

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

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Vol. 8, Issue 10, October 2019

Use of Activated Biocarbon for Water Treatment- Adsorption Process

Prachi N. Raut¹, Sulekha R. Gotmare²

Ph.D Scholar, Department of Analytical Chemistry, S.N.D.T. Women's University, Santacruz (W), Mumbai,
Maharashtra, India¹

Associate Professor, Department of Analytical Chemistry, S.N.D.T. Women's University, Santacruz (W), Mumbai,
Maharashtra, India²

ABSTRACT: The effective removal of heavy metals from industrial wastewater is among the most important issues for many industrialized countries. Cadmium is one of the heavy metal exhibit lethal effect on human as well as aquatic life when exist in maximum contamination limit (MCL) in water. It is necessary to decrease Cadmium concentration by using effective method. Removal of Cadmium (II) from aqueous solutions was studied using biocarbon prepared from cynodon dactylon grass. Batch adsorption experiments were performed as a function of pH, contact time, adsorbent dose for removal of Cadmium concentration.

KEYWORDS: Adsorption, Cynodone dactylone, MCL, Activated Biocarbon

I. INTRODUCTION

Water bodies get polluted as the consequence of discharge of domestic, industrial, municipal wastes every day. Effluent from various industries contains hazardous heavy metals. Human life as well as aquatic life adversely affected because of improper, untreated or poorly treated disposal of waste in lakes, rivers, sea. It is therefore very important to minimize heavy metals concentration in wastewater or effluent before its disposal in water bodies.

The nearness of heavy metals in the environment is one of the major concerns because of their toxicity, bioaccumulation, inclination, risk and danger to human life. Heavy metals are those metals with atomic number above 20 and density more than 5g/cm^3 . (A.K. Dwivedi, 2013) Heavy metals are not biodegradable hence should be removed from wastewater. Concentration of heavy metals above MCL level is dangerous to ecosystem human as well as aquatic life. Heavy metals are of two types essential and non-essential. Cadmium is non-essential and its biological half-life is around 15-20 years. Cd penetrates the cells and may cause cell death. It is eliminated very slowly. (Roberto Chiarelli, 2014)

There are numbers of methods available for removal of heavy metals from wastewater like chemical precipitation, solvent extraction, coagulation, ion exchange, reverse osmosis etc. These methods are expensive and complicated. Biosorption by natural materials is convenient, cost effective as well as effective separation and purification process.(Gunatilake S.K, 2015) (Mohamed E. Goher et al, 2015) Biosorption is the ability of biological materials to accumulate heavy metals from wastewater through physico-chemical pathways of uptake.Cadmium is heavy metal found in wastewater as the consequence of introduction of industrial waste into water bodies without primary treatment from

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cadmium-nickel batteries, fertilizers, mining and alloy industries. (Zeid A. Al Othma, 2011) Its shows lethal effects like kidney damage, renal disorder, human carcinogen, hypertension, stomach irritation, fragile bones etc. when found above maximum contamination limit (MCL). Its MCL is 0.01 mg/ml in water. (Sabine Martin et al, 2009) (Mukesh Parmar et al, 2013) (Ashutosh Tripathi et al, 2015)

Cynodon dactylon:

The plant often known as Bermuda grass, Devil's grass, Couch grass. The blades are grey green color with tinged colored flattened stem. It has deep root system, started growing at 59⁰F. In winter, it becomes dormant and brown. (Wikipedia)

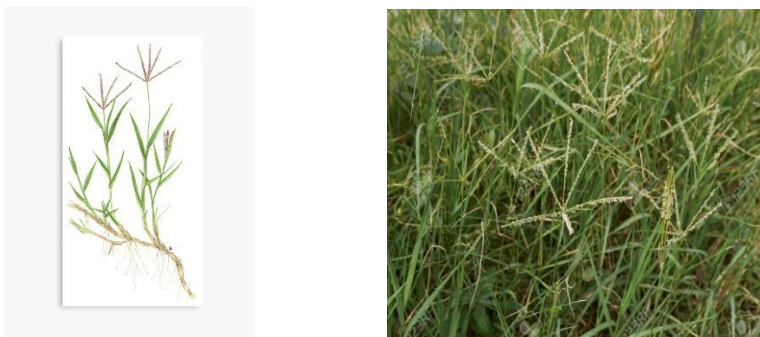


Fig. 1 Cynodon dactylon

Uses of plants:

It is a traditional remedy from ancient times for, cough, cramps, diarrhea, dropsy, dysentery, headache, hypertension, snakebite, sores, stones and wounds. (G. Mathubala et, al 2015)

II. RELATED WORK

Biocarbon prepared from Cynodon dactylon grass used for removal of heavy metals and dyes from wastewater. G. Mathubala has suggested that this medicinal plant used as a adsorbent for Thymol blue (G. Mathubala et al, 2015). G. Alagumuthu suggest that Cynodon dactylon bioadsorbent used to remove fluoride from water (G. Alagumuthu, 2011). Biocarbon of Cynodon dactylon is also used for adsorption of Cu metal (Samu Solomon J, 2012).

III. MATERIALS AND METHOD

Preparation of Biocarbon:

The Cynodon dactylon grass with roots were collected and washed several times with water. Then grass was sun dried for 5 days and was powdered using mortar and pestle. This powder was kept in 1:1 HCl solution for three hrs and kept in an air free oven at 200⁰C. The mixture then washed with deionized water to remove excess acid. Then it was dried in oven at 120⁰C for two hrs. Dried biocarbon kept in airtight bottle for further use. (Singnan, Abebaw 2007) (M. Siganan, 2011)

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Preparation of Cd (II) solution:

Stock solution of 1000-ppm Cd (II) solution prepared by dissolving CdCl₂ in distilled water. This stock solution used to make test samples by dilution method. Standard 100 ppm Cd (II) solution prepared from stock solution

The percentage removal of Cadmium was calculated as:

- % removal of heavy metal by biocarbon = $\frac{C_0 - C_t}{C_0} \times 100$
- Where, C₀: Initial Cadmium concentration
- C_t: Cadmium concentration at equilibrium after treatment with adsorbent

UV Spectrophotometer used to measure absorbance of solution before and after adsorption of heavy metals by biocarbon. (Satish A. Bhalerao et al, 2015) (C. Pragathiswaran et al, 2015)

IV. EXPERIMENTAL RESULTS

- Effect of pH:** pH is very crucial parameter plays a key role in adsorption. (Salman H. Abbas et al, 2014). It is principal parameter in adsorption of heavy metals because it controls functional group and electrostatic interaction between biocarbon and heavy metal. (M. A. Hossain et al, 2012), (Saeed Almohammadi et al, 2016). Biocarbon 3.0 gm and standard Cd (II) solution was taken for pH study. Maximum percentage (80%) removal of Cadmium is at pH 5.0 and decreases with increase in pH of the solution.

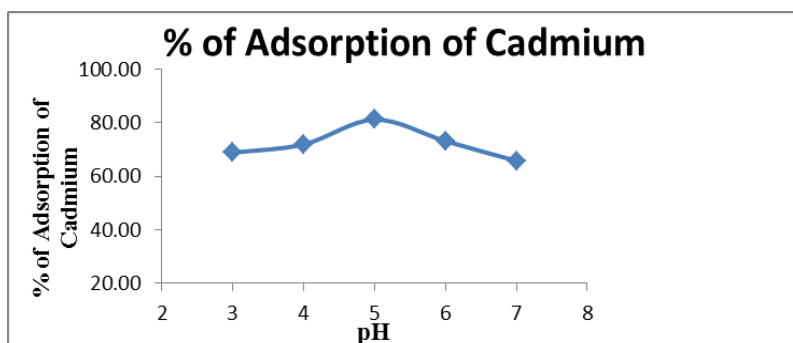


Fig 2. Effect of pH

Effect of contact time: Percentage adsorption is increases with increase in surface area of adsorbent and increase in contact time then more will be the adsorption. (S. P. Tawde and S. Bhalerao, 2010), (Kanyal M, Bhatt AA, 2015). Standard Cd (II) solution is used and pH of the solution is maintained at 5 pH for this study. Appreciable percentage removal of Cadmium is at 120 minutes.

