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Toxicity of Heavy Metals in Water and Its Impact on Farming and Aquatic Life

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ABSTRACT:
With new urbanization and industrialization, heavy metal (HM) pollution has become a prime worry for the present society. Heavy metals are the metals that have high atomic weight, density, and numbers as compared to water. Many people are not aware of heavy metal toxicity in water. Heavy metal contamination is a cause of many serious health threats. The presence of heavy metals can't be seen with unaided eyes and can be only recognized by a water test. The heavy metals are moderate toxic substances to your wellbeing as they didn't have any prompt impacts in your body. These heavy metals enter the water bodies and to the environment through weathering of soil and rocks, from volcanic eruptions, and from an assortment of human exercises including the mining, handling, or utilization of metals as well as substances that contain metal toxicants. The Common heavy metal pollutants are arsenic, cadmium, chromium, copper, nickel, lead, and mercury. These heavy metals cannot be degraded; they only accumulate in the soil, water bodies, and the environment for years.

Introduction

Heavy metals usually called a metallic element that has very high atomic density, atomic weight. The heaviness and toxicity in such metals are interrelated. Some of the heavy metals are even toxic in small amounts. Heavy metals can enter a water gracefully by modern social activities, or even from acid rain isolating soils and releasing heavy metals into streams, lakes, and groundwater.

Also we can call any toxic metal as heavy metals. It is a natural constituent but careless human activities have led the heavy metals to enter our food chain and geochemical cycles, which is not considered to be good for our environment. Any long disclosure to heavy metals can cause genuine medical problems in people and animals. Excessive use of heavy metals in farming as manure or fertilizers and aimless discharge of industrial waste containing traces of heavy metal or even a large amount of heavy metal in the aquatic environment has emerged as the greatest concern over a few decades.

Heavy metals are considered very threatening because they have the tendency to bio-accumulate. If the chemical substance is toxic and it is bio-accumulating in any organism, that will not be possible to break it down by any means and so it can be harmful to everyone. When bioaccumulation takes place such as in fish it can move to another trophic level that is called bio-magnification. [1]

The major pollutants about which we should be a concern are copper, nickel, zinc, lead, gold, arsenic, silver, cadmium, uranium, selenium, mercury, and chromium. The heavy metals for example such as chromium, zinc, lead, etc. have many applications in factories, engineering work, fertilizers, and petrochemical industries, etc. a large amount of lead pollution comes from battery industries. Zinc is one of the major constituents of fertilizers so it is possibly used in such industries.

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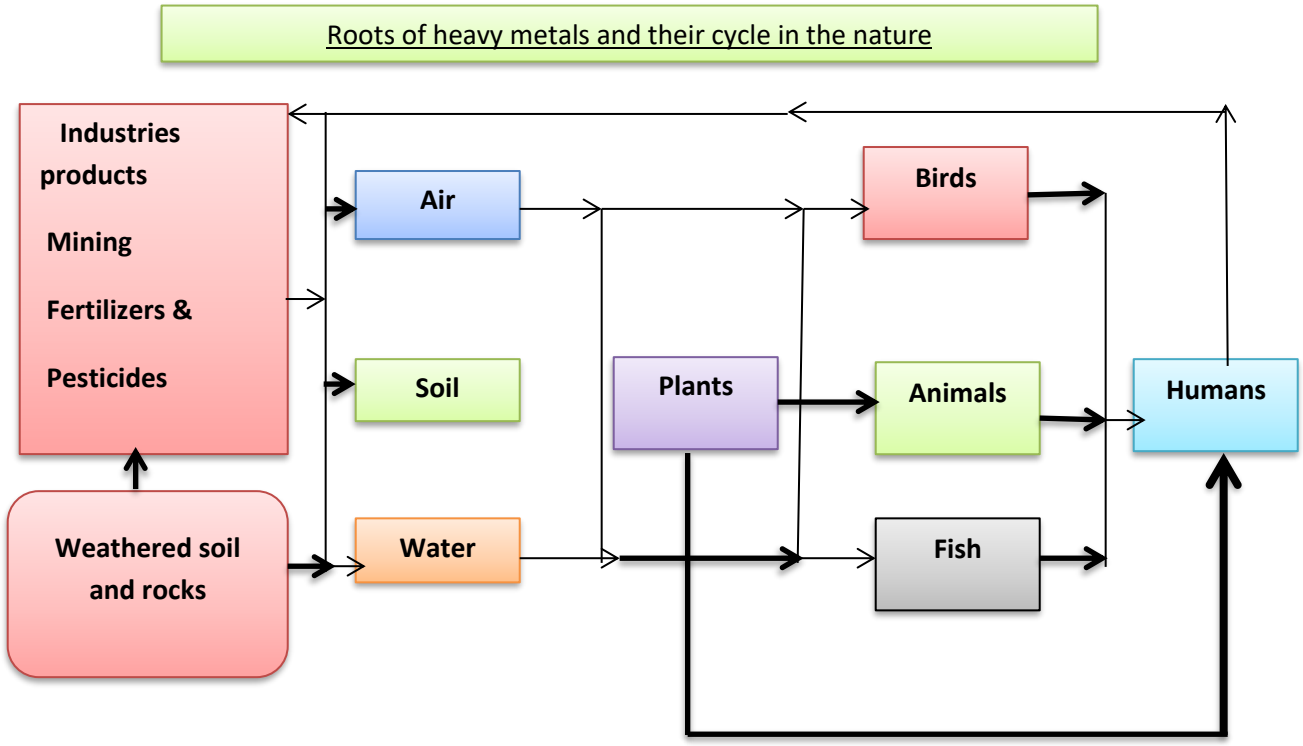

