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Sustainable Production of Activated Carbon from Jetropha Husk Using Chemical Activation by NaOH

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ABSTRACT

It is interesting to note that jatropha curcus is an important plant for the production of biodiesel and that the Waste generated during the production process can be converted into activated carbon using a chemical activation method with NaOH as an activating agent. This can be providing a sustainable solution for managing the biodiesel Waste and reducing the environmental impact of the biodiesel production process. This study examined effect of the activation temperature, impregnation ratio and activation time on the synthesis of prepared activated carbon from biodiesel Waste. It is important to optimize these parameters to ensure the production of high-quality activated carbon. Physicochemical parameters such as moisture content, ash content, volatile matter content and carbon content of the prepared activated carbon were also examined. These parameters are important for determining the quality and effectiveness of the activated carbon. Overall, the study found that biodiesel waste is an efficient raw material for preparation of activated carbon. This has important implication for the biodiesel industry as it provides a sustainable solution for managing the waste generated during the production process. Additionally, the production of activated carbon from biodiesel waste can provide a valuable product that can be used in a variety of applications such as water treatment air precipitation and soil remediation

Keywords: Biodiesel waste, Optimum Condition, activation temperature, impregnation ratio, activation time Physicochemical Parameters and adsorption capacity.

INTRODUCTION

Jetropha Curcus is an important plant for the production of biodiesel. In the production of biodiesel, huge amount of Jetropha husk as biodiesel waste are produce. These Jetropha husk like other agricultural waste cannot be used as agricultural fertilizer although Jetropha husk rich in cellulose, hemicelluloses and lignin. Degradation and digestion is not possible. So it is better to use Jetropha Husk for the preparation of activated carbon.

This activated carbon is excellent adsorbent and can be used to purify, decolourize, detoxicate, filter or remove dissolved substances.

This biodiesel waste converted into activated carbon through following steps: dehydration, carbonization and activation. Moisture isremoving from raw material in dehydration step. During carbonization step, organic matter of raw material is converted into primary carbon. Now primary carbon is activated in activation method. Activation of carbon is done by two method that is gas activation method and chemical activation method. In this research chemical activation is done by treating primary carbon with NaOH.

Some parameterslike activation temperature (500-900^{O}C), Impregnation ratio (1:1-2:1) and activation time (0-120 min) were studied and determine the best suitable condition for the preparation of activated carbon.

This paper present preparation of activated carbon from jetropha husk by chemical activation method by treating NaOH

EXPERIMENTAL METHOD

A. Material and preparation of sample: The raw Jetropha husk were washed with water and dried at room temperature for overnight. Crushed this cleaned Jetropha husk in a blender. Jetropha husk converted into activated carbon through carbonization and chemical activation method. The sample was treated with NaOH solution at room temperature. The mixture was kept overnight at room temperature and then dried in an oven at $105^{O}C \pm 5^{O}C$. This sample was kept at various temperatures and for different time in a muffle furnace in order to get activated carbon. Allow the activated carbon to cool and then washed repeatedly with hot Distill water until the neutral pH is obtained. Activated carbon of Jetropha husk is obtained when the sample is allowed to stand at $100^{O}C$ overnight.

B. Moisture Content: Take a dry and closed previously weighed capsule and fill this capsule with prepared activated carbon sample. Again, weigh the capsule accurately. The capsule is placed in a preheated oven till constant weight achieved. Now cool the capsule to room temperature and then again weigh. The moisture content of activated carbon is determined by the percentage weight difference

C. Volatile Matter Content: Take 1.0 g of the sample in muffle furnace at $950^{O}C$for 7 min. Then allow the sampleto cool at room temperature and determine the weight of sample. The loss in weight percentage was expressed the volatile matter content.

D. Ash Content: Place .1 g of raw material in muffle furnace at $650^{O}C$ until constant weight is achieved. Now sample is allow to cool at room temperature. The ash content is expressed as percentage weight of the sample remained

E. Optimum Conditions for the preparation of Activated Carbon: Various parameters such as impregnation ratio of NaOH to charcoal (1:1-2:1 w/w), activation temperature (500-900◦C) and activation time (0-120min) had their effect on activated carbon. In this research we worked out to determine optimum condition for preparation of activated carbon from Jetropha Husk.

RESULT AND DISCUSSION

1. Yield Percentage: The yield of activated carbon of jetropha husk is calculated as -

$$\text{Yield of AJHC} = \frac{\%\ \text{Yield}}{\text{Weight of JH}} \times 100$$

The yield of activated jetropha husk treated with NaOH was found to be 46%.

2. Physico chemical parameters: The ash contents in raw materialand other physico chemical parameters of activated carbon of jetropha husk are depicted in Table I,

Table 1: Physico Chemical Parameters

Parameter	NaOH treated JH
pH	7.4
Bulk Density (g mL-1)	.20
Moisture (%)	11.11
Ash (%)	13.63
Volatile Matter (%)	66.7
Carbon Content (%)	33.3

3. Adsorption Capacity of Material: Adsorption capacity of activated carbon from Jetropha husk was found to be 700 mg/g while the adsorption capacity of NaOH treated jetropha husk carbon was found to be 810 mg/g.This observation shows that the adsorption capapcity of activated carbon is affected by the treatment of NaOH. Adsorption capacity of activated carbon is increases on treatment with NaOH. This may be because it clogs up the porosity of activated carbon by soaking and hence reduces the ash.

