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Preparation of Activated Carbon from Coconut Husk and Study on Uptake of 2, 4, 6- Trichlorophenol from Water

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Abstract–*The preparation of Activated Carbon from coconut husk and study of the uptake of 2,4,6 – Trichlorophenol from polluted water has been studied in the present work. Production of activated carbon using coconut husk by physicochemical activation method was used. This consisted of potassium hydroxide (KOH) treatment and air gasification inside the furnace. The effect of KOH: Char impregnation ratio on the 2,4,6 – Trichlorophenol uptake and activated carbon yield were investigated.*

1. Introduction

Coconut husk is the mesocarp of coconut and a coconut is consisted of 33 – 35% of husk. In India, about 2,082,000 hectares of land was being used for coconut plantation in year 2016[1].It was estimated that 3790 Kg of dry husks were available per hectare per year. Transformation of coconut husk into activated carbon will have two advantages. First, contaminants such as 2,4,6 - TCP, trichloroethylene could be filtered using microporous activated carbon derived from coconut husk and second, it contributes to solving part of the waste water treatment problem across the globe. The focus of this research was to prepare activated carbon from coconut husk being utilised in removal of 2,4,6– Trichlorophenol (2,4,6– TCP) from aqueous solutions. Microporous activated carbon can be used to filter out TCP from the solution. To track porosity development, Scanning Electron Microscopy (SEM) was used. The effect ofKOH: Char impregnation ratio on the 2,4,6 – Trichlorophenol uptake were studied.

2. Experimental

2.1 Materials and methods

The most important characteristics of an activated carbon is its adsorption capacity which is highly influenced by the activated carbon preparation conditions. The variables are activation temperature, activation time, KOH: Char impregnation ratio. The precursor was first washed to remove dirt from its surface and was then dried in an oven at 115^{o}C for 3-4 hours. The dried husk was cut and the pieces were loaded in a horizontal tubular reactor in a quartz tube. Similar studies were conducted by Tan et al. [2].

Carbonization process

It was carried out by increasing the temperature of tubular reactor from room temperature to 700^{o}C with the heating rate of 10^{o}C/min and held for 2 hours (carbonization time). Throughout the carbonization process, pure nitrogen gas was allowed to pass.

Activation process

Activation of carbonaceous precursor (char) was performed through physical activation (air) and chemical activation (KOH). In chemical activation, the char produced in carbonization process was mixed with KOH pellets with different impregnation ratio (IR= W_{KOH}/ W_{CHAR}, where, W is the dry weight (g)). Double distilled water was then added to dissolve all the KOH pellets and then dehydrated in an oven at 110^{o}C for 3-4 hours to remove moisture[2].Physical activation was carried out in a furnace at 850^{o}C with no vacuum and the product is then cooled to room temperature and washed with double distilled water.

3. Results and Discussion

3.1 Study on the Removal of 2,4,6, -Trichlorophenolby Produced Activated Carbon Using Double beam UV-Spectrophotometer

In our experiment, we used double beam UV-vis spectrophotometer and the results obtained gave us a blue shift (see figure 1.) indicating, there is a loss of conjugation after adding activated carbon to 2,4,6 – TCP solution. λ_{max} decreases as the number of conjugated double bonds decrease.

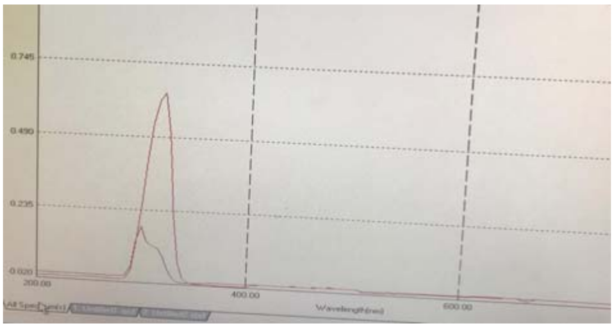

Figure 1: Comparison of absorbance of TCP and that of activated carbon with TCP

3.2 Fourier Transform Infrared Spectroscopy (FTIR)

FTIR analysis is used identify and characterize unknown materials and identify contaminants (2,4,6- TCP) in materials.

FTIR of Activated Carbonbefore 2,4,6 – TCP Uptake(see Figure 2)

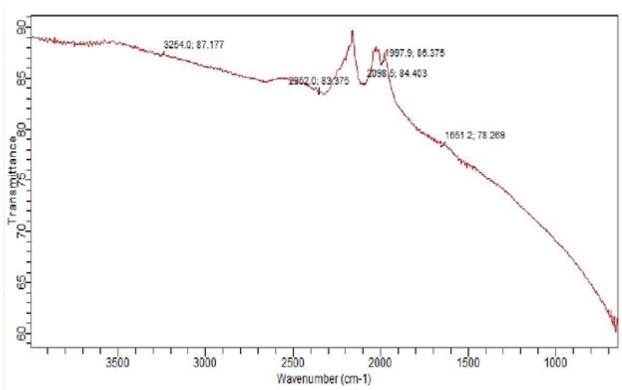

Figure 2: FTIR of Activated Carbon without TCP Uptake

Table 1: Wave number and Corresponding Compounds on Activated Carbon without TCP uptake[3]

Wave Number(cm^{-1})	Compound
16151.2	$RCH=CH_2$, $R_2C=CH_2$, 6- Ring, $RCONH_2$
1997.9	R-N=C=S
2098.5	R-N=C=S
2352.0	PH phosphene, Silane
3254.0	PH- phosphene, Si-H (Silane)

FTIR of Activated Carbon after 2,4,6- TCP Uptake(see figure 3):Here the C – Cl stretch confirms the 2,4,6 – TCP uptake onto the activated carbon.