History of heavy metals

The weight of naturally happening metals, for example, gold, copper, tin, lead, mercury and iron may have been seen in ancient times, considering their pliability, prompted the main endeavors to create metal decorations, devices, and weapons. [2] All metals found from that point until 1809 had generally high densities; their heavy weight was viewed as a uniquely recognizing standard.

From 1809 onwards, light-weighted metals, for example, sodium lithium, aluminum, beryllium, potassium, and strontium were separated. Their low weight tested tried & true way of thinking and it was suggested to allude to them as “metalloids” (signifying "looking like metals in structure or appearance"). This heavy metal recommendation was rejected; the new components came to be perceived as metals, and the word metalloid was used to allude to nonmetallic compound and, after that, components that was difficult to portray as whether they are metals or nonmetals.

Earlier the utilization of the expression "heavy metal" from 1817, when the Germanic scientist expert **Leopold Gmelin** partitioned the components into nonmetals, light metals, and heavy metals. The term later became related to components of high atomic weight or number. It is in some cases utilized reciprocally with the term heavy metals.

Criticism

In 2002, Scottish toxicologist John Duffus overviewed the definitions used in the course of recent years and wrapped up they were so assorted as to effectively given the title illogical. [3] With this finding, the heavy metal status of specific metals is inconsistently tested on the grounds that they are unreasonably light, or are related with natural systems, or once in a while comprise natural disasters.

Popularity

Despite many questions that have arisen about the meaning, the term heavy metal shows up consistently in logical

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writing. A recent report found that it had been progressively utilized and appeared to have become some portion of the language of science. [4]

So it is widely accepted term and used everywhere.

The biological role of heavy metals:

Trace measures of some heavy metals, for the most part in period 4, are required for certain natural procedures. [5]

1. **Iron and Copper:** it is required for oxygen and electron transport.
2. **Selenium:** selenium is required for antioxidant functioning and hormone production.
3. **Arsenic**: Arsenic is required for metabolic growth in some animals and humans.
4. **Nickel**: Nickel is importantly required for cell growth.
5. **Cobalt**: Cobalt is required for complex syntheses and metabolism of the cell.
6. **Zinc**: Zinc is highly required for hydroxylation.
7. **Vanadium and manganese:** they are needed for enzyme regulation.
8. **Chromium**: chromium is important for glucose utilization.

An absence of any of this period 4–6 essential heavy metal may build mechanism in which people cannot fight metal poisoning. A typical 70 kg human body is about 0.01% heavy metals. The metals can be poisonous in a higher level however a little isn't at all unsafe.

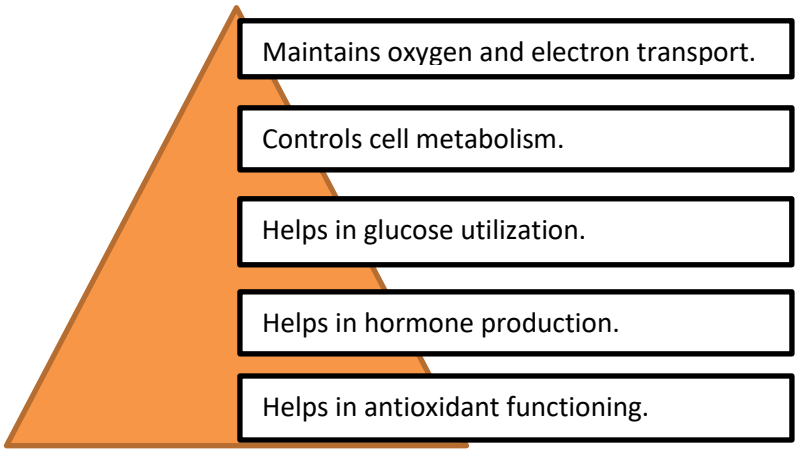

Figure shows the biological functioning of heavy metals

Types of heavy metals and their effects on human beings and the environment:

