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# Study Soil Pollution Spectrum In and Around Industrial Areas of District Shahdol (M.P.) India

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***Abstract--Soil pollution is the contamination of soil with harmful substances that can adversely affect the quality of the soil and the health of those living on it. Pollution can be the result of an accident or carelessness, or done on purpose through illegal dumping. Leachate pollution should get appropriate attention as it may be a source of heavy and toxic metal in soil and it is possible to percolate and may lead to water pollution in the surroundings water sources. In the present investigation the soil samples were collected from the identified area for pH, conductivity and heavy metal analysis. The pH, conductivity and heavy metal pollution of the soil samples resulted that, concentration of certain heavy metals is above permissible limit. The heavy metals like Cr, Cd, Fe, Mn, and Pb, shows highest concentration, while metals such as Cu, Cd and Pb shows low concentration. The heavy metal pollution indicates that leachate produced by uncontrolled and unscientific disposal of industrial solid wastes contaminates soil samples of the identified area. The effects of soil pollution reach across the spectrum from water and air to vegetation, and to human health and society as well. While the specific effects depend on the pollutant, in general they include further environmental contamination as the polluted soil washes into water or is kicked up into the air, and poisoning, such as from lead-tainted soil. The Environmental Protection Agency notes that children can end up accidentally ingesting polluted soil as they play in it.***

***Kew words - Industrial solid waste, Leachate, Heavy metals, Soil, Disposal.***

## I. INTRODUCTION

Soil pollution is caused by the presence of man-made chemicals or other alteration in the natural soil environment. This type of contamination typically arises from the rupture of underground storage links, application of pesticides, percolation of contaminated surface water to subsurface strata, oil and fuel dumping, leaching of wastes from landfills or direct discharge of industrial wastes to the soil. The most common chemicals involved are petroleum hydrocarbons, solvents, pesticides, lead and other heavy metals. This occurrence of this phenomenon is correlated with the degree of industrialization and intensities of chemical usage. In recent years, with the development of the global economy, both the type and content of heavy metals in the soil caused by human activities have gradually increased, resulting in the deterioration of the environment Variety of trace elements, some of them are potentially toxic and are transferred to the surrounding environment through different pathways (Goodarzi *et al.* 2008). The disposal of such huge quantity of fly ash can be a major problem, which leads to the leaching of pollutants into surface water and soil. The impact of coal ash leachates on receiving surface waters sources, apart from increased elemental concentrations cause changes in water pH with implications for trace element mobility (Carlson and Adriano, 1993). Solid waste disposal sites are potentially serious sources of pollution to the environment, especially when located very close to water sources and operated haphazardly. The high pollution potential of these sites is due to the fact that they usually contain almost all types of pollutants from the source community. The contaminants can leach out through the soil, contaminating the soil itself, ground water, and surface water. In the study reported here, environmental pollution impacts of a solid waste disposal site were investigated (Gabriel *et al.*, 2009).

About 70% of India's annual coal production is used in about 72 power generating plants and produce more than 90 million tons of coal ash per year. It is likely that it may cross over 100 million tons during 2001–2010 AD (Muraka *et al.*, 1987). Major industrial regions of Shahdol have become the thermal power generation and paper mill hubs of central India. The disposal and dumping of the industrial solid wastes may leads to leaching problem and resulted in the heavy metal contamination of the soil. The major issues of concern for fly ash and chemicals wastes are unscientific dumping sites are surrounded very close to the populated area. These wastes are considered harmful and may create environmental hazard due to release of leachate to the human health and also soil and water. Utilization of fly ash and chemicals wastes can reduce the extent of the Leachate problems. With increasing capacities, disposal of large quantities of slag becomes a big environmental concern and a critical issue for thermal power and paper makers. Also the leached metals uptake by the plants is affected by the soil properties. The environmental impact of coal fly ash has been

fully recognized. Most ash disposal methods ultimately lead to the dumping of fly ash on open land. Irregular accumulation and inappropriate disposal of fly ash will lead to its disposal over vast areas of land, with resultant degradation of the soil and danger to both human health and the environment (Yao *et al.*, 2015).

A leachate is a liquid that, in the course of passing through matter, extracts soluble or suspended solids, or any other component of the material through which it has passed. Leachate is the fluids generated by the release of excess water from solid waste, and by seepage of rain water through a stratum of solid waste that is basically found in a state of decay (Uguccioni and Zeiss 1997). Leachate production deals with the creation of contaminated liquid at the base of a landfill. It involves the elements of a water balance in which precipitation either runs off from the landfill or infiltrates. Some infiltration will evapotranspire, some may be stored within the landfill, and the balance becomes percolate and eventually leachate. Landfill technology has evolved from the open, burning dump to highly engineered sites designed which can minimize tile impact of contaminants in the waste on the adjacent environment (Farquhar, 1988). The key influences on leachate generation are rainfall and waste moisture content (Kortegast *et al*., 2007).

