International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

Study of Some Heavy Metals in Ground Water in Saline Track of Buldana District and its Remediation by Rhizofiltration

B. M. Tayde[1], B. B. Wankhade[2]

[1]Department of Applied Science, [1]Padm.Dr.V.B.Kolte College of Engineering, Malkapur, S.G.B. Amravati University

[2]Department of Chemistry, Vidnyan Mahavidyalaya, Malkapur, S.G. B. Amravati University

Abstract: ***Water is literally the source of life on earth. Ground water polluted by heavy metals becomes a environmental problem, though the metals are constituent of nature. Plant based technologies such as rhizofiltration are the cost effective and environmentally friendly for removal of heavy metals. Rhizofiltration is a technique of utilising plant root to absorb heavy metals from the ground water. In the present work ground water samples were collected from different villages of Purna river basin. Samples were analysed for physico-chemical parameters such as temperature, pH, TDS, Hardness, Conductivity and heavy metals like Cu, Fe, Cd, Pb, Cr, Ni, and Zn. Heavy metals are assessed before and after rhizofiltration treatment. The result of the study reveals that TDS, Hardness and heavy metal concentration of metal ions are reduced after rhizofiltration treatment.***

Keywords: Ground water, Physico-chemical parameter, Rhizofiltration, Heavy metals

1. Introduction

Water plays a vital role in the development of communities; hence a reliable source of water is essential for the existence of both human and animals [1]. Ground water has been traditionally considered to be pure form of water because of its filtration through soil and its long residence time on the ground. However groundwater is not as pure as traditionally assumed [2]. Pollution of aquatic environments by heavy metals is one of the major threats to the water resources of the world today. Heavy metal pollutants are of concern because their non-degradability creates a hazard when discharged into a water body [3]. Heavy metals are also known to be toxic to both humans and other living forms, with their accumulation over time causing damage to the kidney, liver and reproductive system in addition to cancer [4]. During last few years, it is reported that the patients affected by water pollutants are facing serious health problems like kidney failure, hair loss and cardiovascular damage. If the population use untested and untreated water for drinking this could be the probably cause of so many water borne diseases [5].

Phytoremediation is a green technology of utilizing plants to get rid of wide range of contaminants from any contaminated site (such as soil, sediments, water etc.) Many scientists found that it is basically the root system of the plant which is interacting with the contaminant .Thus the root system plays an important role in phytoremediation. Depending upon the fate of contaminant and the site of metal accumulation phytoremediation are of various types like Phytoextraction, Phytostabilisation, Rhizofiltration, Phytodegradation and Phytovolatization. [6]

Rhizofiltration is one of the phytoremediation strategies, Rhizofiltration can be defined as the use of plant roots to absorb, concentrate and precipitate hazardous compounds, particularly heavy metals or radionuclides from aqueous solutions [7]. The mechanism of rhizofiltration lies in physical and biochemical impacts of plant roots in waste water treatment. Efficiency of mechanism of rhizofiltration lies in the efficiency of roots to synthesis certain chemicals which cause heavy metals to rise in plant body. Root exudates and changes in rhizosphere, pH may cause metals to precipitate onto root surfaces [6].

2. Material and Method

In this work, Brassica Juncea (Indian mustard) is chosen as a test plant for rhizofiltration as the condition to grow mustard plant in target area is suitable. Further it accumulates high level of heavy metals in both shoot and root [8]. B. Juncea seedlings can be naturally grown in farm. After 30 to40 days mustard plants were collected from farm then wash with distilled water and dipped in water sample for 2 days (48 hr.) after 48 hours sample were collected and analysed for physico-chemical parameter & Metal ion before and after treatment of rhizofiltration technique.

Sampling

Samplings of ground water were done by standard methods [9]. Six villages where kidney failure patients are reported and the main source of drinking water is ground water were selected as target area. Those villages are Khandavi, Jalgaon, Borada, Yerali, Panhera and Zodaga of Buldana District. The parameters were determined at research laboratory and metal ion at Central Instrumentation Cell S.G.B. Amravati University Amravati.