- **Cadmium**:

Cadmium metal is naturally occurring heavy metal discovered in 1817 which is toxic and can cause various health threats to humans, animals, and plants. [6] Cadmium is generally used in industries like agriculture, electroplating, and some industries of rechargeable batteries. Smoking is also one of the sources of cadmium.

1. **Effects of cadmium metal on humans and animals**:

- Acute exposure to cadmium can cause lung inflammation, diarrhea, and vomiting and chronic exposure can cause lung cancer, softening of bones, and heavy protein discharge in urine even kidney damage and failure.
- Cadmium can carcinogenic to animals too and can cause cancer in various organs of the animal's body.

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2. **Effects of cadmium metal on aquatic life:**

- Cadmium is not all required by aquatic animals for any kind of biological processes. Acute exposure can cause mortality and chronic exposure can cause
- Chronic exposure can affect reproduction, growth, and development.

3. **Effects of cadmium metal on farming:**

- Cadmium metal may also get in livestock. It also gets into the soil by various means. It can affect the crops changing its variety and lower the affinity and yield.

- **Lead**:

The lead was discovered in 3000BC and known as one of the earliest discovered metal. Lead is also a naturally occurring metal that is found in the earth's crust. Various anthropogenic activities bring the lead to the environment. It is used to produce lead-acid batteries. Overexposure to lead can cause physiological disorder, kidney malfunction, etc. [7]

1. **Effects of lead on humans and animals:**

- Exposure to heavy metal lead can cause very serious health risks in both adults and children. The chronic effect can lead them to coma.
- Those who survived the harsh lead poising can suffer from mental and behavioral disorders.
- It causes anemia, toxicity to organs, hypertension, and can retard the reproductive system.

2. **Effects of lead on aquatic life:**

- Intense impacts are resolved from momentary tests (typically four days or less) led at high fixations and deciphered as an impact on mortality or development. Chronic impacts are resolved from long haul tests for an impact on mortality, development, or propagation. The impact focus differs as indicated by the kind of living beings and their natural surroundings.

3. **Effects of lead on farming:**

- Lead emphatically restrains seed germination, root stretching, seedling improvement, plant development, transpiration, chlorophyll creation, and water and protein content.
- It can inhibit the production of ADP and ATP.

- **Mercury**:

Mercury is a worldwide toxin with unpredictable and irregular concoction and physical properties. [8] The significant common wellspring of mercury is the degassing of the Earth's outside layer, outflows from volcanoes, and dissipation from regular waterways.

1. **Effects of Mercury on humans and animals:**

- The breathed in of mercury containing fumes can create hurtful impacts on the stomach, nervous system-related problems and resistant frameworks, lungs diseases, and kidney malfunctioning, and might cause death.
- The inorganic salts of mercury are harmful for the skin cause irritation, eye irritation, and gastrointestinal tract problems, and may initiate kidney harmfulness if ingested.
- It impairs hearing, speech, vision, and gait.

2. **Effects of Mercury on aquatic life:**

- Fishes in aquatic environmental can store the mercury in organs in the form of methylmercury which is considered as the most fatal form. It can affect the mortality and growth of fishes.
- Affected fishes can affect humans if consumed.

3. **Effects of Mercury on farming:**

- The mercury is proved as very toxic to crops and plants and it is believed that is increases in them as they grow older.
- Germination, growth plants, and roots are inhibited and some more characters are seen to be affected due to heavy exposure in the soil to plants.

- **Nickel**:

Modest quantities of Nickel are required by the human body to produce red platelets, even so, in large amount, can turn out to be somewhat harmful. little overexposure to nickel isn't known to cause any medical issues, yet long-term

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introduction can cause diminished body weight, heart and liver harm, and skin allergy. [9]

1. **Effects of Nickel on humans and animals:**

- The most unsafe impacts from exposure to nickel, for example, constant bronchitis, diminished lung capacity, and malignancy of the lung and nasal related problems have occurred in individuals who have inhaled dust containing some nickel mixes while working nickel-preparing plants.
- It can be very harmful to skin too which causes rashes or irritation on the skin, severe itching, redness on the skin.

