph shows that the high contamination level of lead (Pb) in soil samples taken from both left and right side of the road at 10m away from the road edge, because lead (Pb) can enter the environment through the exhausts of vehicles. The mass of lead (Pb) when compare to other heavy metals, so the large particles of lead will drop to adjacent to the road side immediately and pollute the road-side soil. Lead (Pb) is insoluble water, the movement of lead (Pb) on soil surface is very slow by water flow due to its heavy mass. So, the concentration of lead (Pb) is very high in soil samples collected at 10m away from the road. On comparing left and right side samples, the left side samples has a high level of lead (Pb) than the right side samples. In our consideration, it may be due to industrial activity, traffic density and topography of this area.

From this study, our study area consist high level of lead (Pb) concentration than its standard level (i.e. 10ppm). If the contamination of lead (Pb) goes on like this, the entire area will be polluted by lead poisoning and also varies physiochemical parameters which causes drastic changes in farmland activates. We concluded that, there is only one natural way to control the lead contamination in road-side soil and lead poisoning that is bio-remediation. Bio-remediation is a growing some plant and tree which absorb the lead concentration in the soil and maintain its function.

Table-1: Ranges of physiochemical parameters and level of Lead (Pb) on both right and left side of road at different distance

Distance	pH	EC mS/gm	% of $CaCO_3$	% of total organic carbon	Lead(Pb) in ppm
10 m	3.55-6.5	0.002-0.026	96-104	0.00264-0.773	17-49
200m	3.65-6.3	0.002-0.036	96-105	0.088-0.715	16-40
Average	4.734	0.0117	99.77	0.3766	23.58

Table-2: Physiochemical Properties and Lead level in left side soil sample (10m away from the road)

Samples	PH	EC	% of $CaCO_3$	% of total organic carbon	Lead (Pb) in ppm
RS-1	6.23	0.004	102	0.456	43
RS-2	5.64	0.004	101.5	0.475	27
RS-3	6.58	0.014	102.5	0.718	21
RS-4	6.05	0.006	100	0.68	30
RS-5	6.1	0.024	96	0.488	27
RS-6	3.58	0.016	101.5	0.00264	21
RS-7	5.33	0.016	99.5	<LOD	49
RS-8	3.61	0.004	100	0.066	29
RS-9	3.55	0.008	98.5	0.129	26
RS-10	4.9	0.026	96.5	<LOD	30
RS-11	4.29	0.004	97	0.773	17
RS-12	5.69	0.022	96.5	0.211	25
RS-13	5.57	0.026	99	0.124	23

Table-3: Physiochemical properties and Lead level in of left side soil sample (200m away from the road)

Samples	pH	EC	% of $CaCO_3$	% of total organic carbon	Lead (Pb) in ppm
RS-3a	5.80	0.008	96	0.340	27
RS-4a	5,93	0.04	107	0.496	23
RS-5a	6.36	0.024	102.5	0.435	20
RS-6a	3.66	0.004	104.5	0.552	18
RS-7a	3.65	0.006	106	0.088	16
RS-8a	5.02	0.036	100	<LOD	40
RS-9a	5.61	0.004	96.5	<LOD	25
RS-10a	4.95	0.024	100	<LOD	37
RS-11a	4.92	0.006	99	<LOD	27
RS-12a	5.53	0.01	107	0.633	25
RS-13a	5.56	0.016	105	0.443	24

Table-4: Physiochemical Properties and Lead level of right side soil samples (10m away from the road)

Samples	pH	EC	% of $CaCO_3$	% of total organic carbon	Lead(Pb) in ppm
LS-1	3.89	0.002	95	0.124	23
LS-2	3.99	0.008	98.5	0.315	25
LS-3	5.04	0.016	96	0.454	17
LS-4	3.97	0.016	100.5	0.533	25
LS-5	4.03	0.012	104	0.726	22

Table-5:- Physiochemical properties and Lead level of right samples (200m away from the road)

Samples	pH	EC	% of $CaCO_3$	% of total organic carbon	Lead (Pb) in ppm
LS-1a	5.86	0.006	97.5	0.715	17
LS-2a	4.09	0.004	102.5	0.641	29
LS-3a	4.16	0.02	97	<LOD	28
LS-4a	3.97	0.002	97	0.375	16
LS-5a	3.98	0.002	100.5	0.71	<LOD

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