REVIEW ON HEAVY METALS CONTAMINATION IN THE ENVIRONMENT

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ABSTRACT

Review was made on heavy metals, the various organs that they affect in human body, their sources, effects and control. Heavy metals that are of environmental importance include cadmium, lead, arsenic and mercury. The various sources of these metals in the environment include mining, industry, exhaust fumes of vehicle, soil, food, water and so on. These metals affect various organs in human body such as kidney, central nervous system, gastrointestinal tract, lungs, liver and so on. So in other to experience safety of living in the environment, the way these metals are released in to the environment should constantly be monitored and controlled. And there should be remediation for heavy metals in contaminated soils.

Keywords: Metals, Sources, Organs and Environment.

INTRODUCTION

Heavy metals are found naturally in the earth. They become concentrated as a result of human activities and can enter plant, animal and human tissues through inhalation, diet and manual handling. They can interfere with cellular components. Cadmium, lead, mercury and arsenic appear among the 10 list of chemicals of major public concern to WHO (Brathwaite and Rabone, 1985). Some of their sources include atmospheric deposition, waste disposal, fertilizer, pesticide application, industry and nuclear waste.

METALS THEIR SOURCES AND ADVERSE EFFECTS

Cadmium

Cadmium occurs naturally in ores with zinc, lead and copper. Cadmium is located at the end of the second row of transition elements with atomic number 48, atomic weight 112.4, density 8.65gcm^{-3}, melting point 320.9^{o}C and boiling point 765^{o}C (Wuana and Okieimen, 2011). WHO estimated a urinary excretion of 10nmol/mmol creatinine (corresponding to circa 200mgCd/kg kidney cortex) would constitute a 'critical limit' below which kidney damage would not occur (Jarup, 2003).

Sources

It originated from industrial, mining, electroplating and sewage sources. Cigarette smoking is another source of cadmium (Jarup, 2003). Cadmium is also present in foodstuffs, but the concentration varies, but individual intake also varies due differences in feeding habit.

Adverse effects

It causes damages to the kidney, acute pulmonary effects, and kidney cancer (Kolonel, 1976). It also affects liver and gastrointestinal tract.

Mercury

Mercury is the only liquid metal at standard temperature and pressure (stp). It has atomic number 80, atomic weight 200.6, density 13.6gcm^{-3}, melting point -13.6^{o}C and boiling point 357^{o}C and is usually recovered as a byproduct of ore processing (Smith, 1995). Metallic mercury is used in thermometers, barometers and instruments for measuring blood pressure. Air concentrations in some dental surgeries reached 20µg/cm^{3} during the 1970s (Jarup, 2003).

Source

It can originate from industrial, coal burning, leaching of soil due to acid rain.

Adverse effect

Short time exposure to mercury can cause lungs damage, it can also cause kidney damage and also affect nervous system

Arsenic

Arsenic has the following properties: atomic number 33, atomic mass 75, density 5.72gcm^{-3}, melting point 817^{o}C and boiling point 613^{o}C and exhibits fairly complex chemistry and can be present in several oxidation states (-III,O,III,V)(Smith, 1995). Much higher concentrations > 1000ng/cm^{3} of arsenic have been measured near industrial sources (Jarup, 2003).

Sources

It can be originated from mining, industrial, herbicides and wood preservatives.

Adverse effects

Arsenic cause's damage to the skin, eyes and liver, and it may also cause cancer, affect kidneys and central nervous system.

Lead

Lead is a metal belonging to group IV and period 6 of the periodic table with atomic number 82, atomic mass 207.2, density 11.4g/cm^{3}, melting point 327.4^{o}C and boiling point 1725^{o}C (Wuana and Okieimen, 2011). Blood lead levels in children below 10µmg/dl have been considered acceptable (Jarup, 2003).

Sources

It can be originated from mining, paint and automobile exhaust

Adverse effect

It damages the kidney and affect nervous system and caused mental lapse.

The various sources of metals includes: soil, water, industry, herbal plants, food and they occurred in various regions of the world such as Africa (Nigeria), China, India and so on. Each of these sources of metal in the environment has varying metal contents.

HEAVY METALS CONTAMINATION IN SOIL

Sources of soil contamination can occur through industrial wastewater, sewage water used for irrigation, quarrying sites and through hazardous waste disposal on the soil.