2. **Effects of nickel on aquatic life:**

- Nickel gets observed in various organs of aquatic animals and fishes which causes mortality, anemia, making them weak.
- It can cause allergy in respiratory tracts of aquatic animals, can slow the process of respiration.

3. **Effects of nickel on farming:**

- Nickel plays a variety of essential roles in the functioning of the plant. Besides that, it has various negative effects if exposure is in a large amount. Ni likewise influences supplement assimilation by roots, weakens plant digestion, represses photosynthesis and transpiration, and causes ultrastructural changes.
- At last, these changed procedures produce diminished yields of rural harvests when such harvests experience over the top Ni exposures.

- **Selenium**:

Selenium is required by people and different creatures in modest quantities, yet bigger sums can make harm to the sensory system, exhaustion, and allergies. [10]

1. **Effects of Selenium on human and animals:**

- Selenium acts a significant job in the wellbeing of our immune system. Its side is much more humans if exposure is huge. It can cause loss of hair, rashes, feeling of tiredness, white sticks on nails, vomiting, and feeling of light-headed.
- In animals, selenium harmfulness has additionally been related to irregular fetal improvement in dairy cattle, pig, and sheep, however with barrenness and a higher extent of half-pint posterity and fetal deaths.

2. **Effects of Selenium on aquatic animals:**

- Huge exposure to selenium of sea animals can make them suffer from the physiological and ecological disorder.
- It can sub-lethal to sea animals reduce the reproduction rates and can found I all levels of the food chain.

3. **Effects of Selenium on farming:**

- Selenium is important for plants and crops as it protects the plants from cold, drought, and metals stresses. High doses of selenium cause toxicity in plants. In plants it can distort protein structure and function, but in the low amount it can helpful for high yield and productivity.
- Selenium can interfere with Nitrogen assimilation, which decreases the number of nitrogen compounds in plants.

- **Arsenic:**

Arsenic is the twentieth most copious component on earth. Humans can expose to arsenic through polluted drinking water which enters water due to pesticides, herbicides, etc. [11]

1. **Effects of Arsenic on humans and animals:**

- Arsenic poisoning happens over a short timeframe side effects may have vomiting, stomach pain, encephalopathy, diarrhea, impaired nerve function (which causes numbness), and urine discharge with traces of blood. The long-term disclosure can bring about the skin thickening, blackish skin, and stomach pain, looseness of bowels, deadness, and contagion dieases.
- Heavy exposure to arsenic in humans can cause skin cancer, lung cancer, and bladder cancer. It gets concentrated in blood of cattle and can mix with milk, flesh, etc. which can affect humans too.

2. **Effect of arsenic on aquatic life:**

- In aquatic animals it causes different kinds of physiological and biological disorders or illnesses. It causes cell damage and tissue damage.

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- It reduces the fertility of sea animals and gets accumulated which may enter the food chain of levels.

3. Effect of arsenic on farming:

- Arsenic is a kind of important element for plant growth which can substitute to phosphate in fertilizers.
- But in high quantity it can be very poisonous to plants and crops.

- **Chromium**

It is a heavy metal with symbol Cr which has silvery appearance used in steel industries for various purposes. [12] Chromium compounds are usually colored. It is also used for chromium plating of cars, taps, and various things because of its anti-corrosive properties.

1. Effects of chromium on humans and animals:

- The chromium compound (IV) is very toxic and chromium compound (III) is less toxic.
- The persons working in steel factories are very exposed to chromium which makes them ill due to chromium occurred in their respiratory tract and the linings of the nose tract.
- It causes asthma, shortness of breathing, and whizzing.

2. Effects of Chromium on aquatic life:

- The primary medical issues found in sea animals following consumption of chromium (VI) mixes and causes disturbance, wounds and ulcers in the stomach and small digestive tract, pallor, and defects in sperm emission,

3. Effect of chromium on farming:

- Expanding convergences of chromium causes a decrease in development, yield characteristics, and supplements of an agronomical plant.

- **Thallium**

Thallium is naturally occurring metal. [13] It is present in seawater and soil in trace amounts. The major sources of thallium (TI) metal can various anthropogenic activities. This chemical element has atomic number 81 and is grey.

1. Effects of thallium on humans and animals:

- Studies show that the individuals who ingested a lot of thallium over a brief timeframe have heavy nausea, temporary baldness, gippy tummy, and consequences for the sensory system, lungs, heart, liver, and kidneys.
- It has caused deaths. It isn't recognized what the impacts are from ingesting low degrees of thallium over quite a while.
- Studies on animals show that male reproductive systems might cause injury to animals by low degrees of thallium.

