HEAVY METALS IN RIVER – A REVIEW

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ABSTRACT

Rivers are the life line of any country and it supports a large volume of population since long time. All ancient civilizations have grown in the lap of different rivers as rivers are the source of fresh water, essential to sustain life. After Industrial revolution and population explosion there is a huge pressure on the rivers across the globe. Many rivers have lost their existence due to disappearance of glaciers while some rivers are facing survival problem due to heavy pollution from cities and industries. Industries discharge their treated and untreated waste in the nearby rivers. Several cities also dumped their domestic waste in the river, lead to contamination of water. The domestic and industrial waste carries the load of different heavy metals which are harmful for the aquatic as well as human life. Many metals are known for their carcinogenic effects and some are also affect nervous system of living being. These metals get accumulated in the plants, animals and humans via food chain and become the reason of different diseases. In the present article, efforts are made to explain the heavy metal and its role in river environment.

Keywords: *Heavy metals, pollution, contamination, bioaccumulation*

1. INTRODUCTION

Water is one of the five natural elements which are essential for the sustenance of life. Our earth is covered by about 70% of water, out of which 97.5% is in oceans, 2.4% in lands and less than 0.01% in atmosphere. Water has been continuously exchanged between the three spheres and thus maintains the water balance. Rivers are the main source of water and ancient civilizations have grown near the rivers across the world. There are many regions of Africa and Asia where peoples walk an average of 3.7 miles a day just to fetch water [1]. The available fresh water resources are depleting due to increased demand of different sectors which leads to water scarcity. In India Rivers are not only the source of water for drinking, bathing, washing, transportation but also have religious importance. This religious belief of people to take a holy dip in river and use of soap and detergent led to deterioration of the water quality. There are lack of awareness in India about the availability of water and its judicious use. In the present scenario peoples are wasting water in one region whereas some regions are facing the water scarcity in India. As many rivers are disappeared and others on the verge of extinction due to lack of consciousness and environmental awareness [2]. The increase in the quantity of water used and waste water produced by different communities and industries throughout the world, causing a potential problems to the environment and human health. Sewage water disposal at present is a major problem, causing a pollution of various surface water sources. Many countries are seeking for safe, sound and cost-efficient ways to treat and dispose of waste waters [3, 4]. Water is very essential for life and WHO reports that approximately 36% of urban and 65% of rural Indian were without access to safe drinking water. In the last three decades, the rapid growth of industrialization and urbanization has created negative impacts on the water resources due to industrial, municipal and agriculture wastes containing pesticides, insecticides, fertilizers residues and heavy metals. In modern industrialization period, the most of water resources have affected enormously by seepage, leaching and mixing of industrial effluents in most of the metropolitan cities and industrial townships [5].

Industrialization and urbanization are the other big reasons for the contamination of river water. Rivers are not only life originating but also life sustaining. Rivers play significant role in sustaining life form on this earth. No life on the Earth is possible in absence of fresh water. Due to rapid urbanization and industrialization our rivers, lakes and reservoir become heavily contaminated with harmful chemicals, heavy metals and poisonous substances. Heavy metals are the metals with density higher than 5g cm^3. These metals are heavier than water [6]. Heavy metals are

also called as trace as they are found in trace quantity i.e, 1000 ppm or even lesser in the Earth crust [7]. Heavy metals are assessed in river water because it is non degradable and got bio-accumulated in the living organisms through food chain and cause harmful effects in biological system. The cities alone produce tonnes of waste which is either dumped in soil or discharged in the river, which is a common practice now a day. This waste may contain hazardous chemicals, metals, pesticides, fertilizers which on discharge got mixed in the river sediments. Mining, construction and industrial activities discharge waste directly in to the nearby river, agricultural runoff containing pesticides and fertilizers got mixed into the river water cause contamination in the river [8, 9].

Heavy metals are also present naturally in earth crust and they also contaminate the water via weathering, but the level of natural way of heavy metal contamination is very small. Heavy metals are found distributed in water, sediments and biota of river system. For river polluted with heavy metals, sediments are collected from the river and analysed as they have longer residence time in river [10].

In India many researchers carried out extensive work on heavy metals and found the higher concentration of metals in river which was more than the recommended limits of WHO and BIS. The common metals which have been found in many Indian rivers are Manganese (Mn), Cobalt (Co), Nickel (Ni), Copper (Co), Chromium (Cr), Lead (Pb), Iron (Fe), Cadmium (Cd), Mercury (Hg) and Zinc (Zn). The concentration of heavy metals in river Subamarekha [11], Hindon [12], Ganga, Baitarni [13] and Damodar [14] were found more than the limit as defined by BIS and WHO. Heavy metals in river are hazardous to the plants, aquatic animals and whole ecosystem and also disturb the ecological balance of river system. These metals are usually required in small amount for the development of the plants and organisms. Excessive uptake of these trace elements by plants affects the metabolic activities of plant as well as animals [15]. Plants absorb a number of metals, some of which have no known biological function and some are known to be toxic at low concentrations [16]. In the present article, efforts are made to explain the heavy metal and its role in aquatic environment.

