International Research Journal of Natural and Applied Sciences
Vol. 3, Issue 2, Feb 2016 IF- 2.818 ISSN: (2349-4077)
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PREPARATION AND CHARACTERIZATION OF ACTIVATED CARBON FROM COCONUT OILCAKE

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ABSTRACT

In the present study activated carbon was prepared by using coconut oilcakes, which is a waste from the coconut. Five activated carbons were successfully prepared by carbonization and by activation of coconut oilcakes. The activation was done by physical at 300,400, 500, 600 and 700°C, followed by chemical by impregnating 1N KOH, in 1:1 ratio for overnight and is followed physical activation at 300 °C for 2hrs in muffle furnace. The activated carbon characterized by using scanning electron microscopy (SEM). The BET surface area and pore size of the carbon were from 1.4760 m^2 /g to 4.3352 m^2 /g and 13.96Å to 96.1625 Å respectively. It is found to that the pore diameters of coconut oilcakes activated carbon were increasing when the activation temperature was increased. FTIR analyses also revealed functional groups during different activation temperatures.

Keywords: Activated carbon, Physical and Chemical activation, coconut oilcakes, FTIR, 1N KOH.

INTRODUCTION

Activated carbon, also known as activated charcoal, is a crude form of graphite, the substance used for pencil leads. It differs from graphite by having a random, imperfect structure which is highly porous over a broad range of pore sizes from visible cracks and crevices to molecular dimensions. The graphite structure gives the carbon its very large

surface area which allows the carbon to adsorb a wide range of compounds [1-2]. Activated carbon (activated charcoal) can made from many substances containing high carbon content such as coal, coconut shells and wood [3] The raw material has a very large influence on the characteristics and performance of the activated carbon (activated charcoal) [4].

Activated carbon or porous carbon which plays an important role in adsorption process. It is used for the removal of organic and inorganic chemical waste, odor, color and taste from any kind of chemical industry [5-8]. Activated carbon has high degree of surface reactivity which can influence its interaction with polar or non polar adsorbates. Besides, it also has higher surface area and micro porous structure. Activated carbon are widely use in wastewater treatment to remove harmful chemicals and heavy metal [9-11]. industrial waste water or industrial flue gas.[11]its application also include in the treatment of drinking water, industrial wastewater treatment,[12] decolorizing of syrups [13] and purification of air[14] and pharmaceutical product .[15]It has got a wide a variety of application starting from common house hold materials to highly sophist gated war front gas adsorption mask. Because of its wide usage in the industry, the demand of activated carbon in the industry also got increased largely .Because of the high expensive nature of the commercial activated carbon industry is looking in to a cheap and reliable source for the preparation of activated carbon in order to meet the growing demand of it in market year by year. There are a variety of material from which activated carbon can be prepared which includes,almond shells, olive stones and peach stones, coconut Coir, coconut coir pith, cotton stalks, date-pits, sugarcane bagasse pith, cocoa shells, bituminous coal, pistachio shell, coconut shell coir pith, cassava peel,firwood,oil-palmshell, sugarcane bagasse,babassu,corncob,agricultural waste ,chicken waste etc.[16-25] So in search of a new low cost material for the preparation of activated carbon, which had been not exploited much current study is focusing on coconut oil cake. Since much study has not been done on coconut oilcake .Coconut oil cake is the by product left after coconut oilcake extraction from coconut. With not much industrial application. Inoreder to meet thegrowing interest in cost effective, innovative materials for the preparation of activated carbon, the current study has focused on preparation of activated carbon from coconut cake.

EXPERIMENTAL

Preparation of Activated carbon 1

100g of 5 coconut oilcakes samples were weighed and then subjected to physical activation in a muffle furnace, temperature ranging from 300,400,500,600 and 700^{0}C for 1 hr

and the samples were weighed after physical activation .Samples thus obtained were soaked in 1M KOH in 1:1 ratio for 24hrs followed by weighing the sample in order to know the impregnation of 1M KOH to the samples and is followed by activation in muffle furnace at temperature 300ºC for 2hr. The carbonized material was washed with distilled water to remove the free alkalis and dried at 100±5ºC 2hrs and weighed to calculate the yield [26-28].