Pollution of the natural environment by heavy metals is a universal problem because these metals are indestructible and most of them have toxic effects on living organisms, when permissible concentration levels are exceeded. Heavy metals frequently reported in literature with regards to potential hazards and occurrences in contaminated soils are Cd, Cr, Pb, Zn, Fe and Cu (Akoto *et al.*, 2008; Alloway, 1995). Vehicle exhausts, as well as several industrial activities emit these heavy metals so that soils, plants and even residents along roads with heavy traffic loads are subjected to increasing levels of contamination with heavy metals (Ghrefat and Yusuf, 2006).

## II. METHODOLOGY

### *A. The Study Area*

Shahdol is a city in Shahdol district in the Indian state of Madhya Pradesh. It is the administrative headquarters of Shahdol District. Shahdol is also the 10th Division of Madhya Pradesh state, including Shahdol, Anuppur, Umaria, and Dindori district. Shahdol district has been blessed with lush green forests, natural wealth of Coal, Minerals and with primitive Tribal population. Total Geographical area of the district is 5671 km2. Shahdol District lies in the north-eastern part of Madhya Pradesh.

### *B. The Soil Samples Were Collected From Sampling Site*

Orient paper mill (OPM) Amlai, Thermal Power Plant(TPP), Chachai, Hukum Chand Jute Mill, (HJM) Amlai, Coal fields Limited located about 1.5 km from disposal sites of slag and fly ash, at different horizontal and depth by removing the top layer of about 30 cm. All the samples are labeled properly for the identification of sources in thick quality polythene bags and are immediately brought to laboratory for further analysis. The heavy metals can pollute the surface water sources due to leachate released from the dumps and may be transported to water bodies and soil due to the presence of moisture available in the atmosphere and rain water.

### *C. Digestion of Soil*

The samples were first air dried, then placed in electric oven at a temperature of 40 °C approximately for 30 minutes. They were then homogenized which was previously ground and sieved through IS sieves of stainless steel 2 mm mesh. A 0.1g sample is weighed out and transferred to reaction vessel. 2.0 ml of concentrated nitric acid and 5.0 ml of concentrated hydrochloric acid were then added to each vessel. Vessels then placed in the rotor and the rotor is microwave at the given instrument condition. At the end of the microwave program, the vessels were allowed to cool for a minimum of 25 minutes before removing them from the microwave system. The vessels were carefully uncapped and the digests were filtered through Whatman No. 41 filter paper (or equivalent) and the filtrate was collected in a 100-mL volumetric flask, the volume was adjusted to 100 ml with 0.5% $HNO_3$.

To know the level of concentration of selected elements in study area due to leachate on surface water quality, ten samples from different location around a major industrial region were collected in pre monsoon and post monsoon season. The samples were collected in sterilized polythene bottles and prior to the sampling, all the sampling containers were washed and rinsed with the available surface water. Sampling points were chosen to cover all different directions of dumping/disposal site after preliminary survey of area. The samples were collected and preserve with the help of 1 N $HNO_3$ and were sealed and brought to the laboratory to know the heavy metal concentration by AAS analysis.

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## III. RESULTS AND DISCUSSIONS

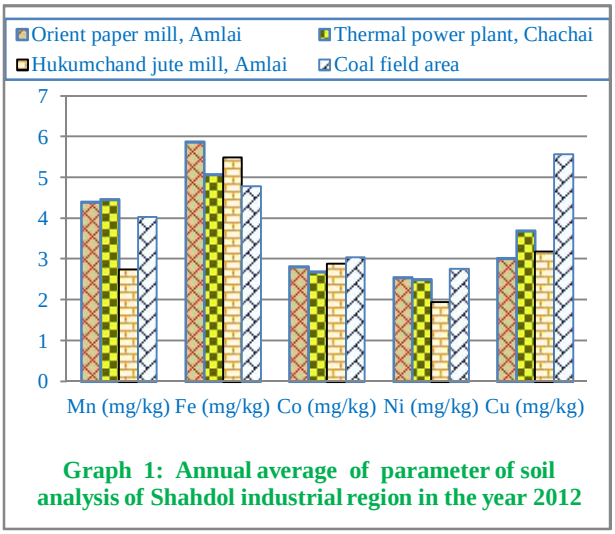
The of selected Parameters and trace metals in all soil and surface water samples i.e. pH, conductivity, Mn, Fe, Co, Ni, Cu, and Zn were analysed using pH meter, conductivity cell and Atomic Absorption Spectrophotometer (VARIAN GTA-120, AA240). Prior to analysis, the samples were diluted with 2% 1N nitric acid solution. Table 1 shows the operating conditions of AAS for selected elements.

Table 1 : Annual average of parameter of soil analysis of Shahdol industrial region in the year 2012.

