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To Synthesis of Activated Charcoal of *Calotropis procera* Leaves and Their Characterization and Use for Removal of Zinc Metal Ion from Contaminated Waste Water

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ABSTRACT
From an environmental aspect, the removal of industrial effluent from aquatic systems due to the presence of metal ions is particularly important. The major goal of this study is to make activated charcoal from Calotropis Procera leaves as a low- cost adsorbent for removing the metal ion Zn (II) from aqueous solution. Batch adsorption was used in this experiment. The adsorption of Zn (II) was discovered to be affected by contact time, pH, starting concentration, and adsorbent dosage. The adsorption of Calotropis Procera into this natural adsorbent was studied using Fourier transformer infrared. Both the Langmuir and Freundlich's equation isotherms were followed by the Zn (II) ion adsorption.
KEYWORDS: *Adsorption, activated charcoal, FTIR, and Industrial effluent.*

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INTRODUCTION

Humans are getting increasingly inconvenienced by environmental issues that have evolved as a result of globalization and rapid industrialization. As a result, particularly in the chemical sector, effective and efficient methods are necessary. Heavy metals in sewage and industrial wastewater are a significant source of environmental contamination. Heavy metals have a density more than 5 grammas per cubic centimeter. Activated carbon is a term that refers to a family of carbonaceous solid material resulting from biomass, coal, and polymer scrap through thermal or thermo chemical processes [3]. Characteristics of AC are influenced by the physical and chemical properties of the raw materials plus the method of activation [4, 5]. Activated carbon is a versatile adsorbent due to its good adsorption characteristics. The adsorption characteristics of activated carbon depend on the precursor type, size of the particles, and method adopted during preparation [6, 7]. AC can also be defined as a tasteless, solid, microcrystalline, no graphitic form of black carbonaceous material with a very porous structure [14].
Preparation of activating chemical agents by chemical activation is a single step method.
Chemical activation is good because it requires low temperature for activation and also helps in development of pore. After thermal treatment it needs a thorough process that recovers the chemical agents. This result might limit its usage due to environment issues.
The majority of the toxics and carcinogenic substances in this group are extremely water soluble. Heavy metals include copper, silver, zinc, cadmium, gold, mercury, lead, chromium, iron, nickel, tin, arsenic, supplied, molybdenum, cobalt, manganese, and aluminum.
They pose serious threats to both the human population and the fauna and flora of receiving waters [1].
AC are nonporous adsorbents in nature and play an important role in both gas and liquid phase separation processes [8]. In recent years, the demand and marketing of AC has grown due to the problems of water pollution globally [10, 11].
AC is characterised by a well-formed pore morphology, high surface area, electron-conducting amphoteric property, and high adsorptive capacity [9].
They can be absorbed and accumulated in the human body, causing cancer, organ damage, nervous system dysfunction, and, in the worst-case situation, death. It also stifles growth and advancement in zinc-contaminated streams because they can accumulate zinc in their bodies. When zinc from cans enters the bodies of these fish, it biomagnifies its way up the food chain. In soils, considerable amounts of zinc can be discovered. If agricultural soils are polluted with zinc, animals will absorb large amounts of zinc that are hazardous to their health. Groundwater can be contaminated by zinc, which is water soluble and

found in soils. [2].
There are many method for removal of zinc metal ion from contaminated water, but we chose adsorption method for this purpose because its eco-friendly and cheap method and effectively remove metal ions.

MATERIAL AND MATHODS

Preparation of activated charcoal of calotropis leaves

The naturally dried leaves of the plant *Calotropis procera* were collected locally. It was taken apart and broken up into small bits. The stem was processed with 2% v/v sulphuric acid in a 1:1 ratio and baked at 150 degrees Celsius for 24 hours. It was filtered and cleaned with demonized water several times before even being dried to remove sulphuric acid. Chemical activation of sulphuric acid produces a huge contact area and a high degree of micro porous structure. The adsorbent was sieved to a mesh size of 45-65 and dried at 120o C for 2-3 hours.

Preparation of synthetic wastewater

A standard solution of a variety of metal ion concentrations was created. The regents were AR grade chemicals that were diluted in demonized water. A test solution was made by diluting 1 ml of metal ion stock solution to the appropriate concentration.
To avoid hydrolysis, the range prepared for stock solution of zinc ranged between 60-150mg/different ph. was fixed to 2-8.
By mixing 0.44gm of AR grade zinc sulphate in 1000 ml distilled water and making a 100ppm solution, a stock solution or artificial contaminated water of zinc metal ion was created.