Characterization of activated carbon 2

The physico- chemical characterization of carbon samples prepared has been done; the yield of activated carbon is the % amount of activated carbon produced at the end of the activation process. This value indicates the activation process efficiency. The surface of activated carbon prepared has been analyzed using SEM (Scanning Electron Microscope), in order to identify the functional group responsible for adsorption Fourier transform infrared spectroscopy (FTIR) analysis was carried out.BET surface of both samples were identified using nitrogen adsorption–desorption isotherms, along with this pore size, pore volume created in samples were also identified.

3. RESULT AND DISCUSSIONS

The preparation of activated carbon has been carried out from coconut oilcakes at 300ºC to 700ºC and chemical impregnation has been done with 1 M KOH in 1:1 ratio, the yield of KOH activated carbon has been decreased gradually when activation temperature has increased from 300ºC to 700ºC after physical activation, but even after chemical activation the yield has been found decreasing when the activation temperature increased. The porosity has been increased till 500ºC when temperature increased, but after 500ºC it starts decreasing again final temperature. But pore volume has been found increased when temperature increased, moisture content, decolourising power, ion exchange capacity was also increased,slightly when activation temperature increased, phenol adsorption capacity has been found increasing highly when activation temperature increased. Matter soluble, pH, bulk density and conductivity have not much varied according to rise in temperature.

The surface area of coconut oilcake KOH activated carbon has found to be increased up to the temperature 700ºC (4.8797M^2/g Langmuir Surface areas).This is due to increase in pore diameter and microspore volume. In coconut oilcake KOH activated carbon the least surface area found to be 1.6924M^2/g at 300ºC (Langmuir Surface area).

Table – 1: The yield of coconut oilcakes carbon under different activation methods

SL NO	Activation temperature	Initial weight in gm	Yield in gm	Yield after chemical activation in g
1	300ºC	100	37.20	45.03
2	400ºC	100	27.52	31.98
3	500ºC	100	25,03	30.48
4	600ºC	100	22.12	27.29
5	700ºC	100	21.01	24.56

