Phytoremediation of E-Waste using Nicotiana Tabacum & Moringa Oleifera

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Abstract— Heavy metals are among the most important sorts of contaminant in the environment. Several methods already used to clean up the environment for these kinds of contaminants, but most of them are costly and difficult to get optimum results. Currently, phytoremediation is an effective and affordable technological solution used to extract or remove inactive metals and metal pollutants from contaminated soil. This technology is environmental friendly and potentially cost effective. This project aims to compile some information about heavy metals of Pb, Cu, Cd sources, effects and their treatment. Pb, Cd, Cu on the environment, the advantages of this kind of technology for reducing them, and also heavy metal uptake mechanism in phytoremediation technology as well as the factors affecting the uptake mechanisms. The plants like Moringa oleifera & Nicotiana tabacum were used in phytoremediation and their capability to reduce the contaminant are also reported.

Keywords: Phytoremediation of E-Waste, Atomic Absorption Spectroscopy (AAS), Nicotiana Tabacum & Moringa Oleifera

I. INTRODUCTION

The worldwide rapid industrial and commercial growth has leading to the increase of municipal solid-waste production. Mainly this large amount of solid waste is disposed in landfill sites due to the economic advantages. However, a sanitary landfill produces wastewater which threatens surface and ground waters. Environmental contamination is one of the most important factors responsible for degradation of the surface environment on earth. Heavy metals play a dominant role in this destruction. Heavy metals released into the environment contribute to a variety of toxic effects on living organisms as they pass through the food chain. Heavy metals and metalloids (e.g., Cr, Ni, Cu, Zn, As, Cd, Hg and Pb) are important to environmental pollutants, particularly in areas under highly anthropogenic pressure. Many of these elements are highly toxic in both elemental and soluble salt forms. The presence of heavy metal pollutants in water bodies poses risk to the health of humans and ecosystems. In particular, the bioaccumulation of heavy metals in the food chain can be highly dangerous to human health. The most common route of human exposure to heavy metals is through ingestion of food and water sources. Water that pose a contamination risk have conventionally been treated by physical/chemical means such as water shielding, dumping in a landfill, or neutral sedimentation. However, the large quantity of existing waste soil and water requires semi-permanent disposal and control measures, especially when considering drainage from abandoned mines. Phytoremediation is a technology that involves the use of plants to remove pollutants from the environments.

II. PHYTOREMEDIATION

Phytoremediation is a form of bioremediation and applies to all chemical or physical processes that involve plants for degrading or immobilizing contaminants in soil and groundwater. The word comes from the Greek word phyto, meaning plant, and the Latin word remedium, meaning restoring balance. When put together, the two words refer to technologies that use living plants to clean up soil, air, and water contaminated with hazardous chemicals. Phytoremediation is a cost-effective, plant-based approach to remediation that takes advantage of the ability of plants to concentrate elements and compounds from the environment and metabolize various molecules in their tissues. It refers to the natural ability of certain plants called hyperaccumulators to bioaccumulate, degrade, or render harmless contaminants in soil, water, or air. Toxic heavy metals and organic pollutants are the major targets for phytoremediation. In addition, several field trials confirmed the feasibility of using plants for environmental clean-up. While the technology is not new, current trends suggest its popularity is growing.

III. PROPERTIES OF MORINGA OLEFIERA

Moringa oleifera is widely grown throughout the tropical region. This tree is 5-12m in height and has straight trunk, whitish bark, white or cream coloured flowers and tuberous tap type roots. This evergreen or deciduous foliage has 1-2cm in diameter leaflets; the flowers are initially, the fruits or pods are light green, slim and tender, but eventually become dark green, firm and up to 120cm long, depending on the variety. The fully mature, dried seeds are round or triangular. The kernel is surrounded by a lightly wooded shell with three papery wings. It rapidly grows from seeds or cuttings and flowering, fruiting is observed within 12 months of planting out. If climate permits then two harvests of pods are possible in a single year. The annual seed yielding can be 3 to 5 tons per hectare for 3m spacing. It prefers hot, semiarid regions type climate and soil conditions having annual rainfall 250- 1500mm. It can adapt well to humid, hot and wet conditions with annual rainfall in excess of 3000mm. It is considered to be suitable only for lowland cultivation at altitudes less than 600m. The tree is tolerant of light frosts and can be established in slightly alkaline soils of up to pH 9. Moringa Oleifera seed kernels contain significant quantities of water-soluble proteins which, in solution, carry an overall positive charge and are considered to act similarly to synthetic, positively charged polymer coagulants. The proteins bind to the predominantly negatively charged particulates such as silt, clay, bacteria

etc. when added to raw water. Then under proper agitation these bound particulates grow in size to form flocks, which settle by gravity or are removed by filtration and it is a better removal of heavy metals such as copper Cadmium, lead from the contaminated soil. In our project we take moringa oleifera for extraction of toxic metals from the e-waste contaminated site