2. HEAVY METALS IN BIOLOGICAL CYCLE:

Heavy metals once entered in the rivers through various sources, it got accumulated in the river sediments. These metals cannot be degraded and become persistent and over the years they settle down in the bottom of the sediments. Thus the sediments of the river act both as a sink and the source of heavy metals [17]. For testing heavy metals in river water, the sediments are taken as samples, heavy metals found more in the sediments as they settle down at the bottom of the river water. From these sediments heavy metals entered in the rooted macrophytes and other aquatic life forms in river. Heavy metal induces oxidative stress in the river water and disrupts the biological life forms. Heavy metals generate radicals like reactive oxygen species (ROS) which is responsible for oxidative stress in aquatic living organism. The storage of this reactive species like oxygen $^1O_2$, hydroxyl radical (HO) and hydrogen peroxide (H_2O_2) led in the disruption of the oxidant antioxidant balance and thus brings a change which is known as oxidative stress. The reactive species then combines with lipids, proteins and disrupts the normal functioning of cells, tissues and organs [18].

These metals do not undergo bacterial degradation therefore persist in the water and disrupts the ecological balance of rivers [19]. Heavy metals accumulated in river water and it would slowly bio-magnify in the aquatic organism, animals as well as in the submerged plants. Heavy metal thus accumulated enters the ecological food chain .It enters in the body of fishes these fishes eaten by other fish and this in turn eaten by human beings and thus accumulation and biomagnification in the living beings takes place. This is how bioaccumulation of heavy metals occurs in the food chain. Long term exposure to heavy metals leads to bioaccumulation of heavy metals in bodies of living organism and ultimately leads to serious diseases. One of the widely known heavy metal mercury is hazardous even in small quantity. When present in the sediments of river water as organic mercury it got converted to methyl mercury by bacterial methylation [20]. It is a toxin which further bioaccumulate in the system. Methyl mercury enters in the fish body via gills, food and also orally. These contaminated fishes when eaten by man it leads to serious disease. One such incident happened in Japan 1950 where due to mercury spill, the river water got contaminated. The disease caused by the ingestion of methyl mercury is known as Minimata. According to International Agency for Research and Cancer (IARC) classified some heavy metals as probable or known carcinogens. Heavy metal pollution in biological system is now considered as hazardous due to its carcinogenicity. In recent studies it was found that heavy metals involve in the base modification and cross linking in the living organism. The metals act as carcinogenic because their oxidative mechanism which generate free radical and target the DNA and enzymatic protein [21]. Heavy metals can cause detrimental and destructive effect when accumulated in excess quantity. It would also disturb the balance of ecosystem due to its property to bioaccumulation and cause dangerous effect in most of the living organism [22].

3. HEAVY METALS TOXICITY MECHANISM:

Toxicity refers to the degree at which a substance could be harmful to plants, animals, and man. Heavy metal toxicity follows three major pathways for its toxic and harmful effects on organism, animals and human being.

1) These metals show strong affinity for sulphydryl (S-H) group. Heavy metal attaches to the S-H group and inhibit enzyme activity in the organism and thus the enzyme starts abnormal functioning.
2) Heavy metal displaces ion synthesis of bio molecule and thus bio molecules got displaced and lose its predefined activity. For example Fluoride displaces calcium (Ca) in the bones and makes the bones fragile.
3) A metal also hinders conformational changes in enzyme and make them inactive and also blocks the body's immune system or the defense mechanism of organism to fight against diseases.

The toxicity of metals varies from metal to metal, metals which can pass through the body would cause little harm, some metals cause immediate and harmful effects on organism and the deadliest effect of heavy metals are those which got accumulated in the food chain through bioaccumulation and biomagnifications. Bioaccumulation of heavy metals mainly depends upon two things first is the quantity of metals which is found in environment and second is how it is gets stored and excreted out from a living organism.[23]Concentration of heavy metal in every organism is different according to their requirements.[24]

4. CONCLUSION:-

Heavy metals are required in very small quantity by all living being as they are the important for functioning of living system but excess of heavy metals in body affects the living being. There are metals that replace the other metal from body or cause toxicity and led to death of organism. The rivers are the life line of any area as it is the primary source of water for all purposes to the population residing near the river bank. The industries also depend on rivers for the water for cooling, production and other purposes but they also dump their untreated waste that causes the heavy metal pollution of rivers. Heavy metals enter in the biological system and accumulate in the food chain. Heavy metal pollutant should be checked regularly in the environment as it is carcinogenic and shows genotoxicity in some cases. There should be proper treatment required for the waste water from industries and cities before dumping in the river or these wastes can be dumped in the landfills. Heavy metals are carcinogenic so the dumping of heavy metals containing waste in aquatic system should be avoided. The proper awareness about the heavy metal pollution of rivers and importance of water should also be imparted to peoples, so they do not throw any waste directly in river and avoid using soaps and detergent while taking bath in river.

5. REFERENCES

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