2. Effects of thallium on aquatic life:

- It is very little we know about thallium toxicity to aquatic life. But it has the power to kill some fishes in a small amount in little time.
- It also affected many algae in a small amount.

3. Effect of thallium on farming:

- Thallium can inhibit the photosynthetic reactions of plants leading them to die.

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Heavy metal	Permissible li mit				
WHO	USEPA	ISI	CPCB	ICMR	
Iron (mg/l)	0.1	–	0.3	1.0	1.0
Cupper (mg/l)	1.0	1.3	0.05	1.5	1.5
Mercury (mg/ l)	0.001	0.002	0.001	No relaxation	0.001
Cadmium (m g/l)	0.005	0.005	0.01	No relaxation	0.01
Arsenic (mg/ l)	0.05	0.05	0.05	No relaxation	0.05
Lead (mg/l)	0.05	–	0.10	No relaxation	0.05
Zinc (mg/l)	5.0	–	5.0	15.0	0.10
Chromium (m g/l)					

This figure shows the allowed limit of heavy metals by organization WHO, USEPA, ISI, CPCB, ICMR

Remediation Processes toward Heavy Metal Removal/Recovery

The existence of heavy metals discharged from different sources is either legitimately or accidently discharged into the way that influences people, creatures, and plants or crops. The principle channel of exposure is through the process of breathing, consumption or taken in, and skin contact. Because of increased toxicity of human introduction to heavy metals, it prompts wellbeing of humans and environment or natural disintegration. [14] Henceforth, such metals are ordered as toxicants that can incite unfriendly wellbeing effects on people that causes cardiovascular infections, formative variations from the norm, neurologic and neuro-behavioral clutters, high level of sugar content in blood, loss of hearing, immunologic diseases, and different sorts of malignant growth.

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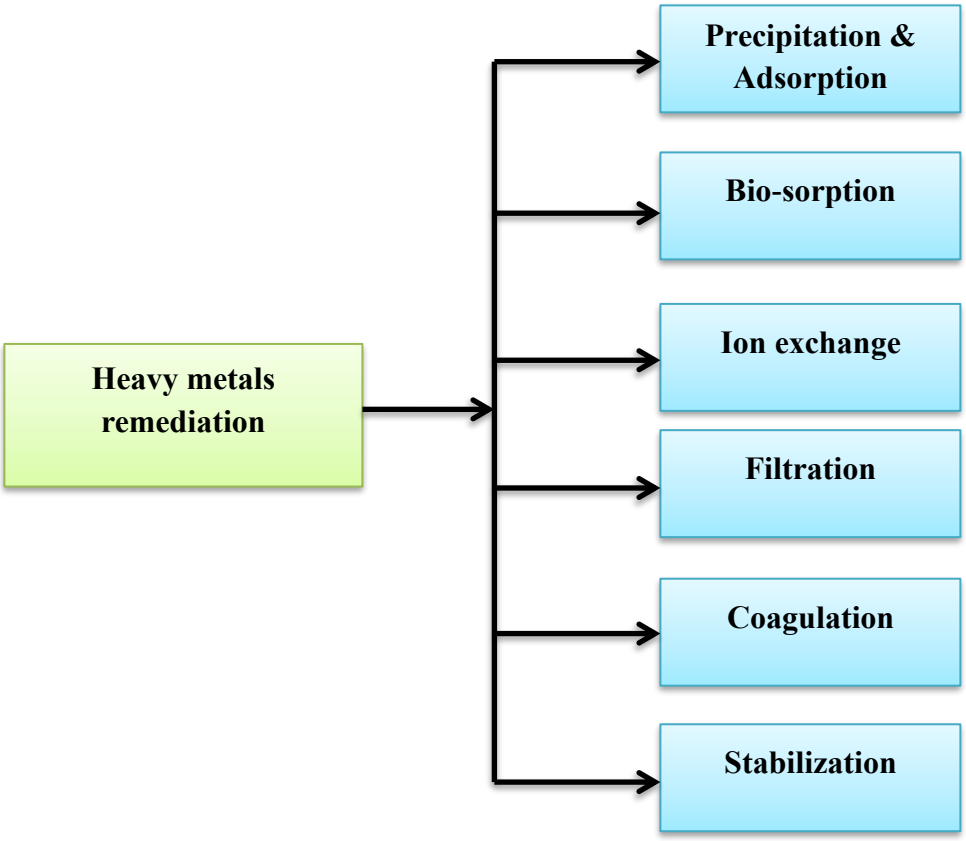

I. Precipitation:

In the hydroxide precipitation process, heavy metals are expelled by including a salt, for example, scathing or lime, to modify the wastewater pH to where the metal(s) show its (their) lowest dissolvability. [24]

II .Adsorption:

Adsorption is broadly utilized by different specialists for the expulsion of heavy metals from rivers or streams and activated C has been much of the time utilized as an adsorbent.

