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SOURCE AND CHEMISTRY OF HEAVY METALS INSIDE CONTAMINATED SOILS: REVIEW

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Abstract: *Heavy metals are group of inorganic chemical compounds. It is a universal problem that these metals are permanent in nature and most of them have toxic effects on living organisms, when permissible concentration levels are exceeded. Excess heavy metals accumulations inside contaminated soils are toxic to living beings. Different possible source in addition of heavy metals like use of pesticides, insecticides, manure & fertilizer, industrial waste material used in crop production.*

Chemistry of heavy metals namely lead, cadmium, chromium, copper, zinc, nickel, arsenic and mercury commonly found in polluted soils. Heavy metal contamination of soil may be toxic for human's health and the ecosystem through direct eating of food-grains along with proportion of contaminated soil, the food chain, drinking of contaminated ground-water. Reduction of food quality through phyto-toxicity and land usability for agricultural production causes food insecurity and land tenure problems. Removal of heavy metals from polluted soils are essential to reduce the associated risks, make the land resource available for agricultural production, enhance food security and scale down land tenure problems arising from changes in the land use pattern.

Key words: *Fertilizer, Pesticides, heavy metals, soil.*

Introduction: Pollution of the natural environment by heavy metals is a universal problem because these metals are indestructible and most of them have toxic effects on living organisms, when permissible concentration levels are exceeded. Soils may become contaminated by heavy metals through emissions of expanding industrial areas, mine tailings, disposal of high metal wastes, leaded gasoline and paints, use of chemical fertilizers, animal manures, sewage sludge, pesticides, waste water for irrigation in crop production, coal combustion and atmospheric deposition [1]. Road construction has been the main activity for development of industrial units. This has led to the loss of forest cover and subsequent loss of soil fertility. Road side soils often show a high degree of contamination that can be attributed to motor vehicles. Heavy metals are a group of inorganic chemical compounds, and these are most commonly found at contaminated of soils are Lead (Pb), Cadmium (Cd), Chromium (Cr), Copper (Cu), Zinc (Zn), Nickel (Ni), Arsenic (As), and Mercury (Hg). Soils are the major source for heavy metals released into the environment by anthropogenic activities and total concentration of heavy metals present in soils persists for a long time after their introduction [2]. Heavy metal contamination of soil may pose risks and hazards to humans and the ecosystem through: direct eating food grains with contaminated soil, the food chain (soil-plant-human or soil-plant-animal-human), drinking of contaminated ground water, reduction in food quality through phyto-toxicity, reduction in land usability for agricultural production causing food insecurity, and land tenure problems.

The sufficient protection and restoration of soil ecosystems contaminated by heavy metals require their removal of heavy metals. Current legislation regarding environmental protection and public health at both national and international levels, are based on data that characterize by chemical properties of environmental phenomena, especially exists in our food chain. While soil characterization and removal of heavy metal speciation and bio-availability, challenge in removal of heavy metal from contaminated soils requires the identification of followings: the sources of contamination, basic chemistry of heavy metals, health risk and effect of environment to cause human health through the heavy metals.

In developing countries with great population density and limited funds available for environmental protection these countries developed the scientific community in the low cast technologies to remediate polluted soils by heavy metals. The sustainable development in contaminated lands resource available for agricultural production, enhance food security after getting rid of problems from heavy metal pollution.

In this paper I am highlighting possible basic sources of contaminated soil and therein existing heavy metal chemistry along with environmental problem and health risks of heavy metals like (Pb, Cd, Cr, Cu, Zn, Ni, As and Hg).

Source of Heavy Metals in Polluted Soil: The use of Agro chemicals and pesticides for crop production, manufacturing of synthetic products like paints, batteries, industrial waste, application of industrial effluents, domestic sewage sludge in crop production results in heavy metal contamination of urban agricultural soils [3]. Heavy metals also occur naturally in the soil environment from the pedogenetic processes (weathering of parent materials in soil formation), but metals have rarely toxic to human beings and plant population.

