

# Heavy Metals Analysis In Solid Municipal Wastes

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**ABSTRACT:** Heavy metals contents of solid municipal waste produce in high density towns showed higher levels of iron zinc, and cadmium. There is no significant difference between the concentrations of other metal in high and low density towns. The inter correlation of those elements may have slightly difference of some heavy metals such as mercury, cadmium and arsenic. Contamination in municipal solid waste (MSW) and its treatment products is huge issue that everyone governs. The effect of heavy metals in mercury, cadmium and lead which are most significant toxic elements of heavy metals and organic forms of lead are absorption through ingestion by food and water. The source of heavy metals and their mobility in solid waste can consequence of the intended use of heavy metals in industrial product, heavy metals in solid waste contaminated soil and ground water to their leachability and manage by recycling municipal Solid waste, land filling and by incineration of solid wastes. By the stabilization through physical and chemical process in the environment, they may pose an adverse effect on the life of Human. Therefore, every person should control his environment from the contamination and their effects.

**Key words:** municipal waste, heavy metals, stabilization, mercury.

## 1 INTRODUCTION

Heavy metals are metallic elements that have relatively high density and toxic even at low concentration [1]. They have a great ecological significance due to their toxicity accumulative behavior. The term heavy metals is used to describe metals having density greater than  $5.6 \text{ g/cm}^3$  heavy metals are often referred to as trace metals, occurring naturally in low concentration in organisms, although the term transmittal might imply by organism for the particular metal. They are not biodegradable and undergo ecological cycle. Some metals are very essential to life but they are toxic at high level of dose [2]. Emission of heavy metals to the environment occurs via a wide range of process and path ways, including to the air, to surface water and to the soil. Tends to be greatest effect on human health. The accumulations of heavy metals in soil reach concentration since become a threat to vegetation and animals. Ultimately affect the quality of human life through food chain. Heavy metals are found in electrical wastes, municipal solid waste and from degradation of organic wastes [4]. They can also be found from disposal of house hold wastes. Hazardous wastes, non hazardous industrial wastes and other chemical by product [5]. The conservation of natural resource and environmental risk reduction are the appropriate control of metals. For the managements of municipal solid wastes proper treatment and efficient recovery is essential to identify their materials flow in the product life cycle. Waste management system is last stage in product life cycle and critical stages to determine whether metals are recovered, deposited in land fill or dispersed to the environment [6]. Solid waste can be managed by incineration method which is used to treat municipal solid wastes due to oxidizing organic materials of wastes and decreasing the volume of the original waste considerably [7]. In other ways recycling of scrap material is considered as the municipal solid waste. Management system [8]. Land filling also remains the predominant management method for the disposal of municipal solid waste. By stabilization, mobility of hazardous substance and contaminates is significantly reduced in the environment [9]

## 1.1. OBJECTIVE

### 1.1.1. General objective

- To study heavy metals analysis in solid municipal waste

### 1.1.2. Specific objective

- To show the effect of heavy metals contamination.
- To determine source of heavy metals and their mobility in solid waste.
- To describe solid waste management system and contamination of heavy metals.
- To determine stabilization of heavy metals solid wastes

## 2.1 Effects of Heavy Metals

Heavy metals have greater density than water. The bio-toxic effect of heavy metals refer to the harmful effects of heavy metals to the body when consumed above the bio recommended limits that mean above or below the normal dose have poisoning and bio-toxicity effect heavy metals includes lead, and cadmium, zinc, mercury, arsenic, silver, chromium, copper and iron [11]. Some of heavy metals are the most harmful of the elemental pollutants and are particularly concern because of their toxicities to humans, heavy metals include essential elements like iron and toxic metals like cadmium and mercury. Most of them have affinity for sulfur and can be directly reacted with sulfur group enzymes [9]. The poisoning effects of heavy metals are due to their interference with the normal body bio chemistry in the normal metabolic processes. When injected in the acid medium of the stomach, they are converted to their stable oxidation states (like  $\text{Zn}^{2+}$ ,  $\text{Pb}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{As}^{2+}$ ,  $\text{As}^{3+}$ ,  $\text{Hg}^{2+}$  and  $\text{Ag}^+$ ) and combine with the body to form strong and stable chemical bonds. The hydrogenation of enzyme are replaced by the poisoning metal and the enzyme is inhibited from functioning. The most toxic forms of these metals in their ionic species are the most stable oxidation for example  $\text{Cd}^{2+}$ ,  $\text{Pb}^{2+}$ ,  $\text{Hg}^{2+}$ ,  $\text{Ag}^+$ , and  $\text{As}^{3+}$ .) in their most stable oxidation state, they form very stable bio-toxic compounds with the body's bio-molecules, which becomes difficult to be dissociated, due to their bio stabilities, during extraction from the body by medical detoxification [1]. Human can be exposed to these metals by ingestion (drinking) or in halation (breathing) [11].

