Efficiency of Electrocoagulation Process on Waste Water Treated with Moringa Oleifera Seeds.

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Abstract: The Moringa Oleifera Seed technique treated waste water is taken for the treatment by means of electrocoagulation process, concluding that, the rate of elimination of pollutants linearly augmented with cumulative doses of seed cake. Throughout electrocoagulation process the heavy metals like lead and cobalt was wholly removed from the water sample and further heavy metal ions such as copper, chromium and zinc concentration in water sample has seen the level of water standards of WHO (World Health Organization).

Index Terms **- Moringa Oleifera, Electrocoagulation Process.**

1. Introduction

The electroplating industry is one of the major industries which produces immense portion of wastewater containing heavy metals. The presence of heavy metals in water is a great threat to human beings and environment. Numerous techniques have been applied for the handling of heavy metals, including precipitation, membrane, biosorption, electrodialysis ion-exchange, and adsorption, separation. In the study, to treat electroplating wastewater a combined procedure has been used in which a nontoxic organic coagulant (*Moringa oleifera* seeds) is used before the electrocoagulation method (Mpagi Kalibbala, H., 2007).

The process electrocoagulation for the treatment of waste water have recently attracted great attention. It is found to be very effective to treat electroplating wastewater, textile wastewater, tannery wastewater and slaughterhouse astewater. The passing of an electric current through water has proven very effective in the removal of contaminants from water. The application of current leads to the generation of hydroxide ions at the cathode. The generated flocs which allow the pollutant to settle down and can be easily removed by sedimentation. During an electrocoagulation process, the anions and salts content will not increase in the water sample, compared with chemical metal precipitation (S. Tchamango et al 2016). This contributes to making metallic sludges which are condensed as comparison to those generated through chemical precipitation. Additionally, electrocoagulation process needs simple apparatus, slight slaughterhouse retaining time and it is very easy to run. These features contribute to the reduction of operating cost for industrial applications (N. Meunier et al 2006).

2. Experimental device for electrocoagulation

The procedure of electrocoagulation was carried out in 1000 mL beaker using vertical potential electrode. The setup has two iron rods one serving as a cathode and the other as anode. The spacing between the electrode is 40 mm and of size 10cm x 4cm. The electrodes are connected to a DC power supply (APLAB regulated DC power supply L6403). During electrolysis, the positive side undergoes anodic reactions, while on the negative side, cathodic reaction is encountered. Consumable metal rod, such as iron, was continuously producing ions in water. The released ions neutralize the charges of particles and thereby initiate coagulation.

The electrodes used in these studies was, the Fe-Fe electrode combination (iron-iron combination). This combination has the maximum heavy metal removal efficiency due to iron oxide effective adsorption capacity. To enhance the efficiency of electrode the electrode were properly scraped with sand paper to remove any scale and cleaning the electrode by dipping it in the solution of 1N sulfuric acid and distilled water, using the electrode without cleaning them prior to every experiment will led to decrease the removal efficiency of electrodes due to passivation with time which results in less generation iron during electrocoagulation process (Divagakar, D. 2011).

3. Experimentation

The process electrocoagulation was executed on the most optimally treated water later treating the wastewater through MO seeds, at a continuous current voltage of 8.0V and pH 8.15. Before experiment, electrode was properly scraped with sand paper to remove any scale and then cleaning it by dipping in 1N sulfuric acid solution and distilled water in order to ensure the homogenous solution. The reactor was placed under the magnetic stirrer and stirred at a rate of 200 rpm throughout the experiment to allow the precipitate to grow large enough for removal (Mohammad A.Z et al 2016). Later, the samples have been collected at time intervals of 10 min, and filtered using Whatman's filter paper. The collected samples were taken to analyse its different parameters.

4. Results and discussion

4.1 Effect of operating time and pH

The operating time was investigated at current voltage of 8 volt from 10 to 50 minute. The maximum efficiency of electrocoagulation process was obtained at a treatment time of 30 minutes, and a further increase in treatment time did not result in any significant improvement in removal efficiency of the studied parameter.

