

Treatment of Saloon Waste Water Using Activated Carbon

EMMANUEL E. EGBON, PhD[1], VICTORIA O. IDODE[2], ELIZABETH I. EGBON[3] AND PATIENCE A. CHUKWUMA[4]
[1&3]Department of Chemistry, Ambrose Alli University,
P.M.B 14, Ekpoma, Edo State.
[2&4]College of Education, Ekiadolor-Benin
Corresponding email: egbon.emmanuel@yahoo.com

ABSTRACT
Waste-water samples were collected from hair dressing saloon in Ekiadolor using composite sampling method. The waste water samples were physico-chemcially characterized before and after treatment according to standard procedure using activated carbon as adsorbent. The results obtained from the various pollution indicators show an appreciable improvement on the quality of the water. The pH value changed from 10.05 to 7.10, the colour changed from grayish-white to colourless while the biochemical oxygen demand BOD was reduced from 20.27mg/l to 5.19mg/l and chemical oxygen demand COD was reduced from 76.00mg/l to 30.00mg/l. The dissolved oxygen, DO increased from 13.47mg/l to 28.56mg/l. Activated carbon used was produced from corn-cob pyrolysed at a temperature of 250^0C in absence of oxygen and size of 100nm and surface area of $200m^2/g$ best adsorbents needed to help remove pollutant from the environment.
Keywords: waste-water, composite, adsorbent, pyrolyzed, pollutant

INTRODUCTION

The conventional methods for treating waste water are expensive. Consequently, the search for contrarily but effective, efficient and economic methods has been on the increase in recent times. Thus, the use of biomaterials, such as agricultural waste as adsorbents for organic and metal ions is being exploited due to their availability and low cost.

The use of activated carbon extends so far back into history. Powdered activated carbon was first produced commercially in Europe in the early 19^{th} century, using wood as raw material. The use of alternative low-cost material as potential adsorbent for the removal of pollutants have been emphasized recently. Activated carbon also referred to as activated charcoal as a form of carbon that has been processed to make it extremely porous and thus have a very large surface area available for adsorption or chemical fixation (2, 3).

Activated carbon has been used to remove organic and inorganic materials from aqueous streams and several studies have equally reported on the use of agricultural wastes in adsorption processes in water treatment (4, 5, 6 and 7). In addition to it been used for water and waste water treatment applications, activated carbon has been reported for use in so many other purposed, such as corn and sugar cane refining, gas absorption, drying and dry cleaning processes. The vast utility of activated carbon has lead different studies to continuously carry out researches using various biomaterials so as to determine their adsorptive capacity. Activated carbon have been prepared from different agricultural waste such as coconut coir pith, coconut shell, shear butter wood and bank, rice straw and maize cob waste (6 and 7).

This paper discusses the preparation of activated carbon from maize cob waste due to fact, that it is highly available and cost effective adsorbent and use it to treat waste water from aqueous alkaline medium (so hair saloon waste water) (6, 8).

Materials and Methods

The maize cob wastes were collected at Ekiadolor, Ovia North West of Edo State, Nigeria. They were sun-dried, carbonized and purified using the methods earlier reported (788). The bulk density, pH cation exchange capacity and surface area values were determined using standard methods (10) and given in table 1 below.

Sampling Techniques

Composite samples was done by collecting waste water, using composite; every one hour from hair dressing saloon in Ekiadolor – Benin, Edo State for five days, in a clean plastic container and stored in refrigerator. The pH, temperature and dissolved oxygen DO were determined immediately using standard methods (1 and 12) were other parameters where analyses were not immediately possible, they were preserved and characterized later on.

Sample Treatment

Batch treatment method was used, with 0.5g of the activated carbon per 100-500cm^3 of wastewater in one litre container. The solution was thoroughly shaken and stirred with magnetic stirrer for 30 minutes and allowed to satnd for 1 hour to achieve effective adsorption of the contaminants. The physico-chemical of the waste water were carried out before with the activated materials. The physico-chemical analyses of the waste water were carried out before and after treatment with activated carbon using standard methods (11 and 12).