Physiochemical characterization of AC-CP FTIR OF AC-CP

ATR investigated the adsorbent's surface morphology. The presence of distinct surface functional groups of activated carbon can be seen via ATR. The position of the distinguishing peaks varied depending on the situation. The existence of carbonyl group was confirmed by a peak around 1897cm-1; the presence of OH group was confirmed by a peak around 3272 cm-1; and the presence of -COOH group was confirmed by a peak around 1900-1700cm-1. In aromatic hydrocarbons, the stitching vibration of C=C is ascribed to the IR peak approximately 1561cm-1.

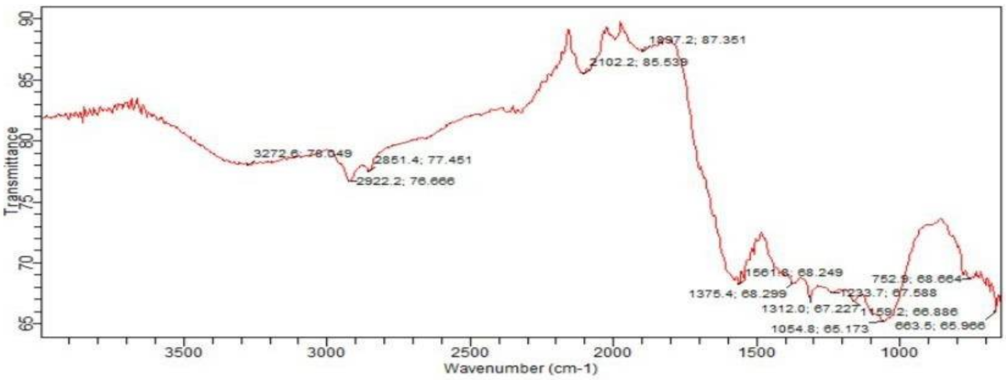

Fig. no.1 FTIR characterization of AC-CP

SEM OF AC-CP

SEM micrographs of surface of activated charcoal of Caltropis Procera was presented in fig no.2, show that activated charcoal present the cavities to the level of their surface area. Surface show heterogeneity and varied structures. The adsorbent is porous in nature.

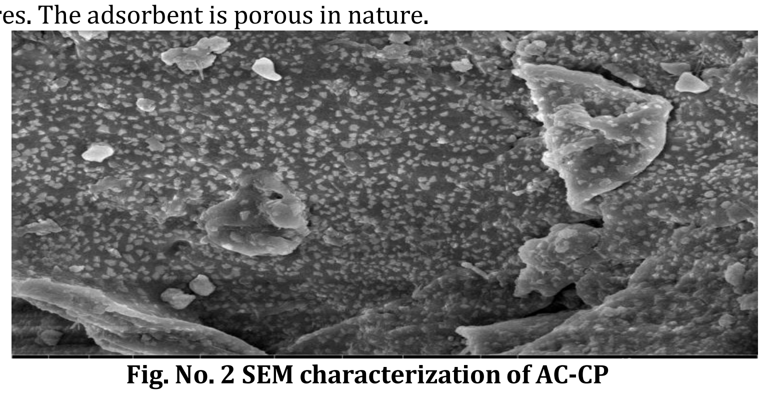

Fig. No. 2 SEM characterization of AC-CP

RESULTS
STUDY WITH BATCH METHOD

Calotropis Procera adsorption capacity was determined by contacting 1.5 gramme of the plant with different concentration (60 - 150 mg/L) of 100 ml Zinc ion solution in 250 ml conical flask. In a rotary shaker, the mixture was stirred at 150 rpm before being filtered through Whatman no.1 filter paper (No. 1). A spectrophotometer set to 540rpm was used to determine the residual Zn (II) level in the filtrate. The effects of contact hours (15-135 minutes), pH (3-8), adsorbent dosage (3-18 gm/l), and zinc ion concentrations of 60-150 ppm were investigated in batch adsorption tests. The untreated metal ion was measured using a spectrophotometer after agitating the sample for the required contact time, centrifuging, and filter the contents through Whatman filter paper.

E (percent) = [(Co – Ce) / Co] x 100 was used to compute the adsorbent's removal effectiveness (E).

Co and Ce are the initial and final metal ion solution concentrations (mg/L), respectively.

