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Heavy Metals in Soil Samples of Guntur Auto Nagar, Andhra Pradesh

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Abstract**—** The heavy metals in soil samples of Guntur auto nagar, Andhra Prdesh were analyzed using standard methodologies of soil analysis WHO and BIS, three sampling stations are studied in six months duration from February to July in the study area. The following metals were detected, Iron (Fe), Zinc (Zn), Chromium (Cr), Copper (Cu), Cadmium (Cd), Lead (Pb) and Nickel (Ni). Their minimum, maximum, average values (mg/kg^{-1}) and standard deviation of three sampling stations were observed and the maximum values are recorded as follow Fe-131.05 mg/kg^{-1}, Cr-1.91 mg/kg^{-1}, Zn-98.37 mg/kg^{-1}, Cu-69.9 mg/kg^{-1}, Cd-9.31 mg/kg^{-1}, Ni-14.32 mg/kg^{-1}, according to the standard values in three sampling stations of soil samples exceeded due to improper sanitation and lack of rainfall the heavy metals are stored in soils.

Keywords**—** Analyses, Heavy Metals, soil, Auto nagar, Industrial Area

I. INTRODUCTION

Environmental pollutants cause the water quality degradation around the world. The water pollutants include nutrients, organic chemicals, microbes, oil, heavy metals and sediments. Heavy metals are released through the domestic, commercial, industrial and agricultural activities (pesticides and fungicides) and the decomposition of solid waste also release the heavy metal into the soil and contaminated [1], [2].

Disposal of solid waste had been a greatest problem in the world. The non degradable solid waste consist the heavy metals release into soils and gradually accumulate to organisms until it reaches maximum concentration. The previous studies are contamination of soil by heavy metals was investigated [3], [4], [5], and the contamination along a motorway was investigated in an industrial zone, there are various factors are affecting the quality of soils, including the following: location, wind, rainfall, human impact, therefore, the heavy elements are evaluated such as copper, zinc, lead and nickel are commonly found in wastewater and soils along the highways [6]. Since these metals are not biodegradable, they persist and accumulate over a long time in the soils and vegetation resulting to serious environmental pollution [7], Soil serves as a reservoir for the metal contaminants of the automobile emissions, that metals like zinc, copper, iron and cadmium are important components of many alloys, wires, tyres and many industrial processes released into the road side soil [8], [9], reported that automobile exhaust about 80% of the pollution by heavy metals and it was corroborated by Adriano [10], the soil profile in automobile mechanic waste dumps [11], crude oil contaminated soils [12] and soils of municipal waste dumps [13], Having more contents of heavy metals reported that automobile exhaust about 80% of the pollution by heavy metals and it was corroborated by Adriano [10], the soil profile in automobile mechanic waste dumps [11], crude oil contaminated soils [12] and soils of municipal waste dumps [13], Having more contents of heavy metals.

II. STUDY AREA

The study area is in Guntur district, coastal Andhra Pradesh. It is situated in southern region of Guntur city named as Auto nagar (Figure 1). The city is a municipal corporation and the administrative headquarters of Guntur. Guntur district is a well and a part of Andhra Pradesh Capital Region, under the jurisdiction of APCRDA. Guntur is located at 16.20°N 80.27°E. It has an average elevation of 33 m (108 ft) and is situated on the plains. In the study area Auto nagar the major industries are small scale and do not have good drainage facilities, more amount the waste water directly percolate into ground layers.

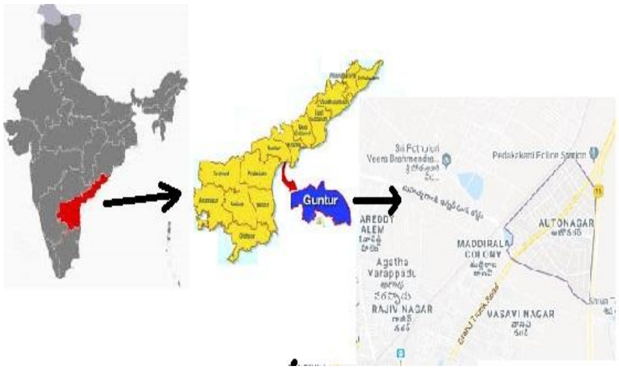

Figure 1: Study area map

III. SAMPLING

The Soil samples were collected in the study area with 0-15 cm depth and the sampling procedure to obtain a representative sample from a particular area. The soil samples were air dried at 25-30 ^{0}C for 2-4 days, ground to pass a 2 mm sieve, and collected the ½ kg and labelled in sealed in one kg transparent plastic cover.

