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Phytoremediation of Heavy Metals by Hydrophytes of Anzali Wetland (Iran)

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Abstract: Concerns on long - term effects of heavy metals as environmental pollutants have increased and it has been clear that Phytoremediation may be a satisfactory and suitable method to measure amount of heavy metals and their bio availability. Measurement of pollutant amount is rational due to complications of determining biological effects in a habitat. hydrophytes due to existence in ecosystem are useful indicators for heavy metal pollution. Wet digestion method was employed for extraction of metals in samples by and through a solution containing HNO_3 and HCL. Atomic Adsorption Spectrophotometry was employed for measurement of the heavy metals. In order to study was performed to study heavy metals accumulation in hydrophytes in 2007 from 5 stations of Anzali wetland by factorial statistical format based on randomized complete block design. Experimental factors were heavy metals (M_1= Cu, M_2= Cr, M_3= Cd and M_4= Zn) and hydrophytes (P_1= Typha Iatifolia, p_2= Trapa Natans and P_3= Hydrocotyle vulgrls). Results indicate that amount of heavy metals accumulation influenced by kind of metal and plant. highest pollutant accumulation was observed in treatment M_4P_3 (38.66 ppm).

Key words: Anzali wetland · Phytoremediation · Heavy metals · Hydrophytes

INTRODUCTION

Among aquatic ecosystems, wetlands and rivers have significant importance [1]. Rivers as carriers of nutrients and non-nutrients and wetlands as accepting places of these materials play roles. If wetland is intermediate between another river and ecosystem then these effects will be more significant. Anzali wetland is among valuable wetlands of southwest Caspian sea. Which has especial importance due to specific ecological, economical, social conditions and diversity on one hand, Anzali wetland receives water of 19 rivers and on the other hand it transmits this water through two outflow (Fig. 1). These rivers by passing through forest, urban and rural regions carry all kinds of minerals, organics, sedimentary materials, industrial area of Anzali wetland catchments basin (374000 hectare) and average annual discharge of input ponds (218 kilometer) and given the long period of time of arresting input river's water to this pond as well as high diversity and number of plant and animal communities it can be explained that Anzali lagoon plays a positive role to decrease the burden of organics, minerals and finally to adjust physical and chemical properties of water entering to Caspian sea through its outflow [2].

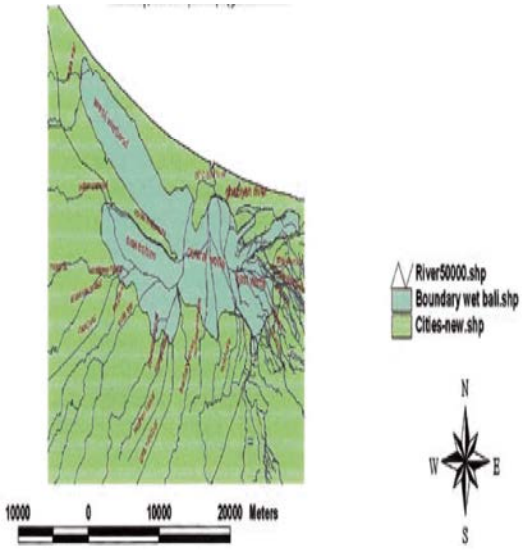

Fig. 1: Map of Anzali wetland

Soil and water are basis of existence, production and storing raw materials and play a crucial role in human life. Supplying environmental requirement for all living creatures is one essential basis in daily activities of organisms and play an important role in their life and survival. Pollution of soil and water by heavy elements is

