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Analysis Of Physico-Chemical Properties And Heavy Metal Concentration In Soil Sample Collected From Industrial Area Jalna, Maharashtra,India

B.U. Kale
Department of Chemistry, Shri Vyankatesh Arts & Commerce College, Deulgaon Raja,Maharashtra,India

Abstract--The aim of this research was to investigate the concentration of some heavy metals in soil sample from industrial area Jalna, Maharastra using Atomic Absorption Spectroscopy (AAS). The results obtained for these metals (Fe,Pb, Cr, Zn and Cd) from the sample location indicated that Fe was higher than all other metals. The higher values are indicative of anthropogenic inputs, either due to large usage of metallurgical processes or welding purposes. The results obtained in dry weight were Fe (1866 µg/g), Pb (142.51 µg/g), Cr (50.12 µg/g), Zn (36.85 µg/g) and Cd (0.321 µg/g). The soil pH in water was 8.26 and in CaCl2 was 6.17 and the moisture content was 5.67%. The concentration obtained was generally higher than the tolerable limit for safe environment .The study revealed that soil samples under study showed higher concentrations of various metals which can be attributed to leaching of the top soil and unproductive nature of the soil at the time of sampling, which indicates that there is heavy metal pollution and allowing preventive measures to be taken.
Keywords:- Heavy metals, soil, atomic absorption spectroscopy, physico-chemical properties.

I. INTRODUCTION

Soil is considered as a complex, living, seasonally changing and dynamic component in the ecosystem. Due to the many anthropogenic activities in industrial areas soil may get polluted which may cause major heavy metal contamination and which is more responsible for increasing the pollutants in the soil. In recent years pollution has increased considerably as a result of increasing human activities such as burning of fossil fuels, industrial and automobile exhaust emissions which were identified as primary sources of atmospheric metallic burden (1,2) and was well established that a variety of motor vehicles introduced a number of toxic metals into the environment (3) . Several studies have shown that metals such as Pb, Fe, Cd, Cr, Mn, Co amongst others are responsible for certain diseases that have lethal effects on man, animals and plant (4) . According to WHO, 20 million children worldwide suffer from pollution which has become critical. The most common environmental pollutants in the world are heavy metals (5). The knowledge of heavy metals accumulation in soils, the origin as well as possible interactions of these metals is a problem of concern (6) . As human activities began to undergo industrialization, the amount of waste thrown in the environment increased tremendously (7) . Heavy metals can accumulate in the soils to toxic levels as a result of untreated waste waters and fertilizer (8) . The extent of soil pollution by heavy metals is very alarming because of their toxicity which lead to adverse effects on human and ecosystem health (9) . Chronic exposure to heavy metals leads to serious kidney malfunction, anaemia, hematological and brain damage (10) . Therefore, it is important to monitor some of the heavy metals pollutants in soil as such this research is aimed at evaluating the level of metallic element concentrations in soil.

II. MATERIALS AND METHODS

A. Sample Collection

The soil sample was collected at surface level (0-10 cm in depth) from various locations of industrial area Jalna. It was properly mixed and transferred into clean and labeled polythene bag for further analysis in the laboratory.

B. Sample Treatment

The soil sample was oven dried at 105^{o}C to constant weight for 6 hours (11) . The oven dried material was crushed and passed

through 2.00mm mesh to obtain a representative sample.

C. Soil pH

The soil pH was determined in1:1 soil water suspension and 1:2 soil 0.01M calcium chloride suspension as described in manual (12) . 20g of air dried soil sample was weighed into a 50cm^3 beaker and mixed with 200cm^3 of distilled water and 0.01M $CaCl_2$ separately. The mixture for each was stirred for 30minutes and allowed to stand for 1 hour. The pH reading was taken after inserting the electrode of the pH meter into the partly settled suspension and reported the result as soil pH in water and 0.01M $CaCl_2$. The pH meter was calibrated with 7.0 distilled water and pH buffer solution before used. The electrode was washed and wiped with dry clean filter paper after each reading (11)