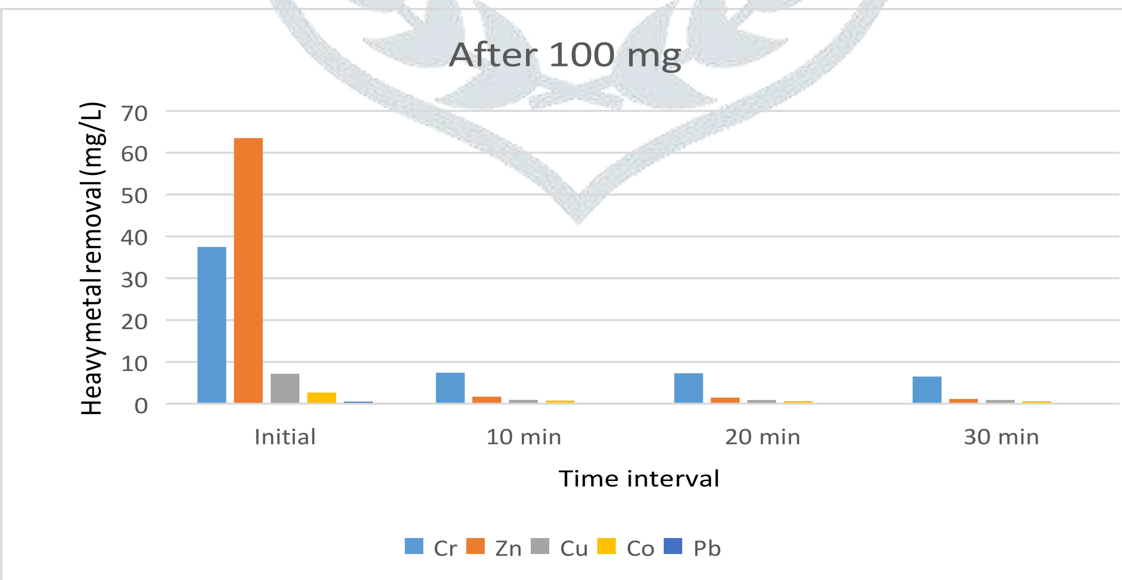
The pH is an important factor influencing the performance of electrocoagulation process. usually, the pH of the medium changes during the operating process and this change depends on the type of electrode material and on initial pH of the water sample. The increase of pH at initial pH is lower than < 2 is attributed to the hydrogen evolution and result in an increase of the concentration of OH ions at the cathodes. The studies shows that the removal rate of heavy metals by electrocoagulation process was increased with the increase in pH (Shiva K. V et al 2013; Vasudevan et al 2009).

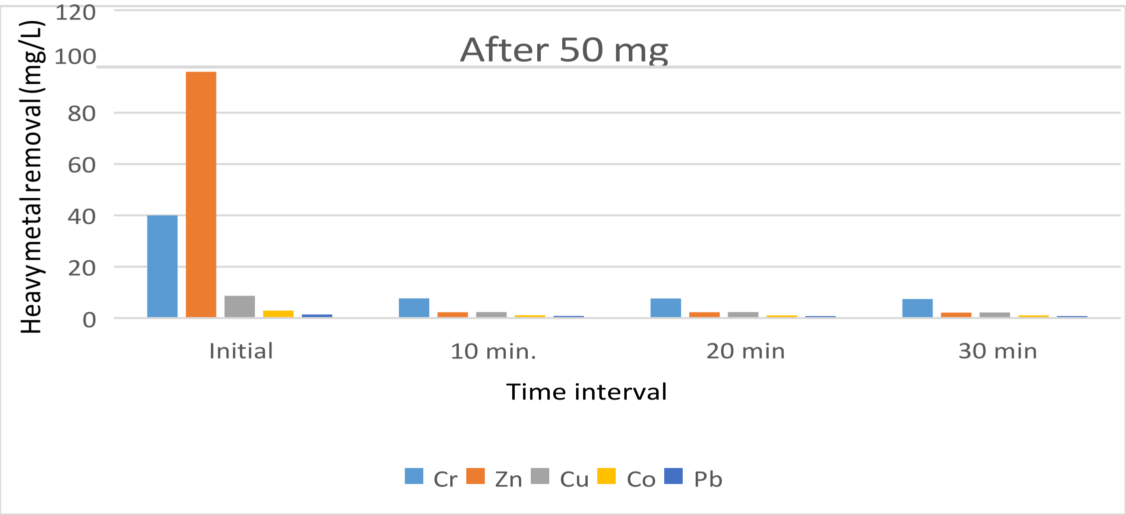
4.2 Removal of heavy metals from MO seed treated water by Electrocoagulation