IV. METHODOLOGY

At the laboratory; the soil samples were air dried and ground to powdery form using a pestle and mortar. The sample was sieved with a 2mm sieve. The soil sample (1g) was weighed into a digestion flask. Concentrated nitric acid (20ml) was added and the mixture was digested using hot plate. After digestion it was allowed to cool and 30 ml of distilled water was added and filtered with Whatman filter paper. The digest was made up to 50 ml solution with distilled water. Then, the digest was use for the determination of heavy metals using atomic absorption spectrometer (AAS). The analysis of the metals like cadmium (Cd), lead (Pb), hexavalent chromium (Cr+6) and mercury (Hg) were done by using (AAS) Atomic Absorption Spectrophotometer [14].

V. RESULTS AND DISCUSSION

These metals accumulate along the roads due to consumption of automotive parts, combustion of fuel, road infrastructure (Eg. road surface-layer fraying, corrosion of galvanized road buffers). Thus, zinc comes from tires which contain ZnO and galvanized parts of the car, while nickel comes from the abrasion of metals in vehicles and gasoline usage.

The nickel is in fuel additives especially in burning fuel (diesel) that are used in operating the machinery of vehicles and mills[15], [16], and standard deviation were very high in three sampling sites of soils in the study area the values are 8.37 mg/kg^{-1}, 14.32 mg/kg^{-1}, 12.19 mg/kg^{-1} & 1.3 mg/kg^{-1}, the maximum values are observed in the month of may in sample 1 (Table 1, fig: 4 & 6), due to industrial waste water the higher levels observed in some industrial sites in Nigeria [17], [18], and [19]. The similar results have been reported for soils around industrial areas in India by Machender et al, [20]. The minimum, maximum, average and standard deviation of cadmium levels are followed as 3.5 mg/kg^{-1}, 9.31 mg/kg^{-1} , 6.85 mg/kg^{-1} and 1.84 in six months of the study in study area , the major source is car tyres in auto nagar region, the open burning and mixing of rubber materials release the cadmium in to the soils and contaminated the soil layers, it was reported that [21], from car tyres the range of 20 to 90 μg/g as Cd contamination in soils through the process of vulcanization. And release into soils due to lubricating oils and/or old tyres that are frequently used as convoy belt in machine and other associated wastes. [22].

