10.48047/jocaaa.2022.30.02.42

A study of Heavy Metals Contamination in Soil and Its Implications on Human Well Being

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ABSTRACT

Heavy metals are common pollutants in the soil environment distributed naturally by both geologic and biologic cycles, poses a threat to environment and food security due to the fast growth of industry and agriculture, and the disruption of natural ecosystems by anthropogenic activities linked to the growth of human populations. In this paper, contamination of soil by heavy metals and their toxic effect on human well being has been discussed.

Keywords : Environment, Heavy metals, Soil contamination.

INTRODUCTION

Heavy metal contamination in soil occurs when toxic metals like lead, arsenic, and cadmium accumulate to unsafe levels from sources such as industrial activities, mining, agriculture, and waste disposal. This contamination harms soil health and fertility, negatively impacts plant growth and crop yield, and can pose serious risks to human and animal health through the food chain. Managing these contaminants often requires remediation strategies, which can include physical, chemical, or biological methods to immobilize or remove the metals.

Heavy metals are group of elements with metallic properties that include transition metals, metallics, lanthanides and actinides (Singh *et al*, 2011). Some of them are essential constituents for different enzymes e.g. Cobalt, Copper, Magnesium, Molybdenum and Zinc etc., while others e.g. Arsenic, Cadmium, Lead, Mercury and Vanadium etc., are non-essential. Soil may becomecontaminated by the accumulation of these metals through emissions from the rapidly expanding industrial areas, sewage irrigation, mining activities, use of fertilizers, pesticides, fossil fuelcombustion etc. Soils act as the major sink for pollutants. These heavy metals in the soil do not affect by microbial disintegration and persist in soil for long time (Adriano DC, 2003) pose risks and hazards to human health by direction ingestion and through ecosystem by entering into food chain (Ling *et al.,* 2007).

SOURCES OF HEAVY METALS IN CONTAMINATED SOILS

Heavy metals occur naturally in the soil environment fromthe pedogenesis, weathering ofparent materials at levels that are regarded as traces (<1000 mg/kg) and rarely toxic (Kabata-Pendias and Pendias, 2001; Bolan *et al.,* 2008). The concentrated deposits of these elements generally occur in insoluble state in rock, deposits and sediments, which are usually not available to the living systems. The natural rate of weathering, decomposition and dissolution is normally pretty slow and as such there is hardly any threat of trace element pollution. It is mainly human activity which has added enormous quantities of these elements in various compartments of the environment.(D'Amore*etal,*2005).Many

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Studies have been done in this area, reporting that the primary sources of heavy metals are agriculture, mining, agrochemicals and industries. In other words, the soil surface is a fertile place for storing heavy metals, and the transferring them to the plants by absorption along with water through roots, followed by the vascular system.

Another, important source of heavy metals in the environment is combustion of fossil fuels and organic matter. In coal, petroleum crude and dead organic matter, most of these elements occur in small amount whereas ash/fly -ash or unburned scum left after the combustion is rich in a number of toxic elements which are usually added to the environmental burden of pollutants. As a consequence of consumption of large quantities of fossil fuels urban localities around the world possess a higher concentration of heavy metals and trace elements in their soil, atmosphere as well as the plants, animals including man.

IMPLICATION OF HEAVY METALS ON HUMAN WELL BEING

During the last five or six decades an increasing amount of heavy metals has been discharged into the soil as discussed earlier. The most common six heavy metals found contaminated sites are As, Pb, Cr, Cd, Hg, Ni etc. (US EPA, 1996).

1) **Arsenic (AS)** - Arsenic is ubiquitous in distribution found extremely in lime stones and siliceous deposits. Common source of arsenic is weathering and degradation of rocks naturally and its sulphide ores.Smelting of lead, Copper, gold and iron ores yields volatile oxides of arsenic, which gets deposited in flues from where they are collected and refined. Arsenic compounds absorb strongly to soils and are therefore transported only over short distances in ground water and surface water. Arsenic is associated with skin damage, increased risk of cancer, and problems with circulatory system.