### 2.1.1. Cadmium

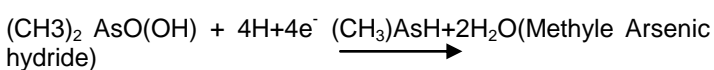
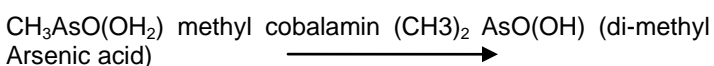
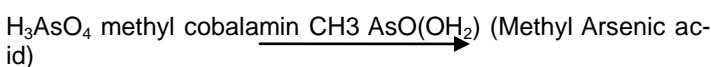
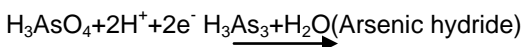
Cadmium exposure may cause kidney and tubular dysfunction, cigarettes smoking is a major source of cadmium exposure since, smoking cause significant increase in blood cadmium level than non-smokers. The cadmium contaminated water used for Agriculture cause high cadmium exposure results skeletal damage consequently irrelatively low cadmium exposure give rise to skeletal damage, evidence by low bone mineral density (osteoporosis) and fractures, also cadmium causes cancer[11]. Mercury combines with other elements to form organic and organic mercury compounds. Mercury is converted by micro organisms to methyl mercury, a bioaccumulation toxin. Mercuric chloride (Hg<sub>2</sub>Cl<sub>2</sub>) and methyl mercury is possible for human carcinogens. Exposure to high level can permanently damage the brain, kidneys and developing fetuses. Effects on brain functioning results irritability, syntheses, tremors, change to invasion or hearing and memory problems. Short term exposure to high levels of metallic mercury vapors cause lung damage, vomiting, diarrhea, increase blood pressure, skin rashes and eye irritation [11]. A high dietary intake of mercury from consumption of fish hypothesized to increase the risk of heart disease and high dose of mercury lead to death[3].

### 2.1.3 . Lead

Lead is the most significant toxic element of heavy metals and the organic forms of lead are absorbed through ingestion by food and water and by inhalation. Lead poisoning causes inhibition of the synthesis of hemoglobin, dysfunction of kidneys, joints and reproductive system acute and chronic damage to the central nervous system[1]. Lead poisoning from environmental exposure is through to have caused mental retardation in many children[9]. The most sign of lead poisoning is disturbance of hemoglobin synthesis and lead to anaemia, as well as in several cases of lead affect the persons from acute psychosis, confusion and reduces consciousness long-term lead exposure also give rise to kidney damage renal tubular damage [3]. In other way, high exposures of lead have great effect on pregnant women which cause miscarriage [11].

### 2.1.4. Arsenic

Arsenic occurs naturally in the environment, it can be released in large quantities through volcanic activity, erosion of rocks, forest fires and human activity. Inorganic arsenic is a known carcinogen and can cause of the skin, lungs, liver and bladder. Low level exposure can cause vomiting, decreased production of red and white blood cells, damage to blood vessels. The ingestion of very high levels can possibly result death [11]. Arsenic in drinking water show excess risk of human health increase risk of skin cancer and other skin lesions [3]. Arsenic can be converted to more mobile and toxic methyl derivative bacteria, according to the following reaction.



## 2.2 Effects of heavy metals contamination

### 2.2.1. Environment

The effect of heavy metals contaminate in the sedimentation benthic organisms can be either acute or chronic (cumulative) [10]. No matter whether metals are essential or not, all heavy metals form an important group of enzymes in habitats when natural concentration are exceeded. Therefore, organisms including animals, plants, and micro organisms living in or adjacent to metal contaminated sediments may suffer toxic that can be fatal in highly contaminated situation to relative in addition, metal enrichment in estuaries and coastal environments is a major concern as heavy metals have the ability to bioaccumulate in the tissues of various biota and can ultimately affect the distribution and density of benthic organisms, as well as the composition and diversity of influenced communities[10].

### 2.2.2. Human

Heavy metals contamination has become subject of public interest because humans have been harmed by metal concentration. Effects on humans can be observed after either a one off exposure to large non-lethal dose (acute) or after repeated exposure to lower doses (chronic) of these heavy metals, classic example of the effect of bioconcentrated oxidants are the painful and fatal. It is a disease caused by chronic cadmium poisonings and Minamata disease, caused by chronic mercury poisoning [10].