Table 2 shows the influence of Impregnation ratio on adsorption capacity. For activated carbon from Jetropha Husk it was observed that the optimal impregnation ratio with the maximum adsorption capacity 1:1.

Table 2: Influence of Impregnation Ratio

Imprgnation Ratio (w/w)	Adsorption Capacity (mg/g)
0	200
1.0	700
1.5	330
2.0	210
2.5	200
3.0	110
3.5	120

Influence of activation temperature on adsorption capacity is shown in Table 3.For activated carbon from Jetropha husk the optimum activation temperature for maximum adsorption capacity was found to be 700°C.

Table 3: Influence of Activation Temperature

Activation Temperature (^{O}C)	Adsorption Capacity (mg/g)
500	648
600	648
700	720
800	680

Influences of activation time on adsorption capacity are depicted in Table 4. It was observed that the adsorption capacity is maximum at 1h activation time.

Table 4: Influence of Activation Time

Activation Time (hr)	Adsorption Capacity (mg/g)
0	410
1	720
2	620
3	600
4	550

CONCLUSION

On the basis of experimental results, it can be concluded that jetropha husk could react with NaOH to make effective activated carbon. However, better adsorption capacity is obtained with NaOH treatment.

The optimum conditions to achieve maximum adsorption capacity for activated carbon prepared from jetropha huskare 700◦C activation temperature, 1h activation time and 1:1 impregnation ratio.

Increase in ash content in activated carbon reduces the mechanical strength and adsorption capacity of activated carbon. Inorganic constitute present in the raw material is responsible for ash content.

REFERENCES

[1]. Sudaryanto, Y., Hartono, S. Á., Irawaty, W., Hindarso, H., &Ismadji, S. (2006). High surface area activated carbon prepared from cassava peel by chemical activation. *Bioresource technology*, *97*(5), 734-739.

[2]. Abderrahim, N., Boumnijel, I., Amor, H. B., &Djellabi, R. (2021). Heat Carbonization and ZnCl2 Functionalization of Date Stone as an Adsorbent: Optimization of Material Fabrication Parameters and Adsorption Studies.

[3]. Dhidan, S. K. (2012). Removal of phenolic compunds from aqueous solutions by adsoption onto activted carbons prepared from date stones by chemical activation with FeCl3. *Journal of engineering*, *1*(18), 63-77.

[4]. Ramakrishnan, K., &Namasivayam, C. (2009). Development and characteristics of activated carbons from Jatropha husk, an agro industrial solid waste, by chemical activation methods. *J. Environ. Eng. Manage*, *19*(3), 173-178.

[5]. Mohammad, M., Yaakob, Z., & Abdullah, S. R. S. (2013). Carbon derived from jatropha seed hull as a potential green adsorbent for cadmium (II) removal from wastewater. *Materials*, *6*(10), 4462-4478.

[6]. Karthick, K., Dinesh, C., &Namasivayam, C. (2014). Utilization of ZnCl 2 activated Jatropha husk carbon for the removal of reactive and basic dyes: Adsorption equilibrium and kinetic studies. *Sustainable Environment Research*, *24*(2), 139-148

[7]. Papalia, T., Barreca, D., &Panuccio, M. R. (2017). Assessment of antioxidant and cytoprotective potential of Jatropha (Jatropha curcas) grown in Southern Italy. *International Journal of Molecular Sciences*, *18*(3), 660.

[8]. Patel, H. (2020). Batch and continuous fixed bed adsorption of heavy metals removal using activated charcoal from neem (Azadirachta indica) leaf powder. *Scientific Reports*, *10*(1), 16895.

[9]. Banerjee, K., Ramesh, S. T., Nidheesh, P. V., & Bharathi, K. S. (2012). A novel agricultural waste adsorbent, watermelon shell for the removal of copper from aqueous solutions. *Iranian (Iranica) Journal of Energy & Environment*, *3*(2), 143-156.

[10]. Ibrahim, H., Sazali, N., Salleh, W. N. W., Ngadiman, N. H. A., Fadil, N. A., & Harun, Z. (2022). Outlook on the carbon-based materials for heavy metal removal. *Biointerface Res. Appl. Chem*, *12*(4), 5303-5323.

[11]. Ullah, M., Nazir, R., Khan, M., Khan, W., Shah, M., Afridi, S. G., & Zada, A. (2019). The effective removal of heavy metals from water by activated carbon adsorbents of Albizia lebbeck and Melia azedarach seed shells. *Soil and Water Research*, *15*(1), 30-37.

[12]. Karnib, M., Kabbani, A., Holail, H., &Olama, Z. (2014). Heavy metals removal using activated carbon, silica and silica activated carbon composite. *Energy Procedia*, *50*, 113-120.