After treating the wastewater sample by MO seed cake at different concentration, the most optimally purified water sample was taken for electrocoagulation process. The percentage of heavy metals present in water were:

4.2.1 Electrocoagulation of 50 mg MO seeds treated water

Heavy metals	Initial	10 min.	20 min.	30 min.
Chromium	40	7.656	7.611	7.405
Zinc	95.978	2.311	2.297	2.135
Copper	8.652	0.490	0.473	0.438
Cobalt	2.665	0.293	0.212	0.211
Lead	0.634	0.046	0.033	0.031



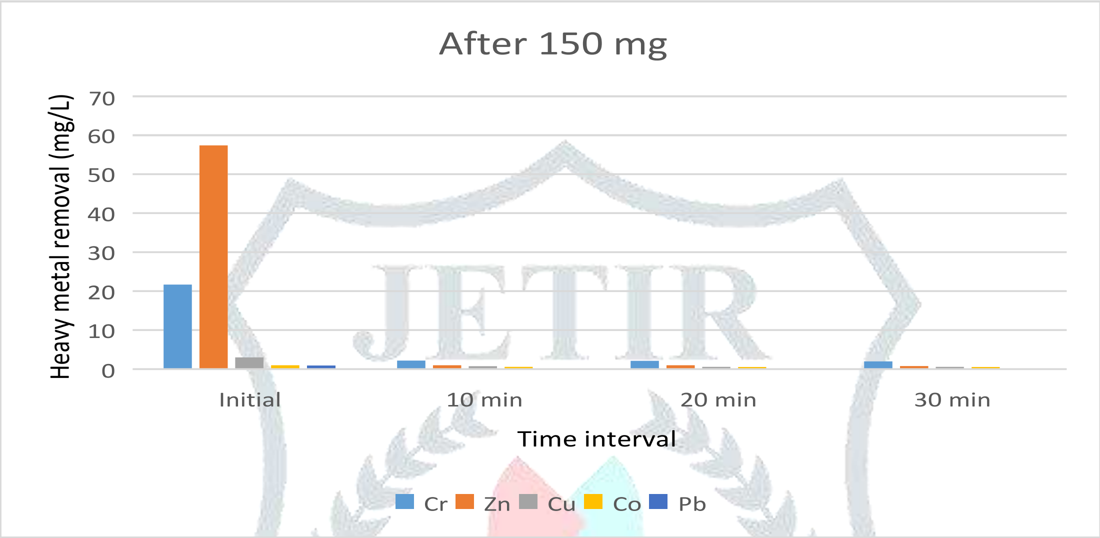


4.2.2 Electrocoagulation of 100 mg MO seeds treated water

Heavy metals	Initial	10 min	20 min.	30 min.
Chromium	37.475	7.436	7.315	6.501
Zinc	63.492	1.660	1.427	1.429
Copper	7.150	0.496	0.411	0.375
Cobalt	1.734	0.267	0.133	0.117
Lead	0.484	X	X	X