## 2.3. Source of heavy metals and their mobility is solid waste.

Some sources of heavy metals and their mobility in solid waste consequence of the intended use of heavy metals in industrial products. At the end of their useful life all products will end up in waste to the extent they are not attractive for recycling. However, heavy metals may be lost to waste during production and use phase losses in the manufacturing process are often disposal of manufacturing waste, while products may be exposed to wear and tear inclusive corrosion during the use phase [12]. The mobility of metals in ground water system is hindered by reaction the cause metals phase to absorb or precipitate or chemistry that tend to keep metals associated with the solid phase and prevents them from dissolving. This mechanism can retard the movement of metals and provided a long term sources of metals contaminants [14].

### 2.3.1. Arsenic (AS)

Arsenic is a semi metallic element that occurs in a variety of minerals mainly as As<sub>2</sub>O<sub>3</sub>, it can be recovered from processing of ores containing mostly Copper, Zinc, Silver and Gold. It is also present in ashes from combustions of coal. Arsenic can be present several oxidation states such as III, IV, V, in aerobic environment. As (V) is dominant, usually in the form of arsenate (AsO<sub>4</sub><sup>3-</sup>) in various protonation states from these: H<sub>3</sub>AsO<sub>4</sub>, H<sub>2</sub>AsO<sub>4</sub><sup>-</sup>, HAsO<sub>4</sub><sup>2-</sup>, and AsO<sub>4</sub><sup>3-</sup> Arsenite can adsorb or coprecipitate with metals sulfide and has a high affinity for affinity for other sulfur compounds. Elemental arsenic and arsine, AsH<sub>3</sub>, may be present under extreme reducing conditions. Bio transformation of arsenic creates methylated derivative of Arsine, such as dimethyl arsine (As(CH<sub>3</sub>)<sub>2</sub>) and trimethyl arsine (As(CH<sub>3</sub>)<sub>3</sub>). Arsenate can be leached easily if the amount of reactive in the soils low. As (V) can be mobilized under reducing conditions that encourage the formation of As (III). Under alkaline and saline conditions, in the presence of the ions that

compete for sorption sites and in the presence of organic compounds that form complexes with arsenic [12]. Arsenic (AS) is a toxic element to human, even trace amount of arsenic can be harmful to human health. The two valence states of arsenic (III) and AS (V) are both mobile and toxic. AS (III) is highly toxic than AS (V). Large quantities of arsenic trioxide ( $AS_2SO_3$ ) are available worldwide as a concentrate by product from various metals (Cu, Au, Ni, Pb, Zn) extraction and refining operations, mainly copper extraction and refining. Another source of AS is the waste from the metalurgical industry [14].

### 2.3.2. Cadmium (Cd)

Some sources of cadmium contamination are including plating operation and the disposal of cadmium containing waste [14]. The most common forms of cadmium include  $Cd^{2+}$ , cadmium cyanide complexes and  $Cd(OH)_2$  solid sludge. Hydroxide ( $Cd(OH)_2$ ) and carbonate ( $Cd(CO_3)$ ) solid are dominant at high pH whereas  $Cd^{2+}$  and aqueous sulfates are dominant form of cadmium at lower pH ( $pH < 5$ ) is formed. Cadmium is relatively mobile in surface water and ground water system. Under acidic conditions, cadmium forms complex with chloride and sulfate and exists primarily as hydrated ions and other organic ligands. Cadmium is removed from natural waste by precipitation and sorption to mineral surface, especially oxide minerals, at higher pH values  $pH > 6$ . Removal by these mechanisms increases as pH increases. Sorption is also influenced by the cationic exchange capacity of clay carbonate minerals and organic matter present in soils and sediment under reducing conditions, precipitation as Cd controls the mobility of cadmium [12].

### 2.4. Solid Waste Management System and Contamination of Heavy Metals

Heavy metals are released to the environment from waste due to these problems, there is appropriate solid waste management practice which requires reliable waste treatment, and solid waste management practice recovering of scrap metal should be considered at a scale beyond the municipal solid waste management system. Recycling of old materials from the waste is very important for managing of environmental pollution [8]. In other way, land filling is the predominant management method for the disposal of municipal solid waste. The chemical composition of municipal solid waste leachate is depending on the types and amount of wastes land filled. Land fill age and environmental conditions. The disposal of hazardous wastes in municipal landfills and waste components containing toxic chemicals entering landfills have great management for the pollution of environment [5]. Incineration is the main method used to treat municipal solid wastes. There are many solid waste management systems from these some of the management systems are as [3].

### 2.5. Recycling

Recycling of old materials reduce the disposal of heavy metals to the environment. Because of the old materials which contain heavy metals wastes have great effect on the environment due to the recycling process the pollution or the disposal of waste to the environment become minimize. Solid waste recycling has a long standing commercial activity. Recycling of materials are considered in to use full materials in industries [8]. Regarding recycling of their operation of their metals heavy metals are present as contaminants requiring special pollution prevention and disposal of residues. To some extent heavy

metals will be integrated in steel continued recycling of plastics only exist for few products like boxes for beer and soft water bottle [14].