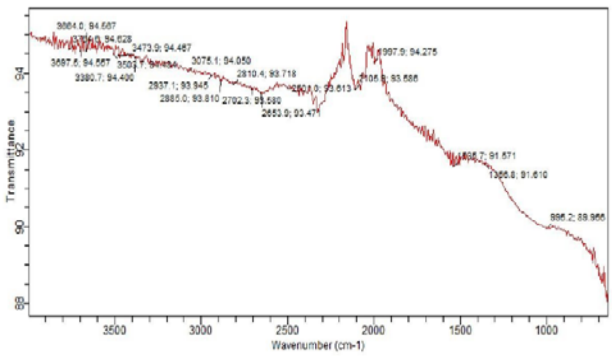

Figure3. FTIR of Activated Carbon with TCP Uptake

Table 2: Wave number and Corresponding Compounds on Activated Carbon without TCP uptake[3].

Wave Number (cm^{-1})	Compound
800	**Alkyl Halides (Chloride)**
995.2	**C-CL Stretch**
1356	Amines, Alkanes
1535	Amides, Nitroso (N=O)
1997	R-N=C=S
2105	Alkynes, Silane
2653	Phosphonic Acid
2702.3	Aldehyde
2810.4	Carboxylic acid, Aldehydes
2937.1	Alkanes, Carboxylic Acid
3075.1	Alkenes, Carboxylic Acid, Aromatic
3380	Carboxylic Acid, Phenols
3473	Alcohols, Phenols
3503	Alcohols, Amides

3.3 Tracking Porosity development Using SEM

The porosity in activated carbon is derived from three main sources, namely, the inherent cellular structure of the precursor material, the impregnation ratio, composition of the precursor material. The 2,4,6 – Trichlorophenol gets adsorbed into the pores of the cellular structure.

Effect of KOH: Char Impregnation Ratio on 2,4,6 – TCP uptake

KOH: Char impregnation ratio plays a decisive role in the formation of pores. At high impregnation ratio, the pore development is mostly due to the intercalation of potassium metal in the carbon structure[4].

$C + 2KOH \quad 2K + H_2 + CO_2$

KOH would promote the oxidation process, therefore, with high impregnation ratio, the gasification of surface carbon atoms is a predominant reaction, leading to increase in the weight loss of the carbon. Therefore, the below micrographs confirm that the 2,4,6 – TCP uptake increases with increase in chemical impregnation ratio (IR).

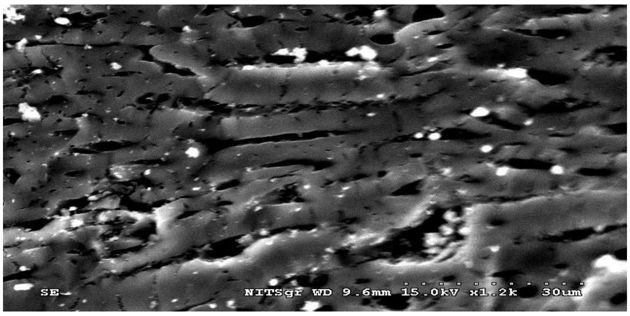

Figure 4 (a): TCP Uptake at IR= 1

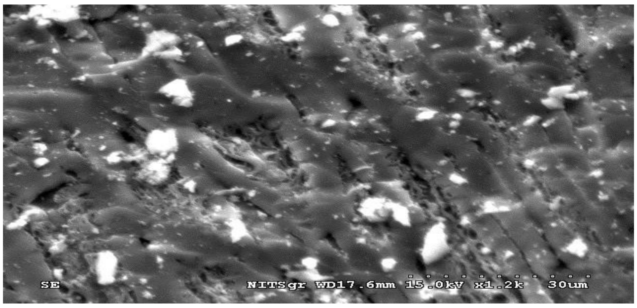

Figure 4 (b): TCP Uptake at IR= 3.9

4. Conclusions

1. 2,4,6 – Trichlorophenol can be adsorbed onto the micropores of activated carbon.
2. The TCP uptake is directly proportional to KOH: Char chemical impregnation ratio.
3. FTIR analysis confirms the adsorption of TCP onto the activated carbon.
4. There is a loss of conjugation in TCP when activated carbon is added due to dechlorination. As a result, blue shift occurs i.e, there is a decrease in wavelength and corresponding increasein frequency after adding the activated carbon.

References

[1] http://coconutboard.nic.in/Statistics.aspx

[2] I.A.W. Tan, B.H. Hameed, A.L. Ahmad, Optimization of preparation conditions for activated carbons from coconut husk using response surface methodology, Chem. Eng. J. 137 (2008) 462–470.

[3] https://irpal.soft112.com

[4] Y. Sudaryanto, S.B. Hartono, W. Irawaty, H. Hindarso, S. Ismadji, High surface area activated carbon prepared from cassava peel by chemical activation, Bioresour. Technol. 97 (2006) 734–739.