



HEAVY METALS CONTAMINATION AND ENVIRONMENTAL IMPACTS

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Summary

Environmental contamination by heavy metals has significantly become a global issue in the recent years as it affects soil, plants, aquatic life and human health. With the increase in anthropogenic activities such as industrialization and also with rapid urbanization, this has results to different kinds of pollutant in the environment without control or remediation. Heavy metals occur naturally in the soil environment from the pedogenetic processes of weathering of parent materials and from anthropogenic sources such as traffic emission from automobile, industrial and energy production, and waste disposal. Excess of heavy metal pollutants deposited on the soil may be transformed and transported from plants as they pass on to animals and to human being at the top of the food chain. Heavy metal contamination has been seen to be damaging to plants and disrupt metabolic functions of vital organs and glands of human. Therefore, it is of important to continually assess the levels of heavy metals in an environment for evaluation of human exposure and for sustainable environment. The aim of this paper is to discuss the environmental (air, soil and water) pollution by heavy metals. Sources of heavy metals in an environment as well

as their potential effects. Different methods of remediating this contamination were also considered and recommendation were presented.

[Introduction:

The term environment has been derived from a French word “Environia” which means to surround. Environment is thus referred to the surroundings within which both abiotic (physical or non-living) and biotic (living) interacts. These are made up of: the land, the water and the atmosphere of the earth; microorganisms, plant and animal life [1].

Environmental contamination is the presence of elevated concentrations of toxic substances in the environment above the natural threshold level, in effect resulting to undesirable and unwanted changes in physical, chemical and biological characteristics of air, water and soil which is harmful for living organisms (animal and plants)

Heavy metals are among the most investigated environmental pollutants. It is defined as a metal with a density greater than 5 g/cm^3 (i.e., specific gravity greater than 5). According to Duffus the term “heavy metals” is often used as a group name for metals and semimetals (metalloids) that have been associated with contamination and potential toxicity or ecotoxicity [2]

Environmental contamination and pollution by heavy metals is a threat to the environment and is of great concern. Rapid industrialization and urbanization have caused contamination of the environment by heavy metals, and their rates of mobilization and transport in the environment have greatly accelerated [3].

Sources of heavy metals contamination in the environment:

Heavy metals are naturally occurring elements in the earth’s crust, a large percentage of environmental contamination and human exposure result from anthropogenic activities such as mining and smelting operations, industrial production, and domestic and

agricultural use of metals and metal-containing compounds. Sources of heavy metal combination include:

- Environmental contamination - Can occur through metal corrosion, atmospheric deposition, soil erosion of metal ions and leaching of heavy metals to soil and ground water.
- Natural processes - such as weathering and volcanic eruptions have also significantly contributed to heavy metal pollution.
- Industrial sources – which include metal processing in refineries, coal burning for power plants, petroleum combustion, nuclear power stations and high-tension lines, plastics, textiles, microelectronics, wood preservation and paper processing plants

Heavy Metal and their adverse effect on biological life:

- i. **Arsenic:** a ubiquitous element that is detected at low concentrations in almost every sample of the earth matrices (air, water and soil). Anthropogenic activities of several arsenic-containing compounds are produced industrially, and have been used to manufacture products with agricultural applications such as insecticides, herbicides, fungicides, wood preservatives, and dye-stuff.

Potential Harm

Research has highlighted significantly in mortality rates for cancers of the bladder, kidney, skin, and liver in many areas of arsenic pollution.

- ii. **Cadmium:** a heavy metal of considerable environmental and industrial concern. The main routes of exposure to cadmium are via inhalation. Other sources of cadmium include emissions from industrial activities, including mining, batteries design for automobile, pigments, stabilizers, and alloys.

Potential Harm

Cadmium is a severe pulmonary and gastrointestinal irritant, which can be fatal if inhaled or ingested. After acute ingestion, symptoms such as abdominal pain, burning sensation, nausea, vomiting, salivation, muscle cramps, shock and loss of consciousness [4].

