PHYSICO-CHEMICAL ANALYSIS OF HEAVY METALS AND ITS EFFECT ON HUMAN HEALTH

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ABSTRACTS: - Heavy metal has toxicity proven to be major threat and there is several healths' problem with it. Heavy metals are natural elements characterized by their rather high atomic mass and their high density. Heavy metal accruing in low concentration. They can found all through the crust of our planet. Commonly a density of at least 5 times higher than of water. Heavy metals require an atomic mass higher than 23 or an atomic number exceeding 20. Their plentiful domestic, industrial, agricultural and technological usages have led to their widespread distribution in the environment. The toxic effect of these metals even though they do not have any biological role remain present in some or the other form harmful for the human body and its proper functioning. Heavy metals are well known environmental pollutants due to their toxicity, persistence in the environment and bioaccumulation nature. Their natural source includes weathering of metal, bearing of rocks and volcanic eruption. While anthropogenic sources include mining and various industrial and agricultural activities. Mining and industrial processing for extract ion of minerals resources and their subsequent application for industrial, agriculture and economic development has led to increase in the mobilization of the elements in the environment and disturbance of their biochemical cycles.

INTRODUCTION: - Metals are substance with high electrical conductivity, malleability and luster, which voluntarily lose their electrons to form cations. Metals are found naturally in the earth crust and their compositions vary among different localities, resulting in spatial variations of surrounding concentration. The metal distribution in the atmosphere is monitration by the properties of the given metal by various environmental factors.

Heavy metals are individual metals and metal compound that can impact human health. Environmental pollution is one the major challenges in the modern human society. Environmental contamination and pollution by heavy metal is a threat to the environment and is of a serious concern. Rapid industrialization and urbanization have caused contamination of the environment by heavy metals and their rates of mobilization and transport in the environment have greatly increased.

Traced element occurs in minute concentration in biological system. They may exert beneficial of harmful effect on animal, plants and life depending upon the concentration. These elements are introduced into aquatic system, river, lakes or ocean through atmospheric fallout dumping, wastes, accidental leaks, runoff of terrestrial system (industrial and domestic effluent) and geological weathering.

Although some heavy metals such as manganese, iron, copper and zinc essential micronutrients other such as mercury, cadmium, arsenic chromium and lead are not required even in small amount by our organism. Some heavy metals become a matter of concern because of their toxicity and tendency to accumulation in food chain. Fishes, mollusk or other aquatic life are located at the end of the food chain may accumulate metal and pass them to the human being through food causing chronic or acute diseases.

Six common heavy metals are discussed in the brief: ARSENIC, CADMIUM, LEAD, MERCURY CHROMIUM can cause a wide variety of health problems. These are all naturally occurring substances which are often present in the environment at low level. In large amount they can be dangerous.

Arsenic, Cadmium, Mercury, lead and chromium have the greatest potential to cause harm on account of their extensive use, the toxicity of some of their combined or elemental forms, and their widespread distribution in the environment. Hexavalent chromium, for example, is highly toxic as are mercury vapors and many mercury compounds.

These five elements have a strong affinity for sulfur; in the human body they usually bind, via thiol groups (–SH), to enzymes responsible for controlling the speed of metabolic reactions. The resulting sulfur-metal bonds inhibit the proper functioning of the enzymes involved; human health deteriorates, sometimes fatally. chromium (in its hexavalent form) and arsenic are carcinogens; cadmium causes a degenerative bone disease; and mercury and lead damage the central nervous system.

ARSENIC:- Aside from occurring naturally, it is released from volcanic activity, forest fire, rock erosion and human activity. Arsenic occurring rarely in the Free State. It is found largely combination with sulphur, oxygen and iron. The metal is generally extracted from arsenopyrites. It is obtained by heating arsenious oxide and charcoal together in a crucible. It is also found in dyes, paints, metals, drugs, soap and semi-conductors. It is one of the most heavy metal cause both ecological and individual health for considering something standpoints. It has a semi-metallic property, is prominently toxic and carcinogenic and also available in oxides and sulfide forms or the salts of iron sodium, calcium, copper etc. Animal feeding operation and certain fertilizers a nd pesticides can release high amount of arsenic to the environment. Humans may encounter arsenic by natural means, industrial source or from unintended sources. Drinking water may get contaminated by the use of pesticides of arsenic, natural deposited minerals or chemicals or arsenic disposal.