The iron concentration found in three soil samples of the study area during six months from February to July vary that sample-1 vales are 98.36 mg/kg^{-1}, 131.05 mg/kg^{-1} , mg/kg^{-1}, 114.08 mg/kg^{-1} and 12.55 sample –2 minimum 97.35 mg/kg^{-1}, Maximum 130.25 mg/kg^{-1}, average value is 115.33 mg/kg^{-1}, and the standard deviation is 12.02 mg/kg^{-1}, as well as in sample-3, the minimum, Maximum, average and standard deviation is 98.32 mg/kg^{-1}, 128.27 mg/kg^{-1}, 113.18 mg/kg^{-1} and 12.66 mg/kg^{-1}, in all sampling stations the Iron value are beyond the standard limit of WHO, BIS (Table: 1, Fig 2 & 5) due to the vicinity of automobile spare parts market [24], and oil field [25]. Similar studies [19], [17], and [23] High concentrations of iron in soils relative to other metals have been reported in various studies, confirming that natural soils contain significant levels of iron [27], [28. Zinc is used in brake linings of vehicles because of its heat conducting properties and can be released during mechanical abrasion of vehicles and from combustion of engine oil and also from vehicle tyres and it is the second most abundant metal obtained in this study the maximum, average and minimum values in three sampling site of soil samples were observed as follow 98.37 mg/kg^{-1}, 78.79 mg/kg^{-1}, 61.29 mg/kg^{-1}, & mg/kg^{-1}, 13.79 mg/kg^{-1}. (Table: 1, Fig 2 & 5), this high level of zinc in roadside soil could be attributed to the wear and tear of vehicle bodies with galvanized steel surfaces [29], and the similar studies are done by El-Gamal, [30], Akbar et al., [31], Manno [32],[34], stated that the source of zinc in auto nagar that is automobile activities, and Elik, [35], reported that high concentration of Zinc in heavy traffic zones indicate that fragmentation of car tyres is a likely sources of the metal. Other possible sources of zinc in relation to automobile traffic in addition to wearing of brake lining are losses of oil and cooling liquid of vehicles and wearing of road paved surface [34]. The lead maximum values in the study area are as follow 122.21 mg/kg^{-1}, 110.82 mg/kg^{-1}, 113.5 mg/kg^{-1}, in three sampling sites S1, S2 and in S3 the average values are 102.13 mg/kg^{-1}, 93.18 mg/kg^{-1}, 96.81 mg/kg^{-1}, and the standard deviation of three soil samples 19.17 mg/kg^{-1}, 14.97 mg/kg^{-1}, 17.32 mg/kg^{-1} during six months period in the study area, the maximum vales are observed in the month of May- 2018, (Table: 1, Fig: 2& 5), the similar studies have been observed by Bamgbose [35], Iwegbue [25], Inuwa [36], the high concentration of lead cause the serious health risk, and reported several deaths. The possible source of copper in auto nagar is engine wear and cassava wastes. The maximum, minimum and average values are as follow 69.9 mg/kg^{-1}, 5.21 mg/kg^{-1}, 19.74 mg/kg^{-1}, (Table 1) in similar studies the higher levels of copper have been recorded in some contaminated sites [25], [11], the chromium concentration in the soil samples of the study area 1.91 mg/kg^{-1}, 1.74 mg/kg^{-1}, 1.62 mg/kg^{-1}, The average values are 1.48 mg/kg^{-1}, 1.54 mg/kg^{-1}, 1.45 mg/kg^{-1}, And the standard deviation of chromium in the study area 0.32 mg/kg^{-1}, 0.19 mg/kg^{-1}, 0.15 mg/kg^{-1}, (table 1 figure 3 & 6) release in soils due oil and grease as well as lubricants of automobiles and machinery activities.

VI. CONCLUSION

Based on the findings, heavy metal concentration is generally higher in the surface soils Therefore, abundances of heavy metals in soil samples of study area and it is extremely contaminated due to random dumping of hazardous waste and free discharge of waste water, oil and grease from auto mobiles in auto nagar region in the study area. The high concentration of all heavy metals indicated that the pollution. There is an urgent need to measure toxic metals in industrial effluents before dumping them. A considerable amount of surface soil/waste from dumping sites and heavily contaminated areas must be excavated and transported to a landfill site for hazardous waste. The study highlights the necessity of control measures for the heavy metal pollution in the study area and the soils requires various remediation technologies like phyto-remediation by growing plants should be carried out to minimize the rate of contamination, and extent of future pollution problems.

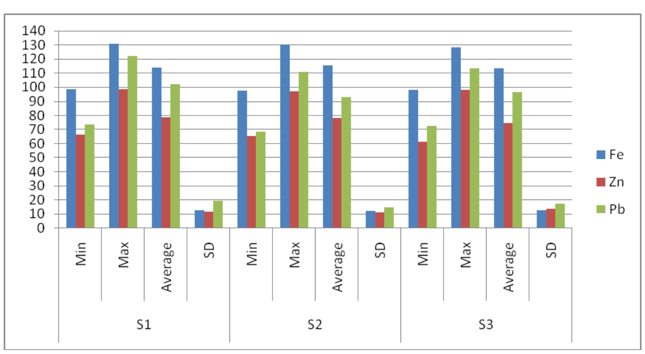

Fig:2. Min, Max, average and Standard deviation of Fe, Zn, and Pb in soil samples

Table 1: Min, Max, Average, and Standard deviation of the three soil samples in the study area

		Fe	Zn	Cd	Cu	Cr	Pb	Ni
S1	Min	98.36	66.52	4.6	6.89	1.01	73.58	10.98
	Max	131.05	98.37	9.31	69.9	1.91	122.21	14.32
	Average	114.08	78.79	6.85	19.74	1.48	102.13	12.19
	SD	12.55	11.72	1.84	24.81	0.32	19.17	1.26
S2	Min	97.35	65.37	4.9	5.9	1.2	68.34	9.54
	Max	130.25	97.05	8.59	15.62	1.74	110.82	11.82
	Average	115.33	78.05	6.78	9.04	1.54	93.18	10.79
	SD	12.02	11.48	1.37	3.47	0.19	14.97	0.82
S3	Min	98.32	61.29	3.5	5.21	1.2	72.3	8.37
	Max	128.27	98.27	8.3	14.06	1.62	113.5	12.03
	Average	113.18	74.58	6.14	8.18	1.45	96.81	9.98
	SD	12.66	13.79	1.78	3.12	0.15	17.32	1.31

