Use of Moringa Oleifera Seeds as a Natural Coagulant in Treatment of Waste Water of Electroplating Industry

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Abstract: The quality and accessibility of drinking water is chief importance to human health. The chief objective of this work was to use Moringa oleifera seeds as a natural coagulant in electrocoagulation procedure for the handling of electroplating industry wastewater. It is found that Moringa oleifera is the superlative bio coagulant which can be substitute of aluminum sulphate (alum). The effectiveness of Moringa oleifera seed cake in eliminating heavy metals ions such as copper, chromium, zinc, lead, and cobalt from the wastewater sample by means of jar test trailed by electrocoagulation process was very much reliable. The subtraction of heavy metal ions observed for Moleifera seeds treated water were 50% for copper, 79% for lead, and zinc, and more than 90% for chromium and cobalt, at an optimal dosage of 200mg/L. Around 90-96% of turbidity has been reduced from the wastewater by Moringa oleifera seed cake, though it has a no glaring effect on the pH which is also an advantage.

***Index Terms* - Moringa Oleifera, Treatment of Waste Water.**

1. Introduction

water is the most important resource on the planet Earth and it is the essence of all life on earth. Nonetheless due to some certain human activities this resource has been getting short in its pure state. The chief cause for contamination of water is uncontrolled population and unplanned industrial development. The water is said to be uniquely vulnerable to pollution known as 'Universal solvent' water is able to dissolve more substances than any other liquid on earth.

Precipitation is the one of the most suitable among these techniques and is considered to be the most economical. It is based on chemical coagulation in which chemical coagulant are used such as aluminum and iron salt to remove colloidal matter as hydroxides from wastewater. Though, it is same efficient in treating industrial effluents, but then the use of chemical coagulation may yield secondary pollution due to the further chemical substances. This disadvantage, together with the necessity for low cost- effective treatment of wastewater, encouraged numerous studies on the usage of natural coagulation for the treatment of some industrial effluents.

Moringa oleifera (MO) seeds, a non-toxic tropical, drought-tolerant tree, available throughout the year found in India, sub-Saharan Africa and Latin America. It is a multipurpose tree used for food and has numerous industrial, medicinal and agricultural uses, including animal feeding it is commonly known as tree of life (Arnoldson E et al 2008). Among many other properties Moringa Oleifera seeds contain a coagulant protein that can be used for treatment of wastewater. The protein act as cationic polyelectrolyte which attributes to the soluble particles and produces binding amid them leading to huge flocs in the water (Ghebremichael, Kawamura, S 1991 et al 2005). *Moringa oleifera* seeds is the best natural coagulant that can replace aluminium sulphate (alum), and it does not have any disadvantages such as high cost and pH alteration that have been exhibited by using chemical coagulant. Moringa has also been proven to produce significantly less sludge as compared to Aluminium Sulphate (alum), which is an advanced advantage especially if the sludge is to be dewatered are treated in some other way before it is disposed of to any water bodies or land. This natural coagulant is biodegradable, non-toxic and, environmentally friendly thus, making a potentially feasible substitute to alum in addressing the challenges facing potable water supply especially in rural and peri-urban areas of developing countries (P.N. Egbuikwem and A. Y. Sangodoyin 2013; Vikashni et al 2012).

This study aims to investigate different parameters of water sample such as; COD, TDS, salinity, conductivity using different concentration of *M. oleifera* seed cake for the treatment of Electroplating industry wastewater from Surajpur Industrial Area to understand the coagulation property of *M.oleifera* seeds and also its application for removal of heavy metals.

2. Sampling site

The sample of wastewater used in current study has been collected from an electroplating industry in Greater Noida Industrial Area, India. The typical qualities of raw electroplating wastewater are listed below in table.

Parameter	Value	Parameter	Value
pH	1.75	Chromium(mg/L)	112.308
COD (mg/L)	521.09	Zinc(mg/L)	96.520
Turbidity (NTU)	65.3	Copper(mg/L)	26.521
Salinity(ppm)	8.97	Cobalt(mg/L)	3.077
TDS (ppm)	9.82	Lead(mg/L)	1.996
Conductivity(μS)	16.10	Sulphate(mg/L)	170.1