Fig. 1: MORINGA OLEIFERA

IV. PROPERTIES OF NICOTIANA TABACUM

The low cost, plant based phytoremediation technique has often been described as a promising technique to remediate agricultural land contaminated with e-waste. The plants used, have to meet certain requirements, which are fulfilled by tobacco. It is a fast growing plant with a high biomass, which is easily harvested. it's propagation is simple, as each plant generate thousands of seeds. Tobacco has also revealed a high tolerance for various organic and inorganic pollutants. It can accumulate heavy metals in relatively high -levels , especially Cd, Cu, Pb. It's rapid growth, high leave biomass and it's high disposition for transformation has made tobacco an optimal plant for genetic engineering. It has not only been applied in the field of medicine and also in the area of phytoremediation. Metal chelator, metallothionin and phytochelatin genes have been transferred to plants for improved metal uptake and sequestration. In our project, we compare Moringa olefiera and Nicotiana tabacum for phytoremediation of heavy metals present in the e-waste contaminated site.

Fig. 2: NICOTIANA TABACUM

V. PHYTOREMEDIATION PROCESS

Phytoremediation is refers to the use of green plants and their microorganisms to reduce environmental problems without the need to excavate the contaminant material and dispose of it elsewhere.it is a natural process and effective remediation method. In study, add 2ml, 5ml solution of pcb's solution in the culture medium. Must kept the medium in the sterilized cool place. Note down all the observation. After 5 days the treatment was done and the plants should be taken for analysis. Before analysis the plants should be burn and digested in a proper solution. Fig

Fig. 3: BEFORE TREATMENT(TOBACCO)

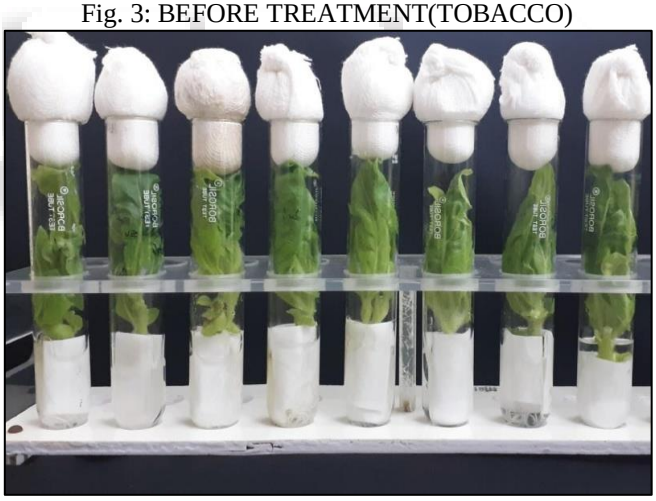

Fig. 4: AFTER TREATMENT (TOBACCO)

Fig. 5: BEFORE TREATMENT (MORINGA)

Fig. 6: AFTER TREATMENT (MORINGA)

VI. DIGESTION OF PLANTS

Fig. 7: DIGESTION OF PLANTS

The plants were dry in the hot plate at 90^0C. It is burned to powder form. The powder was digested in the solution at the concentration of 4:1(HNO_3:Cl_3).All the process should be done in the fume hood. The solution colour is changes red to white. After the digestion the solution kept in room temperature. Next, the solution is makeup by the distilled water after filtered by the whattman filter paper 41. Then, the samples were collected in the graduated centrifuge tube for AAS analysis.

VII. RESULT & DISCUSSION

A. AAS Test

Atomic Absorption Spectroscopy (AAS) determines the presence of metals in liquid samples. The AAS instrument looks for a particular metal by focusing a beam of uv light at a specific wavelength through a flame and into a detector. The technique makes the use of the atomic absorption spectrum of a sample in order to assess the concentration of specific analysts within it. It requires standards with known analyte content to relation between the measured absorbance and the analyte concentration and relies therefore on the Beer-Lambert law.