Table 1: [Methods employed for determination of physico-chemical parameters]

Sr.No	*Parameters*	*Methods employed*
01	pH	pH metry
02	Tempperature	--
03	TDS	TDS meter
04	Hardness	EDTA Titration
05	Conductivity	Conductometry
06	Metal Ions	Atomic Absorption Spectrophotometry (AAS)

Table 2: ISI (Indian Standard Institute), ICMR (Indian Council of Medical Research), WHO (World Health Organization)

Water Parameters	*ISI*	*ICMR*	*European*	*WHO*
pH	6.5-8.5	6.5-8.5	6.5-8.5	6.5-9.2
TDS	500-2000	500-1500	500	500
Hardness	600	300	500	500
Conductivity	--	300	400	300

Analysis of ground water Sample

The ground water sample were analysed for various parameter like TDS, Hardness, pH, conductivity and dissolve metal ion [10]. TDS was determined by TDS meter before and after rhizifiltration technique. Hardness of water is caused by presence of Ca, Mg and other heavy metals. Hardness determination is very important as far as metal concentration concern. The total hardness of water was determined by EDTA method. pH of the solution was determined by pH meter, Equip-tronics, model no. 610. Electrical conductivity was measure by conductivity meter, Equip-tronics, model no. 660A.The chemicals used were of AR grade. Utmost care was taken during sampling to avoid any kind of contamination. Temperature and pH were measured at the time of sampling itself. Metal ion determined by Atomic Absorption Spectrophotometry [5]. Methods employed for determination of physic-chemical parameters are given in the Table 1.The standard limits of water quality parameters in drinking water prescribed by ISI, ICMR, European and WHO are shown in table no.2.

Table 3: Physico-chemical parameters of ground water samples of Purna river basin before treatment

S.N	Temp (0C)	pH	TDS (mg/l)	Hardness (PPM)	Conductivity (Moh/cm)
1	31	7.66	573	600	1.69
2	32	7.63	950	980	3.08
3	31	7.77	1650	1480	6.04
4	31	8.29	1470	820	5.32
5	31	8.40	940	430	2.95
6	31	7.84	582	610	1.63

Table 4: Physico-chemical parameters of ground water samples of Purna river basin after treatment

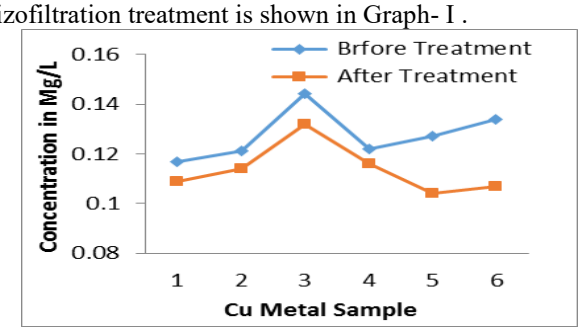
S.N	Temp (0C)	pH	TDS (mg/l)	Hardness (PPM)	Conductivity (Moh/cm)
1	31	8.62	530	490	1.52
2	32	7.89	856	850	3.24
3	32	8.34	1530	1310	6.44
4	31	8.46	1390	800	5.67
5	31	9.8	886	390	2.99
6	31	8.07	522	430	1.49

3. Result and Discussion

The results of the present study are tabulated in table 3, 4, 5 & 6. Physico-chemical parameters like TDS, Total hardness, electrical conductivity, metal ion content and pH are important in assessing the water quality and finding its suitability for drinking purpose [11] pH of some samples are increases after rhizofiltration treatment may be due to presence of metal in metal hydroxide form. The results are tabulated in Table 3 and are compared with water quality standards given by WHO and other agencies. The concentration of heavy metal such as Cu, Fe, Cd, Pb, Mn, Zn, Cr &Ni mg/l in the groundwater sample S1 to S6 were assessed before and after rhizofiltration treatment. From the result it is reveals that the concentration of heavy metal in ground water reduces to certain level after Rhizofiltration treatment.