III .Bio-sorption:

The definition says that it is a procedure of taking out pollutants using biological methods. Bio-sorbent is used in this which can be used which makes this process economically important.

IV .Ion exchange:

Ion exchange procedure is extremely successful to evacuate different heavy metals and can be effectively reused by recovery activity. Resins are a wide range of sorts of trade materials.

V .Stabilization:

It can be defined as the metals that are treated are left bedside the site in a manner that diminishes or wipes out their capacity to adversely impact.

VI. Membrane technologies:

These methods are used for contamination that is usually caused in water. The various methods are: RO, ultra-filtration, Nano-filtration etc.

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Types of Remediation approaches:

1. Chemical and biological remediation:

This procedure is very practical and eco-accommodating choice to treat heavy metals containing untreated water. [15] Execution of this treatment than the integrated or natural treatment has been selected for to be favorable and has demonstrated critical results of heavy metal evacuation by number of experts around the entire world.

When suggested, both the remediation processes face, their benefits and loss, positive and negative marks. If there should arise an occurrence of chemical technique for the treatment, its straight forward activity and brisk results have made this strategy as one of the most generally utilized remediation process to treat heavy metals removal around the entire world. Again, natural treatment (biological) is viewed as invaluable because of its ecological friendlines and financial practicality. However the biological methods are applied and followed by chemical method. Together they are used to reduce Cr(VI) and they can reduce COD upto 77% and turbidity upto 81%.

2. Electro-Kinetic Remediation using microbes:

Electro-kinetics (EK) procedure was proposed in in the years 1980s and was generally utilized to oversee heavy metal pollution in polluted fine structured soils of low hydro-electric potential. In this process of remediation, the natural issue is electrochemically charged over to create valuable offshoot, by the activity of microbial metabolic processes.

As soil contains most of heavy metal in insoluble structure, their expulsion rate was least, so the dissolvability can be accomplished by coupling electro-kinetic with different strategies. Then again, on the off chance that the metal particle was in "dissolvable" structure in the dirt, at that point the remediation rate will be expanded. A experiment was conducted with this process which removed 78% of mercury 7 days and 89% zinc in 5 days using microbes.

3. Electro-kinetic Phytoremediation:

This is a rising strategy for remediation process that has end up being increasingly good as far as metal recovery and being more efficient than the other incorporated method that took existence beforehand. EK remediation perfectly works with phytoremediation process.

The recovery yield of heavy metals from pollutes and procedure rate require a critical upgrade. Nonetheless, this can be improved by joining phytoremediation with various methods like transgenic innovation, bio-augmentation, remediation with electro-kinetics, penetrable receptive boundary. Laboratory studies on EK phytoremediation has displayed a good vision in heavy metal remediation of Zinc, lead, Copper, Cadmium, and Arsenic. Electro-kineticswas furthermore found to accept a critical activity in phytoremediation.

Case Studies: Heavy metals Impact on Farming

Heavy metals pollution in nature is broad and major issues in present society. Heavy metals occur in various structures in soil, which contrasts incredibly with their bioavailability. It usually remains in soil by acid rain. The geochemical conduct of heavy metals in the soil, their take-up by plants, and the impact on crop profitability are influenced by different chemical properties of the soil. [16] Heavy metals for the most part aggregate in root cells because of their hindrance by Casparian strips or because of catching by the cell dividers of roots.

Immoderate accumulation of heavy metals in different parts of plants can damage the various functions of the plants and affects productivity. Heavy metals can hinder the processes done by plants or seeds like germination, photosynthesis, respiration, growth, and reproduction.

Various studies show that a very large number of heavy metals are added to the soil annually through the use of heavy metals based fertilizers and pesticides such as lead, arsenic, and cadmium. Food security is kept as one of the highest priority issues in almost all countries. But in recent years the contamination of food due to heavy metals the food security is at high risk.

The heavy metals that are open for plant take-up are those that are accessible as dissolvable sections in the soil course of action or those that are adequately solubilized by root exudates. Even though plants needs certain amount of such

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metals for their development and upkeep, high measures of such metals can get lethal to the plants. The capacity of plants to gather basic metals makes them tolerable to toxicity of some metals.

As metals can't be separated, when fixations inside the plant surpass ideal levels, they antagonistically influence the plant both straightforwardly and by implication. Heavy metals lessen the quantity of organic matter in soil which can diminish the soil nutrient and minerals.