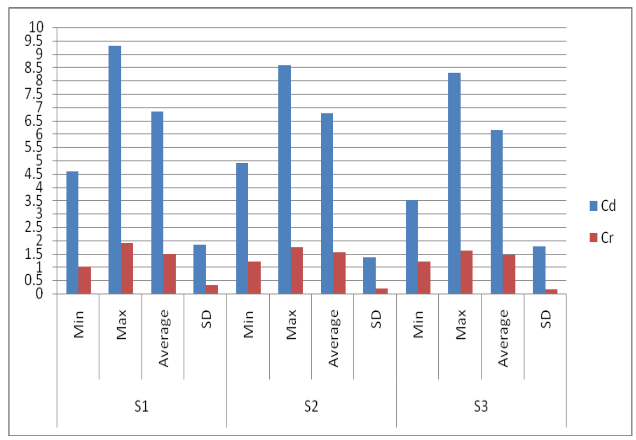

Fig:3. Min, Max, average and Standard deviation of Cd and Cr in soil samples

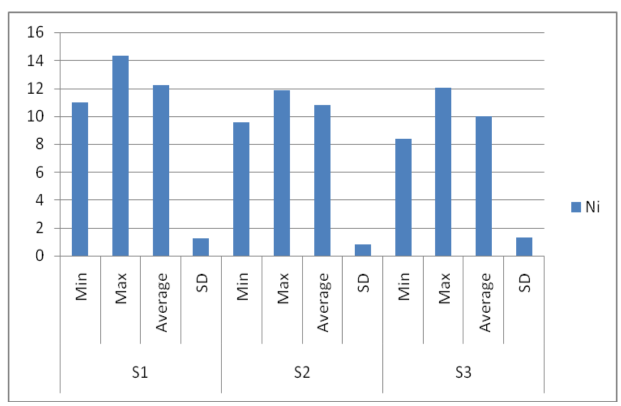

Fig:4. Min, Max, average and Standard deviation of Ni in soil samples

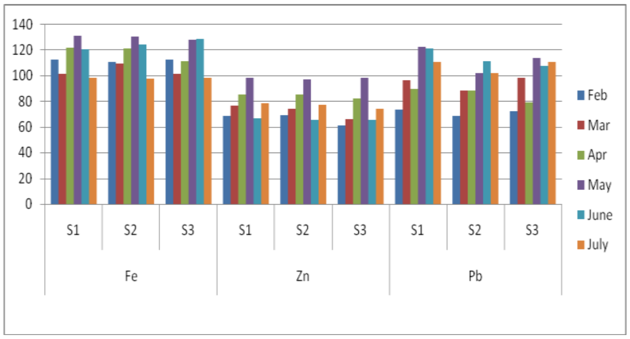

Fig: 5. Monthly wise heavymetals in three soil samples of study area (Fe, Zn & Pb)

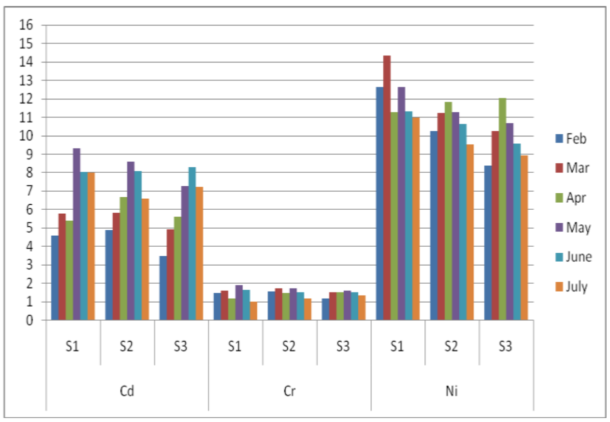

Fig: 6. Monthly wise heavymetals in three soil samples of study area (Cd, Cr & Ni)

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