Low concentration of these metals can interact with the soil, to cause nutrient deficiency (Gebreyesus, 2014). These heavy metals can affect soil matrices, and hence metal transport. Heavy metal contamination of urban and agricultural soils can result from mining, manufacturing, and the use of synthetic products (e.g. pesticides, paints, batteries, industrial waste and land application of industrial or domestic sludge. Contaminated soils may occur at fields that had past applications of waste water or municipal sludge, areas in or around mining waste piles and tailings, industrial areas where chemicals may have been dumped on the ground and so on. The presence of toxic metals in soil can severely inhibit the biodegradation of organic contaminants (Maslin and Maier, 2000). When heavy metals exceed certain levels in the soil due to pollutants brought from outside, contamination of soil occurs and agricultural products become contaminated, this has occurred in Japan (Arao et al., 2010). In Taiyuan city in China, contamination of agricultural soil by heavy metals can occur through different means such as use of sewage water for irrigation for metals like Cd, Cu, Hg, Pb, Zn and Cr or from soil parent material for As and Ni (Liu et al., 2015) . In Beijing in china, people consuming food crops grown in waste water-irrigated soils can ingest significant amount of metals (Khan et al., 2008). The 3 land degradation forms: erosion, bush burning and oil spilage can affect distribution of heavy metals (Oghenero, 2012). Heavy metals contamination of soil and plant samples taken from an abandoned granite quarry has been carried out in Ekiti State Nigeria (Ayodele et al., 2014). Another source of soil contamination is through hazardous waste disposal sites (Parth et al., 2011), which has resulted in heavy metal contamination of soil in India. In Ghana, heavy metal contamination of soils around a hospital waste incinerator bottom Ash dumps site has been carried out (Adama et al., 2016). The factors that affect the bioavailability and occurrence of metals in the soil include soil pH, cation exchange capacity, organic matter content, soil texture and interaction among the target elements (Jung, 2008).

HEAVY METALS CONTAMINATION IN WATER

Heavy metals from the mining, industrial sources are leached into the underground water, moving along water pathways and eventually depositing in aquifer or are washed away by runoffs into surface water, resulting in water pollution (Duruibe et al., 2007). For example, the sources of heavy metals (such as As, Cd, Hg, Pb, Cr and Zn) contamination in Port Klagn in Malaysia were industrial wastewater and port activities, where water were collected from 21 stations at 3 months intervals and contamination factor (C_f) and contamination degree (C_d) were calculated to estimate the contamination status at the sampling areas (Sany et al., 2013). In china, there has been contamination of pond water and soil from illegal e-waste recycling activity (Wu et al., 2015). The occurrence of certain diseases such as renal failure, liver cirrhosis, hair loss, chronic anemia has been linked to the presence of heavy metals such as Pb, Cd, Cu, Mo, Ni and Cr in drinking water in some Great Cairo Cities in Egypt (Salem et al., 2000).

HEAVY METAL CONTAMINATION IN FOOD AND AUTOMOBILE EXHAUST FUMES

Metals can also occur as residues in food because of their presence in the environment, as a result of human activities such as farming, industry or car exhaust or from contamination during food processing and storage. Impact of automobile exhaust fumes on concentration levels of lead on bread has been shown (Weli and Iwowari, 2014). In which there was correlation in concentration of lead in bus terminals and volume of vehicular counts. Metals in the street dust can originate from anthropogenic sources in Kano and Jos cities in Nigeria (Alhassan et al., 2012; Mafuyai et al., 2015). There has been heavy metal contamination of edible vegetables along road construction sites on humans and animals living in such environment (Otitoju et al., 2012)

HEAVY METALS CONTAMINATION IN HERBAL PRODUCTS

Metals can be present in herbal products (Rania et al., 2015). Herbs are traditionally used for the treatment and cure of diseases such as headache, stomach pain, diabetes, hypertension and many others (Sakkir et al., 2012). The toxicity of herbal plants may be related to contaminants such as pesticides, microbes, heavy metals, chemical toxins and adulterants (Saad et al., 2006). In Abeokuta in Nigeria about 51 elements in 32 herbal plants commonly used for cancer therapy have been identified (Olujimi et al., 2014). The concentration of heavy metals such as Pb, Cd, Hg and As in Cassia alata along roadside include 17.650µg/g, 0.900µg/g, <0.001µg/g and <0.001µg/g (Anna et al., 2013).

EFFECTS OF HEAVY METALS CONTAMINATION

Heavy metals contamination such as lead, cadmium, copper, molybdenum, nickel and chromium has led to the following diseases: renal failure, liver cirrhosis, hair loss and chronic anemia in people in Egypt (Salem et al., 2000); bone effects, fractures in cadmium, neurological effect in lead and skin cancer in arsenic (Jarup, 2003)

CONTROL OF HEAVY METALS CONTAMINATION IN THE ENVIRONMENT

Remediation is necessary for protection and restoration of soil ecosystems contaminated by heavy metals (Wuana and Okieimen, 2011). This requires knowledge of source of contamination, chemistry and environmental and associated health effects (risks) of heavy metals. Phytoremediation can also be employed to control heavy metals which are the use of plants to reduce metals pollution (EPA, 1998). It has the benefits of natural solution to environmental problem at low cost. Reduction can of Cadmium uptake by the plant could be achieved through soil dressing, water management (paddy field), chemical cleaning of soil, use of different varieties and rootstock and phytoextraction (Arao et al., 2010). There should be risk assessment in the environment. This is an effective scientific tool which enables decision makers to manage sites so contaminated in a cost-effective manner while preserving public and ecosystem (Zhao and Kaluarachchi, 2002).

CONCLUSION

These heavy metals concentration in the environment should be monitored to prevent hazards to human beings and animals. This can be made possible through proper discharge of environmental pollutants to the environment from the industry, through proper examination

of soil for metal contamination before planting crops in soil with sewage water for irrigation, or area near industrial waste discharge, and automobile waste areas, through monitoring of vehicles not to be discharging fumes un necessarily and proper examination of food and water for metal contamination. There should be involvement of environmental protection agency in proper monitoring of heavy metal contamination in the environment.

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