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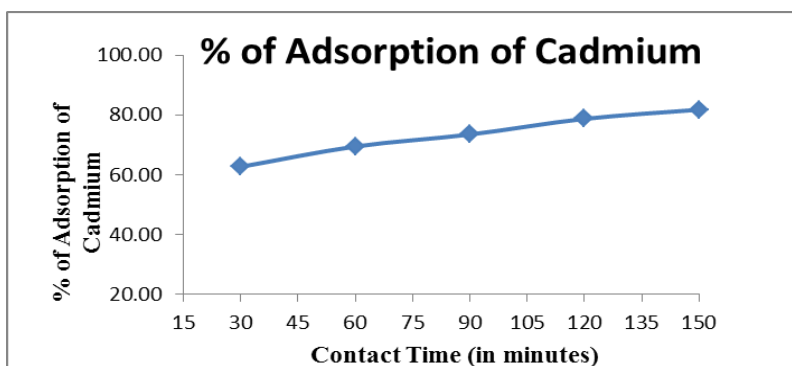


Fig 3. Effect of Contact time

Effect of adsorbent dose: The percentage of adsorption increases with increase in adsorbent dose to particular level and then decreases (S. Jothi Ramalingam et.al 2013). Effect of adsorbent dose is observed at 5 pH with std. Cd (II) solution for 120 mints contact time on removal of Cadmium concentration from water. Maximum removal (84.96 %) is at 3.0 g/100 ml.

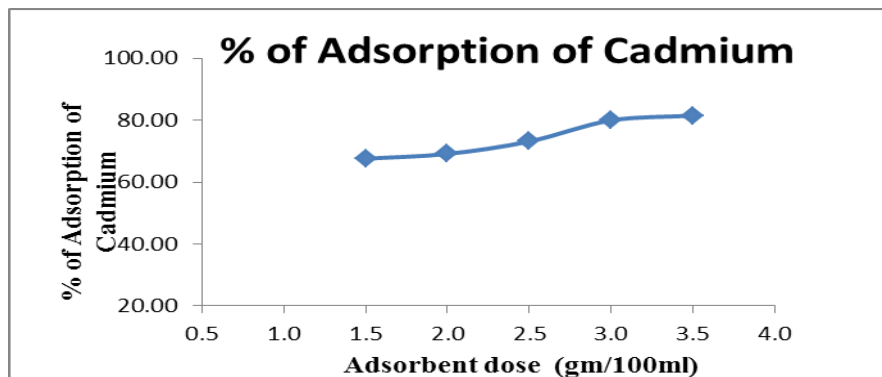


Fig 4 Effect of Adsorbent dose

V. CONCLUSION

Cynodon dactylon is easily grown grass variety and easily available in the market, biocarbon of this grass is found to be effective adsorbent for the removal of Cadmium from wastewater. Maximum adsorption of Cadmium ion on biocarbon of Cynodon dactylon at optimum condition is pH 5, 120 contact time and 3 g adsorbent dose. As effect is studied with 100ppm of Cd (II) solution that is approximately 10% higher than MCL limit of Cd (II). Therefore Biocarbon of Cynodon dactylon can be useful for removal of Cadmium heavy metals present in water contaminated by domestic, agriculture as well as industrial effluent.