Inside old orchards, excess active ingredients present in soil are due to the applications of arsenic containing insecticides. Increasing rate of heavy metals in nature's slowly occurring geochemical cycle of metals by man, most soils of rural and urban environments may accumulate one or more of the heavy metals above clear background values high enough to cause risks to human health, plants, animals, ecosystems, or other media [4].

Heavy metals present in the soil from anthropogenic sources in the form of metal mine tailings, disposal of high metal wastes in improperly protected landfills, leaded gasoline and lead-based paints, land application of fertilizer, animal manures, bio-solids (sewage sludge), compost, pesticides, coal combustion residues, petrochemicals, and atmospheric deposition are discussed here under.

Atmospheric Sources: Sources of heavy metals due to atmosphere are generally free as particulates contained in the gas stream. Some metals such as Cd, Pb and as can also volatilize during high-temperature processing. These metals will convert to oxides and condense as fine particulates unless a reducing atmosphere is maintained. The type and concentration of metals emitted from both types of sources will depend on site-specific conditions. All solid particles in smoke from fires and in other emissions from factory chimneys are eventually deposited on soil. Most forms of fossil fuels contain some heavy metals, therefore, a form of contamination which has been continuing on a large scale since the industrial revolution began. For example, very high concentration of Cd, Pb, and Zn has been found in plants and soils adjacent to smelting works. Another major source of soil contamination is the aerial emission of Pb from the combustion of petrol containing tetraethyl lead which contributes substantially to the content of Pb in soils in urban areas and in those adjacent to major roads. Zn and Cd may be also added to the near road side soils, the sources being metals due to tyres, and lubricant oils [4].

Pesticides: Some common pesticides used in agriculture in crop production in the earlier period restricted substantial concentrations of metals. For instance, in the recent past, about 10% of the chemicals have approved for use as insecticides and fungicides in United Kingdam were based on compounds which contain Cu, Pb, Zn. Mn, and Hg, like such pesticides are copper-containing fungicidal sprays such as Bordeaux mixture (copper sulphate) and copper oxychloride. Lead arsenate was used in fruit orchards for many years to control some parasitic insects. Such contamination has the potential to cause problems, particularly if sites are redeveloped for other agricultural and nonagricultural purposes. Compared with fertilizers, the use of such materials has been more localized, being restricted to particular area of crops.

Fertilizers: Historically, agriculture was the first major human authority on the soil. To grow and complete the life cycle, plants must gain not only macronutrients (N, P, K, S, Ca, and Mg), but also essential micronutrients. Some soils are deficient in the heavy metals (such as Co, Cu, Fe, Mn, Mo, Ni, and Zn) that are essential for healthy plant growth, and crops may be supplied with these as an addition to the use of soil or as a foliar spray [5]. Cereal crops grown on Cu-deficient soils are occasionally treated with Cu as an addition to the soil, and Mn may similarly be supplied to cereal and root crops. Large quantities of fertilizers are regularly added to soils in intensive farming systems to provide adequate N, P, and K for crop growth [6]. The compounds used to supply these elements contain trace amounts of heavy metals (e.g., Cd and Pb) as impurities, which, after continued fertilizer application may significantly increase their content in the soil [7]. Metals such as Cd and Pb, have no known physiological activity. Application of certain phosphatic fertilizers unconsciously adds Cd and other potentially toxic elements to the soil, including F, Hg, and Pb.

Biosolids and Manures: Certain animal wastes commonly applied in agriculture to crops production. Poultry manures as important fertilizers, in the poultry industry is added in the Cu and Zn metals for food material as a growth promoters and arsenic contained in poultry health products may also have the likely to cause soil pollution. The application of numerous biosolids (e.g., livestock manures, varmi compost, and municipal sewage sludge) to soil by mistake leads to the accumulation of heavy metals such as Cd, Pb, Cr, Cu, Zn, Mo, As and Hg. The animals manures control high concentrations of Cu, Zn and as, if constantly applied to controlled areas of soil can cause considerable increase of these metals in the soil in long run [8]. Bio-solids (sewage sludge) are mainly organic solid products, produced by wastewater treatment processes that can be used beneficially. Application of bio-solids is common practice in many countries that agree to the reuse of bio-solids produced by urban populations. The term sewage sludge is used in many references because of its large appreciation and its regulatory clearness. However, the term bio-solids is becoming more common as a replacement for sewage sludge because it is thought to reflect more accurately the beneficial characteristics natural to sewage sludge. There is also considerable interest in the potential for composting bio-solids with other organic materials such as sawdust, straw, or garden waste. If this trend continues, there will be implications for metal contamination of soils. The potential of bio-solids for contaminating soils with heavy metals has caused great concern about their application in agricultural practices.