HEALTH EFFECT OF ARSENIC:-

1. Arsenic is naturally present at high levels in the groundwater of a number of countries.
2. Arsenic is highly toxic in its inorganic form.
3. Contaminated water used for drinking, food preparation and irrigation of food crops poses the greatest threat to public health from arsenic.
4. Long-term exposure to arsenic from drinking-water and food can cause cancer and skin lesions. It has also been associated with cardiovascular disease and diabetes. In utero and early childhood exposure has been linked to negative impacts on cognitive development and increased deaths in young adults.
5. The most important action in affected communities is the prevention of further exposure to arsenic by provision of a safe water supply.
6. Inorganic arsenic is a confirmed carcinogen and is the most significant chemical contaminant in drinking-water globally. Arsenic can also occur in an organic form. Inorganic arsenic compounds (such as those found in water) are highly toxic while organic arsenic compounds (such as those found in seafood) are less harmful to health.

CADMIUM:- Cadmium does not occur in free state. It is found in rocks, animals, plants, and soil it may be in the form of solid, liquid or gas. Cadmium is the seventh most toxic element. Most of the zinc ores such as calamine or zinc blende contain 2 - 3 % of cadmium. It is a by-product of zinc production which humans or animals may get exposed to at work or in the environment. Once this metal gets absorbed by humans, it will accumulated inside the body throughout life. Cadmium is a metal found in natural deposits as ores containing other elements. The greatest use of cadmium is primarily for metal plating and coating operations, including transportation equipment, machinery and baking enamels, photography, television phosphors. It is also used in nickel-cadmium and solar batteries and in pigments.

HEALTH EFFECT OF CADMIUM:-

1. Short-term: EPA has found cadmium to potentially cause the following health effects when people are exposed to it at levels above the MCL for relatively short periods of time: nausea, vomiting, diarrhea, muscle cramps, salivation, sensory disturbances, liver injury, convulsions, shock and renal failure.

2. Long-term: Cadmium has the potential to cause the following effects from a lifetime exposure at levels above the MCL: kidney, liver, bone and blood damage.
3. Acute effect in child.

MERCURY:- Small quantity of mercury occurs in free state. Mercury is an extremely rare element in Earth's crust. It is commonly known as QUICKSILVER. It is silvery white metal. Compared to other metals, it is a poor conductor of heat, but a fair conductor of electricity. In China and Tibet, Mercury use was thought to prolong life, heal fractures, and maintain generally good health, although it is now known that exposure to mercury vapor leads to serious adverse health effects. Mercury is the only metallic element that is liquid at standard conditions for temperature and pressure.

Mercury is used primarily for the manufacture of industrial chemicals or for electrical and electronic applications. It is used in some thermometers, especially ones which are used to measure high temperatures. A still increasing amount is used as gaseous mercury in fluorescent lamps, while most of the other applications are slowly phased out due to health and safety regulations and is in some applications replaced with less toxic but considerably more expensive Galinstan alloy. Mercury is used in the thermometer, barometers, manometers, sphygmomanometers, float valves, mercury switches, mercury relays and other devices, though concerns about the element's toxicity have led to mercury thermometers and sphygmomanometers being largely phased out in clinical environments.

HEALTH EFFECT OF MERCURY:-

1. Mercury is a naturally occurring element that is found in air, water and soil.
2. Exposure to mercury – even small amounts – may cause serious health problems, and is a threat to the development of the child in utero and early in life.
3. Mercury may have toxic effects on the nervous, digestive and immune systems, and on lungs, kidneys, skin and eyes.
4. Mercury is considered by WHO as one of the top ten chemicals or groups of chemicals of major public health concern.
5. People are mainly exposed to methylmercury, an organic compound, when they eat fish and shellfish that contain the compound.
6. Methylmercury is very different to ethylmercury. Ethylmercury is used as a preservative in some vaccines and does not pose a health risk.
7. Health effects caused by short-term exposure to high levels of mercury vapors • Cough, sore throat • Shortness of breath • Chest pain • Nausea, vomiting, diarrhea • Increase in blood pressure or heart rate • A metallic taste in the mouth • Eye irritation • Headache • Vision problems
8. Health effects caused by long-term exposure to mercury vapors • Anxiety • Excessive shyness • Anorexia • Sleeping problems • Loss of appetite • Irritability • Fatigue • Forgetfulness • Tremors • Changes in vision • Changes in hearing

