Journal of Biological Science and Bioconservation **Volume 4, September 2012**

www.cenresinpub.org
ISSN 2277-0143

POWDERED ACTIVATED CARBON FROM MANGO SEED (*Mangifera Indica*) FROM UPTAKE OF ORGANIC COMPOUNDS FROM AQUEOUS MEDIA

[1]Umudi, E. Q. and [2]Ukpebor, E.J
[1]Department of Chemistry, College of Education, Agbor.Delta State, Nigeria
[2]Department of Chemistry, University of Benin, Edo State, Nigeria
E-mail: ese.umudi@yahoo.com

ABSTRACT
Powdered activated carbon (PAC) was prepared from endocarp of mango seed (*Mangifera indica*) by steeping air-dried samples in phosphoric acid 45% v/v and ammonium chloride 4% w/v for 12 hours followed by pyrolysis at 350^0C for 3 hours. The activated carbon obtained in each case was washed free of acid/base and characterised in terms of bulk density surface area (iodine number) and total surface charge. The effectiveness of activated carbon prepared from the endocarp of mango seed in removing the organic compound from aqueous solution was determined from Chemical Oxygen Demand measurement before and after treatment with the activated carbon. The results obtained indicate potential for the utilization of endocarp of mango seeds for the remediation of wastewater.
Keywords: *Activated carbon, mango endocarp, adsorption and characterization.*

INTRODUCTION
Environmental investigations revealed widespread contamination of water by industries during manufacturing processes. Most of these chemicals are toxic to human and aquatic lives[1] because they are discharged into the environment through streams, rivers, this finally causes pollution. The removal of these contaminants still poses problem in the society. Activated carbons made from raw materials as adsorbent like groundnut husk, coconut shells, etc [2, 3, 4]. Activated carbons are highly microporous form with both higher internal structure area and porosity. They are common adsorbents used for the removal of organic compounds from air and aqueous waste stream [5]. Material of high carbon content and low inorganics can be used as a precursor in producing activated carbon. Activated carbon can be prepared by physical and chemical activation [1]. Physical activation involves carbonization of the precursor material followed by activation of the char at 800 – 1100^0C in the presence of steam, oxygen, carbon (iv) oxide, etc. In chemical activation, the material is mixed with an activating agent (chemical) and then pyrolysed at between 35^0 and 600^0C done in a one step process at moderate temperatures resulting in highly porous structures. This accounts for the growing interest in the chemical activation process. Phosphoric acid and zinc chloride being the two most commonly used chemicals activating agents in producing activated carbons. Previous reports on characterization of activated carbons from rice husk and rubber seed using ammonium chloride as activating agent showed effective remover of polar and non-polar pollutants from wastestreams and required investigations of the feasibility of producing activated carbon from other agricultural residues[6]. Mango (*Mangifera indica*) is indigenous to the Indian subcontinent [7]. It is cultivated in Nigeria. It is one of the most extensively exploited fruits for food, juice, flavour, fragrance and colour. It is referred to as "King of fruits, rich in phytochemicals and nutrients, high in prebiotic fibre, vitamin C, polyphenols and from Vitamin A and E, B_6 and K and essential nutrients such as

potassium, iron, copper, phosphorous and amino acids. In this report, the shell covering the seed for mango (endocarp) was used as precursor material activated with ammonium chloride in comparison with phosphoric acid and utilized for uptake of organics (catechol and 4-chlorophenol) in aqueous medium. It evaluates efficiency of activated carbon from mango endocarp.

MATERIALS AND METHODS

Mangoes were obtained from a local market in Agbor. The fleshly parts and seeds were removed, were cut into pieces and air-dried. These were steeped in a 5% solution of ammonium chloride and 45% ortho-phosphoric acid for 12 hours. The mixed was filtered, air-dried and carbonized at 350^0C for 3 hrs in a muffle furnace. It was washed until it was neutral to litmus, air-dried and grounded to powdered. The powdered activated carbon was sieved with 425µm and 180µm mesh sieves. The portion that was retained in the 180µm mesh was used. The pH of carbon was determined by immersing 1.0g of the sample in 10ml deionised water, stirred for 20mins and the probe inserted. Bulk density was determined by tamping procedure described by Ahmed *et al*.[8]. Surface area was measured by iodine adsorption method. The total surface functional group was carried out by the method of Boehnm[9] Chemical Oxygen Demand (COD) by standard methods [10].

ADSORPTION OF ORGANIC COMPOUNDS

AWW were prepared to pollution level for the organics in batches (Catechol and 4-chlorophenol). These were chosen because of their importance as environmental pollutants[11]. The initial chemical oxygen demand of samples before treatment with the powdered activated was determined, to ascertain the efficiency of the activating agent. The method for the adsorption of dissolved organics on powdered activated carbon was adopted from Toles [11]. Equilibrium sorption of catechol and 4-chlorophenol on PAC was studied at ambient temperature. The pH of commercial activated carbon is due to the inorganic constituent from the precursors during its manufacturing. From the above study, the low pH of the endocarp of mangoes could be due to acid activation. Carbon activated with ammonium chloride gave a lower pH than that with orthophosphoric acid and the extent of adsorption is higher. Bulk density is important when activated carbon is to be removed by filtration, because it determines the amount of carbon that can be contained in a filter of given solid capacity. When two activated carbon samples are used at the same loading, the carbon with higher density will be a more efficient filter. Carbons with bulk density of about 0.5g/cm^3 are generally adequate for sugar decolouration. From table I, the PAC activated with ammonium chloride has a higher surface compared with the carbon activated with orthophosphoric acid.

Table 1: Characteristics of Powdered activated carbon from endocarp of mangoes

Acting Agent	pH	Bulk Density g/cm^3	Surface Area	Total Surface (charge mmolH^+)
NH_4Cl 5%	4.01 ± 0.01	0.312 ± 0.002	$1.8 \times 10^{-2} \pm 0.0007$	2.00 ± 0.03
H_3PO_4 45%	4.18 ± 0.02	0.592 ± 0.014	$2.1 \times 10^{-3} \pm 0.0004$	1.11 ± 0.03

Table 2: Removal of catechol and 4-chlorophenol from aqueous solution with PAC (values of 4-chlorophenol)

Initial COD (mg/l)	Equilibrium COD (mg/l/g)		Change in COD mg/g /PAC	
	NH_4Cl	H_3PO_4	NH_4Cl	H_3PO_4
0.613 (1.317)	0.624 (1.273)	0.608 (0.680)	0.048 (0.080)	0.064 (0.686)
0.701 (1.401)	0.460 (1.140)	0.568 (0.610)	0.224 (0.243)	0.130 (0.802)
0.750 (1.431)	0.349 (0.782)	0.500 (0.501)	0.421 (0.531)	0.198 (0.754)
0.762 (1.191)	0.310 (0.700)	0.483 (0.410)	0.381 (0.592)	0.300 (1.001)
0.830 (1.592)	0.230 (0.400)	0.350 (0.251)	0.593 (1.163)	0.502 (1.638)

It is a single most important characteristics of activated carbon designed for the adsorption of components from liquid media. The net charge of functional group bonded to the carbon surface and type is important in understanding of the adsorption mechanism of ionic molecules on activated carbon. The results showed that the measured ΔCOD increases within the initial COD with highest organic compound levels for chlorophenol and catechol. The endocarp carbon activated with ammonium chloride was more effective than the phosphoric acid-activated endocarp in removing the organic compounds from aqueous solution chlorophenol was more effectively removed from solution than catechol because it is more planar than catechol, making it more accessible to the micropores of the adsorbents and accentuates its uptake levels.

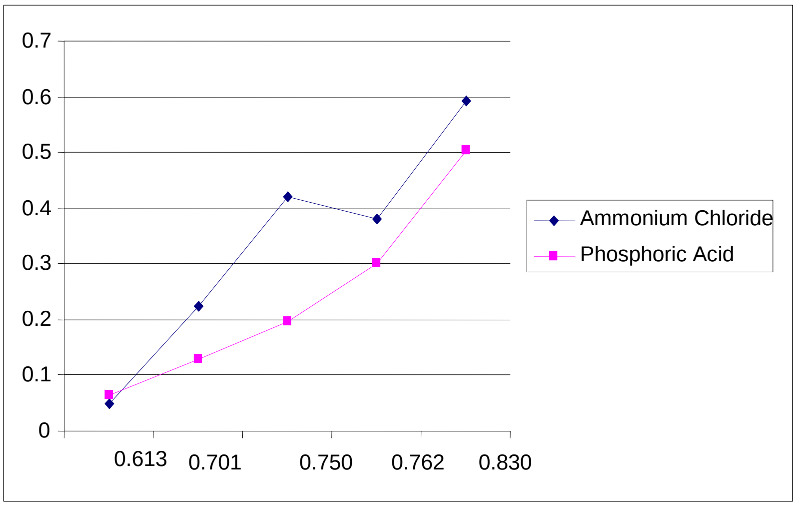

Fig. 1: Sorption of Catechol from Aqueous Solution of Powder activated carbon from endocarp of mangoes

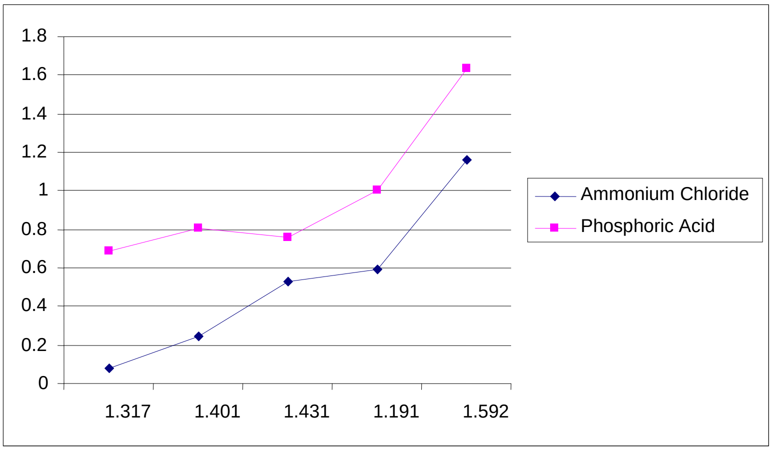

Fig. 2: Sorption of 4-Chlorophenol from aqueous solution on powdered activated carbon from endocarp of mangoes

CONCLUSION

In this study, activated carbon prepared by steeping the endocarp of mangoes in saturated ammonium chloride solution and othophosphoric acid solution have been characterized and used to remove polar organic compounds from aqueous solutions. The results indicate that powdered activated carbon from agricultural by-product could be used in economic treatment of wastewaters. Further work will be required to optimize the production process and effectiveness of the activated carbon.

REFERENCES

Activated carbon market (1994). Report No. 617. The Freedonia Group Inc. Cleveland, OH 166pm.

Toles, A., Marshall, E., Johns, H., Wantell, A. (2000). Activated carbons from almond shells, physical, chemical and adsorptive properties and estimated cost of products. *Bioresource Technol*, **71**: 87 – 92.

Boehnm, (1994). Some aspects of surface chemistry of carbon blacks and other carbons. *Bioresource Technol*; 32:759 – 770.Bernardo, E.C., Egashira, R. and Kawasako, J. (1997). Decolourisation of molasses wastewater using activated carbon prepared from cane bagasse. *Carbon*, 35(9); 1217 – 1221.Fatoki, O.S.N., Lujiza, A., and Ogunfowokon, (2002). Trace metal pollution in Umutata. *Water SA*, **28**(2): 183 – 187.

Ewanisha, C.J., Okiemen, F.E., Ekebafe, L.O., Jatto and Ozabor, C.W. (2010). *J. Chem. Soc. Nig.* Vol. 35, No. 2, pp. 78 – 83.

Aina, J.P. (1990). Physico-chemical changes in African mango.

Ahmed, M., Johnson, M.S.J., Clark, W.E., Marshal and Rao, R.M. (1997). Potential of agricultural byproduct based activated carbon for use in raw sugar decolorisation. *J. Sci. Food Agric.*, **75**: **117 – 124.**

Boehnm, H.P. (1994). Some aspects of surface chemistry of carbon black and other carbon. *Bioresource Tech*., **32**:759 – 770.

APHA (1995). Standard Methods for Examination of Water & Wastewater. 19th Edition American Public Health Association Washington, D.C.

Johns, M.M., Marshal, W.E. and Toles, C.A. (1999). The effect of activation method on properties of peach shell activated carbon. *J. Chem. Techno Biotech*. 1037 – 1044.