Heavy metals most commonly found in bio-solids are Cd, Cr, Pb, Cu, Zn, and Ni. The metal concentrations are governed by the nature and the intensity of the industrial activity, as well as the type of process engaged during the bio-solids treatment. Under certain conditions, heavy metals are added in soils during applications of biosolids which can be leached downwards through the soil profile and can have the potential to contaminate groundwater.

Waste Water: The use of waste water in agriculture for crop production of municipal and industrial effluents in ancient time now is a common practice in many parts of the world. Worldwide, it is estimated that 20 million hectares of arable land are irrigated with waste water. Several studies suggest that agriculture based on waste water irrigation accounts for 50 percent of the vegetable supply to urban areas. Generally farmers are not concerned about environmental hazards; they are primarily interested in maximizing their yields and profits. Though the metal concentrations in waste water effluents are generally comparatively low, long-term irrigation of land with such can eventually result in heavy metal accumulation in the soil.

Chemistry of Heavy Metals and Health Risk: The most common heavy metals found at contaminated of soils are Pb, Cd, Cr, Cu, Zn, Ni, As and Hg. Some metals are in use for crop production but are also decreasing crop production due to the risk of bioaccumulation and biomagnifications in the food chain.

There's also the risk of superficial and ground water contamination. Knowledge of the basic chemistry, environmental and allied health effects of these heavy metals is necessary in understanding their speciation, bio-availability, and remedial options. The fate and transport of a heavy metal in soil depends significantly on the chemical form and speciation of the metal. At first in the soil, heavy metals are adsorbed by initial fast reactions in few minutes, followed by slow adsorption reactions, therefore, redistributed into different chemical forms with varying bioavailability, mobility, and toxicity. This distribution is believed to be controlled by reactions of heavy metals in soils like mineral precipitation and dissolution, ion exchange, adsorption, and desorption, and plant uptake.

Cadmium: Cadmium is located at the end of the second row of transition elements with atomic number 48, atomic weight 112.4, density 8.65 g cm^{-3}, melting point 320.9°C, and boiling point 765°C. Together with Hg and Pb, Cd is one of the big three heavy metal poisons and is not known for any essential biological function. In its compounds, Cd occurs as the divalent Cd (II) ion. Cadmium is directly below Zn in the periodic table and has a chemical similarity to that of Zn.

Uses: common use of Cd in a Nickel Cadmium batteries as rechargeable or secondary power sources exhibiting high output, long life, low maintenance, and high tolerance to physical and electrical stress. Cadmium coatings provide good corrosion resistance coating to vessels and other vehicles, particularly in high-stress environments such as marine and aerospace. Other uses of cadmium are as pigments, stabilizers for polyvinyl chloride (PVC) in alloys and electronic compounds.

Soil Resources: Cadmium is also present as an impurity in several products, including phosphate fertilizers, detergents and refined petroleum products. In addition, acid rain and the resulting acidification of soils and surface waters have increased the geochemical mobility of Cd, and as a result its surface-water concentrations tend to increase as lake water pH decreases. Cadmium is produced as an inevitable byproduct of Zn and occasionally in lead refining. The application of agricultural inputs such as fertilizers, pesticides, and bio-solids (sewage sludge), the disposal of industrial wastes or the deposition of atmospheric contaminants increases the total concentration of Cd in soils, and the bioavailability of this Cd determines whether plant Cd uptake occurs to an important amount.