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REFERENCES

1. A.K. Diwedi et al, "Studies on Adsorptive removal of Heavy metal (CU, CD) from aqueous solution by Tea waste adsorbent", *Jr. of Industrial Pollution Control*, 30(1) 85-90, 2014
2. Ashutosh Tripathi et al, "Heavy Metal Removal from Wastewater Using Low Cost Adsorbents", *J Bioremed Biodeg* , 6:6, 2015
3. C. Pragathiswaran et al, "Studies on The Removal of Hexavalent Chromium From Synthetic Waste Water By Using Activated Biocarbon", *Journal of Applicable Chemistry*, 4 (6): 1811-1820, 2015
4. G. Mathubala et al, "Biosorption of Thymol Blue from Industrial Wastewater Using Activated Biocarbon from Cynodon dactylon Plant Leaves", *Int.J. ChemTech Res.*, 7(7), pp 2894-2901, 2014-2015
5. G. Alagumuthu, "Flouride Sorption Using Cynodon dactylon- based Activated Carbon", *Hem. ind.* 65 (1) 23-35 (2011)
6. Gunatilake S.K., "Methods of Removing Heavy Metals from Industrial Wastewater", *Journal of Multidisciplinary Engineering Science Studies (JMESS)*, Vol. 1 Issue 1, 12-18, November – 2015,
7. Kanyal M, Bhatt AA, "Removal of Heavy Metals from Water (Cu and Pb) Using Household Waste as an Adsorbent", *J Bioremed Biodeg* 6:269, 2015
8. M. Singanan et al, "Removal of lead (II) and cadmium (II) ions from wastewater using activated biocarbon" *ScienceAsia* 37, 115-119, 2011
9. Mohamed E. Goher et al, "Removal of aluminum, iron and manganese ions from industrial wastes using granular activated carbon and Amberlite IR-120H", *Egyptian Journal of Aquatic Research*, 41, 155-164, 2015
10. Mukesh Parmar and Lokendra Singh Thakur, "Heavy metal Cu, Ni and Zn: Toxicity, health hazards and their removal techniques by low cost adsorbents: A Short overview", *International Journal of Plant, Animal and Environmental Sciences*, vol-3(3), 143-157, July-September 2013
11. Roberto Chiarelli, Maria Carmela Roccheri, "Marine Invertebrates as Bioindicators of Heavy Metal Pollution", *Open Journal of Metal*, 4, 93-106, 2014
12. Sabine Martin et al, "Human Health Effects of Heavy Metals", *Environmental science and technology briefs for citizen*, 15, 2009
13. Salman H. Abbas *et al.*, "Equilibrium and kinetic studies of adsorption/biosorption of Cu⁺² and Co⁺² ions from aqueous solution by different adsorbent", *J. Chem. Pharm. Res.*, 6(10):613-627, 2014,
14. Samu Solomon J, "Removal of Cu (II) from Aqueous Solution by Using Natural Plant Material *Cynodon dactylon*", *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, Volume 3 Issue 2, 304-321, 2012
15. Singanan M, Abebaw A, Vinodhini S, "Studies on the removal of hexavalent chromium from industrial wastewater by using biomaterials", *Electron J Environ Agr Food Chem* 6, 2557-64, 2007
16. S. Jothi Ramalingam et.al, "Removal of Pb (II) and Cd (II) ions from Industrial waste water using *Calotropis Procera* roots", *International Journal of Engineering Science Invention*, Volume 2 Issue 4, 01-06, April, 2013,
17. Satish A. Bhalerao1 et al, "Removal of zinc (II) ions using peanut hulls (*Arachis hypogaea* Linn.) from aqueous solutions in a batch system", *Int. J. Adv. Res. Biol. Sci.* 2(4), 136-150, 2015
18. S.P. Tawde and S.A. Bhalerao, "Biosorption of Chromium (VI) from an aqueous solution using *Azadirachta indica*. A. Juss. (Neem) and activated charcoal: A comparative study", *Biological Forum — An International Journal*, 2(2): 4-10, 2010
19. Tripathi A, Ranjan MR, "Heavy Metal Removal from Wastewater Using Low Cost Adsorbents", *J Bioremed Biodeg* ,6: 315, 2015
20. Zeid A. Al Othman et al, Kinetic, "Equilibrium and Thermodynamic Studies of Cadmium (II) Adsorption by Modified Agricultural Wastes", *Molecules*, 16, 10443-10456, 2011