10th International Conference on the Biogeochemistry of Trace Elements

Chihuahua, Chih. México.
13 -18 July 2009

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	Room 1	Room 2	Room 3	Room 4
	Symposium 4	**Technical Session 3**	**Technical Session 6**	**Technical Session 5**
	Bioavailability in the plant-soil system (rhizosphere)	**Advances in the use of wetlands and water treatment**	**Arsenic and fluoride, water contamination and remediation processes**	**Environmental Sustainability**
	Chairs: Walter Wenzel Pável Tlustos and Markus Puschenreiter	**Chairs:** Lydia Hernández, Alejandra Martin D.	**Chairs:** Margarita Gutierrez and Ruth Alfaro	**Chair:** Michel Mench and Giancarlo Renella
11:20-11:40	**Helle Marcussen** Speciation analysis of phytosiderophores released from the roots of barley genotypes	**Teresa Moeslion** Biological treatment to reduce heavy metal content in wastewater by a packed column reactor	**Ruth Alfaro** Arsenic and fluoride in thermal springs at the Eastern zone of Cuitzeo basin (Araró), Michoacán, México	**Ilina Maileena Nieminen** Household biocompost and native woody plants in remediation of Cu-Ni polluted forest soil
11:40-12:00	**Olga Popovic** Bioavailability of trace metals in contaminated soils of western Balkan	**Lydia Hernández Rivera** Electrocoagulation with possible magnetic removal of water pollutants	**Cristo Omar Puente Valenzuela** Behavior of alfalfa (Medicago Sativa) cultivated in an organic soil with three different doses of arsenic	**Rafael Clemente** Evaluation of a composted and uncomposted solid olive mill waste and their water soluble extracts for remediation of a heavy metal polluted soil
12:00-12:20	**Jakob Santner** Ectomycorrhization decreases the ratio of Cd/Zn translocation from roots to leaves of *Populus tremula* plants	**Amir Fotovat** Sand–soil–organic matter filter column for removal of heavy metals from industrial waste water	**Deogracias Ortiz Pérez** Determination of total arsenic and fluoride in drinking water in San Luis Potosí State, México	**Paramsothy Jeyakumar** Comparative tolerance of poplar and microorganisms to copper and zinc toxicity in a biosolids-amended soil
12:20-12:40	**Markus Puschenreiter** Repeated extraction of Cd from	**Ismael** Removal of cinnamic	**Lourdes Ballinas Casarrubias** Arsenic removal by	**Engracia Madejón** Arbuscular mycorrhizal fungi (AMF) and bioplastic to enhance

BACK

Sand–soil–organic Matter Filter Column for Removal of Heavy Metals from Industrial Waste Water

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***Key words*:** Waste water, heavy metals, adsorption, rice husk, leaf compost, soil and sand.

Abstract
Among the different techniques for removal of heavy metals from waste waters filtration is a viable process. In order to investigate the feasibility of sand–soil–organic matter filter column for removal of Ni and Zn from industrial waste water, two soils (calcareous and non calcareous), two soil heights (2.5 and 5 cm), two organic matters (rice husk and leaf compost), and two waste waters (natural and synthetic) were used in greenhouse experiment with a completely randomized design with 16 treatments and 4replicates. P.V.C tubes (columns) were filled from bottom to top by coarse gravel, sand, soil, organic matter, and fine gravel, respectively. Then, 1100 ml of industrial waste water containing nickel and zinc were added to the filter column and 30 ml of leachate were collected and transferred to the laboratory for measurement of metal concentrations by atomic absorption spectroscopy. The experiment was repeated at nine pore volumes. The results showed that the sand-calcareous soil with 2.5 cm height-leaf compost-synthetic waste water, sand-calcareous soil with 2.5 cm height-leaf compost-natural waste water and sand-non calcareous soil with 5 cm height-leaf compost-natural waste water filters columns could adsorb Ni and Zn from industrial waste water. Adsorption percent of Ni and Zn by the filters were 76.8 and 97.7 in all pore volumes, respectively.

Introduction

Water pollution due to industrial and domestic waste waters, toxic heavy metals, and unsuitable dump management are responsible for adversely affecting people's health. The most common heavy metals found in leachate solution were lead (Pb), copper (Cu), zinc (Zn), cadmium (Cd), chromium (Cr), and nickel (Ni) (Elzahabi and Yong, 2001). Several processes have been developed for the removal of metals from waste waters. Each of these processes has advantages and suffers from some disadvantages. The advantages and the disadvantages are based on simplicity, flexibility and effectiveness of the operation, cost, technical problems, and maintenance. Among the different techniques for removal of heavy metals from waste waters, filtration is a viable process. If this type of treatment is successful, one benefit is that a significant mass of the contaminant is accumulated in a finite and accessible volume of material (Kietlinska, 2004).

Therefore, the aim of this study was to investigate the suitability of a sand–soil–organic matter filter column for removal of Ni and Zn from industrial waste water.