2) **Lead (Pb) –** It is the ubiquitous toxic metal and can be detected in practically all components of the environment as well as of the biosphere. In humans, inhalation and ingestion are the two routes of exposure, and the effects from both are the same. Lead accumulates in the body organs (i.e. brain) which may lead to poisoning or even death. More than 90% of the Lead absorbed by the blood, associated with haemoglobin (Barltop and Smith, 1971). Later it is distributed to liver, kidney and bones including teeth. It is finally deposited in bones leads osteolysis. Ingestion of large quantity of Lead causes burning pain in mouth, throat and stomach, followed by abdominal pain accompanied by constipation or diarrhoea and often bleeding in severe causes. Finally, there may be failure of blood circulation and termination of liver and kidney function. In growing child, degeneration of intellect and mental retardation may occur due to lead toxicity (NSC, 2009).

3) **Chromium (Cr)** – Chromium metal and its salts are used in production of stainless steel, ferrochromium and other alloys, chrome pigments, in tanning of leather, mordant dyeing, wood preservation and as an anti-corrosive agent in cooling systems & boilers, oil drilling muds etc. Important sources are ferrochrome production units, refining of ores, industrial activities and combustion of fossil fuels. Only trivalent and hexavalent forms of chromium are of biological significance. Trivalent form of chromium is almost always occurs in living system. Small quantities of this form are essential to carbohydrate metabolism in mammals while it is also a co-factor for action of insulin. Acute chromium toxicity causes serious renal tubular necrosis. Exposure to hexavalent chromium causes dermatitis, allergic skin reactions, chronic ulceration, injury to nasal

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septum, gastrointestinalulcersetc. At present, both formsareconsidered equallypotent carcinogenic agent (Norseth T, 1981).

4) **Cadmium (Cd)-** Cadmium belongs to the same family of elements as Zinc and mercury. The metal is obtained as a by-product of mining and smelting of zinc and lead. Cadmium gains entry into the soil from mining and metallurgical operations, electroplating units, paints, pigments and dyes industries and combustion of fossil fuels etc. The most significant use of cadmium is in nickel / cadmium batteries, coating with cadmium to vessels provide good corrosion resistance. Cadmium is also present as an impurity in several products, including phosphate fertilizers, detergents and petroleum products. The deposition of these contaminants increases the total concentration of cadmium in soils. Cadmium is a potent enzyme inhibitor. It interacts with protein part of several enzyme systems, form metal protein complex that is resulting proteinurea. Food intake and tobacco smoking are the main routes by which cadmium enters the body (Manahan SE, 2003).

5) **Mercury (Hg) -** Mercury belongs to the same group in periodic table with zinc and cadmium main sourceofmercury isCinnabar. It istheonly liquid heavy metals, released fromcoalcombustion, isa majorsourceofmercurycontamination.Inhalation of mercury vapours produces acute corrosive bronchitis, intestinal pneumonitis, impaired vision, muscular convulsions, madness and Paralysis. Mercury is also associated with kindly failure. (Scragg A, 2006).

6) **Nickel (Ni) -** Nickel is a known carcinogen of respiratory tract. The major sources of nickel contamination in the soil are metal plating industries, combustion of fossil fuels, nickel mining and electroplating (Khodadoust *et al.,* 2004). The larger part of nickel compounds in environment will absorbto sedimentsor soilparticles and become immobileasaresult. It mixeswithground water by the process of leaching. Common toxic effects produced by nickel exposures in large amounts include dermatitis ad respiratorydisorders. Most severe cases precede pneumonia respiratory failure and eventually odema and death.

CONCLUSION

Due to enormous economic development and rapid growth in many fields, such as agricultureand industries, the environment is becoming more polluted. Certain environmental processes, such as synthetic industries, coal conservation and waste burning results in hazardous problems for abiotic elements and biotic communities. Usually environmental toxicants include heavy metals and pesticides, threatened the entire ecosystem, seriously damaging its function and structure.

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