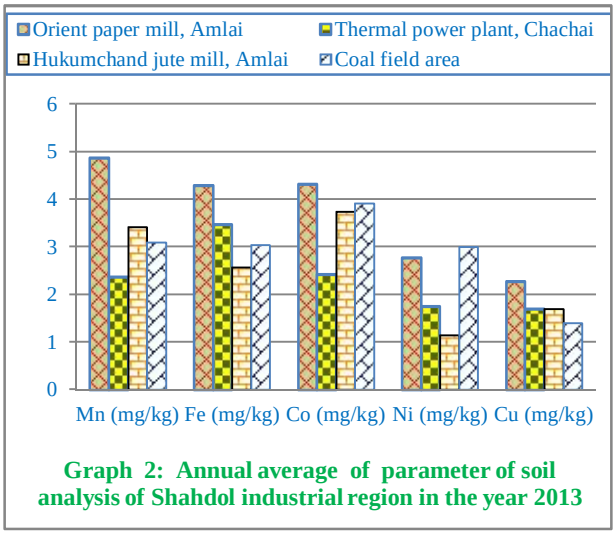
| Parameters | Orient paper mill, Amlai | Thermal power plant, Chachai | Hukumchand jute mill, Amlai | Coal field area |
|---|---|---|---|---|
| pH | 7.985 | 7.493 | 5.36 | 6.648 |
| Conductivity ($\mu$ mho $cm^{-1}$ at 25°C) | 559.8 | 589.8 | 609.3 | 459.8 |
| Mn (mg/kg) | 4.398 | 4.475 | 2.75 | 4.05 |
| Fe (mg/kg) | 5.875 | 5.075 | 5.5 | 4.8 |
| Co (mg/kg) | 2.825 | 2.7 | 2.9 | 3.05 |
| Ni (mg/kg) | 2.55 | 2.5 | 1.95 | 2.775 |
| Cu (mg/kg) | 3.025 | 3.7 | 3.2 | 5.575 |
| Zn (mg/kg) | 3.025 | 4.85 | 3.85 | 3.725 |

Table 2 : Annual average of parameter of soil analysis of Shahdol industrial region in the year 2013.

| Parameters | Orient paper mill, Amlai | Thermal power plant, Chachai | Hukumchand jute mill, Amlai | Coal field area |
|---|---|---|---|---|
| pH | 7.918 | 7.135 | 5.633 | 5.848 |
| Conductivity ($\mu$ mho $cm^{-1}$ at 25°C) | 619.8 | 689.8 | 689.3 | 559.8 |
| Mn (mg/kg) | 4.875 | 2.375 | 3.425 | 3.1 |
| Fe (mg/kg) | 4.3 | 3.475 | 2.575 | 3.05 |
| Co (mg/kg) | 4.325 | 2.425 | 3.75 | 3.925 |
| Ni (mg/kg) | 2.775 | 1.75 | 1.15 | 3 |
| Cu (mg/kg) | 2.275 | 1.7 | 1.7 | 1.4 |
| Zn (mg/kg) | 5.425 | 1.825 | 2.775 | 3.025 |




**Graph 1: Annual average of parameter of soil analysis of Shahdol industrial region in the year 2012**




**Graph 2: Annual average of parameter of soil analysis of Shahdol industrial region in the year 2013**

From the pH meter, conductivity cell and Atomic Absorption Spectrophotometer (VARIAN GTA-120, AA240) selected pH –Value Most of the chemical and biochemical reactions are influenced by the pH, it is of great practical importance. The adverse effects of most of the acids appear below pH 5.36 and of alkalis above pH 7.918. The sewage pH was slightly alkaline, ranging from 7.918-5.36 from selected area and year Electrical Conductance (At 25°C) The electrical conductance is reciprocal to the electrical resistance and the G values show total ions per centimetre. It is a numerical expression of the ability of a soil sample to carry an electric current. There was not much variation in the area samples between year 2012 and year 2013 but there was significance variation was noted in selected area sample which was found to be 609.3 µS in year 2012 and 689.8 µS in year 2013. The total solids in a wastewater consist of the insoluble or suspended solids and the soluble compounds dissolved in water. The organic matter consists mainly of proteins, carbohydrates and fats. Between 40 and 65 % of the solids in an average wastewater are suspended. In this table. the sample of compare selected area and year. heavy metal concentrations results of surface water samples shows that the total concentrations of the heavy metals vary seasonally in small variation with more variation of Zinc (Zn). The concentration of heavy metals in Surface water near the disposal/dumping sites during pre-monsoon and post monsoon is presented in fig. 1and 2 respectively. Also it was observed that the concentration of Mn, Fe and Zn have the high concentration in pre monsoon surface water samples. In post monsoon analysis of surface water samples only the Cr has been found with high concentration. It is observed from above analysis that after monsoon seasons the heavy metals may be transported or diluted by rain water and thus concentration of metals is less.

