

Removal of Cu(II), Ni(II) and Cd(II) Ions from Water by Rhizofiltration Using Brassica Juncea Plant Roots

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Abstract

Water plays important role in human life. Ni, Cu and Cd are known to be toxic metals in drinking water causing serious health effects. Rhizofiltration is a technique to remove toxic metal ions from drinking water. In the present work study of removal of those metals using Brassica Juncea roots was undertaken. Amount of metal ion was determined spectroscopically before and after treatment. It is found that about 25% to 50% metal ions were removed in the period of 24 hours.

Key words: Heavy metals, Rhizofiltration, Spectrophotometer, Brassica Juncea.

Introduction

Natural resources are the important wealth of our country, water is one of them. Water is a wonder of the nature. “No life without water” is a common saying depending upon the fact that water is the one of the naturally occurring essential requirement of all life supporting activities¹. Water for different purposes has its own requirements for the composition and purity and each body of water has to be analyzed on a regular basis to confirm the suitability².

Some elements are essential in trace amount for human beings, while higher concentration of these elements causes toxic effects and Copper, Nickel and Cadmium are among them³. Rhizofiltration is a technique designed for the removal of heavy metals from the aquatic environment using plants. In this process, plants are grown in polluted water where plants absorb metals and concentrate them in roots⁴. Heavy metal pollution of aquatic system is becoming a potential global problem. Trace amount of heavy metals are always present in fresh water from sources such as weathering of rocks, volcanic eruption etc. thus resulting in geochemical recycling of heavy metals⁵.

Literature reveals that the desirable attributes of a plant for the removal of heavy metals from water includes tolerance to high concentration of the metal, its ability to accumulate very high level of the metal and fast growth of plants⁶. Heavy metal pollution in aqueous streams is a major environmental problem facing the modern world. Several methods of removing heavy metals from water based on ion exchange or chemical and microbiological precipitation, Rhizofiltration etc. have been developed⁷. The removal of heavy metals such as Cadmium, Copper, Lead, Nickel, Mercury and Zinc from aqueous environment has received considerable attention in recent years due to their toxicity and carcinogenicity which may cause damage to various systems of the human body⁸. Cadmium is toxic to many organs and tissues in the human body including heart, kidneys, reproductive systems and nervous system⁵. In Saline track of Buldana district of Maharashtra (India) heavy metals are a major source of pollution. The present work deals with the study of the Rhizofiltration potential of Brassica Juncea plant to remove Cd(II), Ni(II) and Cu(II) from aqueous solutions. Several analytical techniques such as Atomic Absorption

Spectrometry(AAS),Inductively Coupled Plasma Atomic Emission Spectrometry(ICP-AES),Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and UV-VIS Spectrophotometry are available for the determination of trace metals with sufficient sensitivity for most of applications⁹.The uptake capacity of and removal efficiency was determined by UV-VIS Spectrophotometer¹⁰.Spectrophotometer is essentially a trace analysis technique and is one of the most powerful in chemical analysis¹¹.

Experimental work

The experimental work was carried out in the research laboratory of Vidnyan Mahavidyalaya Malkapur.

Methods and Materials

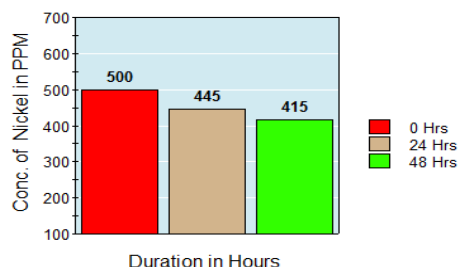
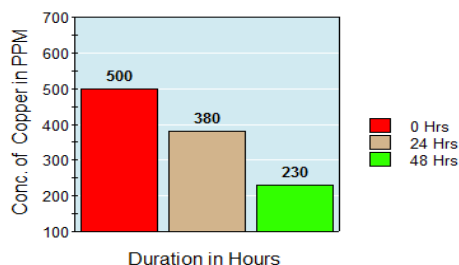
The Brassica Juncea plants were grown in soil for about 60 days during January to March 2016 up to the height of 1.5 feet. Copper(II) was determined by preparing known solution of copper sulphate, Nickel(II) was determined by preparing known solution of Nickel Chloride and Cadmium (II) was determined by preparing known solution of cadmium chloride using Alizarin Red-S as a coloring agent¹².The standard calibration curve of each metal ion was prepared by using UV-Vis spectrophotometer.The Brassica Juncea plant were taken off from soil and their roots were washed with de-ionized water to remove soil.The roots of the plant were deeped in a container containing 750 ml of known solution . Open part of container was covered with plastic paper in order to avoid evaporation.The removal efficiency of plant roots was determined by taking the sample after 24 hours and 48 hours. The optical densities of metal ions were measure by using spectrophotometer.After 48 hours ,the small hairy roots starts decaying causing bad smell to the water.

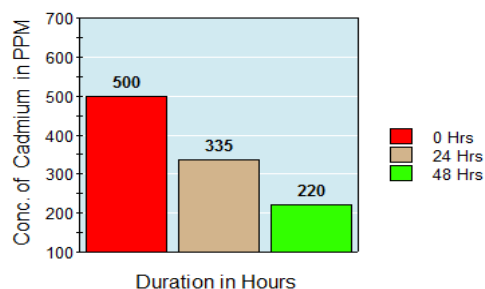
Result and Discussion

Table 1 Experimental results.

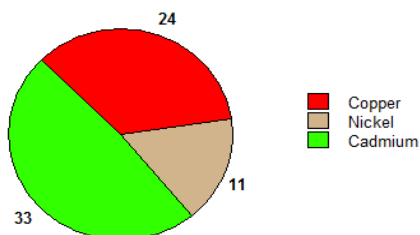
Duration	O.D. for Cu^{2+} at 457 nm	Conc of Cu^{2+} in ppm	% of Cu^{2+} Absorbed	O.D. for Ni^{2+} at 380nm	Conc of Ni^{2+} in ppm	% of Ni^{2+} Absorbed	O.D. for Cd^{2+} at 422 nm	Conc of Cd^{2+} in ppm	% of Cd^{2+} Absorbed
Before treatment	0.075	500	---	0.090	500	---	0.751	500	---
After 24 Hours	0.058	380	24	0.080	445	11	0.550	335	33
After 48 Hours	0.037	230	54	0.065	415	17	0.417	220	56

Graph showing amount of metal ions before and after treatment.

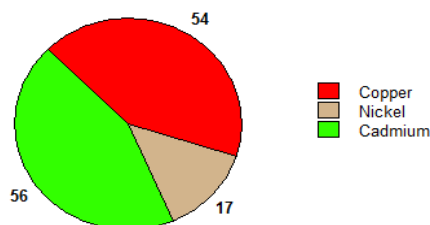




Percentage of metals removed after 24 hours



Percentage of metals removed after 48 hours



From the result, it is very clear that Brassica Juncea is highly effective in removal of Cadmium, Copper and Nickel ions. It removes 11-33% of metal ions in 24 hours duration while it increases to 17-56% upto 48 hours. Further it is somewhat less effective for removal of Ni(II) ion which ranges from 11 to 17% as compared to Cu(II) and Cd(II) ions which ranges from 24 to 56%. Hence Rhizofiltration technique can be applied for removal of heavy metal ions from heavy metal containing polluted water, Specially in the saline track region of Buldana district (MS).

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