Estimation Of Heavy Metals By ICP-Mass Spectroscopy In Different Plant Samples From Bathinda And Suratgarh Thermal Power Stations, India.

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Abstract

The decontamination of soils polluted with heavy metals presents one of the most intractable problems for soil clean-up. In this paper the use of metal-accumulating plants is explored for the removal of heavy metals (Cu, Co, Pb, Hg, As, Cd) from superficially-contaminated soils by fly ash releasing through thermal plant. Heavy metals concentration was analyzed by ICP-MS (Inductively coupled plasma – mass spectrometry). Eight plant samples namely Ganda (*Tagetes s*pp.), Jamun (*Syzgium spp*.), Gudhal (*Hibiscus* species), Rose (*Rosa indica L*.), Sudarshan (*Crinum spp*.), Sadabahar (*Catharanthus Roseus*), Kela (*Musa spp*.) and Guldawari were collected from Guru Nanak Dev Thermal Plant, Bathinda and Suratgarh Super Thermal Power Station, Suratgarh. Cu was maximum found in s *Syzgium spp*. Stem (21.6ppm) GNDP, Bathinda, Co was maximum found in Guldawari root (1.27ppm) in SSTP Suratgarh, Pb is maximum found in leaf of *Musa* spp (7.9ppm) in GNDP, Bathinda, Hg is maximum in *Hibiscus species* leaf (7ppb) from GNDP Bathinda, As is maximum found in *Hibiscus species* leaf (1.99ppm) from GNDP Bathinda and Cd was maximum found in root of *Syzgium spp*. (0.14ppm) in SSTP Suratgarh.

Key words-Heavy metal, plants, ICP-MS, GNDP Bathinda, SSTP Suratgarh.

INTRODUCTION

Heavy metals are considered one of the major sources of soil pollution. Heavy metal pollution of the soil is caused by various metals, especially Cu, Ni, Cd, Zn, Cr and Pb (Karaca et al.2010). Some heavy metals (like Fe, Zn, Ca and Mg) have been reported to be of bio-importance to man and their daily medicinal and dietary allowances had been recommended. However, some others (like As, Cd, Pb, and methylated forms of Hg) have been reported to have no known bio-importance in human biochemistry and physiology and consumption even at very low concentrations can be toxic (Duruibe et al.2007). Heavy metals exert toxic effects on soil microorganism hence results in the change of the diversity, population size and overall activity of the soil microbial communities (Ashraf et al.2007). Elevated Pb in soils may decrease soil productivity and a very low Pb concentration may inhibit some vital plant processes i.e. photosynthesis, mitosis and water absorption with toxic symptoms of dark green leaves, wilting of older leaves, stunted foliage and brown short leaves, stunted foliage and brown short roots (Bhattacharyya P., Chakrabarti K et al.2008).

The metal plant uptake from soils at high concentrations may result in a great health risk considering food-chain implications (Jordao et al., 2006). Uptake of heavy metals by plants and subsequent accumulation along the food chain is a potential threat to human health. The consumption of heavy metal contaminated food can seriously deplete some essential nutrients in the body that are further responsible for decreasing immunological defenses, intrauterine growth retardation, disabilities associated with malnutrition and high prevalence of upper gastrointestinal cancer rates (Khan et al.2008).

THE STUDY AREA:

Suratgarh Super Thermal Power Station: - It is located 27 km away from Suratgarh town in SriGanganagar district and -15 Km from Suratgarh to Biradhwal on NH15, then 12km in east from NH-15 It has having extreme hot and cold climate temp.varies between 50^0c to -1^oc.

Guru Nanak Dev Thermal Plant, Bathinda: - Guru Nanak Dev Thermal Plant is situated in Bathinda (Punjab) on Bathinda-Malout Road the historic town of Bathinda was selected for this first and prestigious thermal power project of the state due to its good railway connections for fast transportation of coal, availability of canal water and proximity of load centre.

Sample Collection

Eight plants namely Ganda (Tagetes spp.), Jamun (Syzgium spp.), Gudhal (Hibiscus species), Rose (Rosa indica L.), Sudarshan (Crinum spp.), Sadabahar (Catharanthus Roseus), Kela (Musa spp.) and Guldawari were collected from Guru Nanak Dev Thermal Plant, Bathinda and Suratgarh Super Thermal Power Station,) for analysis of heavy metal (Cu, Co, Pb, Hg, As, Cd) concentration. Firstly all plant samples (each root, stem and leaf are taken separately, air dried and then oven dried at 200^{o}c for 2days and then samples are acid digested and Analysis was done by ICP-MS (Inductively coupled plasma – mass spectrometry). Random sampling for the following was carried out. Thermal pollution is found due to thermal plant establishment. High fly ash is found due to coal combustion. Both are responsible for high metal concentration.