LEAD:- Native lead is rare in nature. lead is a bluish grey metal and possesses, when freshly cut, a bright metallic lustre which how ever become dull on exposure to air due to the formation of a thin layer of the oxide on the surface. It is so soft that it can be cut with a knife and also scratch with a figure nail too. It marks paper. It is malleable but not ductile. It is a heavy metal that is denser than most common materials. Lead has the highest atomic number of any stable element and three of its isotopes are endpoints of major nuclear decay chains of heavier elements. The presence of other metals makes it hard and brittle. Lead is a major constituent of the lead-acid battery used extensively in car batteries. It is used as a coloring element in ceramic glazes, as projectiles, in some candles to threat the wick. It is the traditional base metal for organ pipes, and it is used as electrodes in the process of electrolysis. One if its major uses is in the glass of computer and television screens, where it shields the viewer from radiation. Other uses are in sheeting, cables, solders, lead crystal glassware, ammunitions, bearings and as weight in sport equipment.

HEALTH EFFECT OF CADMIUM:- Lead can cause several unwanted effects, such as:

1. Disruption of the biosynthesis of haemoglobin and anaemia
2. A rise in blood pressure
3. Kidney damage
4. Miscarriages and subtle abortions
5. Disruption of nervous systems
6. Brain damage
7. Declined fertility of men through sperm damage
8. Diminished learning abilities of children
9. Behavioural disruptions of children, such as aggression, impulsive behavior and hyperactivity

CHROMIUM:- chromium does not occur free in nature. It is found in rocks animals, plants and soil and can be solid, liquid and gas. Chromium compound is bind to soil and are not likely to migrate to ground water but they are persistent in sediment in water. It is a steely-grey, lustrous, hard and brittle transition metal. Chromium is also the main additive in stainless steel, to which it adds anti-corrosive properties. Chromium is also highly valued as a metal that is able to be highly polished while resisting tarnishing. Chromium is commonly used in the leather and tanning industries, paper and pulp and rubber manufacturing application. Due to the presence of excess oxygen in the environment Cr (III) is oxidize to Cr(IV) which is extremely toxic and highly soluble in water. Chromium toxicity greatly affects the biological process in various plants such as maize, wheat, barley, cauliflower citrus fruit and in vegetables. Chromium toxicity causes chlorosis and necrosis in plants.

HEALTH EFFECT OF CHROMIUM:-

1. Direct eye contact with chromic acid or chromate dusts can cause permanent eye damage. Avoid eye contact with dusts, fumes, smoke, liquids, mists, and aerosols containing hexavalent chromium.
2. Prolonged skin contact can result in dermatitis and skin ulcers. Some workers develop an allergic sensitization to chromium. In sensitized workers, contact with even small amounts can cause a serious skin rash.
3. High levels of exposure causes liver and kidney damage and also affect the central nervous system.
4. Chromium compounds in humans can lead to the inhibition of erythrocyte glutathione reductase which in turn lowers the capacity to reduce methemoglobin to heamoglobin.

CONCLUSION:- The effects of heay metals Arsenic, Cadmium, Mercury, lead and chromium on the environment and living organism mainly human being, plants and animals. There are a small number of plants that easily absorbs high levels of metals from the surrounding soil. These are called hyper accumulater. In humans are more likely to be exposed to metal contamination from soil that sticks to plants, then from bioaccumulations it is getting very difficult to wash all soil particles of plants materials before preparing and ingesting them. Animals can accumulate metals as well as eating plants, fish, or drinking water with higher toxic concentration in them. These toxicants are accumulated in the organs as well as the skin, hairs and bones Detection of heavy metals in those area where there are higher level of toxicity found according to the given EFFECTIVE LEGISLATION GUIDELINE AND DETECTION. It is failure to control the exposure will result in severe complication in the future because of the adverse effect imposed by heavy metals.

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