



Arsenic and chromium plays vital role in water pollution

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Abstract :

The toxicity of Arsenic to aquatic biota generally decreases with increasing pH of the medium due to the oxidation to higher valency state whereas chromium (67 – 95%) is present in particulate state in municipal waters(1). About 600 – 700 metric tons of chromium at concentration of 40 – 800 μg^{-1} are discharged annually into coastal waters by the southern California municipal treatment plants(2,3)

Keywords:

Arsenic uses in agricultural chemicals such as weed killers, fungicides, insecticides. Chromium occurs in a variety of foods in the form of a complex with nicotinic acid and possibly glycine, glutamic acid and cysteine.

Introduction :

Water is essential for the survival of any form of life. On an average, a human being consumes about 2 liters of water every day. Water accounts for about 70% of the weight of human body. About 80% of the Earth's surface is covered by water. Out of the estimated 1011 million Km^3 of the total water present on earth, only 33,400 m^3 of water is available for drinking, agriculture, domestic and industrial consumption. The rest water is locked up in oceans as salt water, glaciers and underground. Water is the most precious and vital component of biosphere. The perpetuation and existence of life depends mainly upon the availability of clean water. For centuries, mankind has used the water available to them in rivers, lakes and streams. It is used for variety of purpose, the basic of which is for drinking and personal use. Portable water or drinking water is defined as water which is free from pathogenic micro – organisms and chemicals that are deleterious to human health. Municipal water is

mainly used for drinking purpose and for cleaning, washing and other domestic purposes. The water that is fit for drinking purpose is called portable water and it should have the following characteristics –

1. It should be colorless, odorless and tasteless with free from turbidity and other suspended impurities.
2. It should not contain toxic dissolved impurities, such as heavy metals, trace elements, pesticides etc.
3. It should be free from germs, bacteria and other pathogenic organisms and also it should have a pH in the range 7 – 8.5 .
4. It should be moderately soft, having hardness preferably in the range 50 – 100 ppm. It's hardness should not be above 150 ppm.

Sources of water pollution and health risk

The water which contains impurities or excess amount of any dissolved suspended particle is termed as polluted water. When a particular constituent attains a concentration high enough to affect the system it may be termed as pollutant. The pollutants are divided into three major classes –

- (1). Degradable
- (2). Non – degradable
- (3). Biologically accumulative organic matter from surroundings. The degree of such pollution is determined in terms of BOD and COD. Inorganic substances such as inorganic colloidal matter and soluble salts of variety of heavy metals and trace elements are non – biodegradable pollutants.. during the last three to four decades, data on trace metal pollution of the rivers in all industrialized belts of the world have accumulated to such a great bulk that systematic studies have become essential. The element arsenic and chromium plays a very vital role in water pollution as-

Arsenic :

Arsenic is found in concentration of about 1% in Pb – Zn concentrates used in smelters and because of its volatility, it can be spread into the atmosphere as pollutant. However, the greatest source of pollution from arsenic is its use in agricultural chemicals such as weed killers, fungicides, insecticides and rat poisons. Arsenic occurs in the air wherever coal is burnt, particularly near smelters and refineries. Sea water contains 2 to 5 ppm of As and in public water supplies, its concentration may be higher. Environmental arsenic pollution occurs mainly from its release into air from smelting of arsenic containing ores, burning of coal and use of arsenic compounds in various applications such as fungicides, insecticides, herbicides, pesticides and preservatives.

Arsine (AsH_3), which is a byproduct of many industrial processes involving arsenic, is the most

poisonous of all arsenicals. Arsine may be liberated by the action of fungi in sewage plants. Arsine combines with hemoglobin and is oxidized to a hemolytic compound that does not appear to act by sulphhydryl inhibition.

Low chronic doses of arsenic ingested tend to accumulate in lipid rich tissues. High arsenic levels in man are usually found in hair, nails and skin. When arsenic is inhaled it is deposited in lungs and is retained in the lung tissues for a long time. Soluble arsenicals are absorbed from all mucous membranes. Arsenic containing lipid soluble vesicants are absorbed through the skin. Non – allergic contact dermatitis and conjunctivitis are frequently suffered by workers exposed to arsenic containing dusts. Continued inhalation of arsenic dusts may cause perforation of the nasal septum. Arsenic is toxic to liver, and it produces fatty infiltration and causes central necrosis and cirrhosis. Arsenic poisoning also affects bone marrow and cellular elements of blood. The total amount of As in normal adult human body was estimated at 15 to 20 mg or 0.2 to 0.3 ppm. Analysis of arsenic in human hair and blood gives an indication of poisoning and the analysis is accomplished by neutron activation technique. Normal cow's milk contains 0.03 to 0.06 ppm of Arsenic.

Chromium :

chromium occurs in a variety of foods in the form of a complex with nicotinic acid and possibly glycine, glutamic acid and cysteine. Chromium in this complex form termed “ glucose tolerance factor” is absorbed better than in inorganic form. Animal protein is the best and most reliable source of chromium. Both the trivalent and hexavalent forms are biologically important. Cr (VI) is far more toxic than the Cr(III). Chromium sulphate is used as a mordant in textile manufacture, in leather tanning, in manufacturing green varnishes, paints, inks, and glazes for porcelain. Chromium potassium sulphate and oxalate are used in coloring glass. Chromic

acetate is used in dyeing and tanning. It is also used in explosives and for preservation of wood. Wastes from all the above industrial units can be a source of water pollution from soluble chromate salts. Textile mill wastes may contain 32 mg/l of chromium. Fertilizer materials are also a source of chromium pollution in water.

The presence of chromium in air is mostly due to burning of fossil fuels which contributes about 1450 metric tones of Cr every year. Soil contamination by Cr results from the land disposal of sewage sludge, land disposal of by – products from ferrochrome and chrome – steel industries and from the use of phosphatic fertilizers.

Sparingly soluble chromium (VI) salts, specially calcium chromate, are the most potent carcinogens. These compounds have been found to induce high levels of chromosomal aberrations in cultures of mammalian cells. Hexavalent chromium may be carcinogenic, teratogenic and mutagenic. Fortunately, the more toxic hexavalent chromium is reduced to less harmful Cr(III) due to stomach acidity. The principal chromium discharges into surface waters are from metal – finishing processes such as electroplating, pickling and bright dipping. Uncontrolled emission threaten to contaminate the fresh water with the relatively toxic from Cr (VI). Sources of Cr(III) contamination include liquid waste discharges from leather tanning and textile dyeing containing upto several thousand mg/l of chromium. Municipal discharge in industrial areas is also an important source of chromium contamination. About

67 to 95% chromium is present in particulate state in municipal waters. About 600 – 700 metric tons of chromium at concentration of 40 – 800 µg/l are discharged annually into coastal waters by southern California municipal treatment plants.

Conclusion :

Arsenic salts are soluble in water and they are phytotoxic. The toxicity of arsenic to aquatic biota generally decreases with increasing pH of the medium due to the oxidation to higher valency state while in freshwater anthropogenically introduced soluble Cr (VI) is removed by reduction to Cr (III) and subsequent sorption to particulates and sediments.

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