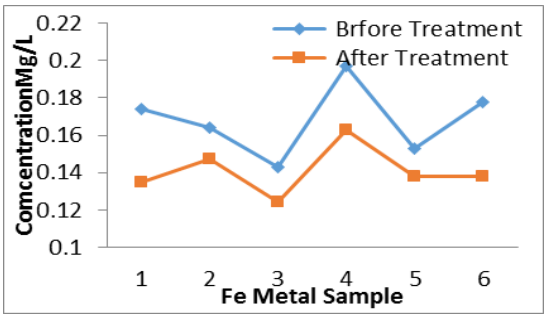
Copper (Cu):

Copper is both an essential nutrient and a drinking-water contaminant [12]. In the present study concentrations of copper are well below the WHO Guidelines for drinking water quality. Measured values are shown in Table 5 & 6, the comparison levels of Copper before and after rhizofiltration treatment is shown in Graph- I .



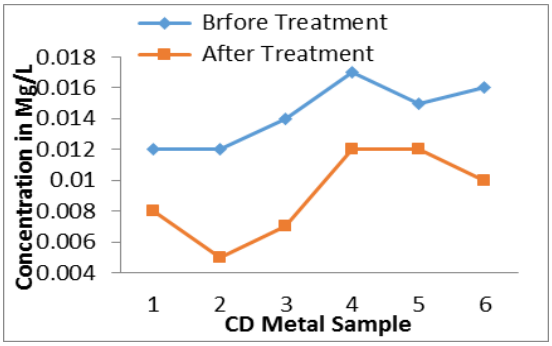
Iron (Fe):

Iron is an essential element in human nutrition, particularly in the iron (II) oxidation state. Estimates of the minimum daily requirement for iron depend on age, sex, physiological status and iron bioavailability and range from about 10 to 50 mg/day [11]. In the present study concentrations of Iron are well below the WHO Guidelines for drinking water quality. Measured values shows in Table 5 & 6, the comparison levels of Copper before and after rhizofiltration treatment is shown in Graph- II.

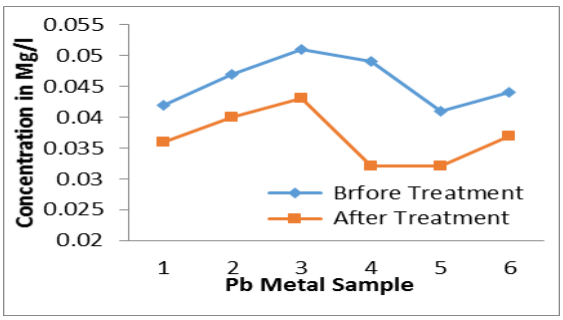


Cadmium (Cd):

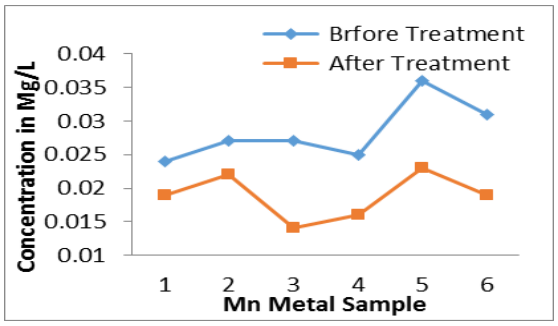
Cadmium is released to the environment in wastewater, and pollution caused by contamination from fertilizers [12].The permissible limit for cadmium in Drinking water no exceed than 0.003Mg/L as per WHO guideline. In the present work it is observed that the concentration of Cadmium is beyond the WHO guideline for all samples. The measured values are shown in Table 5 & 6, it is observed that after rhizofiltration treatment concentration of Cadmium is decreases as shown in Graph- III.



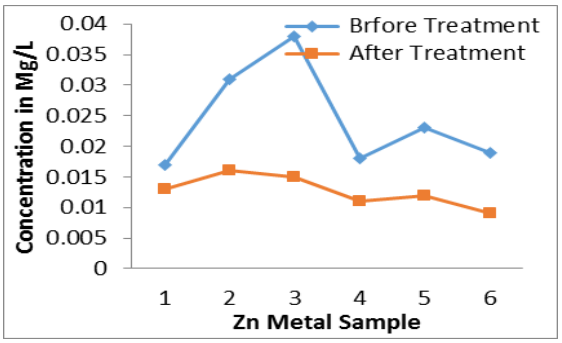
Lead (Pb):
Lead is common heavy metal found in industrial effluent, particularly in developing countries. The mail source of Lead are mining and smelting activities. Lead is toxic to many organs of human body including heart and kidneys, reproductive and nervous system [13]. The permissible limit of Lead in Drinking water is 0.01Mg/L as per WHO guideline. In the present work it is observed that the concentration of Cadmium is beyond the WHO guideline for all samples. The measured values shows in Table 5 & 6, fro the graph it reveals that after rhizofiltration treatment concentration of Lead is decreases which is shown in Graph-IV.