Result and Discussion

Table 1: Some physical characteristic of maize cob activated carbon

Parameters/Units	Values
pH	5.44
Bulk density	0.45g/cm^3
CEC	11.48 moq/100g
Surface area	9.80 m$^{2/g}$
Pore size	100nm

CEC=Cation exchange capacity

Table 2: Results obtained from triplicate characterization of raw and treated hair saloon waste water using activated carbon

Parameters	Raw Wastewater	Activated carbon treated wastewater
pH	10.05 $\pm$ 0.10	7.10 $\pm$ 0.10
Temperature (^{0}C)	29.50 $\pm$ 0.05	26.78 $\pm$ 0.1
Colour (pt.co)	2.65 $\pm$ 3.80	0.01 $\pm$ 0.22
Conductivity (µs/cm)	122.00 $\pm$ 0.92	80.01 $\pm$ 1.02
Total dissolved solid (mg/l)	1700 $\pm$ 4.73	72.27 $\pm$ 2.05
Total suspended solid (mg/l)	406 $\pm$ 6.42	20.17 $\pm$ 2.00
Turbidity (NTU)	950 $\pm$ 1.40	20.01 $\pm$ 0.45
Dissolved oxygen (DO) (mg/l)	13.47 $\pm$ 0.01	20.56 $\pm$ 0.00
Chemical Oxygen Demand (COD)	70 $\pm$ 0.06	30.00 $\pm$ 0.02
Biochemical Oxygen Demand (mg/l)	20.27 $\pm$ 0.52	5.19 $\pm$ 0.01
$NH_4^{\pm}$ - N (mg/l)	32.00 $\pm$ 1.97	5.01 $\pm$ 1.00
NO_3^- - N(Mg/l)	20.02 $\pm$ 0.79	0.05 $\pm$ 0.45
Phenol (mg/l)	0.60 $\pm$ 1.05	NDL
Total hydrocarbon content (mg/l)	10.10 $\pm$ 7.12	0.09 $\pm$ 2.72
Zinc (mg/l)	0.81 $\pm$ 0.01	BDL
Chromium (mg/l)	10.07 $\pm$ 1.05	BDL
Copper (mg/l)	0.09 $\pm$ 0.10	BDL
Cadmium (mg/l)	0.02 $\pm$ 0.00	BDL
Iron (mg/l)	0.01 $\pm$ 0.21	BDL

FEPA Limits

pH	6 -9
Temperature (^{0}C)	20 – 30
Conductivity (µs/cm)	200
Total Dissolved Solid (mg/l)	2000
Total Suspended solid (mg/l)	15 – 30
Dissolved oxygen (mg/l)	5 – 20
Biochemical Oxygen Demand (mg/l)	10 – 50
Chemical Oxygen Demand (mg/l)	15 – 50
Zinc (mg/l)	1.0
Chromium (mg/l)	0.05
Copper (mg/l)	1.0
Cadmium (mg/l)	–
Iron (mg/l)	0.3

Table 3: % Reduction of some Chemical Parameters

Parameters	% Reduction
Turbidity	97.90
Colour	99.62
BOD	74.40
COD	60.53
NH_3-N	84.34