Toxic Effect of Cadmium in Human Health: Food intake and tobacco smoking are the main routes by which Cd enters the human body. Cadmium in the present of human body is known to affect several enzymes activity. Cadmium poisoning in the Jintsu River Valley Japan was attributed to irrigated rice contaminated from an upstream mine producing Pb, Zn, and Cd. The food consumed by people of Japan was poisoned due to cadmium, resulted in the itai itai disease and hence large number of deaths. The symptoms are the result of painful osteomalacia (bone disease) combined with kidney fail. The major threat to human health is chronic accumulation in the kidneys leading to kidney dysfunction.

Lead: Lead is a metal belonging to group IV and period 6 of the periodic table with atomic number 82, atomic mass 207.2, density 11.4 g cm^{-3}, melting point 327.4°C, and boiling point 1725°C. It is a naturally occurring, bluish-gray metal usually found as a mineral combined with other elements, such as sulphur (i.e., PbS, $PbSO_4$), or oxygen ($PbCO_3$), and ranges from 10 to 30 mg kg^{-1} in the earth's crust. Typical mean Pb concentration for surface soils worldwide averages 32 mg kg^{-1} and ranges from 10 to 67 mg kg^{-1}. Lead ranks fifth behind Fe, Cu, Al, and Zn in industrial production of metals.

Uses: Mostly Pb is used in the manufacture of Pb batteries, other uses includes solders, bearings, cable covers, ammunition, plumbing, pigments, and caulking. Metals commonly alloyed with Pb are antimony (in storage batteries), calcium (Ca) and tin (Sn) (in maintenance-free storage batteries), silver (Ag) (for solder and anodes), strontium (Sr) and Sn (as anodes in electrowinning processes), tellurium (Te) (pipe and sheet in chemical installations and nuclear shielding), Sn (solders), and antimony (Sb), and Sn (sleeve bearings, printing, and high-detail castings).

Soil Resources: Ionic lead, Pb(II), lead oxides and hydroxides, and lead-metal oxyanion complexes are the general forms of Pb that are released into the soil, groundwater, and surface waters. The predominant insoluble Pb compounds are lead phosphates, lead carbonates (form when the pH is above 6), and lead hydroxides. Lead sulfide (PbS) is the most stable solid form within the soil matrix and forms under reducing conditions, when increased concentrations of sulfide are present. Under anaerobic conditions a volatile organolead (tetramethyl lead) can be formed due to microbial alkylation. Lead (II) compounds are predominantly ionic (e.g., Pb^{2+} $SO_4^{\ 2-}$), whereas Pb (IV) compounds tend to be covalent (e.g., tetraethyl lead, $Pb(C_2H_5)_4$). Some Pb (IV) compounds, such as PbO_2, are strong oxidants.

Toxicity of Lead: Pb accumulates in the brain of human body, which may lead to poisoning or even death. The gastrointestinal tract, kidneys, and central nervous system are also affected by the presence of lead. Children exposed to lead are at risk for impaired development, lower IQ, shortened attention span, hyperactivity, and mental deterioration, with children under the age of six being at a more substantial risk [9]. Adults usually experience decreased reaction time, loss of memory, nausea, insomnia, anorexia, and weakness of the joints when exposed to lead. Lead is not an essential element for human and plants. It is well known to be toxic and its effects have been more extensively reviewed than the effects of other trace metals. Lead can cause serious injury to the brain, nervous system, red blood cells, and kidneys. Lead performs no known essential function in the human body, it can only do harm after uptake from food, air, or water. Lead is a particularly dangerous chemical, as it can accumulate in individual organisms, but also in entire food chains.

The most serious source of exposure to soil with Pb is through direct ingestion (eating) of contaminated soil or dust. In general, plants do not absorb or accumulate Pb. Studies have shown that lead does not readily accumulate in the fruiting parts of vegetable and fruit crops (e.g., corn, beans, squash, tomatoes, strawberries, and apples). Higher concentrations are more likely to be found in leafy vegetables (e.g., lettuce) and on the surface of root crops (e.g., carrots). Generally, it has been considered safe to use garden produce grown in soils with total lead levels less than 300 ppm. The risk of lead poisoning through the food chain increases as the soil lead level rises above this concentration. Even at soil levels above 300 ppm, most of the risk is from lead contaminated soil from uptake of lead due to the plant.