## IV. CONCLUSION

After the analysis of soil samples, a general conclusion that could be reached is that the concentrations of heavy metals in soil near to the dumping/disposal site is more and decreases as distance increases. Also in the depth wise analysis, it was observed that the in most of the soil samples, higher concentrations of selected heavy metals are observed near the surface of ground and magnesium which has highest concentration. The surface water analysis also indicated that the concentrations of Co and Mn are higher before and after the monsoon. Leachate pollution can be reduced by using scientific designed dumping sites with liners and if possible the amount of industrial solid waste generation may be reduced with the help of process modification of particular products. Also the higher pH (alkaline) of the disposed industrial solid wastes may reduce the leachate generation, so suitable alternatives can be used for the same at the time of industrial solid waste disposal or dumping near populated vicinity.

## V. ACKNOWLEDGEMENT

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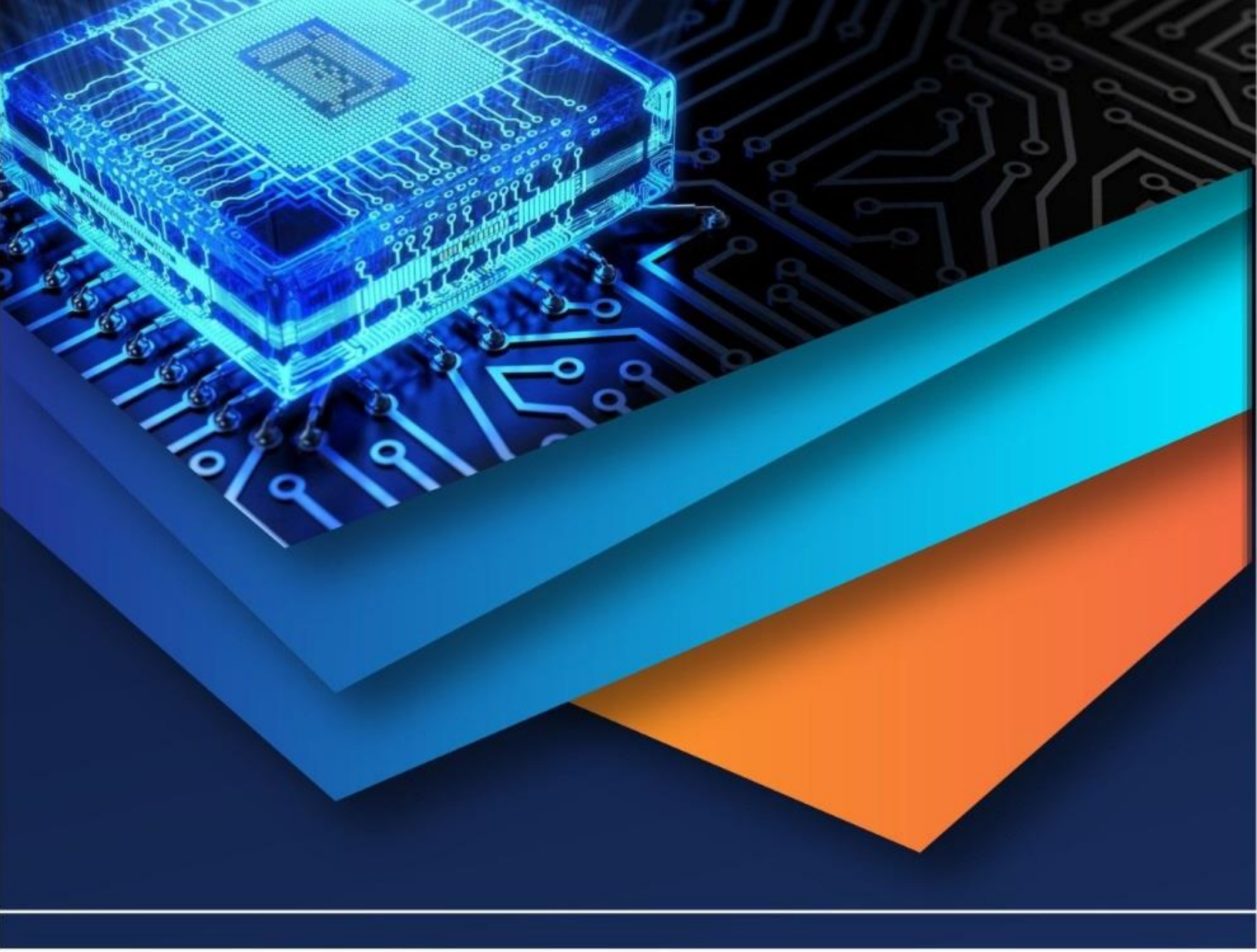

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