

Human Health and Effects of Heavy Metals

Dr. Neelam Kushwaha^{#1}, Dr. Vinita Rajeev*² & Dr. Sibi Jose^{#3}

Associate Professor, Department of Chemistry, TIT-E & University R.G.P.V., Bhopal (M.P.), India^{#1}

Associate Professor, Department of Chemistry, TIT-E & University R.G.P.V., Bhopal (M.P.), India^{#2}

Associate Professor, Department of Chemistry, TIT-E & University R.G.P.V., Bhopal (M.P.), India^{#3}

Abstract

Heavy metal pollution is one of the most serious environmental problem in India and a large number of people are affected by heavy metal pollution. Heavy metals are naturally occurring elements that have a high atomic weight & a density at least 5 times greater than that of water their toxicity depends on several factors including the dose, route of exposure & chemical species as well as the age, gender, genetics & nutritional status of exposed individuals. Arsenic, cadmium, chromium, lead & mercury rank among the metallic elements which are considered as systemic toxicants that are known to induce multiple organ damage, even at lower levels of exposure, they are also classified as human carcinogens according to the U.S. environmental protection agency & the international agency for research on cancer. This paper reviewed the pollution of heavy metals in Bhopal, focusing on the various aspects like sources of heavy metals in Bhopal, toxicity and potential risk.

Keywords

heavy metals, human exposure, toxicity, pollution, potential risk.

I. INTRODUCTION

Heavy metals are defined as metallic elements that have a relatively high density compared to water, their presence is considered unique in the sense that it is difficult to remove them completely from the environment once they enter in it. Pollution typically refers to chemicals or other substances in concentrations greater than would occur under natural conditions.

Heavy metals are important environmental pollutants, metal contamination of the environment results both from natural sources & industrial activities. The metals serving as microelements in living organisms usually occur in trace amounts that are precisely defined for each species. The strongest toxic properties are characteristic for inorganic metal compounds, which dissociate well & are easily penetrate through cell membrane & get into internal organs. These metals accumulate mainly in kidneys, adrenal gland, liver, lungs, hair & skin, cause high

blood pressure, cancer, damage to brain. They may also lead to mental disorders & loss of brain function.

II. SOURCES OF HEAVY METALS

Environmental pollution from hazardous metals & minerals can arise from natural as well as anthropogenic sources. Natural sources are seepage from rocks into water, volcanic activity, forest fires etc. pollution also arises from partitioning of polluting elements (which are concentrated in clay minerals with high absorption capacities) between sedimentary rocks and their precursor sediments and water with rapid industrialization and consumerist life style, sources of environmental pollution have increased.

The pollution occurs both at the level of industrial production as well as end use of the products and run-off.

III. TYPES OF HEAVY METALS

- 1) Chromium (Cr) - Mining, industrial coolants, chromium salts manufacturing, leather tanning.
- 2) Lead (Pb) - Lead acid batteries, paints, E-waste, smelting operations, coal - based thermal power plants, ceramics, bangle industry.
- 3) Mercury (Hg) - Chlor-alkali plants, thermal power plants, fluorescent lamps, hospital waste (damaged thermometers, barometers, sphygmomanometers), electrical appliances etc.
- 4) Arsenic (As) - Geogenic/natural processes, smelting operations, thermal power plants, fuel.
- 5) Copper (Cu) - Mining, electroplating, smelting operations.
- 6) Vanadium (Va) - Spent catalyst, sulphuric acid plant.
- 7) Nickel (Ni) - Smelting operations, thermal power plants, battery industry.
- 8) Cadmium (Cd) - Zinc smelting, waste batteries, E-waste, paint sludge, incineration & fuel combustion.
- 9) Molybdenum (Mo) - Spent catalyst.
- 10) Zinc (Zn) - Smelting, electroplating.

IV. CLASSIFICATION OF HEAVY METALS

Heavy metals can be classified into four major groups on their health importance.

Non Essential - Ba, Al, Li, Zn

Less toxic - Sn and Al

Highly toxic - Hg, Cd

Table -I : Toxic Limit And Recommended / Safe Intake Of Heavy Metal

Heavy metal	Toxic limit	Recommended intake / safe intake
Arsenic	3 mg / day for 2 - 3 weeks	15-25 µg / day (adults)
Cadmium	200 µg/kg of fresh weight	15-50 µg / day adults 2-25 µg/day children
Lead	≥ 500 µg / L blood	20-280 µg/day adults 10-275 µg/day children
Zinc	150 µg / day	15 µg/day

V. TOXIC EFFECTS OF HEAVY METALS

The toxicity of metal ions to mammalian systems is due to chemical reactivity of the ions with cellular structural proteins, enzymes & membrane system. The target organs of specific metal toxicities are usually those organs that accumulate the highest concentrations of the metal in vivo.

Symptoms & effects can vary according to the metal or metal compound, and the dose involved. For humans, typical presentations, associated with exposure to any of the classical toxic heavy metals are shown in the table -

Table II : Harmful Effects Of Heavy Metals In Human Beings

Element	Acute exposure usually a day or less	Chronic exposure often month or years
Cadmium	Pneumonitis (Lung inflammation)	Lung cancer osteomalacia (softening of bones) proteinuria (excess protein in urine, possible kidney damage)
Mercury	Diarrhoea, fever, vomiting	Stomatitis (inflammation of gums and mouth) Nausea Nephrotic syndrome) (non specific kidney disorder) Neurasthenia (Neurotic disorder) Parageusia (metallic taste) Pink disease (pain and pink discoloration of hands and feet) Tumour.
Lead	Encephalopathy (brain dysfunction) nausea vomiting	Anemia Encephalopathy Foot drop / wrist drop (Palsy Nephropathy (Kidney disease)
Chromium	Gastrointestinal hemorrhage (bleeding)	Pulmonary fibrosis (Lung scarring) Lung cancer

	hemolysis (red blood cell destruction) acute renal failure	
Arsenic	Nausea vomiting diarrhoea encephalopathy multiorgan effects Arrhythmia painful neuropathy	Diabetes Hypopigmentation / Hyperkeratosis cancer

VI. CONCLUSION

In order to fully understand the heavy metal pollution status, a comprehensive investigation of heavy metals was performed. Human exposure to toxic elements and their health effects, such as developmental retardation, several types of cancer, kidney damage, endocrine disruption, immunological, neurological effects & other disorders.

Minimization and elimination of heavy metals are more desirable as compared to other pollution control strategies. These aims could be achieved by reducing the use of heavy metal containing items or recycling them before discharging the pollutants to the environment.

REFERENCES

- [1] www.unep.org
- [2] Gao Y, Xia J. Chromium contamination accident in China: Viewing environment policy of China, Environ Sci Technol, 2011, 45: 8605-8606.
- [3] www.globalecology.stanford.edu
- [4] Wang H J, Du, X M, Wang M, et al. Using ion-pair reversed phase HPLC ICP-MS to simultaneously determine Cr(III) and Cr (VI) in urine of chromate workers, Talanta, 2010, 81: 1856-1860.
- [5] Liu C.P Luo C L, Gao Y, et al, Arsenic contamination and potential health risk implication at an abandoned tungsten mine, southern China, Environ Pollut. 2010, 158: 820-826.