Presence of the heavy metals can decrease enzyme activity in the soil which kills the microorganisms responsible for plant metabolism. The side effects of these metals on plants differ as per specific heavy metals associate in the process.

The metals which are not at all required by plants for their growth and metabolism such as lead, chromium, arsenic, and mercury can adversely affect the plant growth even in low amount. For different metals that are helpful to plants, "little" amount of these metals in the soil could improve plant development and advancement..

For instance it is important to mention that specific plants can endure a high amount of heavy metals in their condition. This is possible due to three mechanisms in plants they are (i) Exclusion (ii) Inclusion (iii) Bioremediation.

1. Heavy metals in soil from wastewater irrigation and its effects on farming and food crops:

Heavy metals are extremely poisonous and they are normally discharged from different businesses, wastewater irrigation, the utilization of metal-based pesticides and composts and transportation, and mining enterprises through their wastewater removal. [17] At the point when these waters are discharged consistently in the soil for a longer period, they cause the gathering of heavy metals in these influenced regions.

The wastewater system is the significant giver of the heavy metal substance of the soils. High centralizations of heavy metals were accounted for in vegetables from the untreated wastewater flooded zones. The utilization of mechanical wastewater for raising vegetables is an intense issue in Pakistan in light of the fact that these effluents are vigorously stacked with destructive metals and metallic mixes.

Heavy metal pollution of horticultural land and yields in the encompassing territory of mining has been considered as an essential ecological concern. Vegetable tainting with heavy metals is through assimilation (from the soil) and surface statement (from dirtied air). The heavy metal (Cadmium, Chromium, Copper, Nickel, lead, and Zinc) content in wastewater is similarly more than groundwater (GW).

This effluent very badly affects the soil (changes ph) and the plant crops grown on these soli when irrigated. The heavy metals get accumulated in crops irrigated by wastewater which is considered a great environmental problem. Various studies show that in many areas heavy metal contaminated food crop can cause a health risk to human being and animals and decreases the yield and productivity of crops causing a loss in every way.

2. Risks due to contamination of heavy metal in organic and inorganic fertilizers:

Normal common phosphate (P) manures contain very little quantities of heavy metal contaminants phosphate rocks contains it a little. Animal composts and sewage oozes (bio-solids) and some more natural manures contains heavy metals in it [18]. Such metals in bio-solids might be found in the inorganic structure or might be naturally complexed, which could influence their chemical responses in soil. The heavy metals may gather in soil with repeated manure sprinkle and remain for long time. Cadmium (Cd) is the heavy metal which is considered to be dangerous since it might influence human and animals wellbeing. Other heavy metals of importance are arsenic, lead, mercury, nickel, and vanadium. A few nations have set resistance constraints on heavy metal increases to the soil in light of the fact that their drawn-out impacts are unknown. [19]

Controls on heavy metal focus on runoff bio-solids and their most extreme aggregate and yearly stacking rates to soil have been forced in certain nations. Guidelines likewise have been proposed for staged in limits on greatest heavy metal fixations allowed in P manures, or they are as of now essentially. The majority of the compost guidelines relate Cd

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cutoff points to P focuses, so P application rates direct Cd contributions to the soil. Guidelines influencing sewage bio-solids to incorporate various heavy metals, while those concerning P composts just include limits for Cd as of now.

Case Studies: Heavy metal impact on aquatic life

Heavy metals are introduced to the aquatic environment due to human careless activities like mining or work in industries that need metals for various purposes, volcanic eruption, and weathering of soil and rocks [20]. One of the most frequent pollutions of metal comes from mining industries as they use acidic substances in drainage to separate heavy metals from their ores. Such metals are highly soluble in acidic substances then they carelessly discharge acid solutions in groundwater which have a high amount of heavy metals in it.

At the point, when the pH in water falls, metal dissolvability easily increases, and the metal molecule becomes increasingly motile. That is the reason metals are highly harmful in soft waters. These metals remain in the bottom of the river and can stay there for a long-long time. Unlike other metals these metals cannot be broken into simpler compounds that do not harm the environment.

For aquatic organisms the most suitable environment for living is aquatic ecosystem or sediments. With inorganic substances, the degree of long-term bioaccumulation depends upon the rate of discharge. [20]These harmful toxic metals can accumulate in the organism's tissues and body. The various organisms affect by these pollutants according to their sex, age, and size. Tolerance to such heavy metals has been seen in very few vertebrates and fishes.

Metals for eg. Lead, Cadmium, and Mercury are not required by anyone not even in small quantities. These metals are considered as causing the highest degree of pollution.