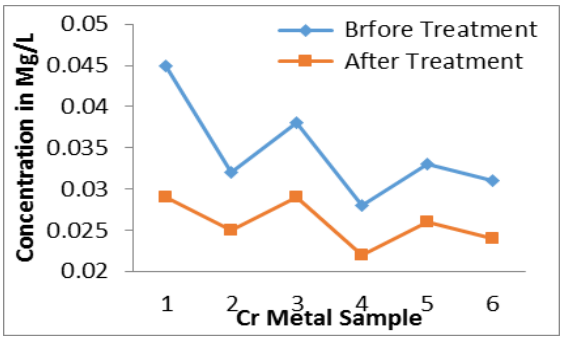
Manganese (Mn):
Manganese is naturally occurring in many surface water and groundwater sources, as per WHO guideline the permissible of Lead in drinking water is 0.4mg/l.[12] In the present study concentrations of Manganese are below the WHO Guidelines for drinking water quality. Measured values shows in Table 5 & 6, the comparison levels of Manganese before and after rhizofiltration treatment is shown in Graph-V.



Zinc (Zn):
Zinc is an essential trace element found in virtually all food and potable water in the form of salts or organic complexes. Although levels of zinc in surface water and groundwater normally do not exceed 0.01 to 0.05 mg/l, respectively [12]. In the present study concentrations of Zinc are below the WHO Guidelines for drinking water quality for all samples. Measured values shows in Table 5 & 6, from the graph it is observed that concentration of Zinc decreases after rhizofiltration treatment as shown in Graph-VI.



Chromium(Cr):
The maximum allowable limit for chromium as per WHO guidelines is 0.05 mg/L. Chromium concentration levels in all studied samples were below then WHO Standards. The concentration levels of chromium in all the samples are shown in Table 5 & 6 and the comparison levels of Chromium before and after rhizofiltration treatment are shown in Graph- VII.



Nickel (Ni):
The maximum allowable limit for chromium as per WHO guidelines is 0.07mg/L. Concentration levels of Nickel in all studied samples were below then WHO Standards. The concentration levels of Nickel in all the samples are shown in Table 5 & 6 and the comparison levels of Nickel before and after rhizofiltration treatment are shown in Graph- VIII.

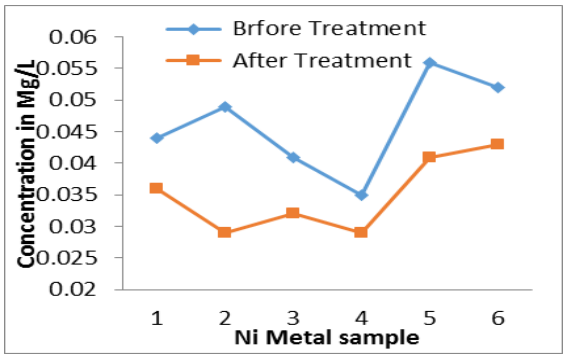


Table 5: AAS analysis of water sample for heavy metal before rhizofiltration treatment

Sr. no	Element	Sample-1	Sample-2	Sample-3	Sample-4	Sample-5	Sample-6	WHO Guideline
1	Cu	0.117	0.121	0.144	0.122	0.127	0.134	2mg/l
2	Fe	0.174	0.164	0.143	0.197	0.153	0.178	50mg/l
3	Cd	0.012	0.011	0.014	0.017	0.015	0.016	0.003mg/l
4	Pb	0.042	0.047	0.051	0.049	0.041	0.044	0.01 mg/l
5	Mn	0.024	0.027	0.027	0.025	0.036	0.031	0.4 mg/l
6	Zn	0.017	0.031	0.038	0.018	0.023	0.019	0.01-0.05 mg/l
7	Cr	0.045	0.032	0.038	0.028	0.033	0.031	0.05 mg/l
8	Ni	0.044	0.049	0.041	0.035	0.056	0.052	0.07 mg/l

Table 6: AAS analysis of water sample for heavy metal after rhizofiltration treatment.