D. Moisture Content Determination

The soil sample was dried at a temperature of 105^oC for 24 hours and dried to constant weight. The sample was removed and cooled in a desiccator and weighed again (13) . The weight lost was obtained by subtracting the weight of dry sample from original weight of the sample using the following equation (12) ;

$$\text{Moisture content (\%)} = \frac{\text{Loss in weight on drying (g)}}{\text{Initial weight of sample}} \times 100$$

E. Sample Digestion

1g of the oven dried sample ground sample was weighed using a top loading balance and placed in a 250ml beaker which has been previously washed with nitric acid and distilled water. The sample was reacted with sample was reacted with 5ml of HNO_3, 15ml of concentrated H_2SO_4 and 0.3ml of $HClO_4$ using dropping pipette. The mixture was digested in fume cupboard, heating continued until a dense white fume appeared which was then ingested for 15minutes, set aside to cool and diluted with distilled water. The mixture was filtered through acid washed Whattman No.44 filter paper into a 50ml volumetric flask and diluted to mark volume (7,14,15) . The sample solution was then subjected to Atomic Absorption Spectroscopic machine at different intervals.

III. RESULTS AND DISCUSSION

The results of pH, moisture content and average concentration of heavy metals in soil sample collected from Industrial area Jalna are presented in tables-1, 2 and 3 respectively;

Table-1
pH of Soil sample

Source	pH in Soil	pH in 0.01M CaCl2
Industrial area Jalna	8.26	6.17

Table-2
Moisture content of Soil sample

Source	Moisture (%)
Industrial area Jalna	5.67

Table-3: Heavy metal distribution in industrial area Jalna
(µg/g dry weight)

Sr.No.	Element	Mean (approx.)
1	Fe	1866
2	Pb	142.51
3	Cr	50.12
4	Zn	36.85
5	Cd	0.321

Values are expressed as approximate mean of replicate determinations. The pH of the soil is an important parameter that directly influences mineral mobility. The soil pH of the sampling site in water is 8.26 indicating mildly basic soil (table-1). The soil pH in CaCl2 is 6.17 indicating moderately acidic soil. In general, the acidic nature of the soil may be attributed to the industrial pollution

of acidic gases, effect of bush burning and harmattan dust (7) . The higher pH of Industrial area Jalna can also be attributed to the deposition of calcium compounds in the soil of Maharashtra. As Brady and Weil (16) reported that, the neutral to alkaline pH observed in semi-arid soil such as that of Sokoto was due to low rainfall, alkaline compounds are not leach away, thus making the soil of the region too alkaline. The same problem was observed with Maharashtra due to low rainfall which made the soil mildly basic. The moisture content of the sampling site was 5.67% (table-2) which might depend on the nature of the soil. The results of the study revealed that Fe, Pb, and Cr present in the soil sample are in higher concentrations than Zn and Cd, that are in trace amount and were in the following order of abundance Fe > Pb> Cr> Zn> Cd (Table 3). Fe is present in concentration higher than other metals investigated because of large usage of metallurgical processes at sampling site .The higher Fe, Pb and Cr concentrations showed that there is heavy metals pollution at the sampling site where anthropogenic inputs such as usage of metallurgical processes, welding are heavier while the lower concentration of Zn and Cd showed that anthropogenic inputs are lower. In general, the results obtained showed that, the heavy metals concentration in the soil sample can be attributed to leaching of the top soil and unproductive nature of the industrial area Jalna at the time of sampling. The concentrations of Fe, Pb and Cr have exceeded the permissible limit prescribed by World Health Organization WHO (17) . This means that the inhabitants of this area are vulnerable to heavy metal toxicity(18,19).

IV. CONCLUSION

The concentrations level of heavy metals determined in the present study are generally higher than the tolerable limits prescribed by WHO, it implies that the inhabitants around the sampling site are liable to heavy metal pollution. It can be concluded that the physicochemical analysis of soil samples under study showed variable concentrations of various metals which may be attributed to large usage of metallurgical processes at sampling site.

