Recent Research in Science and Technology 2013, 5(5): 98-99
ISSN: 2076-5061
Available Online: http://recent-science.com/

Heavy metal water pollution- A case study

Rashmi Verma[1] and Pratima Dwivedi[2]

[1]Dept of Chemistry Dr C.V. Raman University Kota Bilaspur, India.
[2]Dept of Chemistry Chouksey Engg college Bilaspur, India.

Abstract
Heavy metals are dangerous because they tend to bioaccumulate. Bioaccumulation means an increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment. Compounds accumulate in living things any time they are taken up and stored faster than they are broken down (metabolized) or excreted. Heavy metals can enter a water supply by industrial and consumer waste, or even from acidic rain breaking down soils and releasing heavy metals into streams, lakes, rivers, and groundwater. Heavy metal toxicity can result in damaged or reduced mental and central nervous function, lower energy levels, and damage to blood composition, lungs, kidneys, liver, and other vital organs. Long-term exposure may result in slowly progressing physical, muscular, and neurological degenerative processes that mimic Alzheimer's disease, Parkinson's disease, muscular dystrophy, and multiple sclerosis. Allergies are not uncommon and repeated long-term contact with some metals or their compounds may even cause cancer (International Occupational Safety and Health Centre1999).

Keywords: Toxic metal , Heavy metals, Pollution

INTRODUCTION

Water pollution is contamination of water by foreign matter that deteriorates the quality of the water. Water pollution covers pollutions in liquid forms like ocean pollution and river pollution. As the term applies, liquid pollution occurs in the oceans, lakes, streams, rivers, underground water and bays, in short liquid-containing areas. It involves the release of toxic substances, pathogenic germs, substances that require much oxygen to decompose, easy-soluble substances, radioactivity, etc. that becomes deposited upon the bottom and their accumulations will interfere with the condition of aquatic ecosystems. For example, the eutrophication: lack of oxygen in a water body caused by excessive algae growths because of enrichment of pollutants. According to the water cycle, naturally, water around us will be absorbed to the land (soil) and rivers will stream from the upstream to the downstream and released to the sea. In normal situation organic pollutants are biodegraded by microbes and converted to a form that brings benefits to the aquatic life. And for the inorganic pollutants, in the same situation, don't bring to much hazards because they are widely dispersed and have almost no effect to the environment which they are released to. Some of the pollutants like lead (Pb), arsenic (As), mercury (Hg), chromium (Cr) specially hexavalent chromium, nickel (Ni), barium (Ba), cadmium (Cd), cobalt (Co), selenium (Se), vanadium (V), oils and grease, pesticides, etc are very harmful, toxic and poisonous even in ppb (parts per billion) range. There are some minerals which are useful for human and animal health in small doses beyond which these are toxic. Zinc (Zn), copper (Cu), iron (Fe), etc fall into this category. For agriculture, some elements like zinc, copper, manganese (Mn), sulphur (S), iron, boron (B), together with phosphates, nitrates, urea, potassium, etc are useful in prescribed quantities. There are some compounds like cyanides, thiocyanides, phenolic compounds, fluorides, radioactive substances, etc which are harmful for humans as well as animals.

SOUCES OF HEAVY METAL - Environmental pollution from hazardous metals and minerals can arise from naturalas 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. These toxic elements enter the human body mostly through food and water and to a lesser extent through inhalation of polluted air, use of cosmetics, drugs, poor quality herbal formulations‘(herbo-mineral preparations) and `Unani’ formulations, and even items like toys which have paints containing lead.

Sources of heavy metals (Source: Gautam SP, CPCB, New Delhi)

Chromium (Cr)-Mining, industrial coolants, chromium salts manufacturing, leather tanning

- Lead (Pb) lead acid batteries, paints, E-waste, Smelting operations, coal- based thermal power plants, ceramics, bangle industry
- Mercury (Hg) Chlor-alkali plants, thermal power plants, fluorescent lamps, hospital waste (damaged thermometers, barometers, sphygmomanometers), electrical appliances etc.
- Arsenic (As) Geogenic/natural processes, smelting operations, thermal power plants, fuel
- Copper (Cu) Mining, electroplating, smelting operations
- Vanadium (Va) Spent catalyst, sulphuric acid plant
- Nickel (Ni) Smelting operations, thermal power plants, battery industry

- Cadmium (Cd) Zinc smelting, waste batteries, e-waste, paint sludge, incinerations & fuel combustion
- Molybdenum (Mo) Spent catalyst
- Zinc (Zn) Smelting, electroplating

One group of factors that may be detrimental to all organisms within urban ecosystems is metal contaminants, such as lead, zinc, copper, cadmium, mercury, nickel, and iron, that get deposited in soil. Metal contaminants are introduced into food webs at the bottom of the food chain and reach earthworms and other invertebrates that live in the soil. When consumed by organisms such as birds and snakes, the contaminants and their potential toxic effects accumulate within sensitive organs and tissues.