3. Pre-treatment of MO seeds

Removal of the oil is done by eliminating MO seed pod shells and the kernels has been grounded by a domestic blender and were sieved through 600-micrometer sieve. The oil from the powdered MO seeds were removed with the help of hexane. The powder of MO seed and hexane were mixed for 30 min, by means of magnetic stirrer and filtered through a Whatman filter no. 40. The remaining solids in the filter (press cake or seed cake) was dried at room temperature for 24 hours. The stock solution is prepared by addition of different concentration of seed cake (50,100,150 and 200 mg) into a distilled water. To avoid ageing effect a new solution is prepared each day for different concentration. Some studies shows that the coagulation efficiency of MO seeds decreases with increase in duration of storage seeds, however the coagulation efficiency is independent of storage temperature and container. To get a proper treatment effectiveness the duration of seed should not surpasses 24 hours

4. Wastewater treatment by MO seeds

To determine the efficiency of MO seeds as a coagulant for the treatment of wastewater by using a PB- 700 6 Paddle jar test apparatus. Each beaker was labelled and was filled with 1000mL of raw water with identical turbidity level, the coagulant dose of different volumes was put into each beaker using pipettes from the stock solution and operated with initial speed of 120 rpm for 3 min. Then the stirring rate was lowered to 40 rpm and this rate was kept for 17 min. The paddles were stopped completely and the beakers were left for 45 - 55 minutes sedimentation (Arnoldson E et al 2008). The coagulation took place and the floc settle at the bottom leaving the transparent medium at top due to the presence of water- soluble cationic coagulant protein. The most optimally purified water at selected dosage was transferred into another beaker for electrocoagulation.

5. Measured parameters

5.1 Turbidity measurement

The turbidity is measured by a 2100P turbidimeter from Hach and the water sample is compared before and after the treatment.

5.2 COD measurement

The instrument is used to measure the COD value was DR 2800 spectrophotometer. The sample is prepared by addition of about 2mL of the water sample before and after the treatment is pipetted into COD reagent vials, along with 1.5mL potassium dichromate (strong oxidizing agent) which reacts with the organic matter was inserted into a COD digestor. The sample was heated for 2 hours at 150C.

5.3 Electric conductivity, pH, salinity, TDS, DO

A multifunction PCD 650 water-proof portable meter was used to measure the electrical conductivity, salinity, pH, TDS, DO.

5.4 Heavy metal removal measurements

To determine the concentration of heavy metals present in wastewater sample foregoing to and after treatment, a perk-in Elmer Analyst 800 high performance atomic absorption spectrometer (AAS) was used. A series of calibration solution such as chromium, zinc, copper, cobalt and lead were prepared from standard stock solution (1000mg/L). Each metal was prepared at different concentration from 0 to 6 ppm.

The water sample was digested on a hot plate before analyzing the concentration of heavy metals (Vikashni et al 2012).

5.5 Sulphate measurement

A DR 5000 UV spectrophotometer was used to measure the sulphate, about 20 ml of buffer solution was added from stock solution (containing 30 gm magnesium chloride, 5 gm sodium acetate and 20 ml of acetic acid) in 50 ml of wastewater sample for the measurement.

6. Results and discussion

6.1 Result for different parameters

The current studies shows that the pH of electroplating wastewater sample did not changed after treating the water sample with MO seed cake. The initial pH value was 1.75, but after treatment the pH value shows a very slight increment. This proved that MO seed cake is not affecting the pH Value in water samples, conceding with published observations (Arnoldson et al 2008; B. Nancy et al 2014) but it has shown a very promising effect on different parameter of wastewater sample like conductivity, salinity, TDS, turbidity, COD, DO.

Conductivity value has been increased from 16.10 µS to 68 µS. The value of salinity also increased from 8.97 ppm to 23.90 ppm. The results obtained were similar with what was concluded by Arnoldson et al (2008). The value of TDS was decreased from 9.81 ppm to 5 ppm after treatment, completely agreeing with studies of (Meenakshi M et al 2015). However, TDS result was not in agreement with Arnoldson et al (2008) who stated that TDS was increased after treating the wastewater by MO seed cake. The initial COD of electroplating wastewater sample was 521.09 mg/L before treatment but increased to 641.54 mg/L after the treatment, this is due to the presence of oil content in MO seed cake which has not been removed completely. The factor which is also responsible for increase in the value of COD was due to the remaining organic matter present in the MO seed cake (Arnoldson et al 2008). Regarding the DO, it has improved from 9.33 mg/L to 11.01mg/L after the treatment by MO seed cake. The initial value for turbidity of electroplating wastewater sample was from 65.3 NTU which decreases to 2.31 NTU, this shows that the removal efficiency of turbidity could be increased by using high concentration of MO seed cake (Hendrawati et al 2016).