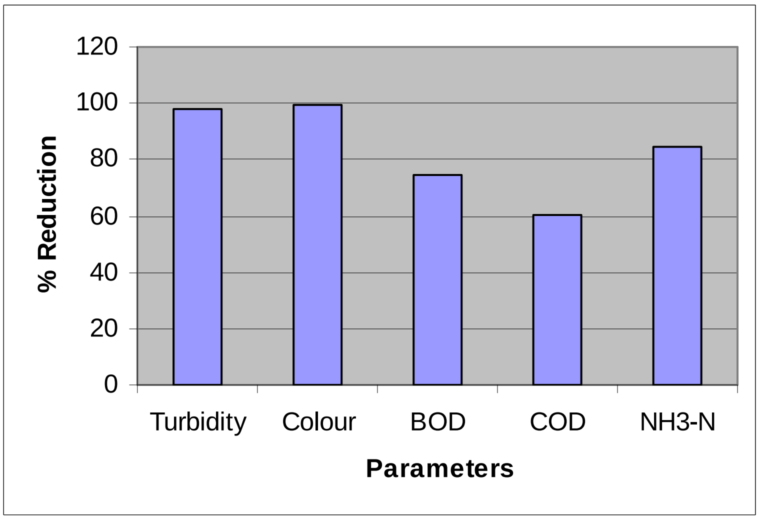

Fig. 1: % Reduction of Some Chemical Parameter

pH was measured using pH meter, 291 MK2 model, temperature determined using mercury in bulb thermometer, and electrical conductivity using HACH TDS conductivity meter (11, 12 and 13). Dissolved oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solid (TSS), and Total Dissolved Solid (TDS) were analyzed according to standard methods (11 and 12). Nitrogen compounds inform of nitrates and ammonia was determined using the Brucine method (11). Phenol and total hydrocarbon (THC) were determined using method described in (12). All the heavy metal levels were determined by atomic adsorption spectrophotometer (AAS) method (12 and 13).

Results and Discussion

The physical analyses of the activated carbon from maize cob are shown in table 1. While the results of the physicochemical and heavy metal level of the raw and treated waste water are shown in table 2. The result of activated carbon treated waste water shows reduction of pH from highly alkaline to near neutral level, this can be attributed to the CEC, and surface area values. Also, there was significant reduction in colour, conductivity, turbidity etc. This could be small pore sizes of the activated carbon couple with its large surface area. The large pore sizes increases its capability of adsorbing large molecules, colours and even smaller molecules in waste water (5, 6, 7 and 8). Activated carbon materials are know and reported to have great sorption proportion due to their well developed and accessible pore structure (6). This can also be attributed to the significant reduction of TDS and TSS of the effluent after treatment. Also, activated carbon reduced the BOD and COD to levels within the FEPA standards and increase in DO of treated waster water. It can also be seen from table 2 that all the heavy metals were reduced to below detectable level (BDL). Activated carbon as an adsorbent and its effectiveness in pollutant reduction can be attributed to its unique features like large surface area, high degree of surface reactivity and favourable pore size.

Conclusion

Adsorption processes have been shown to be the most effective method for the removal of contaminants from effluent. Activated carbon obtained from maize carbon effectively served this purpose as its used for this study showed significant performance in the reduction of solid particles, colour, BOD and COD etc from the waste water obtained from hair dressing saloon. Also, it has the likelihood of limited natural supply as maize is seasoned but its easily available when in season. Activated carbon have been found from this study can serve as a vital sorption material for the adsorption of molecule contaminants from aqueous solution. The use of activated carbon prepared from maize cob for the adsorption of colours, solid particles, inorganic materials and heavy metal levels can serve as cheap sorption material alternative and its sorption capacity enhanced as it has high pore size and surface area. It utility can be enhanced and maximized with chemical modification to further increase its uptake of contaminants from aqueous environment due to its high surface reactivity and corresponding capacity as adsorbent to removal of colours, polar and non-polar contaminants from aqueous medium.

REFERENCES

(1) J.M Randall, F.W. Reuter and A.C Waiss (1975). Removal of cupric ions from solution by contact with peanut skins. *Journal of Applied Polymer Science* Vol. 19, 1563 – 1571

(2) C. P. Huang and D.W Blankenship (1984). *Water Research*. Vol. 18. pg 37

(3) R.C Bansal, D. Baptiste and S. Fritz (1988). Active Carbon Marcel. Dekker Inc. New York. Pp. 266 – 269

(4) F. E. Okieimen and J. E. Ebhoaye (1986). Adsorption of Heavy Metal Ions on Cellulose grafe copolymer. *Journal of Applied Polymer.* Vol. 32. 4971 – 4976