HUMAN EXPOSURE THROUGH FOOD, AIR AND WATER

Heavy metal pollution of surface and underground water sources results in considerable soil pollution and pollution increases when mined ores are dumped on the ground surface for manual dressing (Garbarino et al., 1995 INECAR, 2000). Surface dumping exposes the metals to air and rain thereby generating much AMD. When agricultural soils are polluted, these metals are taken up by plants and consequently accumulate in their tissues (Trueby, 2003).Animals that graze on such contaminated plants and drink from polluted waters, as well as marine lives that breed in heavy metal polluted waters also accumulate such metals in their tissues, and milk, if lactating. In summary, all living organisms within a given ecosystem are variously contaminated along their cycles of food chain.

HEAVY METAL POISONING AND BIOTOXICITY

The biotoxic effects of heavy metals refer to the harmful effects of heavy metals to the body when consumed above the bio-recommended limits. Although individual metals exhibit specific signs of their toxicity, the following have been reported as general signs associated with cadmium, lead, arsenic, mercury, zinc, copper and aluminium poisoning: gastrointestinal (GI) disorders, diarrhoea stomatitis, tremor, hemoglobinuria causing a rust–red colour to stool, ataxia, paralysis, vomiting and convulsion, depression, and pneumonia when volatile vapours and fumes are inhaled (McCluggage, 1991). The nature of effects could be toxic (acute, chronic or sub-chronic), neurotoxic, carcinogenic, mutagenic or teratogenic.

Cadmium is toxic at extremely low levels. In humans, long term exposure results in renal dysfunction, characterized by tubular proteinuria. High exposure can lead to obstructive lung disease, cadmium pneumonitis, resulting from inhaled dusts and fumes. It is characterized by chest pain, cough with foamy and bloody sputum, and death of the lining of the lung tissues because of excessive accumulation of watery fluids. Cadmium is also associated with bone defects, viz; osteomalacia, osteoporosis and spontaneous fractures, increased blood pressure and myocardic dysfunctions.

Lead is the most significant toxin of the heavy metals, and the inorganic forms are absorbed through ingestion by food and water, and inhalation (Ferner, 2001). A notably serious effect of lead toxicity is its teratogenic effect. Lead poisoning also causes inhibition of the synthesis of haemoglobin; dysfunctions in the kidneys, joints by food and water, and inhalation (Ferner, 2001). A notably serious effect of lead toxicity is its teratogenic effect. Lead poisoning also causes inhibition of the synthesis of haemoglobin; dysfunctions in the kidneys, joints and reproductive systems, cardiovascular system and acute and chronic damage to the central nervous system

Zinc has been reported to cause the same signs of illness as does lead, and can easily be mistakenly diagnosed as lead poisoning (McCluggage, 1991). Zinc is considered to be relatively non-toxic, especially if taken orally. However, excess amount can cause system dysfunctions that result in impairment of growth and reproduction (INECAR, 2000; Nolan, 2003). The clinical signs of zinc toxicosis have been reported as vomiting, diarrhea, bloody urine, icterus (yellow mucus membrane) .liver failure, kidney failure and anemia (Fosmire, 1990).

Mercury is toxic and has no known function in human biochemistry and physiology. Inorganic forms of mercury cause spontaneous abortion, congenital malformation and GI disorders (like corrosive esophagitis and hematochezia). Poisoning by its organic forms, which include monomethyl and dimenthylmecury presents with erethism (an abnormal irritation or sensitivity of an organ or body

CONCLUSION

The toxic elements enter the body mainly through water, food and air. Cosmetics, dental products, some drugs, particularly Ayurvaid and Unani drugs also contribute. More research is needed to assess the extent to which these products affect human health. Public awareness should be created. There should be monitoring and control over the concentration of heavy metals in cosmetics.

Heavy metals are important in many respects to man, especially in the manufacturing of certain important products of human use, such as accumulators (Pb), mercury-arch lamps and thermometers (Hg), utensils (Al) and a wide range of other products (Yaw, 1990; McCluggage, 1991). But the biotoxic effects, when unduly exposed to them could be potentially life threatening hence, cannot be neglected. While these metals are in many ways indispensable, good precaution and adequate occupational hygiene should be taken in handling them. Although heavy metal poisoning could be clinically diagn-osed and medically treated, the best option is to prevent heavymetal pollution and the subsequent human poisoning.

REFERENCES

[1] Krishnaswamy K, Kumar BD, 1998.Lead toxicity. Indian Journal of Paediatrics. 35: 209-216.

[2] Voutsaand D, Samara C, 2002.Labile and bio accessible fractions of heavy metals in the airborne particulate matter from urban and industrial areas. Atmospheric Environment, 3583-3590.

[3] National Institute of Nutrition, Hyderabad, 2006. Role of Nutrients in Environmental Toxicity. Annual report 2005–2006, pp 62–64

[4] Goel P.K. Water pollution causes effects and control, new age international publisher.

[5] Gupta PK. 2010. Elements of Biotechnology, 3rd Edition. Rastogi Publications, Meerut.