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one of most important factors effecting of limitation of growth and production in agricultural and aquatic plants. Excess increase of population and industrialization of societies specifically since second half of present century caused some new problems in environmental pollution. Among pollutants available in waste waters of industries, mines urban and agricultural outflows, heavy metals may be mentioned. Heavy metals enter to soil and water be mentioned. Heavy metals enter to soil and water in solution and pollute surface waters, ground waters and soil waters and disturb ecosystems entering it. Generally, heavy in living ecosystems [3, 4]. These elements are very resistant pollutants and they don't be decomposed through biological processes [5]. In an aquatic medium performing studies on pollution of bed sediments is important from various aspects. Firstly, pollution to sediments especially heavy metals phage as well as aquatic plants. Secondly, if amount of sediment pollution exceed a given level, rapidly disturbs ecosystem's balance and declines it. Phytoremediation may be a suitable and satisfactory technique to measure heavy metals rate and their bioavailability [1, 6]. Plant purification is one of bio purification methods in soils to which many concern has been paid in recent decades. In this technique resistant plants are used to purify environments polluted to minerals and organic materials [7, 8]. Advantages of this technique compared to other methods are including: Simplicity, being inexpensive, possibility to utilize in wide extension. Plant selection has an especial importance to measure amount of pollution. Plant selection depends on climatic conditions and amount of pollution [9, 10, 11]. In plant purification process of pollutant systems, several mechanisms may cause purification such as: Rhizosphare bioremediation, phytotransformation, phytovolatilization, phytostabilization, phytoextraction and Rhizofitration. In order to study was performed to study heavy metals accumulation in hydrophytes in 2007 from 15 stations of Anzali wetland.

MATERIALS AND METHODS

In southern coast of Caspian sea in 37 20' to 37 30' North latitude and 49 15' to 49 40' eastern longitude, one of most important wetland of the world with approximate area of 218 kilometer is located which due to vicinity to Anzali is called this name. In order to study was performed to study heavy metals accumulation in hydrophytes in 2007 from 5 stations of Anzali wetland by factorial statistical format based on randomized complete block design. Experimental factors were heavy metals (M_1= Cu, M_2= Cr, M_3= Cd and M_4= Zn) and hydrophytes (P_1= Typha Iatifolia, p_2= Trapa Natans and P_3= Hydrocotyle vulgrls). After defining studying regions, Sampling stations were determined on the map. Then points defined on the map were marked in the pond by using global positioning system (GPS). Wet digestion method was employed for extraction of metals in samples by and through a solution containing HNO_3 and HCL [12]. Atomic Adsorption Spectrophotometry (Shimadzu AA-680/680) was employed for measurement of the heavy metals. Firstly, preliminary analysis was performed to provide standards and concentration limit for each element and required standards were prepared for each element [13].

RESULTS AND DISCUSSION

Results of Table 1 Shows that 5 stations of Anzali wetland don't have significant effect on pollutant accumulation. Results of data variance analysis demonstrated that the kind of heavy metal with 99% probability and the kind of hydrophytes with 95% probability don't affect on pollutant accumulations (Table 1). The comparison of Mean of data (Table 2) indicated that highest pollutant accumulation with average of 32.551 (ppm) was related to Zn and lowest amount was related to Cu and Cr. Finally it may be described that evaluation of desired heavy metals amount in hydrophytes of Anzali wetland provided this result that amounts of Cu, Cr and Cd were lower than Zn. (Table 2). Among hydrophytes, lowest pollutant accumulation was observed in Typha Iatifolia and highest pollutant accumulation was observed in Trapa Natans and Hydrocotyle Vulgrls. Very high amount of Zn accumulation was due to entrance of various waste waters resulting from human activities to pond range. It indicates that aquatic plants by using phytoremediation will transform huge amounts of Zn to ecosystem across plant organs. Continuous examination of pollutant amounts in the number of species and defining its effects requires understanding wide range of physical and chemical to ecological factors such as defining influence of interaction of the species to other ecosystem components, defining rates of pollutant transition in various levels, measuring digestion percent which describes resistance percentage in species in various levels [14]. In studying the interaction effects of two factors including the kind of heavy metal and the kind of hydrophytes, according to the results of data variance analysis (Table 1) it can be stated that their effects is significant on pollutant accumulation ($P<5\%$) such that greatest pollutant accumulation lation was observed in treatment M_4P_3 (38.66 ppm) (Fig. 2).