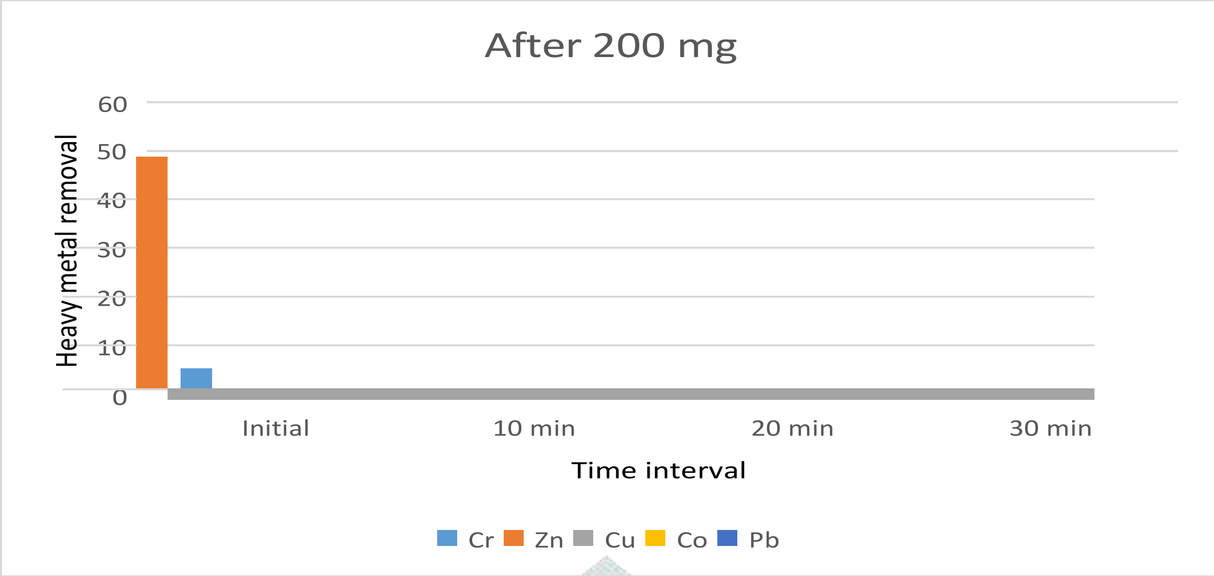
4.2.3 Electrocoagulation of 150 mg MO seeds treated water

Heavy metals	Initial	10 min	20 min.	30 min.
Chromium	21.682	2.184	2.130	1.973
Zinc	57.398	0.972	0.944	0.759
Copper	2.998	0.286	0.116	0.112
Cobalt	0.972	0.052	0.048	0.048
Lead	0.426	X	X	X



4.2.4 Electrocoagulation of 200 mg MO seeds treated water

Heavy metals	Initial	10 min.	20 min.	30 min.
Chromium	5.530	0.097	0.054	0.048
Zinc	48.615	0.474	0.194	0.06
Copper	2.497	0.08	0.07	0.07
Cobalt	0.098	X	X	X
Lead	0.410	X	X	X



Later treating the wastewater sample via various dosage of *M.oleifera* seed cake, the most optimally treated water i.e.; water treated with 200 mg/L *M.oleifera* seed cake has undergone electrocoagulation process. Due to electrocoagulation, the pH has increased to 8.15. The value conductivity and salinity decrease from 68 µS to 4.64 µS, and 23.90 ppm to 4.45 ppm. TDS has reduced from 5.00 ppm to 2.97 ppm. The DO decreases from 11.01 mg/L to 1.62 mg/L. COD decreases from
641.54 mg/L to 87.41 mg/L. The value of turbidity also decreases from 2.31 NTU to 0.108 NTU.

Parameters	Value at 200 mg/L	10 min	20 min	30 min
pH	1.8	7.30	7.81	8.15
Turbidity (NTU)	2.31	0.133	0.117	0.108
Conductivity(µS)	68	9.32	7.85	4.64
Salinity(ppm)	23.90	8.22	6.45	4.45
TDS (ppm)	5.00	5.08	4.98	2.97
DO (mg/L)	11.01	1.53	1.51	1.62
COD (mg/L)	641.54	137.33	129.60	87.41
Sulphate(mg/L)	170.1	61	63	64

5. Conclusion

This paper concluded that wastewater coming from electroplating industry can be treated and reused via advanced method of electrocoagulation and using Moringa oleifera seeds as a coagulant, to evaluate the impact and optimize the different parameter levels related with this combined process in treatment of wastewater and in removal of heavy metals. *Moringa oleifera* seeds can be used in the coagulation procedure because it has a good coagulating property as equated alum, result suggested that, the optimum dosage of *M.oleifera* seed cake was 200mg/L as a coagulant to treat wastewater effectively. Turbidity was removed up to 90-96% after the treatment and DO was increased to 11.01 mg/L.

Although there was no noteworthy change on the value of pH, However, the value of COD was increased due to the organic content present in the MO seed cake. Except that, *M. oleifera* seed cakes were successfully able to remove the heavy metals from the wastewater. More than 90% of chromium (Cr) and cobalt (Cb) was removed, whereas copper (Cu) and zinc (Zn) was removed up to 50%, the amount of lead (Pb) removed was more than 70%.