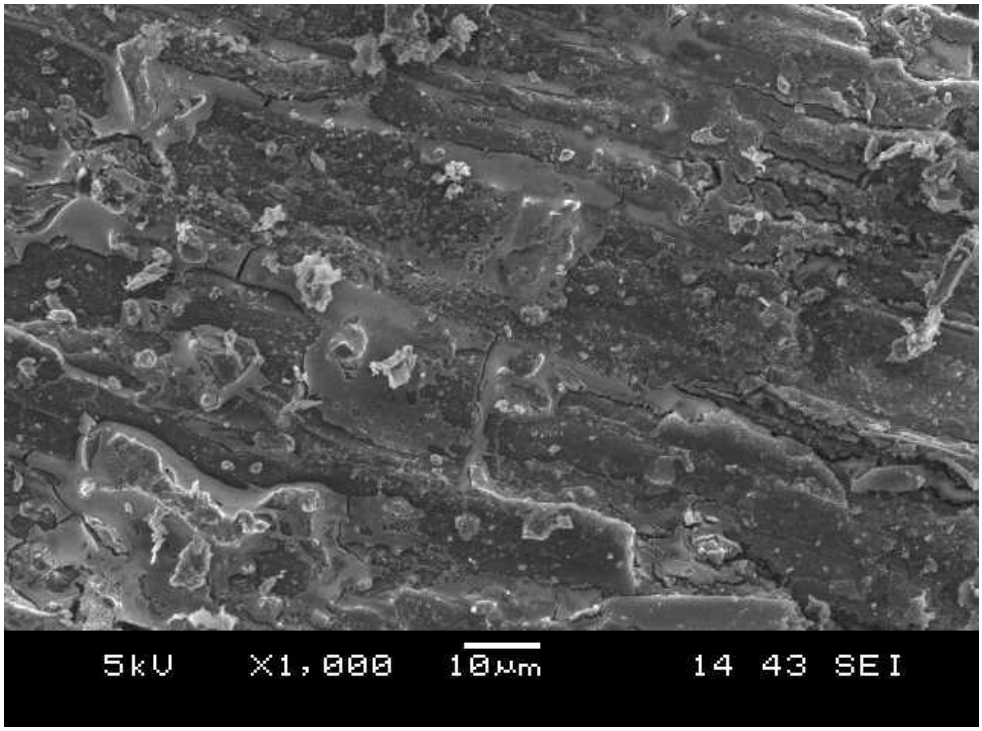

Fig-1:SEM analysis of KOH activated carbon sample

Table – 2: Characteristics of activated carbon prepared

SL NO	Parameters	300ºC	400ºC	500ºC	600ºC	700ºC
1	pH	7.84	7.92	7.89	8.03	8.51
2	Conductivity ($S \cdot m^{-1}$)	0.10	0.15	0.12	0.12	0.15
3	Bulk density	1.1	1.0	0.90	1.05	1.25
4	Porosity Å	>17.141	>1489.66	>1525.066	>1367.618	>1319.033
5	Specific gravity	1.72	1.71	1.69	1.78	1.62
6	Ion exchange capacity	0.125	0.125	0.142	0.162	0.105
7	Decolorizing power	3.0	2.25	4.5	4.6	3.0

8	Pore size/value Å	13.96	83.3472	90.64	96.1625	62.3048
9	Pore diameter in Å		173.860	181.634	182.389	192.271
10	BET Surface area in m^2/g	1.4760	2.0054	2.6391	3.0722	4.3352
11	LangmuirSurface area in m^2/g	1.6924	2.2803	2.9896	3.4670	4.8797
12	Moisture content in3.0g	0.13	0.07	0.14	0.12	0.08
13	Phenol adsorption capacity in %	68.8	88.4	90.8	91.0	91.7
14	Matter soluble in %	0.012	0.009	0.032	0.024	0.024

Table – 3: FTIR analysis

SL NO	Temperature	Functional groups identified in FTIR analysis
1	300^0C	CH=CH2,CH3,C=O non-conj CH=CH-cis,C=O non-conj strch
2	400^0C	C=C non-conj CH=CH-cis,C=O non-conj strch,intr mol H bond
3	500 ^{0}C	C=C non-conj CH=CH-cis,C=O non-conj strch,intr mol H bond
4	600^0C	C=C non-conj CH=CH-cis,C=O non-conj strch,intr mol H bond
5	700^0C	Aromatic C=C/C=O conj, intra molecular H bond