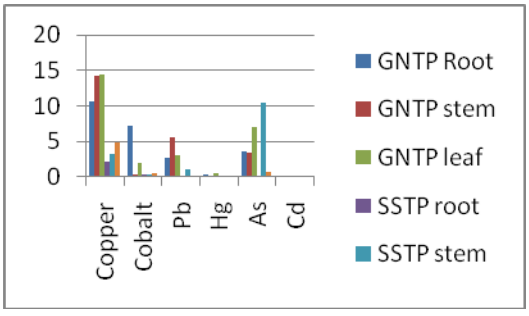
Preparation of samples for analysis

For total elemental analysis samples are digested using a 4-acid digestion procedure in order to dissolve most silicate minerals. This digestion is carried out in open vessels on a hot-plate. This method uses a combination of nitric, hydrochloric, hydrogen peroxide and perchloric acids. Samples are taken for analysis of heavy metals by ICP-MS (Inductively coupled plasma mass spectrometry) for analysis.

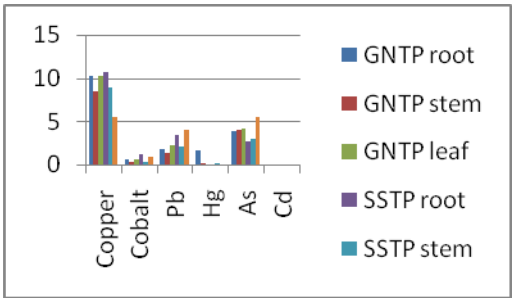
Estimation of Heavy Metal:

It is a multielement analytic method. It has very low limit of detection that is in ppb (parts per billion)

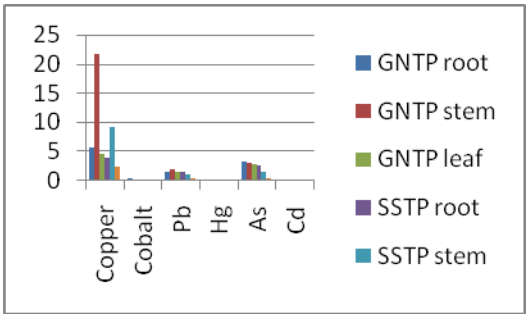
RESULT AND DISCUSSION:



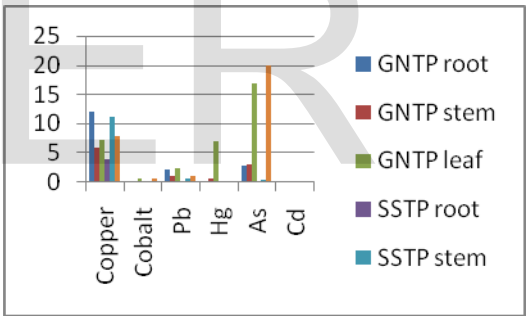
TAGETUS PLANT



GULDAWARI PLANT



SYZYGIUM PLANT



HIBISCUS PLANT

Heavy metals (Cu, Co, Pb, Hg, As and Zn) concentrations in plants were analyzed in two thermal plants. Cu was maximum found in stem of *Syzgium spp*. (21.6ppm) GNDP, Bathinda, Co was maximum found in root of Guldawari (1.27ppm) in SSTP Suratgarh, Pb is maximum found in leaf of *Musa* spp (7.9ppm) in GNDP, Bathinda, Hg is maximum in *Hibiscus species* leaf (7ppb) from GNDP Bathinda, As is maximum found in *Hibiscus species* leaf (1.99ppm) from GNDP Bathinda and Cd was maximum found in root of *Syzgium spp*. (0.14ppm) in SSTP Suratgarh. Heavy metal concentration in plants sample is high in Guru Nanak Dev Thermal Plant (Bathinda) as compared to Suratgarh thermal plant (Rajasthan).

Some of these heavy metals i.e. As, Cd, Hg, Pb or Se are not essential for plants growth,

since they do not perform any known physiological function in plants. Others i.e. Co, Cu, Fe, Mn, Mo, Ni and Zn are essential elements required for normal growth and metabolism of plants, but these elements can easily lead to poisoning when their concentration greater than optimal values.(Garrido et al.2002 and Rascioet al.(2011). The elemental concentrations in soils, in this thesis, are comparable with the mean concentrations of Cd, Cu, Cr, Zn and Fe as reported by Maas et al. (2010)for different types of soils in Algeria, with Fe, Co Cr, Cu and Ni concentrations in forest soils ported by Nael et al. (2009), with elemental concentrations from a geochemical survey in North America as reported by Reeves and Smith (2009) with concentrations reported in agricultural and non-agricultural soils of Dexing china(2010).

CONCLUSION

In thermal plant electricity is formed by coal combustion and fly ash is produced in million tones every day these fly ash mix in soil and increase heavy metal concentration. Heavy metals containing fly ash may change the physical, chemical and biological properties of soil and increase metal concentration ,these metal are harmful for soil and plants growing there and when these metals uptake by plants from the soil, it reduces the crop productivity by inhibiting physiological metabolism. Therefore, if the plants that accumulate heavy metals can use in thermal plant it can reduce heavy metals in soil. These plants may use for phytoremediation purpose.

ACKNOWLEDGMENTS

I would like to thank my parents, Akash pathela and Saruchi for their valuable help in research work.

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