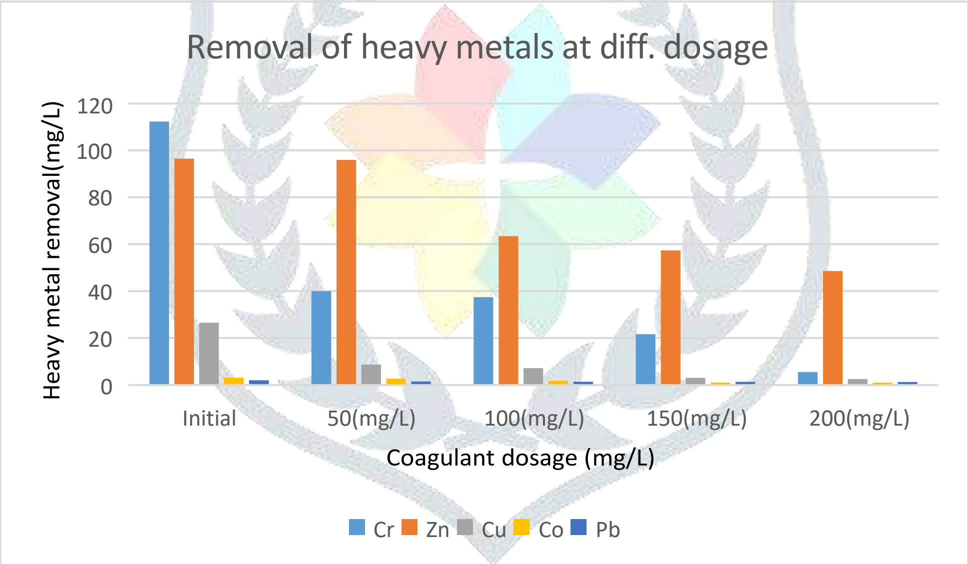
Parameter	Initial	50 mg/L	100 mg/L	150 mg/L	200 mg/L
pH	1.75	1.75	1.75	1.78	1.8
Turbidity (NTU)	65.3	7.36	6.27	4.08	2.31
Conductivity (µS)	16.10	21	56	63	68
Salinity (ppm)	8.97	11.43	17.95	19.06	23.90
TDS (ppm)	9.82	7.67	7.08	5.98	5.00
DO (mg/L)	9.33	9.86	10.41	10.80	11.01
COD (mg/L)	521.09	428.85	442.62	563.49	641.54

6.2 Heavy metals removal by MO seeds

The concentration of heavy metal present in wastewater sample at initial stage of Cr (112.308 mg/L), Zn (96.520 mg/L), Cu (26.521 mg/L), Cb (3.077 mg/L), Pb (1.996 mg/L). The presence of high concentration of heavy metals are typically associated with severe environment and health effects (R.K. Gautam et al 2015). For reducing heavy metals concentration from wastewater sample MO seed cake were used as a coagulant, adsorbent and antimicrobial agent (Mangale S.M et al 2012; Ndibewu PP et al 2011). Due to the removal of oil from MO seed, the polyelectrolyte protein was activated and combined with the heavy metals leading to complex formation. The polyelectrolyte is unchained due to the extraction of oil since it is not soluble in the lipid (Kawamura, S. 1991).

The current studies show that, the heavy metals removal efficiency was increased by increasing the concentration of MO seed cake for the electroplating industry wastewater sample. Vikashni et al (2012) have reported that the removal efficiency for copper (Cu) and chromium (Cr) was up to 90% and 50% using MO seed cake. The concentration of copper was similar with what was found in by Vikashni et al (2012), but in the case of chromium the removal efficiency was more than 90% after the treatment, concurring to the studies of Eman N Ali et al (2014) and contradicting the studies of Vikashni et al (2012). The percentage of cobalt (Cb) removed from the wastewater sample after treatment was 96%, amount of zinc (Zn) removed from the wastewater sample was up to 50% completely agreeing with vikashni et al (2012), although zinc is an essential element needed for human body in small amounts but if its concentration is slightly more than the permissible limit in water it will affect the human health severely (W. Maret and H. Sandtead 2001). The removal of lead was not that much satisfying although its concentration was not that high as compared to other heavy metals, the amount of lead (Pb) removed was 79% after the treatment, which is similar to the studies of Sajidu et al (2005) and Subramanium et al (2011). The removal percentage of Pb in their studies were 89 and 80% respectively.

Heavy metals	Initial	50(mg)	100(mg)	150(mg)	200(mg)
Cr	112.308	40	37.475	21.682	5.530
Zn	96.520	95.978	63.492	57.398	48.615
Cu	26.521	8.652	7.150	2.998	2.497
Co	3.077	2.665	1.734	0.972	0.098
Pb	1.996	0.634	0.484	0.426	0.410



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