Materials and methods

This experiment was conducted in a greenhouse with a completely randomized design with 16 treatments and 4 replicates. For filter construction, P.V.C tubes (columns) with 66.5 cm height and 10 cm diameter were chosen and according to the experimental treatments filled from bottom to top by 15 cm coarse gravel, 15 cm sand, 2.5 or 5 cm soil, 15 cm organic matter (rice husk and leaf compost), and 5 cm fine gravel, respectively. Natural waste water contains heavy metals such as Ni and Zn. The concentrations of the metals were elevated to 130.25 and 1218 $mg.l^{-1}$, respectively by addition of nickel nitrate ($Ni(NO_3)_2$) and zinc sulphate ($ZnSO_4$) salts in the synthetic waste water. Then, 1100 ml of industrial waste water with pH=1.4 and EC=17.1 $dS.m^{-1}$ were added to the filter and 30 ml of leachate were collected and transferred to the laboratory for measurement of metal concentration by atomic absorption spectroscopy (Shimadzu AA – 670). The experiment was repeated at nine pore volumes.

The results of the experiment was analyzed by MSTAT-C software and the comparison between data means was accomplished by Duncan's Multiple Range Test at 5% ($P<0.05$) Alpha Level.

Results and discussion

Effect of experimental treatments on Ni removal

The results showed that the sand-calcareous soil with height of 2.5 cm-leaf compost-synthetic waste water filter column (S1H2O2W2) adsorbed Ni from industrial waste water. Adsorption percent of Ni in this treatment was 76.8 in all pore volumes (Fig. 1). Formation of surface complexes for Ni by humic compounds in the presence of leaf compost (Chien et. Al., 2006) has been reported as an important attenuation mechanism for Ni from waste water. This study demonstrates that in addition to leaf compost, other components of the filter material (soil and sand) enhanced the reduction of Ni concentration in waste water. Ion exchange, surface adsorption, and chelation with organic material might be important mechanisms for the removal of heavy metals from waste water by soil in the filter material (Changrui and Donahoe, 1997). However, there is no enough information on the effect of sand on Ni removal.

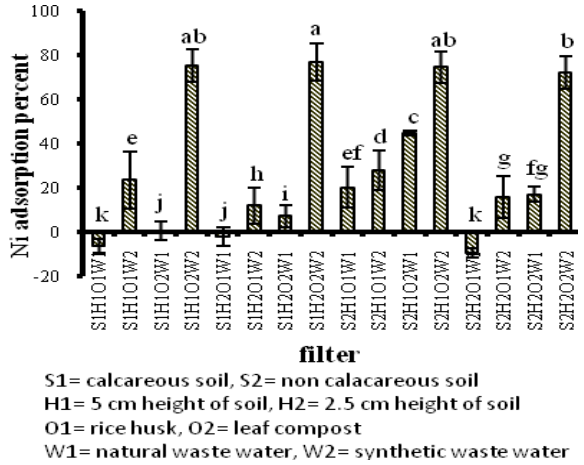

Figure 1. Effect of different filters on Ni adsorption

Effect of experimental treatments on Zn removal

The results showed that the sand-calcareous soil with height of 2.5 cm-leaf compost-natural waste water (S1H2O2W1) and sand-non calcareous soil with height of 5 cm-leaf compost-natural waste water filters (S2H1O2W1) had the highest removal of Zn from industrial waste water (Fig. 2). Adsorption percent of Zn by the filter was 97.7 in all pore volumes. Leaf mold growing on composted leaves, formation of surface complexes as $=SO_2Zn$ for Zn by humic compounds in the leaf compost (Chien et. Al., 2006) may be possible mechanism for Zn removal from waste water in the filter. Increasing solution pH by components of sand and formation of Zn hydroxide and Zn oxide and also adsorption of Zn as Zn^{2+} cations are the important attenuation mechanisms for Zn from waste water by sand (Lee et. Al., 2004).

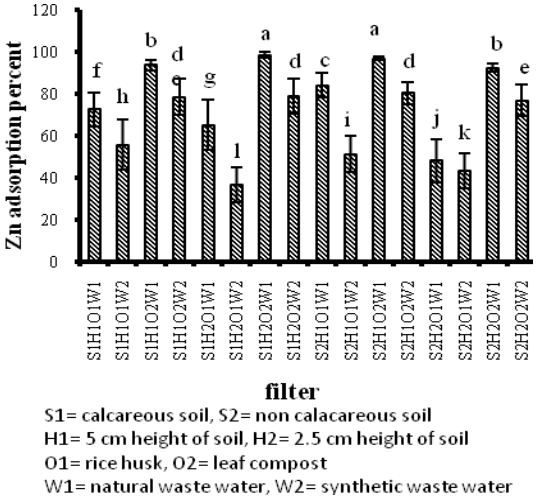

Figure 2. Effect of different filters on Zn adsorption

Conclusions

As the term sorption refers not only to adsorption, but also to processes such as precipitation, ion exchange, complexation and mechanical filtration. This study was not able to identify the predominant mechanism. High sorption ability of these filters for metals could be possible because of increased pH. It appears that the application of sand–soil–organic matter filter column could be employed for the removal of certain metals from industrial waste water.

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