The performance of electrocoagulation process was increased due to the pre-treatment of wastewater by MO seed cake. The most optimally purified water was taken for electrocoagulation. The Fe-Fe electrode combination at pH 8 is observed to be more efficient for the treatment of electroplating industrial wastewater and the optimum time is observed to be 30min. It has been noted that electrocoagulation process is capable of having high removal efficiency of COD, heavy metals, and sulphates. After electrocoagulation it was noticed from our results that more than 90% chromium (Cr), zinc (Zn) and copper (Cu) were removed from water sample and the cobalt (Co) and lead (Pb) was completely removed.

REFERENCES

[1] Akbal, F., & Camcı, S. (2011). Copper, chromium and nickel removal from metal plating wastewater by electrocoagulation. Desalination, 269(1-3), 214–222.doi: 10.1016/j.desal.2010.11.001

[2] Divagakar, D. (2011). Simultaneous Oxidation and Removal of As (III) and As(V) by Electrocoagulation-Filtration. WERC.

[3] Katayon S., Megat Mohd Noor M.J Asma M., Thamer A.M., LiewAbdullah A.G., Idris A., Suleyman A.M., Aminuddin M.B, Khor B.C., 2004, Effects of storage duration and temperature of Moringa Oleifera stock solution on its performance in coagulation, IJET, Vol. 1(2), pp. 146-151, ISSN: 1823-1039

[4] Hendrawati,1,2 Indra Rani Yuliastri,2 Nurhasni2, Eti Rohaeti3, Hefni Effendi3, Latifah K Darusman3 1Doctoral Program in Environmental and Natural Resources Management (ENRM), IPB (2016). The use of Moringa Oleifera Seed Powder as Coagulant to Improve the Quality of Wastewater and Ground Water

[5] Kawamura, S. (1991). Effectiveness of natural polyelectrolytes in water treatment, J. Am. Wat. Wks. Assoc. 83:88-91

[6] Meenakshi M, B M Manjunatha, N T Manjunath (2015) Performance Assessment of Moringa oleifera in Clarification of Surface Water. International journal of Science, Engineering and Technology Research (IJSETR), Volume 4, Issue 7, July 2015.

[7] Mohammad Ali Zazouli, Jamshid Yazdani Charati, Seyed Mohsen Alavinia, Efficiency of Electrocoagulation Process Using Iron Electrode in Hospital Laundry Wastewater Pre-treatment. J Mazandaran Univ Med Sci 2016; 26(134): 251-260 (Persian).

[8] N. Meunier, P. Drogui, C. Montan´e, R. Hausler, G. Mercier, J.-F. Blais, Comparison between electrocoagulation and chemical precipitation for metals removal from acidic soil leachate, J. Hazard. Mater. B137 (2006) 581–590.

[9] R.K. Gautam, Sanjay K. Sharma, Suresh Mahiya and Mahesh C. Chattopadhyaya, Contamination of Heavy Metals in Aquatic Media: Transport, Toxicity and Technologies for Remediation, in: Sanjay Sharma, edited: Removal of Heavy Metals Present in Water (Book: RSC Publisher, In Press).

[10] S. M. Sajidu, E. M. T. Henry, G. Kwamdera & L. Mataka, Removal of lead, iron and cadmium ions by means of polyelectrolytes of the Moringa Oleifera whole seed kernel.

[11] Subramanium S, Vikashni N, Matakite M et al (2011) Moringa oleifera and other local seeds in water purification in developing countries. Res J Chem Environ 15:135–138

[12] S. Vasudevan, J. Lakshmi, G. Sozhan, Studies on the Removal of Iron from Drinking Water by Electrocoagulation – A Clean Process, Clean: Soil, Air, Water 2009, 37, 45

[13] S. Tchamango Tchamango1, *, O. Kamdoum Kamdoum2, D. Donfack Donfack3, D. Babale4and E. Ngameni Ngameni5(2016), Comparison of electrocoagulation and chemical coagulation in the treatment of artisanal in the treatment of artisanal tannery effluents.

[14] Verma, K. S. (2013). Journal of Hazardous, Toxic and Radioactive Waste. Removal of Chromium from Electroplating Industry Effluent Using Electrocoagulation.