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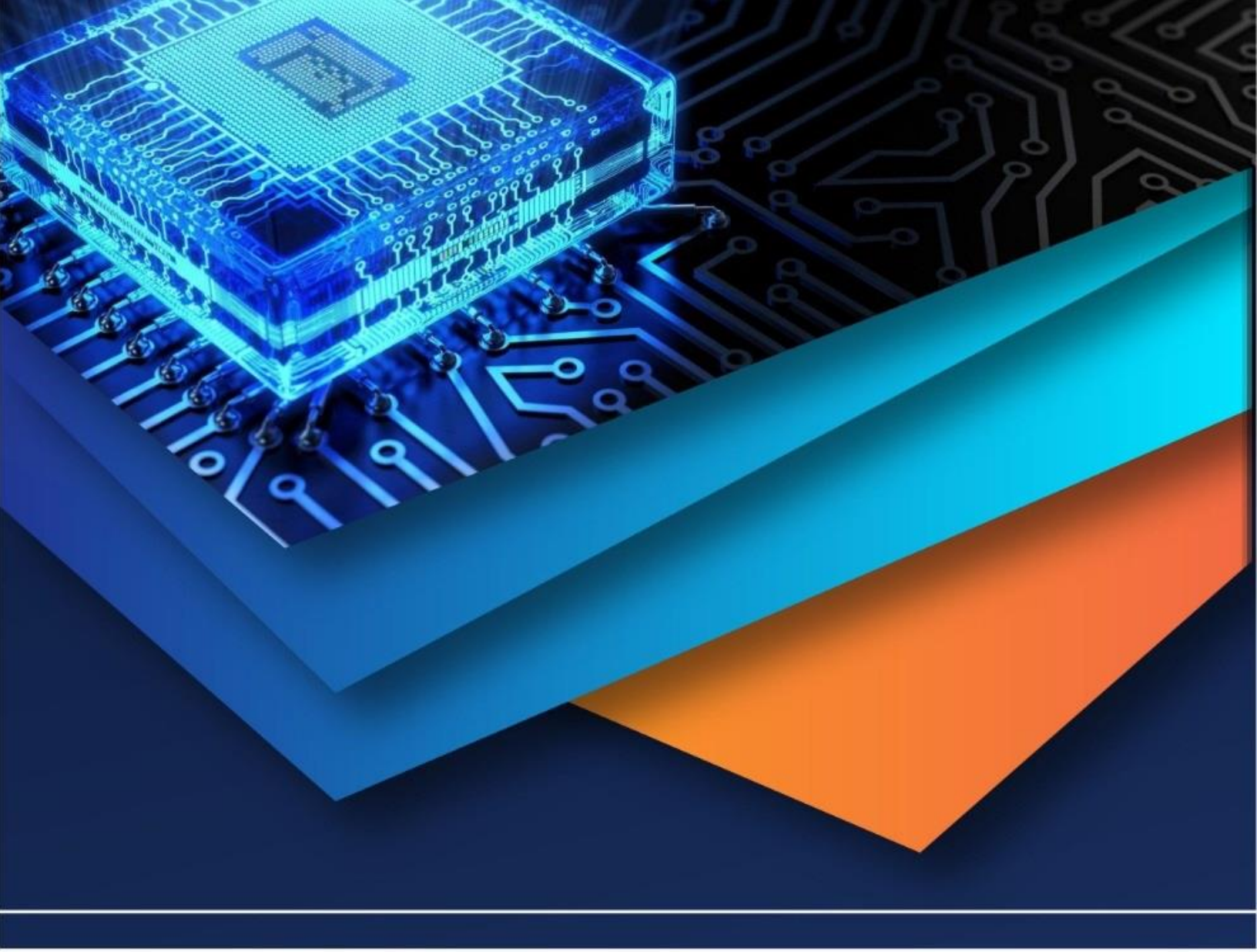

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