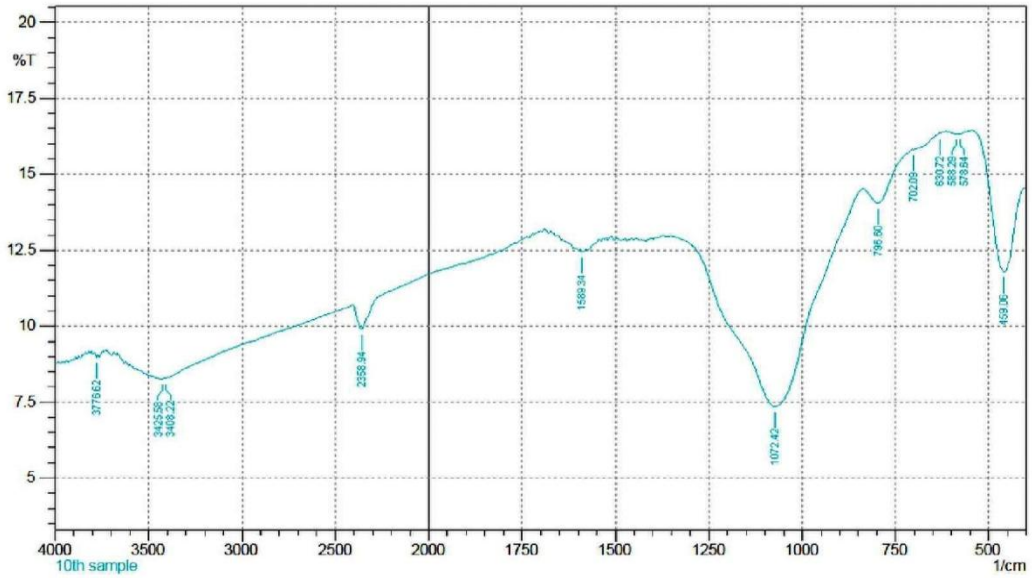

Fig-2:FTIR spectrum of KOH activated carbon

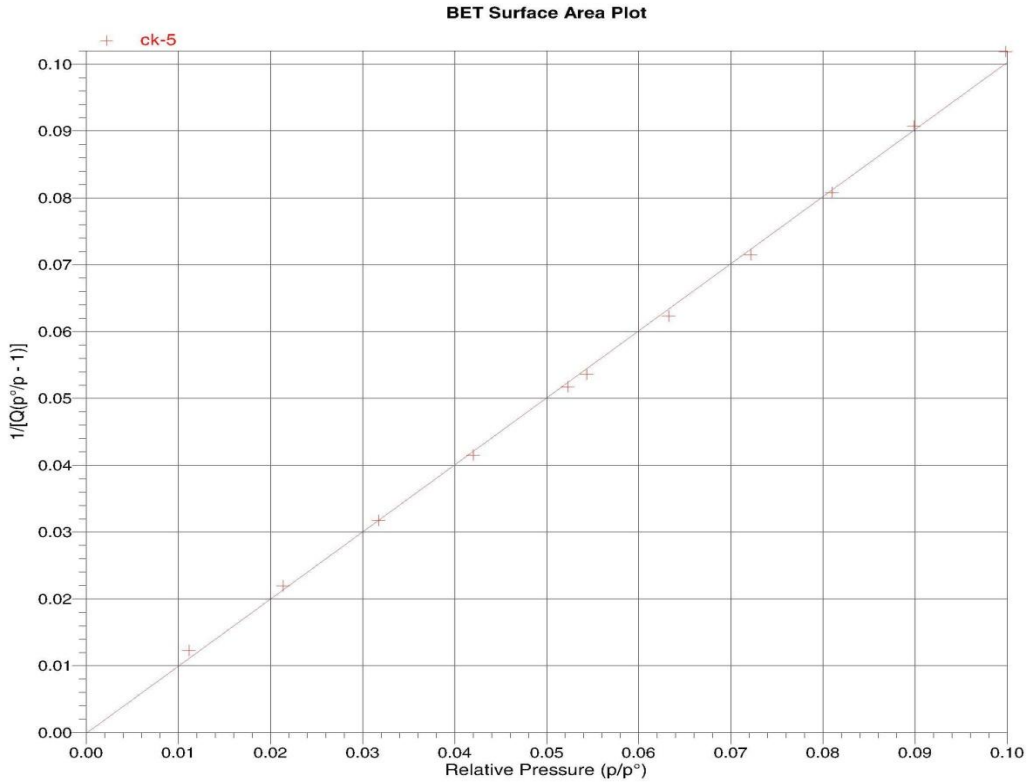

Fig-3: BET Surface Area Plot of KOH activated Carbon

4. CONCLUSIONS

The surface area of activated carbon prepared from coconut oilcakes by chemical activation with KOH has found to be increased when temperature increased up to the temperature 700°C (4.8797M^2/g). Porosity and pore size also found be attained a maximum at 600°C.

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