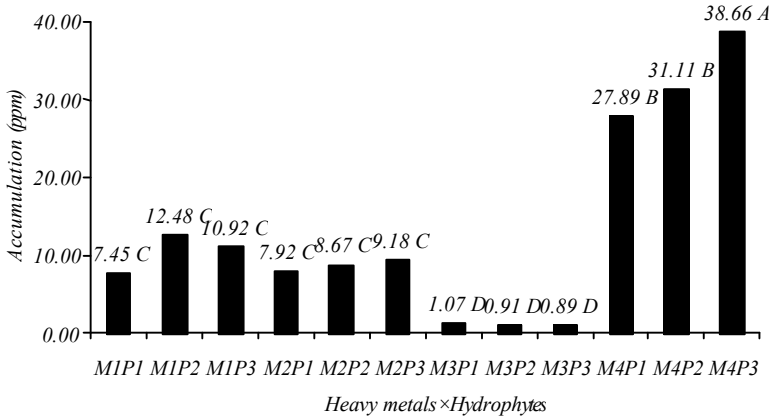

Fig. 2: Comparison of Mean on Accumulation Heavy Metals of hydro plants

Table 1: Analysis of variance on Accumulation Heavy Metals of hydro plants

S.O.V	df	SS	MS
Replication	4	110.74	27.68
Heavy metals	3	8311.47	2770.49**
Hydro plants	2	147.84	73.92*
Heavy metals×Hydro plants	6	228.10	38.01*
Error	44	706.93	16.06
C.V	30		

** and * respectively significant in 1% and 5% area

Table 2: Comparison of Mean on Accumulation Heavy Metals of hydro plants

Treatment	Accumulation (ppm)
Heavy metals	
Cu	10.287 B
Cr	8.589 B
Cd	0.956 C
Zn	32.551 A
hydrophytes	
Typha Iatifolia	11.083 B
Trapa Natans	13.292 AB
Hydrocotyle Vulgrls	14.913 A

Within each column, means followed by the same letter do not differ significantly at P<0.05

Result of investigate the precipitation of heavy metals in Anzali wetland and evaluate its refining performance this study was carried out on the wetland showed that Among the metals studied, Zn was of the highest concentration Heavy metal concentrations in stations [15]. Comparative study for heavy metal concentration (Zn, Cu, Pb, Cd and Hg) in water, sediments and soft tissue of Anodonta cygnea in Anzali wetland (Anodonta cygnea) sampled in two seasons, Autumn and Spring (2004 and 2005 year) showed among the metals studied, that Zn was of the highest concentration Heavy metal concentrations in stations [16]. The present work evaluated the potential of five green marine macroalgae (*Cladophora fasicularis, Ulva lactuca, Chaetomorpha* sp, *Caulerpa sertularioides* and *Valoniopsis pachynema*) for the removal of Cd, Hg and Pb from aqueous solutions (Okha Port, india). The results obtained in this study indicated the highest adsorption ability of *Chaetomorpha* sp. for Cd and Pb while maximum Hg sequestration was observed in *C. sertularioides* [10]. Anderson *et al.* [17] performed heavy metals absorption in sediments of an artificial wetland located in sacramento during 1994-1998 period. Sediment sampling and analysis indicated that concentration of As, Zn, Ni, Cu and Cr have increased by time, But concentration of Ag, Hg, pb and cd didn't significantly increase in sediments. Law *et al.* [18] Studied sediment pollutant in Mai po wetland in Hong Kong. Samples were collected from 6 satiation along the pond in February and Zn, Ni, Cu and Cd parameters were measured. Using data statistical analysis including variance analysis indicated that in beginning and in the end of this pond amount of total N and Cu have been accumulated more than other parts. In addition total P concentration has greatest amount in the end of the wetland and Zn concentration has greatest amount in the beginning the wetland. Totally, amount of pollutants was high in the entrance of industrial waste waters.

As mentioned in this study, further research is required to find the direction of pollutant sources. Results of this study may be used in continuous care on heavy metals in hydrophytes of Anzali wetland.

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