Sr. no	*Element*	*Sample-1*	*Sample-2*	*Sample-3*	*Sample-4*	*Sample-5*	*Sample-6*	*WHO Guideline*
1	Cu	0.109	0.114	0.132	0.116	0.104	0.107	2mg/l
2	Fe	0.135	0.147	0.124	0.163	0.138	0.138	50mg/l
3	Cd	0.008	0.005	0.007	0.012	0.012	0.01	0.003mg/l
4	Pb	0.036	0.04	0.043	0.032	0.032	0.037	0.01 mg/l
5	Mn	0.019	0.022	0.014	0.016	0.023	0.019	0.4 mg/l
6	Zn	0.013	0.016	0.015	0.011	0.012	0.009	0.01-0.05 mg/l
7	Cr	0.029	0.025	0.029	0.022	0.026	0.024	0.05 mg/l
8	Ni	0.036	0.029	0.032	0.029	0.041	0.043	0.07 mg/l

4. Conclusion

The ground water samples were collected from saline track of Buldana District, Maharashtra, India, in December 2015 for the determination of physico-chemical parameters and heavy metals by standard methods. The results obtained for the various parameters shows that pH, Temperature and Conductivity value are well within the permissible limit. TDS and Hardness of some samples beyond the limits. Heavy metals like Cd, Pb exceed than WHO limit for all samples. From the result it is clear that after rhizifiltration treatment the concentration of heavy metal decreases up to certain level of all metal ions.

The excess concentration of Lead causes damage to nervous system, it may cause brain disorder. Other heavy metals may cause kidney disorder. From the result of present study it is clear that the quality of water is poor and not good for drinking and domestic use. The ground water needs treatment to reduce the TDS, Hardness and metal ion concentration. Rhizofiltrtion is very useful to reduce metal ion concentration in ground water.

References

[1] B. G. Kolo & M. Waziri ,*International Journal of Basic and Applied Chemical Sciences*,Vol 2(3), pp18-20, 2012.
[2] O. M. Collins & U. Ugbune ,*Sky Journal of Soil Science and Environmental Management*, Vol 2(3), pp31-33,2013.
[3] M Thayaparan, S.S Iqbal, P K D Chathuranga & M C M Iqbal, *international journal of environmental sciences*, Vol 3 (6), 2013.
[4] A Z Hussain & K M M Sheriff, *Journal of Chemical and Pharmaceutical Research*, Vol 5(3), 2013, pp73-77.
[5] B. M. Tayde and B. B. Wankhade *IndianResearchTransaction*Vol.5,No.2 Apr- Jun2015
[6] K Rawat, M H Fulekar & B Pathak, *International Journal of Innovations in Bio-Sciences*, Vol 2 (4), 2012, pp 193-199.
[7] *A State-of-the-Art report on Bioremediation, its Applications to Contaminated Sites in India, Ministry of Environment & Forests*, Government of India, 2011.
[8] D Viatcheslav, P B A Nandakumar, M Harry & R Ilya, *environ Sci Techno*, Vol 29, 1995, pp 1239-1245.
[9] D. Franceska, National Field Manual for the Collection of Water-Quality Data - chapter A4, U.S. Geological Survey TWRI, Book 9, 2006.
[10] S. S. Dara, *Experiments &Calculation Engineering Chemistry*, S Chand Publication and company Ltd, 2011.
[11] P. Trivedi, A. Bajpai& S. Thareja, *Nature and Science*, , 1(6), 91, 2009.
[12] World Health Organisation *Guidelines for drinking-water quality* – 4 edition, 2011
[13] V. Hanuman Reddy, P. M. N. Prasad, A. V. Ramana Reddy and Y. V. Rami Reddy *Scholars Research Library*, Der Pharma Chemica, , 4(6), pp2442-2448, 2012.