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Heavy Metals in Water and Health Effects

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Abstract:

Water is very important and necessary element for the existence of all living being. Since long, water has become more polluted because of some factors, among them pollution mainly created by heavy and toxic metal like, lead, barium, antimony, copper, chromium, cobalt, iron etc. This review paper is based on Heavy metals in water and its effects on health. This paper also advised to all who use water, should check the standard guideline for trace metals by WHO, EPA, Indian standard. Water is life we must be careful about pure water instead of poison based (polluted) water.

Introduction:

The earth is the only planet in whole universe, have living beings. There are many requirements for living being among them water is one of the main necessity. Water is main source of existence and progress of all living beings. But, for last few years water has become more and more polluted by industrialization, fertilizer and pesticides use in agriculture and increased human population. ^[1] Many diseases occur because of contaminated drinking water, that's why the quality of water must be checked.

Pure water performs important role for healthy life. Water from natural source has also much impurity, like aerosol, dissolved rock minerals and soil. Water got more polluted because of human efforts like the excess use of metals at everywhere. Access use of Metal based fertilizer and pesticides in agriculture increase metal base pollution.^[2,3,4] This type of water creates water-born diseases in living beings, every year many people die because of pollution of drinking water. ^[5] Concentration of heavy metals is increased in polluted water. In 2006, Raj et al checked the sewage water of a river nearby Hyderabad; he has found heavy metals like Cd, Cr, Ni, Co, Zn, Cu, Fe and Mn. The concentration of heavy metals was more than WHO permissible limit. ^[6]

Air, Water and Soil are getting change their biological, physical and chemical characteristics and it's directly or indirectly affects living beings. ^[7] Industrial development has become major cause of high pollution and all mankind are not able to repair the disturbed environment for next many years. ^[8, 9]

Heavy metals:

Heavy metals in water are harmful for aquatic animals and trees, because heavy metals are non-biodegradable, bio-available and toxic. ^[10,11] Heavy metals like Mercury, arsenic and chromium are generally found as components of earth's crust, as minerals, salt and other compounds which absorb by plants. In this way heavy metals entered in food chain. ^[12, 13]

Sewage water is used in agriculture as fertilizer in developing country like India. Sewage water performs major part of fertilization to provide organic matter and nutrition to plants. ^[14] Farmers are also like to have benefits by their large agriculture gain, affordable irrigation source, easily available organic matter and nutrition for crops. But some time they are not aware of the damages of soil and crop by the use of sewage water. It is proved by the research that access use of sewage water makes soil unfertilized. ^[15,16] Sewage water have very harmful substances dissolve and also have heavy metals dissolve as salt like Cu^{+2} , Zn^{+2} , Mn^{+2} and Pb^{+2} . That's why concentration of heavy metals getting increase higher then require in plants and it directly effect to health of living being. ^[17]

Main reason of the ground water and surface water pollution is done by the solid waste dump by industries and municipality, therefore water get heavy metals and become non potable. This heavy metals water is mainly used by people when water scarcity occurs in summer. The heavy metals, metal ions and harmful bacteria in polluted water produce health related problems. Recently a research indicates the poor water quality because of solid and liquid waste by industries, irresponsible water use by people and mismanagement of government. ^[18]

Heavy metal health effect:

Trace amount of metals in water is very normal, and it's not harmful. The metals like Calcium, Magnesium, Potassium and Sodium are very necessary for human body but in a limit. Cobalt, copper, iron, manganese, molybdenum, selenium and zinc are useful as catalysts for enzyme activities in human body. But the excess ratio of these essential elements and toxic metals like aluminum, arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver very harmful for health. The concentration of these metals in water depends on different areas. ^[19]

In India, high concentration of metals in water is major problem for human being, animals and environment. Environmental pollution is become unsolved problem for developing country like India. Main reason for this is industrialization, population, rapid urbanization and improper way to destroy of solid waste. ^[20] About 5 million people die because of use of impure and toxic water. ^[21]

Cadmium is one of the very toxic elements. It creates carcinogenic effect to human being. ^[22] Cadmium is proved toxic for fishes and all aquatic organisms. ^[23] Main reason of pollution of Cadmium in water is cadmium batteries and affected agriculture land by used of phosphate fertilizer. ^[24]

Lead is known as highly dangerous and toxic metal for human being. ^[25] People absorbed 50% lead from the exhaust of vehicles. ^[26] Vehicles fumes are main cause of spread lead pollution. In addition to, used batteries, use of sewage water in agriculture and lead base waste spread lead in water.