Table no. 1 Effect of ph on zinc ion removal at various concentrations by 15gm/l dose ofactivated charcoal at time 105 min constant

Ph	% REMOVAL				
	150ppm	**120ppm**	**100ppm**	**80ppm**	**60ppm**
3	26.2	29.3	32.2	34.2	36.6
4	38.2	42.2	43.1	45.2	48.2
5	53.2	55.2	62.1	63.8	67.2
6	66.3	70.2	77.2	74.5	**84.2**
7	59.1	62.3	66.2	67.2	69.2
8	40.1	46.2	50.6	52.1	57.8

Table no. 2 Effect of activated charcoal dose on % removal of zinc metal ion at contacttime 105 min and effective 6 ph

Concentration (ppm)	% REMOVAL					
	3gm/l	**6gm/l**	**9gm/l**	**12gm/l**	**15gm/l**	**18gm/l**
60ppm	70.1	75.2	78.2	83.3	85.2	85.0
80ppm	67.2	70.1	73.2	77.2	78.2	75.2
100ppm	64.2	67.2	69.3	71.3	75.6	74.2
120ppm	61.2	64.5	67.2	69.2	70.2	69.8
150ppm	60.8	62.2	64.2	66.8	67.2	67.1

Table no.3 Effect of concentration adsorption capability at 105 min contact time andeffective ph 6 for zinc metal ion

Dose(gm/l)	Adsorption capacity "q"				
	60ppm	**80ppm**	**100ppm**	**120ppm**	**150ppm**
3	14.4	19.22	22.23	25.32	31.2
6	8.62	10.42	12.23	13.63	16.25
9	6.35	7.45	7.66	10.22	11.23
12	4.23	6.32	7.11	8.02	9.23
15	3.55	5.21	5.23	6.35	6.89
18	2.22	3.66	4.65	4.22	5.55

Table no.4 Value of Langmuir isotherm constant for adsorption of Zn (ii)

Dose(gm/l)	Langmuir constants			
	Qm(mg/g)	**b(l/mg)**	**R_L**	**R^2**
3	55.65	0.0185	0.492	0.976
6	23.65	0.0293	0.381	0.985
9	17.23	0.0325	0.352	0.965
12	11.53	0.0495	0.260	0.972
15	9.35	0.0562	0.245	0.975
18	7.98	0.0651	0.210	0.971

Table no.5 Value of freundlich isotherm constants for adsorption of Zn (ii)

Dose(gm/l)	Freundlich constants			
	Kf	1/n	N	R^2
3	3.362	0.594	1.682	0.998
6	2.123	0.503	1.985	0.993
9	1.682	0.500	1.998	0.982
12	1.563	0.389	2.568	0.995
15	1.452	0.348	2.869	0.991
18	1.152	0.377	2.652	0.992

Table no.6 Freundlich isotherm for effect of adsorbent amount 15gm/l on adsorption ofZn (ii) at optimum conditions by AC-CP

logCe	logq(15g/l)
0.956	0.526
1.256	0.625
1.452	0.698
1.582	0.754
1.785	0.852

Table no.7 Langmuir isotherm for effect of adsorbent amount 15 gm/l on adsorption ofZn (ii) at optimum conditions by AC-CP

Ce	Ce/q(15g/l)
10.25	2.896
19.01	4.562
26.32	5.551
36.54	6.856
51.45	7.562

DISCUSSION

Effect of ph

At equilibrium time, the effect of pH on Zn (II) ion adsorption by activated charcoal surface was investigated, and it was discovered that at pH 6, 84.2 % of the Zn (II) ion was eliminated, and that when pH rises to 7 and 8, the % of Zn (II) ion removed declines. As a result, the ideal adsorption pH for removal of dye was discovered to be 6.

Effect of adsorbent dose

The effect of adsorbent dosage on % Zn (II) ion removal is illustrated by the graph. Figure 3.11 depicts the influence of adsorbent dosage on percent zinc ion elimination. The adsorbent dose was changed (3, 6, 9, 12, 18 g/L), and the adsorption tests were conducted at pH 6. Increasing the activated charcoal dose to 15 g/L increases the amount of metal ions adsorbed on the charcoal, but the increase in elimination is small after that, according to the results. As a result, the effective dose is calculated to be 15 g/L.

Effect of contact time

As indicated in the preceding results, the % elimination of Zn (II) ion increased considerably up to 105 minutes. Increasing the contact duration after that resulted in a modest increase in removal (at 120 min, 135 min). As a result, the effective contact time (equilibrium time) is 105 minutes, independent of the initial concentration of 60 ppm.

Effect of initial concentration

In the above figure and data, the effect of the concentration of Zn (II) ion by AC- CP concentration on the percent removal of Zn (II) is demonstrated. The results show that clearance effectiveness is 85.2 percent and 78.2 percent at lower concentrations (60 and 80 ppm).

Adsorption capacity

We increased the metal ion concentration to 150ppm to achieve the maximal adsorption capability of AC-CP for zinc (II) metal ions. The maximal adsorption capacity of AC-CP was reported to be 3.55 mg Zn (II) /g. The above results show that the yield of activated carbon increases with increase in consecration of reducing agent. The presence of hydrogen bonding and crystalline in natural cellulose has been reported to contribute to the lower adsorption capacity; hence, its capacity can be improved by modifying its structure using chemicals [12]. Also, an increase in the concentration of the reducing agent reduces excessive sample burn-off and hence leads to high yield [13].

CONCLUSION

Activated carbon produced from the dried stem of *Calotropis procera* readily removes the Zn(II) ion from aqueous solutions. When the adsorbent dose is increased, the proportion of Zn(II) ion extracted by activated charcoal increases, but when the baseline Zn concentrations increase, it decreases. The absorption of Zn(II) ions on the charcoal surface improved when the pH was elevated from 3 to 8.

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REFERENCES

1. Babel, S. and T.A. Kurniawan, (2004). Cr (VI) removal from synthetic wastewater using coconut shell charcoal and commercial activated carbon modified with oxidizing agents and/or chitosan. Chemosphere, 54(7): p. 951-967.
2. Sörme, L. and R. Lagerkvist, (2002). Sources of heavy metals in urban wastewater in Stockholm. Science of the Total Environment, 298(1): p. 131-145.
3. K. Ukanwa, K. Patchigolla, R. Sakrabani, E. Anthony, and S. Mandavgane, (2019). "A review of chemicals to produce activated carbon from agricultural waste biomass," Sustainability, vol. 11, no. 22, p. 6204.
4. A. Verla, M. Horsfall (Jnr), E. N. Verla, A. I. Spiff, and O. A. Ekpete, (2012). "Preparation and characterization of activated carbon from fluted pumpkin (*Telfairia occidentalis* hook.F) seed shell," Asian Journal of Natural & Applied Sciences, vol. 1, no. 3, pp. 39–50.
5. R. Chen, L. Li, Z. Liu et al., (2017). "Preparation and characterization of activated carbons from tobacco stem by chemical activation," Air & waste, vol. 67, no. 6, pp. 713–724.
6. M. D. F. Salgado, A. M. Abioye, and M. Mat, (2018)."Preparation of activated carbon from babassu endocarpunder microwave radiation by physical activation," Earth Environment Science, vol. 105, p. 012116.
7. P. Ravichandran, P. Sugumaran, S. Seshadri, and A. Basta, (2018). Optimizing the Route for Production of Activated Carbon from Casuarina Equisetifolia Fruit Waste, Royal Society of Chemistry.
8. M. A. Yahya, M. H. Mansor, W. Amani, and A. Wan,(2018). "A brief review on activated carbon derived from agriculture by-product," in In AIP Conference Proceedings, AIP Publishing LLC.
9. A. Min and A. T. Harris,(2006). "Influence of carbon dioxide partial pressure and fluidization velocity on activated carbons prepared from scrap car tyre in a fluidized bed," Chemical Engineering Science, vol. 61, no. 24, pp. 8050–8059.
10. A. L. Cazetta, A. M. M. Vargas, E. M. Nogami et al.,(2011). "NaOH activated carbon of high surface area produced from coconut shell: kinetics and equilibrium studies from the methylene blue adsorption," Chemical Engineering Journal, vol. 174, no. 1, pp. 117–125.
11. N. Arena, J. Lee, and R. Clift, (2016)."Life cycle assessment of activated carbon production from coconut shells," Journal of Cleaner Production, vol. 125, pp. 68–77.
12. A. E. Burakov, E. V. Galunin, I. V. Burakova et al., (2018). "Adsorption of heavy metals on conventional and nanostructured materials for wastewater treatment purposes: a review," Ecotoxicology and Environmental Safety, vol. 148, pp. 702–712.
13. M. Danish and T. Ahmad, (2018)."A review on utilization of wood biomass as a sustainable precursor for activated carbon production and application," Renewable and Sustainable Energy Reviews, vol. 87, pp. 1–21.
14. A. Achebi Se, C. E. Gimba, A. Uzairu, and Y. A. Dallatu, (2013)."Preparation and characterization of activated carbon from palm kernel shell by chemical activation," Research Journal of Chemical Sciences, vol. 3, no. 7, pp. 54–61.
15. A. C. Lua and J. Guo,(2001). "Microporous oil-palm-shell activated carbon prepared by physical activation for gas-phase adsorption," Langmuir, vol. 17, no. 22, pp. 7112–7117.

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