### 2.6. Municipal Solid Waste Land Filling

Land filling remains the predominant management method for the disposal of municipal solid waste. The chemical composition of municipal solid waste leachate depends on the type and amount of waste and filled, land fill age and environmental condition, environmental regulation in United States limit the disposal of hazardous waste in municipal land fill, but regulation waste component containing toxic leachate may be a vehicle for the introduction of heavy metals. Chemical and physical affinity of metal ion and various waste materials may reduce their leach ability under typical and fill conditions [5]. Heavy metals commonly found in leachate includes Cr, Cd, Pb, Hg, Ni, Cu and Zn etc. The actual number of concentration of heavy metal in leachate varies from one land fill to another [15].

### 2.7. Municipal Solid Waste Incineration

Incineration is the method used to treat solid wastes. Its advantage is to oxidize the organic materials of the waste to the conservation volume of the original wastes considerably. Owing to the conservation nature of heavy metals with respect to thermal oxidation, their nature is not changed during the process, due transferred to be the fuel gases and then condensed in the fly ashes with fly ashes posing serious threats to the environment due to leaching of heavy metal and hazardous material and need to be pretreated properly by means of solidification, chemical stabilization thermal treatment etc before final disposal [13].

### 2.8. Stabilization of Heavy Metal Solid Wastes.

Stabilization is one of the most effective methods of dealing with heavy metals contaminated sites. By the method of mobility of hazardous substances and contaminants is significantly reduced in the environment through physical and chemical means. Physical aspect involves changes in mechanical properties of materials and chemical aspect involves change to the form and mobility of the contaminants by leaching present. The goal of stabilization is to limit migration of hazardous waste in to environment by leaching mechanisms. Solidification and stabilization seeks to immobilize contaminants within their host medium instead of removing them through chemical or physical treatment [9]. The term solidification/stabilization refers to a general category of processes used to treat a wide variety of waste, including solids and liquids. Solidification refers to the process that encapsulates to form solid material and to restrict contaminant migration by decreasing the surface area exposed to leaching by coating the waste with low permeability materials. Stabilization refers to processes that involve chemical reaction that reduce the leachability of waste. The physical nature of the waste may or may not be changed by this process [16].

## 3. SUMMARY, CONCLUSION AND RECOMMENDATION

### 3.1 Summary

The main objective of this study is to determine the concentration of heavy metals found in the municipal waste water so as to point out the possible solution for their effect. Heavy metals

are metallic elements that have a relatively high density and toxic in low concentration. They have great ecological significance due to their toxicity of some metals are very essential to life but they are toxic to high level of dose. Solid waste can be managed by incineration method which is used to treat municipal solid waste by incineration method due to oxidizing organic material of wastes and decreasing the volume of the original waste considering municipal solid waste management system. The effect of heavy metals has a greater density than water. The bio-toxic effect of heavy metals refers to harmful effects of heavy metals to the body. Normal doses have poisoning and to toxicity effects of heavy metals chromium, copper, cadmium, zinc, mercury, arsenic, silver, harmful of the elemental pollutants are particular concern because of their toxicities to human, environmental, heavy metals include essential elements like iron and toxic metals like cadmium and mercury. The effect of heavy metals contamination in the sedimentation benthic organisms can be either acute or chronic (cumulative) all heavy metals from an important group of enzyme inhibitors when natural concentration. Heavy metals are released to the environment from waste due to this problem, there are appropriate solid waste management practices or municipal expenditure of solid waste management practice recovering of scrap metal should be considered of the disposal of municipal solid wastes. The recycling of old material reduces the disposal of heavy metals to the environment. Land filling remains the predominant management method for the disposal of municipal solid waste. Conservative nature of heavy metals with respect to thermal oxidation, their nature is not changed during the process to their thermodynamic volatile metals. Heavy metals in the solid waste can be contaminating soil and ground water their leachability and mobility. The mobility of hazardous substances and contaminants can be reduced by stabilization of heavy metal.

### 3.2 Conclusion

Generally, heavy metals are metallic elements, which have a relatively high density. These include chromium, zinc, arsenic, copper, mercury, lead and cadmium some of them are harmful elemental pollutants to the environment and they have great influence in the health of human being. Heavy metals in the solid waste can be contaminating soil and ground water due to their leachability and mobility. There are leaches of solid waste to the environment can be managed by recycling municipal solid waste land filling can be managed by recycling and incineration of the solid wastes. The mobility hazardous substance and contaminants can be reduced by stabilization through physical and chemical means in the environment. The main role of stabilization to reduce the migration of hazardous waste in to the environment.

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