People get affected of liver problem by the use of contaminated drinking water with Copper and Molybdenum. Copper is very useful metal for human being but the access use of

Copper is invite anemia and also damage liver and kidney. [27,28] In addition copper creates problem for blood circulation system. [29]

Molybdenum is also useful for human body like cooper. Molybdenum is an essential dietary nutrient. Molybdenum is a essential constituent of many enzymes like, Xanthine oxidaze, Sulfite oxidaze and aldehyde oxidaze. [30] But access ratio of Molybdenum creates imbalance to the minerals.

Nickel found as component of nickel sulfides, nickel oxides and nickel silicates in nature. Nickel is an important part of enzyme urease in plants and animals. [31] But access ratio of nickel creates toxic effect for human and cause of lungs cancer and nasal sinus.

Metals like Zink, cobalt and cooper are useful for metabolic activities for human. Same way cobalt and cooper are mainly useful for physiological process. Access use of zinc creates negative effect to human health like fatigue and dizziness. [32, 33] Zink is also toxic for aquatic organism like fishes. [34]

Chromium is essential element for animals and human. But access ratio of chromium is harmful. Generally chromium used in metal alloys, paints, cements, paper, rubber and other materials. Chromic acid produce during electronic process and chromium trioxide in air are effect direct to skin disease and lungs. [35] Chromium dust is cause of lung cancer. [36]

Thus, the required ratio of metals is necessary for life. But access ratio of metals is dangerous for life. In the developing country like India, industries dump their waste in to the rivers. As a result, river water gets access metals ratio then standard one. It is very dangerous matter. According to USEPA, India standard, WHO and Australian guideline, the source of metals, effect to health and guideline value as under.

Table - 1

Trace Metals with Source of Occurrence and Potential Health Effects and Guideline Values as Per USEPA, Indian Standard, WHO and Australian Guidelines.
(All values are in mg/liter unless not mentioned.) (Ref. 37, 38, 39, 40, 41)

S. No.	Trace metal	Source of Occurrence	Potential health effect	USEPA	Indian Stand	WHO	Australian	EU
1	Al	Alum used for coagulation process	It cause dementia, neurological problems and has been cited as a contributory factor to Alzheimer disease.	0.03	0.03	0.2	0.2	200 Ug/l
2	An	Discharged from petroleum refineries, ceramics, electronics etc.	Increase in blood cholesterol and decrease in blood pressure.	0.006	-	0.02	0.003	5 ug/l
3	As	Erosion of natural deposits, runoff from	Skin damage or problems with circulatory systems, and may	0.010	0.05	0.01	0.007	10 Ug/l

		orchards, runoff from glass & electronics production wastes	have increased risk of getting cancer					
4	Ba	Discharge of drilling wastes, metal refineries, erosion of natural deposits	Increase in blood pressure	2	-	0.07	0.7	-
5	Cd	Corrosion of galvanized pipes, erosion of natural deposits, discharge from metal refineries, runoff from waste batteries and paints	Kidney damage	0.003	0.003	0.003	0.002	5 ug/l
6	Cr	Discharge from steel and pulp mills, erosion of natural deposits	Allergic dermatitis and carcinogenic	0.05	0.05	0.05	0.05	50 Ug/l
7	Co	Corrosion of household plumbing system, erosion of natural deposit.	Astringent taste, discoloration and corrosion of pipes, fitting and utensils will be caused beyond	2	0.05	2	2	2 Mg/l

8	Fe	Due to corrosion	Excessive ingestion of iron result in Hemi chromatists, where in tissue damage occurs as a consequence of iron accumulation. Interference with dyeing, tanning, paper industry etc.	0.3	0.3	1	0.3	200 Ug/l
9	Pb	Corrosion of household plumbing systems, erosion of natural deposits	Infants and children: Delays in physical or mental development, children could show slight deficits in attention span and learning abilities, Adults: Kidney problems, high blood pressure	Zero 0.015	0.05	0.01	0.01	1 ug/l
10	Hg	Erosion of natural deposits, discharge from refineries and factories, runoff from landfills and croplands	Kidney damage	0.002	0.001	0.006	0.001	1 ug/l
11	Se	Discharge from petroleum refineries, erosion of natural deposits, discharge from mines	Hair or fingernail loss, numbness in fingers or toes, circulatory problems	0.05	0.01	0.01	0.01	10 Ug/l
12	Th	Leaching from ore processing sites, electronics and glass and drug	Hair loss, changes in blood, kidney, intestine, liver problem etc.	0.002	0.01	-	-	-

		industries.						
13	Zn	From corrosion of galvanized pipes and Fittings.	Taste changes and Opalescence in water.	5	5	3	3	-
14	Mn	Due to mining and agriculture, fly ash from coal power station	Beyond this limit cause osteoporosis base disorder	-	0.07	0.07	0.05	-

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