Chromium: Chromium is a first-row *d*-block transition metal of group VI-B in the periodic table with the following properties: atomic number 24, atomic mass 52, density 7.19 g cm^{-3}, melting point 1875°C, and boiling point 2665°C. It is one of the less common elements and does not occur naturally in elemental form, but only in compounds. Chromium is mined as a primary ore product in the form of the mineral chromite, $FeCr_2O_4$.

Soil Resources: Major sources of Cr-contamination include releases from electroplating processes and the disposal of Cr containing wastes. Chromium (VI) is the form of Cr commonly found at contaminated sites. Chromium (VI) is the dominant form of Cr in low aquifers where aerobic conditions exist. Chromium (VI) can be reduced to Cr (III) by soil organic matter, S^{2-} and Fe^{2+} ions under anaerobic conditions often encountered in deeper groundwater. Major Cr (VI) species include chromate ($CrO_4^{\ 2-}$) and dichromate ($Cr_2O_7^{\ 2-}$) which precipitate readily in the presence of metal cations (especially Ba^{2+}, Pb^{2+}, and Ag^{+}). Chromate and dichromate also adsorb on soil surfaces, especially iron and aluminum oxides. Chromium (III) is the dominant form of Cr at low pH (<4). Cr^{3+} forms solution complexes with NH_3, OH^-, Cl^-, F^-, CN^-, $SO_4^{\ 2-}$, and soluble organic ligands. **Toxicity of Chromium:** Chromium (VI) is the more toxic and is also more mobile but chromium(III) mobility is decreased by adsorption to clays and oxide minerals below pH 5 and low solubility above pH 5 due to the formation of $Cr(OH)_3(s)$. Chromium mobility depends on sorption characteristics of the soil, including clay content, iron oxide content, and the amount of organic matter present. Chromium can be transported by surface runoff to surface waters in its soluble or precipitated form. Soluble and un-adsorbed chromium complexes can leach from soil into groundwater. The leachability of Cr (VI) increases as soil pH. Most of Cr released into natural waters is particle associated, however, and is ultimately deposited into the sediment. Chromium is associated with allergic dermatitis in humans and bronchial cancer.

Copper: Copper is a transition metal which belongs to period 4 and group I-B of the periodic table with atomic number 29, atomic weight 63.5, density 8.96 g cm^{-3}, melting point 1083°C and boiling point 2595°C. The metal's average density and concentrations in crustal rocks are 8.1×10^3 kg m^{-3} and 55 mg kg^{-1}, respectively.

Uses: Copper is the third most used metal in the world. It is an essential micronutrient required in the growth of both plants and animals. In humans, it helps in the production of blood haemoglobin. In plants, Cu is especially important in seed production, disease resistance, and regulation of water. Copper is indeed essential, but in high doses it can cause anaemia, liver and kidney damage, and stomach and intestinal irritation. Copper normally occurs in drinking water from Cu pipes, as well as from additives designed to control algal growth. Cu is not magnified in the body in the food chain.

Soil Resources: Cu is the strongly complexes to the organic compounds that only a small part of copper will be found in solution as ionic form. The solubility of Cu is significantly increased at pH 5.5, which is slightly close to the ideal farmland pH of 6.0–6.5. Copper and Zn are two important essential elements for plants, microorganisms, animals, and humans. The connection between soil and water contamination and metal uptake by plants is determined by soil through many physico-chemical factors as well as the physiological properties of the crops.

Toxicity of Copper: Direct use of copper has negative effects in crop's growth and yield. Indirectly, by entering through human food chain gives a potentially negative impact on human health. Even a reduction in crop yield by a few percent could lead to a significant long-term loss in production and income. Some food importers are now specifying acceptable maximum contents of metals in food, which might limit the possibility for the farmers to export their contaminated crops.