- iii. **Lead:** a naturally occurring bluish-gray metal present in small amounts in the earth's crust. Lead several industrial, agricultural and domestic applications. It is currently used in the production of lead-acid batteries, ammunitions, devices to shield X-rays etc. Lead released into the environment makes its way into the air, soils, and water. Lead can remain in the environment as dust permanently.

Potential harm

Exposure to lead occurs mainly via inhalation of lead-contaminated dust particles or aerosols, and ingestion of lead-contaminated food and water. At high levels of exposure, lead attacks the brain and central nervous system to cause coma, convulsions and even death.

Environmental Impact of Heavy Metal Contamination:

The presence of heavy metals in the environment leads several adverse effects which cuts across all spheres of the environment, that is, hydrosphere, lithosphere, biosphere and atmosphere.

Effects on Water

Although there are many sources of water contamination, industrialization and urbanization are two of the culprits for the increased level of heavy metal water contamination. Heavy metals are transported by runoff from industries, municipalities and urban areas. Most of these metals end up accumulating in the soil and sediments of water bodies [4].

Heavy metal found in traces quantities in water sources are still considered to be very toxic and impose serious health problems to humans and other ecosystems.

Effects in Air

Industrialization and urbanization, due to rapid world population growth, have recently made air pollution as a major environmental problem around the world. Natural processes which release particulate matters into air include dust storms, soil erosion, volcanic eruptions and rock weathering, while anthropogenic activities are more industrial and transportation related [5]. Heavy metal contamination in the air can cause skin and eyes irritation, respiratory infections, and cardiovascular diseases. These pollutants also cause deterioration of infrastructure, corrosion and formation of acid rain [5].

Effects in Soil

Soil contamination by heavy metals is of most important apprehension throughout the industrialized world. Heavy metal pollution not only result in adverse effects on various parameters relating to plant quality and yield but also cause changes in the sizes, composition and activity of the microbial community [6].

Effects on Human Health

Utilization of food crops contaminated with heavy metals is a major food chain route for human exposure. The cultivation of such plants in contaminated soil represents a potential risk since the vegetal tissues can accumulate heavy metals [7]. Heavy metals become toxic when they are not metabolized by the body and accumulate in the soft tissues [8]. Chronic level ingestion of toxic metals has undesirable impacts on humans and the associated harmful impacts become perceptible only after several years of exposure [9]

Remediating Heavy Metal Contamination

The remediation methodologies can be chemical or biological in nature. Since heavy metal contamination itself is a chemical process, chemical remediation should be avoided, and

biological processes should be introduced. The phytoremediation of heavy metals from the contaminated sites generally happens through any one or more of the following mechanisms or processes [9]: “Phyto-accumulation,” “Phyto-stabilization,” “Phyto-degradation,” and “Phyto-volatilization,”

- **Phyto-accumulation:** Phyto-accumulation is a mechanism through which heavy metals in soil and water at a specific region are accumulated in native plants and are disposed thereafter.
- **Phyto-stabilization:** Phyto-stabilization comprises the establishment of a plant cover on the surface of the contaminated sites for reducing the mobility of contaminants within the vadose zone via accumulation by roots or immobilization within the rhizosphere, reducing off-site contamination.
- **Phyto-degradation:** It is also known as Phyto-transformation, is the breakdown of contaminants taken up by plants through metabolic processes within the plant or the breakdown of contaminants surrounding the plant through the effect of enzymes produced by the plants.
- **Phyto-volatilization:** Phyto-volatilization is a process where plants take up contaminants from soil and release them as volatile form into the atmosphere via transpiration. The process occurs as growing plants absorb water and organic contaminants.

Conclusions and Recommendations:

Awareness of the adverse impacts of heavy metals is vital to mitigating such impacts. Therefore, efforts should be made to raise public awareness and understanding of the toxic nature of heavy metals in the environment and its hazardous effect on human health.

Attention need also be paid to the discharge of waste water into natural water bodies by ensuring appropriate treatment prior to discharge and dislodgement.

Scientific research on environmental assessment of toxic chemicals including toxic heavy metals and metalloids should be encouraged and promoted through allocation of appropriate funds for protecting human health and the environment.

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