Heavy metals influence all gatherings of life forms and environment forms, including microbial activity. The bioaccumulation of such components in living beings and biomagnification in them portrays the pathways of movement of heavy metal in food chain travelling in all the trophic levels [25] A portion of these living beings is eaten by humans. They could likewise cause very serious disease like Minamata and Itai-Itai.

1. Heavy metal pollution in river Ganga

The Sacred River Ganga is considered as holy river in India which provides life to all living beings. Ganga is one of the most important river systems in the country of India which accounts for 25% of total water sources of India. Various anthropogenic activities have raised questions about the safety and cleanliness of Ganga water. [21]

The Holy Ganga is continuously degrading by various activities like agricultural runoff, aimless discharge of waste materials from industries, and due to some ill activities of humans. The river is suffering from a serious loss of aquatic biodiversity. Many pieces of research show that heavy metals cannot be broken down and natural processes like decomposition cannot decompose heavy metals.

Ganga has numerous tributaries like Gomati, Kali, Yamuna, and Ramganga around the center stretch from Haridwar to Varanasi. The various cities of India like Haridwar, Varanasi, Prayagraj, Kolkata, Kanpur, and Patna are established on the banks of the Ganga River and people of these cities directly discharge the wastewater in the river. A study in the Central Pollution Control Board(CPCB) of India shows that nearly 2,723 million liters of domestic waste water are aimlessly discharged into the holy river. The region of Ganga between cities of Haridwar to Varanasi and Kannauj to Kanpur is considered as the most polluted. Different types of waste and pollutants also change the physical appearance of river water.

The river water around the city of Kanpur changes from brown to black where 1000 million per liters toxic waste discharged in water which comes from 400 tanneries located in Kanpur city.

Ganga river water is not at all fit for domestic purposes, drinking, and also it is proved bad for aquatic animals and plants according to WHO and USEPA standards.

The holy Ganga is also largely polluted by 2500 tons of pesticides. 1.2 million tons of fertilizers. Heavy metals enter the body of the fishes from gills, digestive tracts, and the

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body surfaces and get accumulated in the kidney, liver, and various tissues and can lead to poisoning. The aquatic plants

in lower Ganga also affected by heavy metals pollution. Eutrophication is observed in some lower Ganga region.

2. The Aznal collar mine disaster - the heavy metal disaster in Guadiamar River

The Aznalcollar mine disaster also known as the Donana disaster or Guadimar disaster which is a huge industrial accident that happened in Andalusia situated in southern Spain. On April 28, 1998 a sudden dam burst took place at the mine which released approximately 4 million cubic meters of waste ore of mine, a large amount of acid reflux which holds an assorted number of heavy metals in it [22].

The burst arrived at the river which is nearby and soon reached the river Guadiamar and the spread becomes unstoppable. The river Gaudiamar is the main source of water in the National park of Donana which is the largest national park in Europe. The muck out activity of the river took three years, at an expected expense of €240 million.

Because of the disaster, nothing endures as a result of the high acidity of the waste, which contained a blend of lead, copper, zinc, cadmium, and different metals, alongside sulfides. The disaster prompted a chain of genuine ecological issues in the Andalusia district. A not truly obvious harmful chain spread through nature which was hard to separate. High levels of substantial metals are as yet implanted in soil and water and have discovered a route into the untamed life.

Another serious issue lies in the strength of the creatures that lived around the recreation center. Soon the birds breed started to migrate but this stopped because almost 2000 birds, eggs, etc. were killed due to dam explosion and after that more than 25000 kilos of dead fish were collected from the river. There was a great loss to aquatic life and also to the crops near the river.

Conclusion

Here we reviewed various heavy metals in water and its impacts on humans, farming and aquatic life. Heavy metals can be very dangerous for the environment, and can fatal for humans and animals if they exposed to it in a huge amount. Looking at current pollution by heavy metals it is very important to remove them from the environment to save nature and make it pollution-free. To clean up heavy metals from soil and water the various processes like Excavation, stabilizing metals in soil, and phytoremediation-planting trees and plants that sucks out metal from and store them in leaves, roots, and stems. These methods are done at a low cost so they are cost-effective and so that we can save crops from such contamination. Rhizofiltration is another way by which plants can be used to remove contamination by heavy metals in the aquatic environment. Various chemical methods like reverse osmosis, electrochemical treatment, and membrane filtration can also be used to treat a small amount of water to some extent. The various integrated approaches for heavy metals are also tested by scientist, which are very successful and ecologically beneficial for everyone can be used to remove contamination from soil and water.

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