VIII. COMPARATIVE EXTRACTION CONCENTRATION

The above chart, describes the comparative extraction concentration of toxic metals (Cu, Pb, Cd) by moringa and tobacco by using Atomic Absorption Spectroscopy (AAS). So we conclude, moringa is the best extraction plant for e-waste contaminated soil & it is also a locally available plant. It is suitable for all environment.

SAMPLE	PCB ALONE	TOBACCO CONTROL	TOBACCO (1ml)	TOBACCO (5ml)	MORINGA CONTROL	MORINGA (1ml)	MORINGA (5ml)
COPPER (ppm)	4705	25	101	317	56	166	528
CADMIUM (ppm)	0.6	1.9	2.1	1.1	2.8	3.7	3.1
LEAD (ppm)	13.6	4.7	5.9	19.4	5.9	22.8	21.5

Table 1: Extraction of Heavy metals

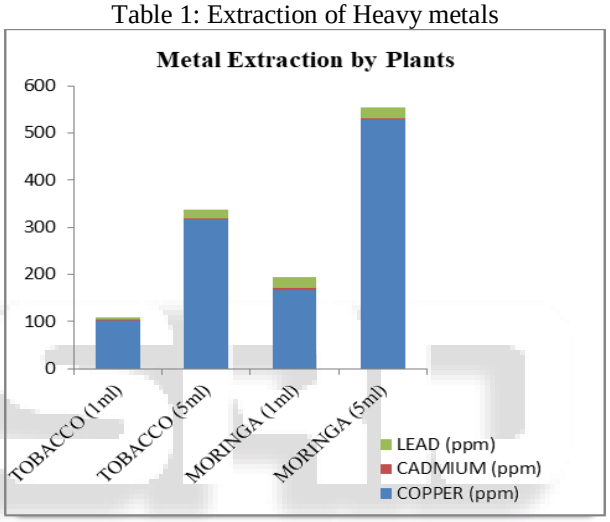

Fig. 9: Bar Chart Representation

IX. CONCLUSION

In this study it was found that the extract heavy metal from e-waste by using phytoremediation process. The most of the natural materials can be used as phytoremediation process. In conclusion, we using Moringa oleifera and Nicotiana tabacum to extract heavy metals from printed circuit board (e-waste). This method to reduce the soil contaminants and environmental pollutants. It has considerable advantages such as low cost, sustainable, locally available, simple, reliable, acceptable, eco-friendly. It decontaminates along with the metabolism processes of species without disturbing the physical, chemical, and ecological characteristics of soil. Heavy metals uptake, by plants using phytoremediation technology, seems to be a prosperous way to remediate heavy-metals-contaminated environment. Moringa has removal of 97% copper, 75% lead, 54% cadmium from the PCB powder. So in our suggestion moringa is the good capability of extraction of toxic metals.

REFERENCES

[1] Rohma Razza "Phytoremediation: An environmental friendly technique", Journal of environmental analytical chemistry vol 1, 2017.

[2] Parisa Ziarati & Somaye Alaedini "The pytoremediation Technique For Cleaning Up Contaminated Soil By Amarathus Sp", Journal Of Environmental And Analytical Toxicology,2014.
[3] Dr.Shiv kumar, "Pytoremediation Of Waste Water By using Moringa oleifera",GE-International Journal Of Engineering Research Vol-5, May 2017.
[4] Limei Cai &Shihua Qi, "A Multi –technique pytoremediation approach to purify metals contaminated soil from e-waste recycling site" Article in Journal Of Environmental management August 2017.
[5] E.A Omondi, P.K Ndiba & P.G Njuru, "Pytoremediation of polychlorobipnenyls (pcp's) in landfill e-waste leachate with water hyacinth", International Journal of scientific and technology research volume 4, may2015.
[6] Chhotu D.Jadia & M.H. Fulekar "Pytoremediation of heavy metals: Recent techniques" African Journal of Biotechnology Vol-8, March 2009.
[7] H.Shahandeh & L.R. Hossner, "plant screening for phytoremediation", International journal of phytoremediation 23 August 2006.