Zinc: Zinc is a transition metal with the period 4, group II-B, atomic number 30, atomic mass 65.4, density 7.14 g cm^{-3}, melting point 419.5°C, and boiling point 906°C.

Soil Resources: Zinc occurs naturally in soil (about 70 mg kg^{-1} in crustal rocks), but Zn concentrations are rising unnaturally, due to anthropogenic additions. Mostly Zn is added during industrial activities, such as mining, coal, and waste combustion and steel processing. Many foodstuffs contain certain concentrations of Zn. Drinking water also contains certain amounts of Zn, which may be higher when it is stored in metal tanks. Industrial sources or toxic waste sites may cause the concentrations of Zn in drinking water to reach levels that can cause health problems. Zinc is a trace element that is essential for plant and human health [10]. Zinc shortages can cause birth defects. Water is polluted with Zn, due to the presence of large quantities present in the wastewater of industrial plants. A consequence is that Zn-polluted sludge is continually being deposited by rivers on their banks. Zinc may also increase the acidity of waters. Some fish can accumulate Zn in their bodies, when they live in Zn-contaminated waterways. When Zn enters the bodies of these fish, it is able to bio-magnify up the food chain. Water-soluble zinc that is located in soils can contaminate groundwater. Plants often have a Zn uptake that their systems cannot handle, due to the accumulation of Zn in soils. Finally, Zn can interrupt the activity in soils, as it negatively influences the activity of microorganisms and earthworms, thus retarding the breakdown of organic matter.

Nickel: Nickel is a transition element with atomic number 28 and atomic weight 58.69. In neutral to slightly alkaline solutions, it precipitates as nickelous hydroxide, Ni $(OH)_2$, which is a stable compound. This precipitate readily dissolves in acid solutions forming Ni (III) and in very alkaline conditions; it forms nickelite ion ($HNiO_2$) that is soluble in water. In very oxidizing and alkaline conditions, nickel exists in form of the stable nickelo-nickelic oxide, Ni_3O_4, that is soluble in acid solutions. Other nickel oxides such as nickelic oxide, Ni_2O_3, and nickel peroxide, NiO_2, are unstable in alkaline solutions and decompose by giving off oxygen. In acidic regions, however, these solids dissolve producing Ni^{2+}. In low pH regions, the metal exists in the form of the nickelous ion, Ni (II).

Soil Resources: Nickel is an element that occurs in the environment only at very low levels and is essential in small doses, but it can be dangerous when the maximum tolerable amounts exceeded. The most common application of Ni is an ingredient of steel and other metal products. The major sources of nickel contamination in the soil are metal plating industries, combustion of fossil fuels, and nickel mining and electroplating. It is released into the air by power plants and trash incinerators and settles to the ground after undergoing precipitation reactions. It usually takes a long time for nickel to be removed from air. Nickel can also end up in surface water when it is a part of wastewater streams.

Toxicity of Nickel: This can cause various kinds of cancer on different sites within the bodies of animals, mainly of those that live near refineries. Microorganisms can also decrease in the growth due to the presence of Ni, but they usually develop resistance to Ni after a while. Nickel is unknown to accumulate in plants or animals and as a result has not been found to biomagnify up the food chain. For animals Ni is an essential foodstuff in small amounts.

Arsenic: Arsenic is a metalloid in group V-A and period 4 of the periodic table that occurs in a wide variety of minerals, mainly as As_2O_3, and can be recovered from processing of ores containing mostly Cu, Pb, Zn, Ag and Au. Arsenic has the following properties at atomic number 33, atomic mass 75, density 5.72 g cm^{-3}, melting point 817°C, and boiling point 613°C, and exhibits fairly complex chemistry and can be present in several oxidation states. In aerobic environments, As (V) is dominant, usually in the form of arsenate ($AsO_4^{\ 3-}$) in various protonation states: H_3AsO_4, $H_2AsO_4^{\ -}$, $HAsO_4^{\ 2-}$, and $AsO_4^{\ 3-}$ [12].

Soil resources: Arsenic (As) is introduced into soil and groundwater during weathering of rocks and minerals followed by subsequent leaching and runoff. It can also be introduced into soil and groundwater from anthropogenic sources. Arsenate and other anionic forms of arsenic behave as chelates and can precipitate when metal cations are present. It is also present in ash from coal combustion. Arsenite can adsorb or coprecipitate with metal sulfides and has a high affinity for other sulfur compounds. Elemental arsenic and arsine ($AsH_{3)}$, may be present under extreme reducing conditions. Biotransformation (via methylation) of arsenic creates methylated derivatives of arsine, such as dimethyl arsine HAs $(CH_3)_2$ and trimethylarsine As $(CH_3)_3$ which are highly volatile. Since arsenic is often present in anionic form, it does not form complexes with simple anions such as Cl^- and $SO_4{}^{2-}$. Arsenic speciation also includes organometallic forms such as methylarsinic acid (CH_3) as O_2H_2 and dimethylarsinic acid $(CH_3)_2AsO_2H$. Many as compounds adsorb strongly to soils and are therefore transported only over short distances in groundwater and surface water [11].

Toxicity of Arsenic: It is associated with skin damage, increased risk of cancer, and problems with circulatory system.

Mercury: Mercury is a metallic element that is a liquid at room temperature, it is one of the transition elements it is a transition metal with the period 4, group II-B, same group of the periodic table with Zn and Cd. It has atomic number 80, atomic weight 200.6, density 13.6 g cm^{-3}, melting point −13.6°C, and boiling point 357°C and is usually recovered as a byproduct of ore processing.

Soil Resources: The major source of Hg are metal processing, incineration of coal ,medical and other waste, and mining of gold and mercury contribute greatly to mercury concentrations in some areas, but atmospheric deposition is the dominant source of mercury over most of the landscape. After release to the environment, Hg usually exists in mercuric ($Hg2^+$), mercurous ($Hg_2{}^{2+}$) and elemental mercury (Hg) and other converted forms are methyl and ethyl mercury. Elemental mercury may be found in higher concentrations in environments such as gold mine sites, where it has been used to extract gold [13]. As gently reducing conditions exist, organic or inorganic Hg may be reduced to elemental Hg, which may then be converted to alkylated forms by biotic or abiotic processes. Accumulation of soils sediments and humic materials is an important mechanism for the removal of Hg from solution. Under anaerobic conditions, both organic and inorganic forms of Hg may be converted to alkylated forms by microbial activity, such as by sulfur-reducing bacteria. Acidic conditions (pH less than 4) also favor the formation of methyl mercury, whereas higher pH values help precipitation of HgS.

Toxicity of Mercury: The toxic effects of mercury depend on its chemical form and the route of exposure. Accumulation of mercury in human body affects the kidney. Methylmercury [CH_3Hg] is the most toxic form. It affects the immune system, alters genetic and enzyme systems, and damages the nervous system, including coordination and the senses of touch, taste, and sight. Methylmercury is particularly damaging to developing embryos, which are five to ten times more sensitive than adults [14]. Exposure to methylmercury is usually by ingestion, and it is absorbed more readily and excreted more slowly than other forms of mercury. Mercury is most toxic in its alkylated forms which are soluble in water and volatile in air.

Conclusion: surroundings knowledge for the sources of heavy metals, chemistry, and toxicity of heavy metals in contaminated soils. Different possible sources for addition of heavy metals like use of pesticides, insecticides manure and fertilizer and industrial waste material used in crop production, and chemistry of heavy metals present in soils namely lead, cadmium, chromium, copper, zinc, nickel, arsenic and mercury commonly found in polluted soils. Removal of heavy metal polluted soils is essential to reduce the associated risks, make the land resource available for agricultural production, enhance food security and scale down land tenure problems arising from changes in the land use pattern. Heavy metal contamination of soil may be toxic for human's health and the ecosystem through direct effect on the eating food grains produced within contaminated soil, the food chain, drinking of contaminated ground water, reduction in food quality through phyto-toxicity, reduction in land usability for agricultural production, causing food insecurity, and land tenure problems.

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