(5) F.S Baker, C.E. Miller, A.J. Repik and E.D Tolles (1999). Activated Carbon.Kirk – Ottimer *Encyclopedia of Chemical Technology* Vol. 4. pp.1029-1037

(6) C.J. Ewansiha, F.E. Okiemen and D. I. Edoh – Osunde (2005). Preparation and Characterization of Activated Carbon from Cassava Peels. *ChemTech. Journal*. Vol. 1 pg. 10-17

(7) H. I. Adegoke and F.A Adekola (2011). Adsorption of Lead (II) Ion from aqueous solution using activated carbon prepared from coconut coirpith. *Journal of Chemical Society of Nigeria*. Vol. 36, pp134-138

(8) F.A Adekola and H.I. Adegoke (2005). Adsorption of Blue-dye on activated carbon produced from rice husk, coconut shell and coconut coirpith. *Ife Journal of Science.* Vol. 7, No. 1 pp.151-157

(9) E.G. Uwumarogie – Ilori, V.O. Idode, F. E. Okieimen and F.I. Obahiagbon (2012). Effect of locally pylolysed maize cob biochar on Nutrient Status of Soil used for oil palm cultivation. *Journal of Chemical Society of Nigeria.* Vol. 37, No.1, pp.87-91

(10) IITA, (1982). Automated and semi-automated methods for soil and plant analysis p.5-34

(11) Ademoroti, C.M.A (1996). Standard Methods for Water and Effluent Analysis. Foludex Press Ltd, Ibadan, Nigeria. Pp.111-120

(12) APHA (2005). Standard Methods for the Examination of Water and Wastewater, 23rd Edition. *American Public Health Association.* Washington D.C

(13) FEPA – Federal Environmental Protection Agency (1991). Nathan Environmental Protection (Effluent Limitation Regulation, 1991, Federal Government Press, Lagos, pp.38

(14) WHO – World Health Organization (1983). Compendium of Environmental Guidelines and Standard for Industrial Discharge. Pub. No. EPA/53.49. *General*. P.256

ABOUT THE AUTHORS

Dr. Emmanuel E. Egbon is a senior lecturer in the Department of Chemistry, Ambrose Alli University, Ekpoma. He holds a PhD degree in analytic/environmental chemistry. His reseach interest is in the area of organic modification of clay and waste water management.

Idode O. Victoria is a lecturer is in College of Education, Ekiadolor, Benin City, she holds, M.Sc in Industrial Chemistry and presently doing M.Phil in Environmental Chemistry

Elizabeth I. Egbon is a Senior research fellow, doing her M.Sc in Environmental Chemistry, in Ambrose Alli University, Ekpoma.

Patience A. Chukwuma is final year research student in College of Education, Ekiadolor, Edo State.

SUGGESTED CITATION

Ize-Iyamu, O.K., O. Eguavoen, M. Osuide, E.E. Egbon, O.C. Ize-Iyamu, V.O. Akpoveta and O.O. Ibizugbe, (2011). Characterization and Treatment of Sludge from the Brewery using Chitosan. *Pacific Journal of Science and Technology*. 12(1): 542-547

ACKNOWLEDGEMENT

We specially acknowledge the Ambrose Alli University, Ekpoma for the provision of the laboratory used in carrying out this work.

This academic article was published by The International Institute for Science, Technology and Education (IISTE). The IISTE is a pioneer in the Open Access Publishing service based in the U.S. and Europe. The aim of the institute is Accelerating Global Knowledge Sharing.

More information about the publisher can be found in the IISTE's homepage: http://www.iiste.org

CALL FOR JOURNAL PAPERS

The IISTE is currently hosting more than 30 peer-reviewed academic journals and collaborating with academic institutions around the world. There's no deadline for submission. **Prospective authors of IISTE journals can find the submission instruction on the following page:** http://www.iiste.org/journals/ The IISTE editorial team promises to the review and publish all the qualified submissions in a **fast** manner. All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Printed version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

Recent conferences: http://www.iiste.org/conference/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar